

**THE BOUNDARIES BETWEEN SCIENCE AND POLITICS AND THE
IMPLICATIONS FOR PRACTICES IN KNOWLEDGE TRANSFER**

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In Partial Fulfillment of the Requirements
For the Degree of Masters of Arts
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ABSTRACT

Complex policy problems in today's world require sound evidence for good decisions. Yet what constitutes sound evidence can often itself become a matter of political contention. Using original qualitative interview, focus group and document analysis, this thesis finds both that many Canadian organizations with a mandate for communicating scientific information (knowledge transfer) are working to bring together researchers and end-users into various forms of direct contact (known as interaction practices) and that different social groups have concerns with these interactions. Through using interaction practices to improve communication efforts by establishing end-user/researcher relationships, the socially constructed boundaries that exist between science and politics become blurred. When the science communicated has controversial political implications, this blurring becomes problematic, "polluting" the wider credibility of the science communicated. This thesis uses "boundary theory" to argue that organizations engaging in knowledge transfer must be aware of these risks, and in controversial political topics, work to *span* rather than *blur* these boundaries, in order to protect scientific credibility necessary to successfully communicate scientific information in politically controversial situations.

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CHAPTER 1 - Introduction

1.1 Background

In July of 2012, a rally took place on Parliament Hill. Clad in lab coats and standing around coffins draped in black, dozens of scientists proclaimed the 'death of evidence'. The protesters were angry at the federal government for what they perceived as a lack of scientific evidence (that is, empirical evidence produced using the scientific process) being utilized in the government's policy making. Katie Gibbs, Ph.D. student at University of Ottawa and organizer of the rally, said to the gathered crowd, "We feel that most Canadians regardless of their values or beliefs think that policies should be made based on evidence and based on facts, and that regardless of the decisions that the government decides to make, our democracy depends on an informed public" (CBC News, 2012).

This is a normative statement and powerful one, and also indicative of the growing interest in evidence informed decision making more generally. The increasing amount of attention being paid to the role evidence plays in decision making, both at a government level as well as industry, is not limited to protests (Cooper and Levin 2010). There are many different organizations, departments, and individuals who focus specifically on facilitating the transfer of knowledge from knowledge producers (that is, scientists and other researchers, not just within the physical sciences but also within the social sciences) to knowledge consumers (individuals who are decision makers such as policy makers, industry officials or public administrators, but also the general public), in the interest of evidence informed decision making. These range from advocacy groups dealing with a specific issue that list knowledge transfer (the process of communicating scientific research to non-scientific audiences for use in decision making) related to their advocacy as one of their key objectives, to education institutions that have specialists devoted to translating and disseminating research data produced at the institution to a wider audience. Many organizations have been founded since the mid-1990s that specifically focus on advocating for knowledge transfer and its role in evidence informed decision making. For instance, the Campbell Collaboration, founded in 1999 and based

in the United Kingdom, aims to “help people make well-informed decisions about the effects of interventions in the social, behavioral, and educational arenas” (Campbell Collaboration, 2014). In the United States, Coalition for Evidence Based Policy, founded in 2001, has a mission “to increase government effectiveness through the use of rigorous evidence about ‘what works’” (Coalition for Evidence Based Policy 2014). The trend is also mirrored in universities, with many establishing new departments dedicated to communicating the research conducted at the university. In Canada, ResearchImpact is an organization dedicated to creating a larger collaboration of such departments within universities, in service of the larger goal to “turn research into action” (ResearchImpact 2014). In addition to university based departments specifically dedicated to disseminating research, an increasing number of organizations state within their mission statements that using research to inform policy is a part of their mandate (Goreham Hitchman 2010). On the campaign trail in the 2015 federal election, Justin Trudeau sought to appeal to voters by promising that if his party formed government, it would approach policy issues in an “evidence based” manner (Globe and Mail 2015). In the same vein, Thomas Mulcair promised that if elected, his government would create a parliamentary science office, that would allow for “evidence-based decision making rather than Harper's decision-based evidence making” (CBC 2015).

This interest and rhetoric from politicians and other political actors concerning evidence informed policy is understandable, given that public policy has a direct impact on the lives of ordinary citizens. Scientific evidence, including the physical and social sciences, allows public policy makers to gain a reasonable understanding about the potential effects of policies. In addition to this predictive capability, sound evidence used in public policy making also gives policy makers an accurate representation of the world, both in the present and in the past. In essence, evidence can help facilitate decision making by giving decision makers a better understanding of what the world is, what the world was, and what the world could be through policies they may enact. For Katie Gibbs and many others, evidence informed policy making is important because good policy is more likely to result from a decision making process that utilizes sound evidence.

But if evidence informed decision making is a valuable goal, decision makers must be made aware of evidence in order to use it to make those decisions. This transfer of knowledge is an important part of evidence informed public policy, something that is recognized by various advocacy groups previously mentioned. In order for public policy makers to have access to the best evidence possible, it must be transferred to them from evidence producers such as scientists or researchers. Without this crucial transfer of scientific knowledge, evidence informed public policy would be impossible. Understanding the processes through which evidence can be transferred between knowledge producers and knowledge consumers can help us to develop better strategies to facilitate this process. The growing number of organizations, such as research granting agencies, that are neither strictly knowledge producers nor knowledge consumers yet are devoted to facilitating this process of knowledge transfer as third-party intermediaries is also of particular interest.

Although there can be a distinction made between the concepts of “knowledge” and “information” (that is, that knowledge is a cogitative state within the mind that can be produced by various pieces of information), for the purposes of this thesis, “knowledge” refers to scientific information produced by researchers, consistent with relevant literature on knowledge transfer.

Yet there is an implicit question that presents itself when one considers the virtues of ‘evidence informed policy making’: what evidence? There is seemingly a value judgement inherent in the virtues of evidence informed policy making that views scientific evidence as something that exists with an objective definition that can allow us to know it when we see it. In this view, science is merely a way of stating fact, and evidence must simply be out there somewhere in the ether waiting to be used by policy makers. How do we go about deciding what constitutes the evidence to be used in this decision making? What are the factors that distinguish one sort of evidence from another? What are some of the features that define good evidence and bad evidence? These questions are important given the risk of politicization of scientific evidence. If evidence informed policy proceeds when using scientific evidence that is openly disputed within society, the legitimacy of that policy can be challenged on the supposed

weakness of the evidence used to inform it. In an increasing number of controversial policy areas, differing political actors openly contest science related to the policy by using different definitions of what constitutes good science. The idea that some science can be “polluted” by impermissible violations from other arenas, such as the political arena, undermines the role that scientific evidence plays in evidence informed policy. To support evidence informed policy, these definitions of pollution and the thinking that constructs them need to be explored.

1.2 Thesis Objective, Research Questions, and Importance

This thesis will attempt to expand our knowledge by focusing on the discussions surrounding scientific evidence, as well as the role that third party intermediaries or knowledge brokers (that is, individuals or organizations are who neither knowledge producers or knowledge consumers, but are communication specialists who work to facilitate the transfer of knowledge between these two groups) play in transferring scientific knowledge to decision makers, more specifically on the practices or strategies employed by these intermediaries. The thesis will help to better understand the processes utilized by knowledge brokers to assist knowledge transfer, and more importantly, will seek to analyze these strategies in light of considerations of how science is defined within society. While it is also possible to analyze scientific evidence at its production or at its utilization, this thesis focuses on its transfer.

More specifically, this thesis seeks to identify the key strategies utilized by these knowledge brokers that facilitate knowledge transfer, their perceived effectiveness, and the key factors that influence knowledge transfer as identified by the brokers themselves. The thesis then moves to consider how these practices may relate to knowledge consumers’ perceptions of evidence, with particular attention to their perceptions of the level of separation between science and non-science based on perceived violations of socially constructed boundaries. To consider this relationship, the knowledge transfer practices are considered through the lens of the “boundary work” theoretical framework, which considers the way in which scientist and non-scientist alike define these conceptual boundaries of science. This is done through an

assessment of different audience perceptions of knowledge transfer practices; focusing on the definitions these audiences create in order to differentiate “pure” science from “polluted” science. Purity claims are a measure of how a particular piece of scientific research or scientist has not violated these boundaries and therefore has avoided contamination from non-science, while pollution claims are a measure of opposite.

Four research questions will be answered by this thesis:

- 1) What strategies or practices do knowledge brokers utilize in order to facilitate knowledge transfer?
- 2) What do these brokers think are the key factors that impact knowledge transfer?
- 3) How do different audiences perceive knowledge transfer practices?
- 4) What are the implications for the strategies utilized by knowledge brokers given their perceptions of these strategies, as well as different audience perceptions?

These questions are valuable given the importance of evidence informed public policy and the lack of understanding of the specific mechanics through which knowledge brokers assist in knowledge transfer. By studying the role played by knowledge brokers in the knowledge transfer process, this thesis helps to fill a research gap that has been identified in literature in the field of knowledge transfer (Cooper and Levin 2010; Crona and Parker 2011; McNie 2007). Although the value of knowledge brokers has been recognized given their ability to translate knowledge and foster interactions that facilitate knowledge transfer, it is not yet well understood precisely how knowledge brokers go about doing this. There is a lack of knowledge as to the specific strategies that are utilized, if there are common strategies used, as well as the effectiveness of those strategies. The proposed research seeks to help fill this gap in our knowledge by identifying specific communication strategies utilized by knowledge brokers. While this thesis will not empirically test the effectiveness of knowledge transfer strategies, it will be a step towards doing so by identifying said strategies and situating them within existing theory concerning the role of knowledge brokers.

This thesis also makes a unique contribution through its exploration of the perceptions of different groups concerning scientific evidence from the theoretical lens

of “boundary work”. This thesis will explore how different groups define these boundaries as well as raise new questions concerning potential complications with regards to these boundaries that may arise from knowledge transfer. This thesis will help to add to existing literature that seeks to explore boundary work in terms of purity and pollution, a measure of keeping within or violating socially constructed boundaries between science and non-science, and how definitions of purity and pollution can impact perceptions of science (Swedlow 2007; Waterton 2005; Zehr 2005). The essential purpose of this thesis is to explore the practices of knowledge transfer through the lens of boundary work, and examine the resulting political consequences from this analysis. By doing so, this thesis aims to uncover potential complications that can arise from the use of knowledge transfer practices currently assumed to be benign.

1.3 Research Methodology and Ethical Considerations

In order to discover the communication strategies and knowledge transfer practices of knowledge brokers, this thesis employed original key informant interviews with communications professionals working as knowledge brokers. In addition to this, to explore the way different groups define the boundaries of science, this thesis also draws on data from four focus groups, with scientific researchers, industry members, community members, and government officials.

As this thesis uses human participants in the form of interview and focus group subjects, special consideration must be given to the ethical implications of the research. Given that this thesis uses interview and focus group data gathered by the Nuclear Policy Research Initiative, the ethics application that was approved for that larger project was followed when gathering data. The guidelines presented within the approval ethics application was applied during all interviews and focus groups. Interview and focus group subjects were fully informed regarding the goals of the research, as well as made aware that their participation was strictly voluntary. All interviews and focus groups were recorded and digitally transcribed unless otherwise noted. Subjects who were interviewed in person as well as focus group participants all signed written forms consenting to this. In the case of interviews that were conducted via telephone, subjects

were sent participant consent forms through e-mail to review before the interview, and then gave verbal consent over the telephone prior to beginning the interview. The identities of subjects were protected through the use of pseudonyms on transcriptions, and all identifying information that was provided during interviews or focus groups was edited out to ensure participants' identities are protected. There are no known physical, psychological, economic, or social risks associated with participating in this study for subjects.

1.4 Thesis Outline

The first chapter has established the significance of evidence informed public policy as a topic of research, and linked evidence informed policy and knowledge transfer. The chapter then noted the importance of the role played by knowledge brokers in knowledge transfer, while also raising questions concerning how science is defined. The research questions have been presented and justified, and the methodology has been introduced.

The second chapter will deal with relevant literature on the topic. An outline of theoretical understandings of knowledge use will be first covered, followed by an examination of the literature on knowledge transfer. A synthesis of relevant literature on knowledge brokers will be covered, beginning with the 'two-communities' theory, covering relevant grey literature on 'knowledge brokers, then fully explicating the development of 'boundary theory'. This literature review will form the theoretical framework that will support the analysis of key-informant interview and focus group data.

The third chapter will deal with the original primary research being utilized. Both focus group and key-informant interview methods being utilized for the research will be justified. The inductive nature of the research will be explicated in further detail, and explanation for coding of interview data will be explored. The analysis of both interviews and focus groups will be presented. Following this, the research questions will be answered given the analysis of the data collected. This chapter will also identify

common themes within interview data that will be combined with primary themes found in focus group data for discussion in the next chapter.

The fourth and final chapter will conclude by exploring the implications of the interview and focus group data analysis when combined with existing literature. Potential complications and concerns will be raised, as well as avenues for further research.

CHAPTER 2: Literature Review

2.1 Introduction

The objective of this chapter is to explore and explicate the underlying theories and previous empirical research that inform the following research and analysis in this thesis. This chapter also seeks to demonstrate how this literature supports the choice of research questions and design, by showing the importance of the practices of knowledge brokers in the knowledge transfer process, as well as the suitability of boundary theory as a method of examining perceptions of science from different groups.

The chapter is divided into two sections. The first section begins by introducing the conceptual models of “knowledge use”. The section moves to explore empirical research that developed from these conceptual models of “knowledge use”; starting with the relationship between the knowledge producer and consumer, which is identified in literature as the most important feature, this empirical work explores the various factors that impact positively and negatively on knowledge use. This literature is covered in order to establish the basis for primary themes that will be analysed from interviews with knowledge brokers. Following this, the theory of two-communities is examined, with emphasis placed on how certain cultural differences between knowledge producers and consumers can create communication problems that knowledge brokers seek to correct. This discussion will also form a link between the importance of relationships and the importance of knowledge brokers. The section concludes by exploring literature on knowledge brokers and their role in the knowledge transfer process, with attention paid to the connection these individuals or organizations have to the practice of relationship-building.

In the second section, boundary work theory is introduced and explained as a useful lens for examining the socially constructed distinctions between science and non-science. Attention is paid to the link between political controversy and boundary work in particular, with focus on a recent theoretical definition of purity / pollution boundary-work. After this, principal-agent theory is introduced in order to fully explain the theoretical foundations of the next section. Finally, boundary organization theory is

explained as a combination of principal-agent theory and boundary-work theory. The role such organizations can play in stabilizing the boundary between science and non-science will also be explored, as well as the empirical research demonstrating their effectiveness at this.

The literature covered in this chapter will demonstrate that while there is a solid foundation of research in knowledge transfer and boundary work, research has yet to explore how these two bodies of work might intersect and even influence each other. This thesis will demonstrate and explicate this.

2.2 Knowledge Use

Before beginning any exploration of the role knowledge brokers play in the process of knowledge transfer, it is necessary to first establish what exactly is meant by “knowledge use”, as it is referred to in evidence-based decision making. If decisions are made using evidence or knowledge, what exactly is meant by use? As noted in Chapter 1, for the purposes of this thesis, “knowledge” is defined as scientific information derived from research, both in natural and social science arenas. The foundation of academic literature on knowledge use comes primary from the seminal work of Carol Weiss (1979). Her exploration of the use of social science research by American policymakers in the 1970s established key definitions and understandings that have remained fairly consistent while investigating the transfer of scientific knowledge, even while other researchers have explored the topic (Innvaer et al. 2002; Nelson et al. 1987; Walter, Nutley, and Davies 2002; Cooper and Levin 2010).

2.2.1 Models of Knowledge Use

Three main conceptual models of knowledge use have developed. The first conceptual model for knowledge use is known as instrumental use. Broadly speaking, in this model research knowledge is used directly by policymakers in providing the necessary answers to questions that inform a policy decision (Weiss 1979). This model is most recognizable as the idealised method by which research from science is employed to make decisions. Instrumental use can be further subdivided into the

knowledge-driven model and the problem-solving model. The distinction between the knowledge-driven model and the problem-solving model is a question of which party is initiating the knowledge transfer. In the knowledge-driven model, basic research is done without any interaction from policymakers. Researchers decide the choice of research subject, methods and analysis of the results without any direct influence from policymakers. The research knowledge eventually filters through to policymakers who then use it to inform their decision making process. Essentially, this model holds that because the knowledge exists it will inevitably be used. In the reverse of this process, the problem-solving model sees knowledge transfer being propelled by the needs of policymakers. In the problem-solving model, when faced with a problem that requires remedy through policy, policymakers seek out researchers to gain answers to the policy problem. Researchers then perform research to discover answers, which they then transfer to the policymakers to inform their decisions. This model assumes that there is a necessary amount of information required to make a policy decision, and that a lack of information will compel policymakers to seek information in order to make decisions (Weiss 1979).

The second of the major models is known as contextual use. In this model, research informs decision making by establishing a larger context of information from which policymakers draw on in order to make decisions. As opposed to instrumental use, which views knowledge transfer between researchers and policymakers as a rather direct process, in the contextual model knowledge indirectly affects the decisions of policy makers. Broadly speaking, in this model research is not used to directly answer a question concerning a decision; rather it influences decisions by affecting broader theories and ways of looking at the world (Innvaer et al. 2002; Nelson et al. 1987; Weiss 1979). Contextual use is further subdivided into two categories. The first is the enlightenment model. In this model, research knowledge is not directly transferred to policymakers, but instead filters out to broader society through a variety of channels, such as journals, mass media and everyday conversation (Weiss 1979). While policymakers may not be able to point to a specific study or research results that led to a specific decision, knowledge obtained through research has influenced that decision indirectly through the changes to societal thought that have occurred from the diffusion

of the research knowledge. This model shares a feature with the instrumental research-driven model in that it views knowledge use as something of an automatic or inevitable process. The second of the contextual models is known as the interactive model. This model views knowledge use as a complex process that involves multiple interactions between various actors, not simply between researchers and policymakers (Contandriopoulos et al. 2010; Weiss 1979). From this viewpoint, it is rare for knowledge produced by researchers to have every answer necessary for the development of a policy. Policymakers also engage with a variety of sources of information beyond the descriptive nature of research, interacting with administrators, journalists, interest groups, concerned citizens and many others (Nelson et al. 1987; Weiss 1979). Researchers are part of an ongoing interactive communication process between these different groups, with research being only one part of it. Research knowledge in this model is utilized as part of a larger decision making process.

The last of the models on knowledge use is known as symbolic use. In this model, knowledge is not a major factor influencing the decision making process by policymakers. Rather, knowledge is used symbolically to justify decisions that have already been made (Boswell 2008; Innvaer et al. 2002; Nelson et al. 1987). In this model, knowledge is not utilized to inform decisions, but rather utilized as rhetorical ammunition in political struggles (Weiss 1979). The transfer of knowledge still occurs in this model, generally understood as policymakers leading the process, in searching out research that will reinforce their predetermined position. Policymakers use research to both legitimize their use of power through being viewed to make decisions based on evidence, as well as substantiating their specific policies with said evidence (Boswell 2008). There is a variation of symbolic use of knowledge with regards to the political realm, known as the tactical model. In this model, the active process of research is used as a political means to demonstrate responsiveness to a particular issue, even though the policymakers do not intend to take any serious action in addressing the policy problem. Rather, the existence of research itself is used tactically in order to silence complaints concerning the issue (Weiss 1979). This model of knowledge use has neither actual knowledge transferred nor knowledge used in the decision making

process, only the fact that knowledge is being pursued is used tactically to quiet political adversaries.

Several factors have been identified to impact how knowledge is used in policymaking. For instance, instrumental use of knowledge is far more likely when the research is commissioned (Innvaer et al. 2002). In cases where there is significant political contestation or struggle in a controversial policy area, symbolic use of knowledge is also more likely (Boswell 2008; Innvaer et al. 2002). In addition to this, administrative agencies that are political are more likely to use knowledge symbolically, whereas administrative action agencies that are judged on quality of outputs more likely to be using knowledge instrumentally (Boswell 2008).

There is no single dominant model of knowledge use within academic literature at this time. The models of knowledge use previously described are generally understood to each label a certain facet of knowledge use, and no one model can fully explain the process alone. Literature has also noted that it is difficult to precisely determine which model should be used when analyzing a specific case of knowledge use, since it can be hard to differentiate the symbolic use of knowledge from instrumental or contextual. Without access to backroom discussions or reading a policymaker's mind, it can be hard to determine whether knowledge was used in a decision or whether merely used to support a decision already made (Contandriopoulos et al. 2010; Innvaer et al. 2002). Despite the difficulty of measurement, these three main conceptual models of knowledge use are used in the literature when exploring knowledge utilization. It is more useful to think of these conceptual models not as exclusive theories that necessarily preclude the validity of the others, but rather as each capturing a different manner through which knowledge use can occur. This is important to keep in mind as the next section focuses on empirical research that has attempted to discover which factors positively or negatively impact knowledge utilization.

2.2.2 Factors Impacting Knowledge Use

The literature on the knowledge utilization comes from a variety of academic fields. Because of this, there are differing systems of specification and terms used to

refer to what are often similar processes. Many literature reviews have attempted to create synthesized concepts of what is currently known, and the majority of these have focused on identifying the processes involved and the various factors that work to inhibit or facilitate it (Contandriopoulos et al. 2010; Crona and Parker 2011; Innvaer et al. 2002; Jack et al. 2010; Landry, Amara, and Lamari 2001; McNie 2007; Nisbet and Scheufele 2009). Generally speaking, there are five main factors that have been examined. These factors are the relationship between the researcher and policymaker, the attributes of the research being transferred, the attributes of the researcher, the attributes of the policymaker, and the broader political context. While literature has found that each of these factors have an impact knowledge transfer, relationships or interactions is one factor that has been consistently found to be influential by a wide variety of studies and researchers.

The relationship between the researcher and decision maker appears to be a critical element in knowledge utilization. One of the most important aspects of the relationship affecting knowledge utilization identified in the literature is personal contact and communication between researchers and decision makers (Cash et al. 2003; Cook et al. 2013; Crona and Parker 2011; Innvaer et al. 2002; Landry, Amara, and Lamari 2001; Lavis et al. 2003; Nelson et al. 1987). The more communication that occurs between researchers and decision makers regarding the research, the more likely the research will be utilized by the decision maker. In addition, the level of interaction between researcher and decision maker also impacts another factor that influences knowledge utilization: the level of trust between researchers and decision makers (Innvaer et al. 2002; Malka, Krosnick, and Langer 2009; McNie 2007). A relationship that is categorized by higher levels of trust has higher levels of knowledge utilization. This is also reflected in that the longer a relationship between a researcher and a decision maker exists, the higher rate of knowledge utilization. Conversely, a high turnover of policymakers negatively impacts the relationship, thereby lowering knowledge utilization (Innvaer et al. 2002). Further, relationships between researchers and decision makers that include active mediation of conflicts, as well as balancing the differences in values, perspectives and goals between each party is linked with higher levels of knowledge utilization (Cash et al. 2003; Nisbet and Scheufele 2009).

The interaction model incorporates and pulls together explanations from the various sorts of knowledge use existent in literature (Landry, Amara, and Lamari 2001). This model explains the primary factor that influences the use of research by end users is the number and level of interactions between these two groups. Higher numbers of positive interactions between researchers and end-users make each aware of the needs of the other, which in turn facilitates knowledge use. Support for this model is found in the evidence in literature that finds that interactions are an important part of knowledge transfer; as already noted, much research to date finds that knowledge transfer can be improved through interaction and communication between researchers and end users: the more interaction that occurs between researchers and end users regarding the research, and the longer a relationship between a researcher and an end user exists, the more likely the research will be utilized by the end users (Amara, Ouimet, and Landry 2004; Cash et al. 2003; Cherney and McGee 2011; Cook et al. 2013; Crona and Parker 2011; Landry, Amara, and Lamari 2001; Lavis et al. 2003; Lavis 2006; Nelson et al. 1987; Walter, Nutley, and Davies 2002). These interactions are understood to increase knowledge utilization by increasing the legitimacy, relevance and credibility of the research for the end users interacted with. Increased interactions mean that a transparent research process can increase the credibility of the research in the eyes of an end-user, increasing likelihood of utilization. Early interactions between researcher and end-user in the research process can also influence the choice of research question, increasing the relevance of the research produced, again increasing likelihood of use by the end-user. Research that has more involvement from decision makers throughout the research process typically produces knowledge more readily utilized by decision makers (Cash et al. 2003; Dunn 1980). It is important to note how it is not merely the interaction that produces that positive effect on knowledge utilization, but rather the quality of that interaction. In this case, a high quality interaction between producer and consumer in the early stages of the research process produces a research product of increased relevance for the end user. In this case, the interaction is useful because of the increased relevance found in the resulting research. In addition to interactions between researchers and end-users, interactions between knowledge brokers and end users or knowledge brokers and researchers have also been found to

have a positive impact knowledge transfer (Dobbins et al. 2009; Hammami, Amara, and Landry 2013). The quality of interactions is also important; as noted previously, relationships between researchers and end users that include active mediation of conflicts, as well as balancing the differences in values, perspectives and goals between each party, are linked with higher levels of knowledge utilization (Cash et al. 2003; Nisbet and Scheufele 2009).

In addition to interactions, four other factors appear to influence knowledge utilization. First, the attributes of scientific research that is being transferred affects the process in a variety of different ways. One such attribute is the timeliness and relevance of the research to the particular policy problem being considered. Research that provides information that is related to the policy problem and is up to date is more likely to be utilized by policymakers (Innvaer et al. 2002; Cash et al. 2003; Oh and Rich 1996). Another attribute of research impacting likelihood of use is whether it has been transformed into a brief. Research that has been adapted and condensed into a brief that includes policy recommendations is more likely to be utilized than research which has not (Innvaer et al. 2002; Landry, Amara, and Lamari 2001). The quality of research being transferred also impacts utilization (Innvaer et al. 2002; Cash et al. 2003). In this sense, quality refers to the soundness of the scientific methods utilized during the research and the adequacy of the evidence relative to the arguments present. The perceived bias of the research is another important factor, although the literature is split concerning its impact. It has been found that research that appears unbiased and fair to differing stakeholders involved in a policy decision has a greater chance of being utilized (Cash et al. 2003). Conversely, it has also been found that research that confirms an already existing policy or endorses self-interest of a decision maker is also more likely to be utilized (Innvaer et al. 2002; Oh and Rich 1996). The source of funding for research also impacts the likelihood of use. Externally funded research has a higher level of utilization than internally funded research, with the suggestion that universities using internal funds for research have low expectations that research results will be utilized (Landry, Amara, and Lamari 2001). Finally, the organizational structure from where the research originates is important, given that research that is done within the

same organizational structure of the policymaker rather than from an outside, separate organization is also more likely to be utilized (Dunn 1980; Oh and Rich 1996).

The second factor influencing knowledge use is the various attributes of the end users involved in the decision making. The existence of power struggles within the larger organization structure in which the policymaker operates negatively impacts utilization, as do budget struggles (Innvaer et al. 2002). How familiar the policymaker is with a particular policy problem also impacts use of scientific evidence. When facing policy problems related to a topic that a policymaker is unfamiliar or has little experience with, they are more likely to attempt to reduce this by seeking out information such as research knowledge. This desire for familiarity increases utilization of scientific information (Oh and Rich 1996). Finally, the attitudes decision makers have about social science research impact utilization: as one might expect, negative attitudes about research in general decrease utilization (Oh and Rich 1996).

Third, there are two attributes of the researcher have been argued to positively impact knowledge utilization: researchers who are more actively engaged in dissemination efforts tend to produce research that is more utilized by policymakers (Landry, Amara, and Lamari 2001) and the larger number of publications that a researcher has attributed to their name, the more likely that research they produce will be utilized (Landry, Amara, and Lamari 2001). Generally, however, there has been little indication that the attributes of the researcher have much impact whether information is utilized by policymakers.

Fourth, and finally, the context surrounding the research being communicated has also been identified as important to knowledge transfer (McNie 2007). A controversial context is especially important. Controversy can be understood as widespread disagreement between societal actors regarding what is a problem, how much of a problem it is, and what are acceptable solutions (Contandriopoulos et al. 2010). In contexts of low issue polarization, instrumental use of knowledge is more likely (Contandriopoulos et al. 2010; Murphy, Fafard, and O'Campo 2012). Yet in cases where there is significant political contestation or struggle in a controversial policy area,

symbolic use of knowledge is more likely (Boswell 2008; Innvaer et al. 2002; Fafard 2012; Contandriopoulos et al. 2010). Since symbolic use of knowledge is understood to refer to utilization of research not in decision making, but for political purposes, this sort of knowledge utilization is generally not the sort sought after in knowledge transfer.

In summary, literature examining factors impacting knowledge transfer have focused on five factors: the relationship between the researcher and policymaker, attributes of the research being transferred, the attributes of the researcher, the attributes of the policymaker, and the political context. Of these, the researcher-policymaker relationship (interaction) has been found to be of particular importance.

One challenge for promoting interaction between researchers and policymakers is the differing cultural and structure environments within which each set of actors operates. The 'two communities theory', discussed below, explores the sources of tension that emerge from these differences. These tensions will be especially important to consider as they create the need for third parties or knowledge brokers to overcome them through facilitating communication and interaction.

2.2.3 Two-Communities and Knowledge Brokers

Two-communities theory holds that significant cultural and structural differences exist between knowledge producers and knowledge consumers. So much so that it is possible to conceive of the two groups as distinct communities (Caplan 1979; Dunn 1980; McNie 2007). There are several differences between researchers and decision makers that are elucidated by two-communities theory. First off, there is a disconnect between how each party views themselves and how they are viewed by the other party. Researchers view themselves as rational actors, open to new ideas and ways of thinking. They view decision makers as less interested in new ideas or evidence, and only concerned with their own narrow interests. Conversely, decision makers view themselves as responsible and pragmatic, and view researchers as out of touch and unaware of practical realities (Innvaer et al. 2002). There are also differences in the systems that researchers and decision makers inhabit. Decision makers operate in a system that requires definite answers to problems, as the nature of their work requires

decisions to be made on a continuous basis. In contrast, researchers work in a system that does not often require that they make decisions that have far reaching impacts. The system researchers exist in is generally concerned with conducting research (Caplan 1979). These structural differences lead to differences in language. Given that their decisions have real world impact, policymakers prefer answers that reflect the level of certainty present in decision making (Caplan 1979; Dunn 1980; McNie 2007). This level of certainty is not mirrored in the world of probability in which researchers generally inhabit, and the language of research provides answers that are in terms of probability rather than absolute fact. The theory of two-communities views the three main areas of values, structures and languages as the key differences that inhibit knowledge transfer between these knowledge producers and knowledge consumers.

A particular sort of solution to the problems posed to knowledge transfer by these areas is having certain third party intermediaries or “knowledge brokers” work to overcome them. It has been noted that the existence of a third party in the knowledge transfer process is linked to an increase in knowledge use (Cash 2001; Cooper and Levin 2010; McNie 2007). Perhaps due to these positive impacts, there have been an increasing number of professionals and organizations working in this third party role as knowledge brokers (Goreham Hitchman 2010). Knowledge brokers can be individuals, organizations (such as research institutions or advisory councils), or structures within organizations (such as within granting agencies) (Ward 2009); this emerging class of communication specialist focuses on facilitating the spread and utilization of scientific research beyond a purely academic audience. Knowledge brokers do not actively engage in the production of research themselves, but rather serve as a third-party intermediaries in the knowledge transfer process, sitting between the researcher and the end-user, reacting to the demands and perspectives of each side (Turnhout et al. 2013). The role played by these organizations or individuals is that of interpreters and mediators, working to promote active linkages and interactions between researchers and policymakers (Bielak et al. 2009; Cooper and Levin 2010). These professionals work to assist in knowledge transfer by serving as a link between the researcher and end-user communities by actively identifying issues and problems that affect knowledge transfer and working to overcome these (Dobbins et al. 2009). The general goal of

knowledge brokers is to be situated between knowledge producers and knowledge consumers, in order to facilitate knowledge utilization (Goreham Hitchman 2010; Cooper and Levin 2010). The role played by these individuals or organizations helps to overcome the three main barriers identified by two-communities theory. By actively translating and adapting research results, the barrier of language can be overcome. Through the role played as mediators between researchers and policymakers, third-party intermediaries can help overcome conflicts that might arise due to structural and value differences, helping to facilitate knowledge utilization.

2.2.4 Conclusion

This section has covered the conceptual models of “knowledge use”, the empirical research that explores the various factors that impact positively and negatively on knowledge use, as well as the theory of two-communities and its connection to the emergence of knowledge brokers in the knowledge transfer process. After examining the literature it is clear that both relationships and knowledge brokers are important factors in knowledge transfer. What is left somewhat unclear is how precisely knowledge brokers are going about facilitating knowledge transfer, both the particular practices or strategies they utilize as well as broader perceptions of these strategies, from the actors involved in knowledge transfer as well as the brokers themselves.

While the literature indicates that knowledge brokers facilitate research utilization by bridging the identified gap between the two communities of researchers and decision makers, there is another theory that helps explain why we can understand the need for knowledge brokers to facilitate knowledge transfer not only as a function of structural and cultural differences between researchers and decision makers, but also as a result of socially constructed boundaries between science and non-science.

2.3 Science / Politics Boundary Theory

In this section, the distinctions between science and non-science are explored through the lens of boundary theory. This is accomplished by first by explaining the nature of demarcating this boundary through what is known as boundary work, then by

exploring its link to political controversy. Particular focus is then paid to a form of boundary work as purity / pollution boundary-work, which is a measure of boundary violation. After this, principal-agent theory is introduced and boundary organization theory is explained as a combination of principal-agent theory and boundary-work theory. The effectiveness and importance of these organizations in stabilizing the boundary between science and non-science is examined as well.

2.3.1 Boundary Work

While the two-communities theory focuses on the difference between the policy and science world in concrete descriptive terms, boundary work as theorized by Thomas Gieryn focuses instead on the discursive practices used by various social actors to define science (1983). Instead of clearly defining a supposed objective difference between scientific knowledge and other sorts of knowledge, Gieryn focuses on actions of both scientists and non-scientists who are themselves working to define the difference. Boundary work is the term used to describe the various actions to construct this boundary, through making definitions and demarcations to separate science from non-science. An example of boundary work would be when a scientist makes a distinction between the conclusions of research as being accurate and unbiased, as opposed to claims from a politically motivated actor. In this example, a boundary is constructed that associates the characteristic of 'unbiased' and 'detached' to scientific endeavours and conversely associates 'biased interpretation' to non-scientific endeavours. It is also important to note that boundary work is not only limited to defining the difference between science and non-science. As defined by Sheila Jasanoff, boundary work is "a communally approved drawing of lines between "good" and "bad" work (and, not trivially, between "good" and "bad" workers) within a single discipline, between different disciplines, and between "science" and other forms of authoritative knowledge" (1987: 53). The fundamental assertion in this theory is that this boundary work is pursued by scientists because it is useful for them, since it allows the concept of science to achieve an elevated intellectual authority that confers career opportunities, authority, independence and resources to scientists while denying it to "pseudoscientists". In this view, science is not defined in a set way, but the boundaries

that define it are continuously negotiated and redrawn in historically changing ways driven by the interests of those actors engaged in creating those boundaries (Jasanoff 1987).

Yet while social actors conduct boundary work for their own reasons, we can conceive of benefits that are conferred onto society by having a clear boundary between science and politics. In this normative view, the distinction between science and politics is necessary and even beneficial. If there was too much political interference in science, the validity of research might be compromised. Conversely, if there was too much science in politics, the role of politics to balance diverse views and interests might be compromised by technocratic policy making (Guston 2001).

2.3.2 Purity and Pollution Boundary Work

A particular sort of boundary work that reflects this view of a socially beneficial boundary focuses on the legitimacy of science in terms of its purity from outside “polluting” influences, such as ideological or industry sources. As mentioned in the introduction, these definitions of “pollution” and “purity” are defined as measures of level of separation between socially constructed boundaries between science and non-science. Purity claims are a measure of how a particular piece of scientific research or scientist has not violated these boundaries and therefore has avoided contamination from non-science, while pollution claims are a measure of opposite. In this sort of boundary work, the boundary between science and non-science is argued to be necessary to ensure that science remains a neutral, objective source of unbiased information about our world. A case study by Brendon Swedlow’s examined these sort of pollution and purity claims in boundary work (2007). In the case study, a political struggle over public policy regarding the recommendations from a scientific committee saw extensive use of purity/pollution boundary work from both scientific and non-scientific actors. The key factor in these acts of boundary work were accusations of pollution from inappropriate association with non-scientific factors, be it collusion with industry, politics, or ideology. For instance, discrediting a scientific study as “corrupted” non-science because of its source of funding or a previous professional association with

a researcher is an example of pollution boundary work that was present in the case study. In these cases the boundary between pure science and impure non-science had been violated, rendering the scientists and their findings suspect. Conversely, in order to protect themselves against charges of pollution, many scientists sought to associate themselves with purifying elements, such as universities. Purity/pollution boundary work is essentially about defining and measuring inappropriate boundary violations. In this way, some science can be ostracized as polluted, while other science can be valorized as pure.

Context is an important facet of boundary work. In the case of science being transferred in issues of high political contestation, scientists and non-scientists alike use purity/pollution boundary work in order to privilege certain forms of information as science and discredit others as non-science (Swedlow 2007; Zehr 2005). Identifying and exposing supposed inappropriate sources of bias tainting the objective nature of science is the particular aim of this sort of boundary work, and it has been noted to be linked to politically controversial contexts (Swedlow 2007; Zehr 2005). Just as is the case with other sorts of boundary work, the social actors engaging in it are motivated by differing interests (Gieryn 1983). Clearly, unrestrained acts of boundary work attacking the legitimacy of science presents a serious problem to evidence informed policy, especially given the likelihood of its use in politically controversial contexts. An answer to the question of how to mediate these acts of boundary work is offered in the form of special “boundary organizations”, which is the focus of the next subsection.

2.3.3 Principal-Agent & Boundary Organizations

G.H. Guston first conceptualized an important theory related to knowledge brokers in 1999. His theory focuses on boundary organizations, which he conceptualized as serving the important function of mediating acts of boundary work that frustrate the transfer of knowledge between the world of science and politics. Before these organizations can be described fully, it is necessary to explain the theoretical underpinnings of their operation. Boundary organization theory relies on an important adaptation of principal-agent theory, originally from economics but adapted by

Dietmar Braun for examining the relationship between policymakers and researchers, specifically the role of mission-agencies (semi-public funding agencies with a goal to promote and execute basic scientific research to improve the transfer of scientific knowledge in a specified area, such as the Atomic Energy Commission) in promoting and conducting research.

Initially, principal-agent theory was used in economics as a means of interpreting the transaction costs between a principal and a contracting agent. The idea is that the agent works in the interests of the principal with regards to a third party (Braun 1993). An example of this is a shareholder and the manager of a corporation. The usual situation that leads to this relationship is when an actor has significant resources, but not the sort of resources that are best suited to pursue the interest in question. Both principal and agent expect to gain from the relationship: the principal by gaining access to resources to pursue an interest, and the agent through the transferred resources from the principal in compensation of their own resources used in pursuing the interest. There are two main problems with this arrangement: the agent might not pursue the interest of the agent as much as they ought to because the agent lacks the information to effectively control their efforts, a problem referred to moral hazard (Braun 1993); and the principal doesn't have effective means to determine the qualifications of any potential agent, known as the problem of adverse selection (Braun 1993).

Braun's adaptation defined the relationship between policymakers and research mission-agencies as that of a principal and an agent. This adaptation makes two further major distinctions in its application to the field of politics. First, there is a unique rationality guiding the actions of actors within a political system distinct from an economic system: while actors in an economic system are motivated almost entirely by profit, actors within a political system are motivated by political incentives, such as legitimacy and political support (Braun 1993). Second, while economic application of principal agent theory involves two actors of principal and agent, Braun's political application has three actors: principal (politician/policymaker), agent (researcher/knowledge producer), and third party (1993).

The problem of information imbalance that leads to moral hazard also exists in a political situation, as the politician (principal) lacks the connection to the knowledge producers (agent) that the knowledge broker (third party) has. The politician therefore has an interest to develop strategies to overcome this lack of information, such as monitoring systems and incentives for good actions from agent researchers. Third party intermediaries satisfy this interest by serving as a mechanism through which policymakers can monitor researchers and provide incentives for good actions. It is this notion of the intermediary serving disparate interests in the relationship between differing actors, through the use of capacities that the intermediary possesses while both of these actors lack that is crucial for understanding boundary organizations. How this notion is combined with the concept of boundary work is explored in the next subsection.

2.3.4 Boundary Organization Theory

Boundary organization theory as conceptualized by D.H. Guston (1999) utilizes Braun's adapted principal-agent theory, and adapts it further by combining it with Gieryn's science / non-science boundary work (1983). Guston expanded this conception of the boundary between science and non-science to examine the role of certain organizations that straddle the boundary between science and politics, interpreting their role through the perspective of principal-agent theory (2001). Although the theories of two-communities and boundary work are useful for explicating the divide that exists between science and politics, evidence informed policy requires that there be some sort of effort to cross this divide. Examples of incentives to bridge this gap could be when a policymaker has a requirement for information regarding the potential causal effects of policy, or when researchers seek out potential sources of resources to conduct research (Parker and Crona 2012). Yet these sort of activities can be interpreted as violations of the science / non-science boundary, and can present certain risks to those actors engaging in them (Guston 1999). Boundary organizations function as a special sort of principal, serving the differing agents of politics and science. The organization accomplishes this by sitting on the science-politics boundary, in the interest of allowing for the maintenance of the boundary between the sides while facilitating the beneficial

transfer of knowledge and resources (Crona and Parker 2011). While direct interactions between science and politics without a boundary organization can lead to such interactions being attacked as inappropriate through boundary work, boundary organizations intentionally structure and situate themselves in such a way as to be neither strictly within the realm of science or politics, but rather existing on the boundary.

Boundary organizations have three criteria, according to Guston (2001). First, they provide opportunity and incentive for creation of information artifacts that can be used by both actors interacting with the agent boundary organization. These artifacts, known as boundary objects, much like the organizations themselves, exist in the boundary of both science and non-science, and can be used by actors from either side without losing its unique identity (Guston 2001). An example of a boundary object could be a map. Second, they involve participation of actors from both sides of the boundary as well as professionals who serve a mediating role. Third, they exist between the two different worlds of politics and science, and have distinct lines of accountability to each. Principal-agent theory is involved in this third aspect, as policymakers are viewed as principals that seek knowledge from agent researchers, while principal researchers seek incentives from agent policymakers (Parker and Crona 2012). Boundary organizations sit between this principal-agent relationship, serving as an agent to either side to facilitate their goals. In this manner, it is possible to conceive of boundary organizations as a particular example of a knowledge broker, working to assist in knowledge transfer between the two-communities of researchers and policymakers as functioning as agent to both sides. Moreover, the professionals who serve as mediators facilitating the participation of actors from either side of the boundary can be understood to be individual knowledge brokers in this function.

2.3.5 Adapted Boundary Organization Theory

Parker and Crona (2012) developed boundary theory further, identifying practical challenges with the theory by conceptualizing it to fit a case study of a boundary organization situated within Arizona University. This is not an ideal situation, given the

definition of boundary organizations given by Guston, as a boundary organization situated within a university would not have the clearly delineated lines of accountability to both policymakers and researchers, given that it would be part of a university, which is primarily a research institution. Funding for the boundary organization in such a setting would be also largely dependent on government, meaning an imbalanced level of accountability to that source of funding, undermining a principal-agent relationship. Yet the clear distinction as elucidated by Guston doesn't apply to current realities, given the gradually increasing involvement of politics and industry within a university setting (Parker and Crona 2012). There are now considerable overlaps of academic, political and industrial activity. Parker and Crona also questioned Guston's third criteria, which is the accountability between the boundary organization and its stakeholders. It is increasingly unlikely that there will be equal levels of accountability to all stakeholders involved in the boundary organization, given certain stakeholders like funding agencies or public policy communities wielding more power than scientists involved. Parker and Crona therefore challenged Guston's idea that stakeholder groups can be equally satisfied (2012). Differing demands placed on a boundary organization by the different stakeholders involved creates a set of tensions as to which demand will receive primacy. This forces a boundary organization to make choices between incompatible demands, necessarily favouring one and diminishing the other (Parker and Crona 2012). The challenge for a boundary organization is to not necessarily achieve equal satisfaction, but to answer the needs of stakeholders sufficiently to maintain their participation in and the stability of the boundary organization.

While there are challenges that exist to achieve this stability, boundary organizations have the potential to be useful in dealing with the political application of purity/pollution boundary work, since they are able to bring the various stakeholders involved in these boundary work struggles together and mediate the science-politics boundary (Cash 2001; Cook et al. 2013; Parker and Crona 2012). An effective boundary organization essentially brings these outside acts of boundary work within the organization itself, then works to actively mediate and resolve them. As a result, information artifacts (boundary objects) that are produced by the boundary organization are less vulnerable to boundary work attacks on their scientific legitimacy.

2.3.6 Conclusion

This section has covered several aspects of boundary theory, such as boundary work, pollution/purity, as well as boundary organizations. When considered with the previous section, this literature raises certain questions concerning knowledge transfer practices. If literature has identified relationships and knowledge brokers as important factors in knowledge transfer, does pollution/purity boundary work play a role in the perceptions of practices meant to establish relationships?

2.4 Chapter Summary

This chapter has touched on the empirical literature and theoretical frameworks that will be used throughout this thesis. It has covered the conceptual models of knowledge use, the factors impacting knowledge transfer, the two-communities theory and knowledge brokers. It has also covered the various aspects of boundary theory, including boundary work, pollution and purity, principal-agent theory and boundary organizations. These theories are an appropriate choice to serve to as a guide for this thesis because how they capture both the political and non-political dimensions of evidence informed policy. Literature on knowledge use describes the different ways we can understand how evidence can be utilized in decision making, while the empirical work done measuring the impacts different factors have on knowledge transfer helps to situate these understandings with practical realities of their applications. Two-communities theory describes the foundational structural and cultural differences that exist between science and politics that create the need for knowledge brokers to participate in knowledge transfer. Finally, boundary theory describes the less foundational and more socially and politically constructed distinctions between science and politics. This is especially useful for interpreting how different groups define science, as evidence informed policy, like all policy creation, necessarily involves disparate social actors impacting it.

There are a few conclusions that can be drawn from the literature. First, knowledge brokers can play an important, positive role in knowledge transfer. Secondly, interactions and relationships have been identified as influential on knowledge transfer,

something knowledge brokers have been noted as being effective at facilitating. Thirdly, pollution/purity boundary work is a practice often used in politically controversial areas to discredit research or researchers who violate social boundaries separating science and non-science. What is unclear is exactly how knowledge brokers go about facilitating knowledge transfer. If interactions and relationships are important, and knowledge brokers are effective at facilitating them, how exactly are interactions facilitated? In addition to facilitating such interactions, are other practices that target other factors identified in literature utilized? Examining knowledge transfer through the lens of pollution/purity boundary work also raises questions concerning potential boundary violations that may arise from knowledge transfer practices aimed at fostering interactions between knowledge producers and knowledge consumers. Could these interactions be viewed as a potential boundary violation? What perceptions do knowledge brokers have of these practices? What perceptions do researchers and various end user groups have of these practices? The following chapter will outline both the methods and findings used to answer these questions.

CHAPTER 3 – Methods and Findings

3.1 – Introduction

This chapter will explicate the methods that are utilized while conducting original research for this thesis. It will cover the context that the research is carried out in and justify and explain the choice of a qualitative approach to the research. Sampling, data collection, and the method of analysis will also be explained in detail. With the methodology clearly defined and justified, the chapter moves to answer the first three research questions: What strategies or practices do knowledge brokers utilize in order to facilitate knowledge transfer? What do these brokers think are the key factors that impact knowledge transfer? How do different audiences perceive knowledge transfer practices? Drawing on the original qualitative data, this chapter provides evidence that knowledge brokers utilize three main strategies when pursuing knowledge transfer: using appropriate language when communicating, fostering interactions between researchers and end users, and working to establish themselves and the research in question as credible by associating themselves with science and presenting themselves as unbiased. Further, this chapter demonstrates that knowledge brokers hold that the key factors to successful knowledge transfer as establishing their trustworthiness, understanding the end-user audience being communicated to, the level of relevance of the communicated research to the end-user, and maintaining positive relationships between themselves, researchers and end users. Finally, this chapter will provide evidence that there is a significant amount of divergence of perception in different audiences about knowledge transfer practices with regards to the boundaries of science.

3.2 – Methods

The goal of this research is to explore those communication strategies being utilized by knowledge brokers as well as perceptions of various audiences on the purity/pollution boundary work implications to better understand the broader implications of knowledge transfer. The increasing existence of knowledge broker organizations as well as individuals working as knowledge brokers mean these organizations and

individuals are well suited to provide insight into knowledge transfer strategies (Goreham Hitchman 2010). In addition to this, capturing the perceptions of different groups regarding purity / pollution boundary work will provide insight into how this relates to knowledge transfer. The research methodologies employed to obtain the relevant information from these actors is detailed below.

3.2.1 – Context

The research was conducted within the Nuclear Policy Research Initiative at the University of Saskatchewan, a research study that is aimed at exploring relevant issues surrounding nuclear policy within the province of Saskatchewan. Given the highly complex and politically controversial nature of nuclear policy, evidence informed decision making is very important for the creation of sound nuclear policy. Research conducted through the initiative on knowledge transfer and surrounding theoretical issues is intended to contribute to general knowledge to support evidence informed decision making. While the Nuclear Policy Research Initiative is focused on nuclear policy issues, the research conducted for this thesis is directed more broadly, on the knowledge transfer of general scientific information. Thus, while this research examines knowledge transfer of science relevant to nuclear issues, there is not a specific focus on this. Rather this research seeks to examine knowledge transfer strategies in a wider span of contexts, levels of political controversy, and audiences.

3.2.2 - Qualitative Approach

Examining communication strategies and practices is an effective way of analysing knowledge transfer, as it is these strategies and practices that essentially comprise knowledge transfer. Since this research is concerned with discovering which strategies and practices are being utilized by knowledge brokers, rather than empirically testing whether these strategies are effective, the best way to approach this was to utilize a qualitative research method. The research included interviews, document analysis, and focus groups. Interviews were an appropriate choice to examine what strategies or practices were being utilized by knowledge brokers as well as discovering what these individuals thought were key factors that lead to successful knowledge

transfer. Interviews provide for rich and descriptive data, as well as allow for subjects to both relate direct answers on the communication strategies they utilize as knowledge brokers and what they feel are key issues impacting their communication efforts (Patton 2015). Document analysis was used to supplement these interviews, focusing on publically available documents such as annual reports and knowledge transfer plans from knowledge brokering organizations that outlined knowledge transfer efforts utilized by that organization. Reviewing these documents allowed for discovering what strategies were being utilized for knowledge transfer, but did not allow for examining the perceptions of individuals carrying out these strategies within these organizations. As such, these documents were used to supplement interviews.

In answering the question of how different groups perceive knowledge transfer practices, focus group method is particularly valuable. Since this research is focused on interpreting the socially constructed definitions of science and non-science, focus group method allows for interpreting the collective social aspect of these constructions through observing group interactions, something focus groups are well suited to encourage participants to do (Smithson, 2000). In addition to this, focus group method allows for observing both differences and similarities in the construction of definitions of science and non-science between different groups (Stewart, Shamdasami & Rook, 2009). While the data produced from focus groups cannot be said to be representative, the depth and nuance that emerges from these data are more useful for interpreting the discursive practices involved in boundary work.

3.2.3 - Sampling and Data Collection

For key-informant interviews, non-probability, purposive sampling was used, focusing on gathering a diverse sample of different knowledge brokering organizations and individuals in different political contexts. This was done in order to enable comparative analysis between subjects, to assess the potential impact of varying contextual factors on knowledge transfer (Patton 2015). A total of eighteen organizations with knowledge brokering mandates were examined. Of these organizations, seven focused on health related issues, seven on environmental issues, and four on general scientific knowledge. Of these organizations, seven dealt with

information that was of low political controversy, six dealt with information that was of moderate political controversy, and four dealt with information that was of high political controversy. When determining level of political controversy for scientific information communicated, the definition as used by Contandriopoulos et al. (2010) was utilized, determining controversy by the level of polarization in the consensus that the area constituted a problem, the importance of the area opposed to other areas, and the criteria by which potential solutions should be assessed. All organizations were located in Canada. To supplement these interviews, six documents such as annual reports, operating plans and knowledge translation plans were also analyzed. Thirteen of the organizations were examined through interviews with individuals working as knowledge brokers within the organization, one organization was examined through a combination of interview and documents, and four organizations solely through documents. Of the organizations examined solely through documents, two organizations dealt with low controversy, one with moderate controversy, and one with high controversy.

Interviews were conducted between October 2014 and May 2015, with a total of 16 subjects, of whom 10 were female and 6 were male. Potential interview subjects were identified by searching the internet for keywords such as knowledge transfer, knowledge mobilization, and scientific communication. Initial subjects were selected based on if they had previous experience working to communicate scientific information as a knowledge broker between researchers and end users. A list of potential interview subjects was formed using this search, and subjects were then contacted by phone and e-mail to request their participation, as well as to secure their consent to be interviewed. In addition to this initial list of subjects, snowball sampling was subsequently utilized, asking interview subjects if they knew of any other organizations or individuals also working to communicate scientific information. Seven interview subjects dealt with scientific information of low political controversy, six of moderate political controversy, and three of high political controversy. Interviews were conducted in person when possible, and otherwise were conducted via telephone. Interviews were digitally recorded and transcribed. In order to maintain confidentiality of subjects, the specific job titles of subjects were generalized to “knowledge brokers”. Subjects did not necessarily

have this as a specific job title, but this was used in order to protect anonymity. Transcriptions of interviews were then coded in NVivo qualitative research software.

For focus groups, again non-probability, purposive sampling was used. The focus groups were carried out as part of ongoing research conducted by the Nuclear Policy Research Initiative, aimed at improving the understanding that the role evidence plays in decision making in industry, community, and in the creation of nuclear policy. Subjects were recruited through a combination of email and telephone contact. The initial sampling frame was established inductively and snowball sampling was used to identify additional respondents. In order to allow for analysis of differences between certain stakeholder groups, focus groups were organized into four sessions: community, industry, scientist, and government. For the purposes of the study, participants in the community focus group were individuals active in societal groups focused on nuclear issues, industry participants were individuals working in the private sector related to nuclear issues, both directly employed or as consultants, participants in the scientist focus group were researchers working within an academic setting, and finally government was defined as non-elected public servants. Due to the context of the study, all focus group participants had some connection to nuclear and/or energy policy. As was the case with interviews, focus groups were digitally recorded and later transcribed, except for the government focus group. This particular focus group was not recorded because one participant would not consent to the recording. Instead of recording and transcribing later, two researchers made detailed notes during the focus group to record what transpired. These notes were later compared to ensure their accuracy.

Four focus groups were held between November and December of 2014. Before each focus group began, respondents provided written informed consent to participant. Focus groups ranged in size from five to seven participants. In total, there were 25 participants in all four groups, with men outnumbering women (see Table 1). A focus group moderator was present during each session, and ensured that discussion flowed smoothly as well as allowing each participant an opportunity to speak.

Table 3.1 - Focus Group Demographics

Scientist	6 men 1 woman
Industry	4 men 3 women
Government	5 men 0 women
Community	2 men 4 women

3.2.4 - Moderation and Guide

An interview guide and a focus group guide were utilized, allowing for comprehensiveness of data and keeping data collection somewhat systematic while allowing for probing questions for depth when appropriate (Patton 2015). Interview questions focused on identifying specific communication strategies utilized by subjects and organizations for communicating scientific information, the perceived effectiveness of these strategies, and what subjects thought were the key factors that lead to successful communication of scientific information. Questions were aimed broadly, at identifying those strategies used by the organization and subject for communicating scientific information. Although the term “knowledge transfer” was not specifically used in the guideline, probing questions were used that conceptualized science communication more broadly as knowledge transfer. As such, subjects were informed that we were interested in learning about communication strategies for a variety of potential audiences, such as policymakers, key stakeholders or the general public. Figure 3.1 outlines the interview framework utilized during interviews.

Figure 3.1 - Interview Questions Guideline

<p><u>Evidence communication</u> We would like to ask you to think about a particular instance in which you communicated about three particular research findings/topics and explain the communication strategies you employed. For each case:</p>

- Please describe briefly the research topic you were communicating about.
- What was the aim of the communication? Did you have a particular audience in mind?
- Please describe in as much detail as possible the steps you took to communicate these research findings?
- In your mind, how successful were the selected communication strategies?

Generalizing experiences and suggestions for successful communication strategies

- What do you believe are the key factors that influence evidence communication between evidence producers and consumers?
- What makes communication strategies successful?
- What makes them fail?
- How do you measure communication success?

In order to assist the focus group moderator, a question guideline informed by literature on knowledge use was developed. This guideline started with a general discussion concerning perceptions of what constitutes credible scientific evidence, then branched out to explore factors related to evidence use. Two different guides were utilized for focus groups, with slight differences in questions between groups identified as knowledge consumers (community, industry and government) and knowledge producers (researchers).

Figure 3.2 – Focus Group Guide (knowledge users)

<p>Focus Group Questions Guideline</p> <p><u>Part II: Focus group themes (for knowledge users: policy makers, industry, community organizations)</u></p> <p>1) What do you consider credible scientific information?</p> <ul style="list-style-type: none"> • What are some of the characteristics of credible scientific information? • Does it make a difference who produces/d the scientific information? If so, how and why? • Is externally-produced scientific information treated differently than internal (if there is internal)? <p>2) What does it mean to 'use' scientific information?</p> <p>3) How do you use scientific information (also: use within your department/organization/within public debate)?</p> <ul style="list-style-type: none"> • Is use of scientific information an integral part of everyday activities / a routine occurrence? Is it driven from within the organization or by external factors? • In what instances is scientific information being used (continuously (to be on top of the latest

- developments) or only when a specific problem has been identified)?
- Do different types of decision making levels (or different types of public debates) require different scientific information? What are the types of scientific information that are required?
 - Are there individual differences between decision makers within your organization in terms of how/how frequently they use scientific information? What causes those differences between decision makers' use of scientific information (and are such differences a cause for concern)?
- 4) Is there anything specific that facilitates or hinders the use of scientific information for you/ within your department/organization/within public debate?
- Are there specific organizational structures in place that are particularly relevant to the use of scientific information? What effects do organizational structures have on use?
 - How would you judge your organization's ability to access, assess and communicate new scientific findings within your organization? What are factors promoting or hindering this? How is new/relevant scientific information disseminated within your organization?
 - Is scientific information developed within your organization disseminated outside your organization (how much, in what way, and are there types of knowledge that are more or less likely to be externally disseminated)
- 5) What could evidence producers do to facilitate more effective use of scientific information within your department/organization/within public debate?
- Are there obstacles hindering you or your organization's learning about new scientific information?
 - Is there something evidence producers could do to increase / improve the use of scientific information within decision-making?
 - Are you aware of any form of communication between producers and users of scientific information?
 - What are the challenges for this type of communication?
 - Are there examples of communication between evidence producers and evidence consumers that are working well?

Figure 3.3 – Focus Group Guide (knowledge producers)

- Part II: Focus group themes (for knowledge producers)**
- 1) What do you consider credible scientific information??
 - What are some of the characteristics of credible scientific information?
 - Does it make a difference who produces/d the scientific information? If so, how and why?
 - 2) What does it mean to 'use' scientific information
 - 3) To the best of your knowledge, how is scientific information being used within policy, industry and public

debate?

- Is use of scientific information an integral part of everyday activities within policy making, industry, and community groups?
 - Should the way evidence is being produced be influenced by specific users of scientific information within policy, industry and public debate?
 - What do you think drives the use of scientific information within such organizations? In other words, why do organizations use it? In what instances is scientific information being used?
- 4) Is there anything specific that facilitates the use of scientific information within policy, industry and public debate? Is there anything that hinders its use?
- What effects do organizational structures have on use?
 - How would you judge your own/ your research units ability to communicate new scientific findings to policy makers, industry and/or community organizations? What are factors promoting or hindering this? How is new/relevant scientific information disseminated?
- 5) What could evidence producers like you do to facilitate more effective use of scientific information within policy, industry and public debate?
- 6) What are the barriers for this occurring?

3.2.5 - Analysis

Following interviews, transcripts were coded using NVivo, and an inductive open coding method. Since both interviews and transcription were conducted by the same researcher, familiarization with the data had been prior to analysis. This allowed a foundational conceptual framework to guide the inductive coding process, as the researcher was already familiar with recurring themes and strategies present in the data (Ritchie & Lewis, 2003). An inductive coding approach was used in order to ensure that analysis remained grounded in data rather than superimposed by theory (Ritchie & Lewis, 2003). The focus of analysis was on establishing commonalities in communication strategies used between subjects and the key factors subjects identified as important when communicating scientific information.

After establishing a coding framework from interviews, this coding framework was also applied when analyzing documents from knowledge brokering organizations, focusing again on communication strategies and key factors identified for pursuing these strategies. As with the interview data, the documentary data were analyzed in NVivo.

Transcripts (in the case of the government focus group, detailed notes) were then coded for primary themes using the theoretical structure of purity/pollution boundary work. These primary themes are expected as a result of literature review (Braun and Clarke 2006). As was the case with interviews of knowledge brokers, familiarization with the data had been achieved through transcribing the audio recordings of the focus groups. The focus of analysis was identifying instances where participants engaged in purity/pollution boundary work, as well as how and where boundaries were constructed when doing so.

3.3 – Findings: Knowledge Transfer Strategies

The first research question asks: what strategies or practices do knowledge brokers utilize in order to facilitate knowledge transfer? Analysis of interviews with knowledge brokers and document analysis identified three main interrelated communication strategies employed by knowledge brokers for knowledge transfer: using appropriate language, fostering interactions between knowledge producer and knowledge consumer, as well as appealing to the credibility of science. These strategies, as well as the reasons identified by knowledge brokers to pursue them, are detailed in the following section.

3.3.1 Strategy: Using Appropriate Language

Using appropriate language was identified as a strategy by sixteen of eighteen organizations analyzed. The use of appropriate language as a strategy can be further divided into two main forms, each seeking to avoid two separate potential communication pitfalls: a lack of understanding from end-users, and to establish the credibility of the research communicated.

In order to avoid miscommunication, subjects noted modifying the technical or scientific nature of the language used to describe research information in order to increase accessibility to a wider, non-technical audience. Subjects noted that the level of technical sophistication used when communicating the scientific information needed to be modified in order to ensure that the target audience could understand what was being communicated. Subjects sought to reduce scientific complexity of research

communications; using more commonly understood terms or analogies in order to increase the accessibility of the research to a wider audience. This finding was also supported by the document analysis.

This was viewed as a complicated balancing act, which also had implications for the relationship between the researcher and the knowledge broker. Subjects explained that making language more accessible to all sorts of stakeholders raised concerns about losing scientific credibility or corrupting the scientific information. When the broker had a direct relationship with researchers for communicating their research, a negotiation process concerning this translation process resulted. A knowledge broker for a university put it this way:

For researchers, not a lot of people like to 'dumb down', but it's not 'dumbing down,' it's making it more accessible for all kinds of stakeholders. And yes it's alright to just have it the way you would have it for like-minded researchers but for us it's really important that whatever they're doing also has clarity there for some of the other audiences that we need to see their work.

A knowledge broker from a research institution had this to say about using appropriate language in communicating scientific knowledge, and the negotiation process with researchers:

You know, you hear about people on TV saying, talk to us like you're talking to a grade five student or whatever. They're our audiences, not grade five kids, that's not who is watching the newscast, it's probably like your parents or grandparents that are watching the newscast, but that's sort of the idea... you just want to be able to talk to anybody in the same way, and have them understand it. Which is tricky, it's hard to tell a PhD in physics that they need to talk like they're speaking to a person in grade five. But that's how it works.

This negotiation process saw the knowledge broker seeking to find a middle ground, balancing the interests of researchers concerned about more accessible language compromising the scientific integrity of the research findings with the need to simplify complex scientific language that would otherwise hamper communication efforts. Language too complex would be a barrier to communicating to a less technically

minded audience, while language too broad would compromise or misrepresent the scientific validity of the communication.

While subjects noted that it is important to simplify technical information for a non-scientific audience, it was also noted that if the target audience has greater knowledge or technical sophistication, it is important to use a higher degree of technical language when communicating. In this case, more technical language was deemed important for establishing the scientific credibility of the research. Language that is accessible to a non-scientific audience was noted to potentially degrade the credibility of the research when used to communicate to a more scientifically minded audience. What was important was using an *appropriate level* of technical or scientific language, striking a balance that did not compromise the scientific accuracy and was at the level most likely to be understood by the audience while not alienating them. A knowledge broker from a health safety organization explained:

You need to present the information to them in a way that makes it accessible to them. It's not just the information itself, it's how you present it, it's the words you use. So someone who has a bit of a scientific background, you can use more scientific language, you can get a little more technical, they appreciate that. That's their background, it's reassuring to them. It also proves to them that you know what you're talking about. But if you do that with a regular home owner, it seems pretentious, they don't know what these terms mean. Now it seems like you're just trying to ... look important. So you need to find a way to relate to them correctly.

Overly technical language when communicating to a less scientifically minded audience could also degrade credibility, though this was only raised as an issue with regards to appropriate language from subjects working in a politically controversial area. A knowledge broker working to communicate scientific information to interested public in a high-controversy political setting noted that overly technical language used to communicate scientific information could be seen as a way to obscure truth. By using appropriate language when communicating to an audience potentially or likely to be suspicious of the scientific information, this risk could be mitigated. The subject had this to say:

You know, you can't put someone in who is going to speak to a lay person as if they're an accomplished PhD graduate, because then they can come across as a bit of a jerk, it can come across kind of condescending or that you're trying to hide something, if you use language that's so opaque to an average person that they're not going to get it.

Conversely, language that is too simplified can also offend an audience by giving the impression of condescension. A knowledge broker working on environmental science focused on the balance required when communicating:

I think, just like hitting the right level of detail. If you get that wrong, you've instantly lost your audience and if you're focused on the wrong level or assume they know things about [the science] you've lost them. Yeah, basically being too sciencey when you don't need to be. ... I guess you don't want to talk down to people. So if you're scared of being too sciencey you can swing the other way and be condescending. That can take away from your trust relationship, that creates a bad dynamic.

3.3.2 Strategy: Interactions between Researchers and End-users

Another key communication strategy identified was fostering interactions between the producers of scientific information and its end users. Sixteen of the nineteen organizations examined through interviews and document analysis utilized this strategy for communicating scientific information. This strategy was used for a variety of audiences, such as policymakers, stakeholders and the general public. Most commonly, the knowledge brokering organization would serve as a method of connection or intermediary between researchers and end users. In many cases, these interactions were established through the organization inviting potential end users and researchers to meetings, symposiums, research consortiums or presentations that had opportunities for interaction.

A knowledge broker from an environmental organization explained the practice of fostering interactions between researchers and end users as pursued by their organization:

We bring them all together, both end users and researchers to share what they've done, what challenges they've encountered in the process of doing this,

what they've done to combat those challenges... really this cumulative effects assessment is quite difficult, it's very challenging. Bringing together a number of research teams of various backgrounds in multidisciplinary backgrounds, end users who have a series of different interests... it's just about sharing. Sharing lessons, sharing progress, and encouraging one another. Sharing results.

Fostering interactions between researchers and end users had several identified purposes. One of the identified purposes for fostering interactions was to establish relationships that would facilitate the transfer of new research information in the future. A knowledge broker from a health organization speaking of a program connecting policymakers with researchers explained:

So if they know us, and they know who we are, they know that we do good work, maybe we're not coming with research messages the first time, or the second time, or the third time or fourth time, but one day when we have some really important research findings that we want to tell them about, they're going to listen because they know us. And we've built those relationships.

By facilitating and mediating interactions between researchers and end-users, relationships can be established that may impact positively on knowledge transfer.

A second aspect of fostering interactions beyond establishing relationships was linked to the research or scientific information itself. If interactions are established early in the research process, the relevance of the research can be increased by involving end users directly in the research process. A knowledge broker working in an environmental organization described this practice:

We did a series of workshops with end users that we could identify who had interest in the area or key stakes in the area and we brought them together to work with a series of topics and of questions around that area to identify what were some of the areas of key importance to them, and to get them to work through a sort of prioritizing exercise there and to sort of clarify what specifically their questions were in the area, and work to turn those into questions that research could answer.

Interactions between the researcher and targeted end-user in this way could increase the relevance of the research for the end-user by tailoring the research question

towards the needs of the end-user. A knowledge broker for a health organization echoed this:

There's also evidence that's generated in collaboration between university and industry, and I think that's a really powerful combination because I actually just did an interview with one of our scientists who got funded for [a health research project] and he was starting out his research, a five year program, and when he started out he went to the community and said, okay what do you guys need from me? And they said well gosh, rather than starting from scratch with your own interventions, why don't you come and see what we're doing and see if you can somehow work with us. And that's what he did. So they've got these interventions that they created to meet their needs, and he as a researcher is now coming in and infusing it with research methodology so that at the end he can publish papers and create an evidence base so that other programs can then emulate that, and then there's a credibility factor, there's research that's done on it.

The previously mentioned environmental organization focused on connecting researchers with end users early on in the research process in order to increase the relevance of the research to specific questions that end users might need answered. This strategy saw the organization serving as a brokering agent or an intermediary in this process, helping end users and researchers match with one another in order to better facilitate this communication. Another health organization explicitly listed using this strategy in their knowledge transfer plan document so that research would be relevant to end users: "Opening up the research process so that the priorities of end-users routinely influence the research agenda. This will result in research that is both responsive to the knowledge needs of those end-users, and that identifies and addresses high-priority topics."

A third reason for fostering interactions between researchers and end-users was that researchers themselves could be excellent communicators. Those researchers who were identified as having excellent communication skills speaking directly to end-users about their research was a very effective method of communicating research. A knowledge broker working for an environmental organization put it this way:

I'm actually blessed right now to be working with some scientists who are some extremely effective communicators. We often put them front and center, and people can ask directly, and it's pretty empowering for people actually, in a community we're working with, to be able to speak with the chief geologist or the chief engineer to understand... to ask questions directly and get an answer that means something to them, in the context of their community.

Similar to this, a knowledge broker working in a health organization also echoed this sentiment, that having researchers who are good communicators work to directly communicate scientific information is very effective, but also noted that how in a controversial situation, it could be even more effective:

People don't want to hear from the PR people, okay? ... I'm sure the PR people do a wonderful job and they have their role, but when people have concerns that affect their family and their health and they're scared, they want to talk to an expert. [I have a] friend that works at [nuclear power company], she's pretty high up in the ranks and she gets training on an ongoing basis from the Nuclear Safety Commissions, she knows more than the average engineer, and she's the one you want to ask about anything. About safety systems, about risks, about anything like that. She'll sit down and tell you, okay you need to worry about this, you don't need to worry about this. And oh by the way there are these backup systems and... and she can explain it in plain English and she's really cool and down to earth. ... She's an amazing example of exactly what needs to be done. And she doesn't even try to do it, she'll be out at a bar, and somebody will ask her what she does, and she will say and they'll say oh and start asking questions and they'll happily tell them. She has a lot of impact that way.

The advantages of having researchers skilled in communicating for knowledge transfer was also identified by a health organization linking researchers with stakeholders invested in the research they were working on. A knowledge broker working for a health organization noted:

So two of them, I've sort of been on the periphery of it, connecting people but haven't had a chance yet to be dead center, but working on that as well. One of them was [a research chair working on a health issue]. That research chair is possible as a result of partnership with the [related health advocacy organization]. Between [health organization and related health advocacy organization], [the researcher] was brought into a room as a speaker that had other researchers working in that area, students working in that similar areas, end users, doctors and physicians, and caregivers, patients and families. And

he'd not had that opportunity before, which I found astounding actually, and that only happened last year. And he is a brilliant, brilliant man, but he's also completely accessible, it's amazing to just have a regular conversation with this person. There wasn't one stakeholder in the room that felt left out. They all understood what he was doing, they all understood why it was important, and they all appreciated the opportunity to meet with him and hear where his research was going.

An identified risk of fostering interactions between researchers and end-users came from the potential for communication failure due to poor communication skills from researchers. While this was a risk, organizations were there to serve as training and advising bodies to help researchers who may have had communication difficulties to develop communication skills or to rely on communication specialists to communicate their research and to establish these relationships. Six of the organizations identified as having helped train researchers in communication skills. A knowledge broker from a health organization said this:

I often will give media training. I've done that many times over the course of my career, or hired a media trainer to come in and train scientific experts, even when I worked at [another organization] and part of what we wanted to do was make the depth of our expertise more visible, and we wanted scientists out talking to media more about their work, giving them that kind of communications training so that once we actually helped them land the interview, with the reporter, that the quotes were actually usable to the reporter and the reporter can build a story around what they had to say, that can make all the difference. And again, some people, scientists or not, are more comfortable with that than others. But where you have a kind of openness or comfort level to that kind of coaching, I think it can be really valuable. You know, it's credible for people. Face to face communication can be really powerful. So to be able to have a direct conversation with someone who is the expert in the field is much more compelling than talking to a PR person, for example. ... it's always going to be more compelling for the audience to hear it directly from the horse's mouth so to speak.

3.3.3 Strategy: Credibility of Science, Brokers as Uninterested Actors

Communicators would also use the strategy of identifying themselves as third-party or uninterested parties to the nature or content of the scientific information being transferred. By presenting themselves as having no stake or financial interest in what

the science communicated, they sought to demonstrate the scientific information they were communicating was unbiased and accurately reflected reality. A knowledge broker working for a health organization working in a controversial area said this:

Subject: That reminded me of another strategy I think we take ... when people ask "where do I buy [testing kit for environment health issue] we don't just tell them us. We tell them where they can get a test kit; if they're in [different province] we tell them where in [that province] they can get a test kit. We don't try to bias things in our favour. I think that tends to be a strategy we take, which makes people trust us.

Interviewer: To be viewed as objective or non-biased, a credible actor for [particular environmental health risk]?

Subject: Exactly. For example, one of the questions I got yesterday was, "If I order this test kit and it malfunctions, how do I know when I sent it back to you that you don't do that on purpose so I have to buy another one?" So I said, well, we don't have a bias here. We're a non-profit organization.

Associating the scientific information with the credibility and trustworthiness of other non-interested actors as a method of establishing trustworthiness of a particular piece of scientific information was also mentioned by a knowledge broker for an environmental organization working in a controversial area, who said this:

Well also if there is also an opportunity to highlight what others are saying. So if a credible third party for example, publicly agreed with the findings of something we were putting forward, or the actions that were being taken as a result, you know... a third party supporter basically. We would often point to that as well. Because then it's not just you taking our word for it, it's showing you what others are saying about this project. ... So in the case of a policymaker it might be, if a third party is an important constituent group in the group. A chamber of commerce or a mayor and council or... some other community group, or rotary club or whatever, came out in support of the project and had heard the findings that our steps were based on, that we were taking then that's a helpful endorsement... to make visible.

By presenting themselves as representatives of science or through appealing to third party groups who also support the information being communicated, knowledge brokers were able to overcome issues surrounding resistance from distrustful audiences. It is especially noteworthy that this particular strategy was identified by knowledge brokers

operating in controversial political areas, whereas brokers working in areas of little political controversy did not mention it.

3.3.4 Summary

In interviews and document analysis, knowledge brokers identified three main strategies they would utilize when pursuing knowledge transfer: using appropriate language, fostering interactions between researchers and end users, and working to establish themselves and the research in question as credible by associating themselves with science and presenting themselves as unbiased. Using appropriate language was used in order to enhance understanding while also securing credibility. Fostering interactions between researchers and end users was used in order to establish relationships to facilitate knowledge transfer, increase relevance of research to end users, as well as benefit from the communication abilities of certain researchers. Finally, presenting themselves as disinterested actors concerned with only the accuracy of science or relying on other groups perceived in this way was identified as a strategy to overcome distrust in controversial political situations.

In the interviews, it became clear that the wider political context that the knowledge broker operated in while engaging in knowledge transfer had an important influence on both practices and the identified purposes of practices utilized during knowledge transfer. While the use of interaction practices and appropriate language proved to be a widespread practice used by knowledge brokers interviewed, a controversial political context surrounding the science communicated changed the identified purpose of engaging in these strategies. Similarly, the use of establishing the credibility of the knowledge broker themselves or the research by appealing to the credibility of science or the unbiased stance of the knowledge broker was a practice that was only identified in those cases where the knowledge broker interviewed was operating in a controversial political context.

3.4 Findings: Perceptions of Key Factors that Impact Knowledge Transfer

Interview analysis also provides answers the second research question, what do these brokers think are the key factors that impact knowledge transfer?

During interviews, knowledge brokers identified several factors as being key to successful knowledge transfer. The main key success factors identified are: establishing the trustworthiness of the communicator, understanding the end-user audience being communicated to, the relevance of the communicated research to the end-user, and maintaining positive relationships with both researchers and end-users. As will be explained, each of these factors also relates back to an associated knowledge transfer strategy identified through the first research question, demonstrating a complex set of interrelated factors that motivate communication strategies utilized by knowledge brokers.

3.4.1 Key Factor: Establishing Trustworthiness of Knowledge Broker

The knowledge broker's perceived trustworthiness was identified to be a key factor for communication by seven of the eighteen organizations examined. There also appeared to be a correlation between the wider political context of the scientific information being communicated and the importance of establishing this trustworthiness: science communicators working where the level of political contestation was higher made mention of the importance of establishing trusting relationships more often than communicators who worked to communicate general scientific information or information that carried fewer politically contentious implications. For instance, a knowledge broker working in a controversial setting said this:

Interviewer: So did you find trust to be an issue when you were doing this?

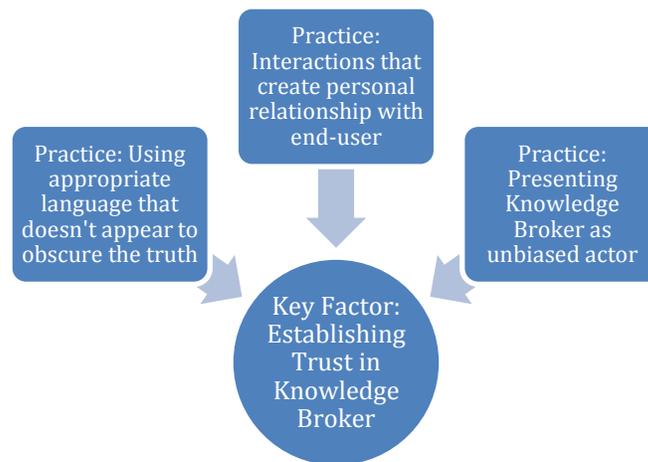
Subject: Yeah, well we definitely... some people had point blank said to us, you work for a company so you're lying to us. So yeah, that's for sure for some people, the source of the information is more important than the information.

A knowledge broker for an environmental organization said this:

A lot of it does depend sort of on a relationship being built. In the case of the type of information that we're getting out there, and trying to put across to landowners, a lot of it is built up like I said, from a trust, comfort factor with the organization and the landowner.

This factor of trustworthiness of the knowledge broker relates back to each of the main communication strategies previously identified. Appropriate language was noted as important for establishing the trustworthiness of a communicator, fostering interactions as a method to establish relationships to create trust, as well as the strategy of utilizing the credibility of science or presenting oneself as a disinterested third party to overcome mistrust.

Figure 3.4 – Establishing Trustworthiness of Knowledge Broker



3.4.2 Key Factor: Understanding Audience

Understanding the target audience was identified as a key factor in knowledge transfer by ten of the eighteen organizations examined in analysis. Relatedly, understanding the target audience was identified as a crucial factor in the use of appropriate language as a communication strategy. This makes intuitive sense, as one cannot shape language to be appropriate to a target audience without first knowing who that audience is, and by extension, what language will be appropriate.

A knowledge broker working for health-organization explained the connection between the strategy of appropriate language and the key of understanding the end-user:

Before you want to communicate research to them. I think... the word translating sounds really one way, as I mentioned before, knowledge translation is really multidirectional conversations. So finding out about what people's knowledge needs are, and then doing the very best you can to meet those needs either with research that already exists or by creating new research to fill those information needs.

A knowledge broker working in a conservation organization echoed this, explaining how it was crucial to understand the target audience in order to successfully transfer knowledge:

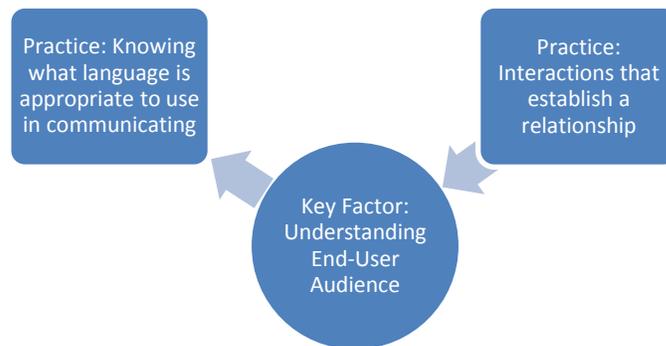
Pretty much it would be to try to take a step back and try to consider the ways in which other people will need to be taking that information in. Again, identify your audience. How likely are they to have the certain education to read your research, what level should you be presenting it at, and then going from there.

Understanding the target audience as a key factor in knowledge transfer was also linked to fostering interactions between researchers and end users. A knowledge broker working in an environmental organization noted that understanding the target audience was an important piece of the relationship that is established through interactions:

And again, a third but still related to the two previous pieces is understanding each other's context. So everyone knows the challenges when it comes to knowledge mobilization, different timelines, different priorities. The researcher understands the context in which the end user wants to use that knowledge, and the end user understanding the researcher's context is really important in helping that go well. And again, it comes back to strong relationships. Build that strong relationship, understand the context.

By understanding the characteristics of the end-user audience, knowledge brokers could best shape their communication strategies in order to maximize the likelihood of successful knowledge transfer, as well as ensure that interactions between researchers and end users promoted successful knowledge transfer.

Figure 3.5 – Understanding Audience



3.4.3 Key Factor: Relevance of Information Transferred

The relevance of the scientific information being transferred to knowledge consumers was identified to be a key factor by seven of eighteen organizations examined in analysis. This is related to interaction practices, as well as the previous key factor of understanding the target audience. The strategy of engaging end-users in the research process to increase research salience/relevance was a key part of interaction strategy, while understanding the end-user was noted to be important for understanding what research would best be transferred to that end-user.

The knowledge broker of a health organization was very explicit in linking relevance as a critical element of knowledge transfer:

If you're running a program or [are a] policymaker or something, you're trying to make funding decisions. They are certain questions you have, and if you can't find any evidence for it, you have to rely on experience or other ways to make your decision. If you're providing a summary of research and that completely doesn't answer what they need, they're not going to use it. As simple as that.

Also stressing the importance of relevance of research for knowledge transfer and noting how it was linked to fostering interactions between researchers and end users, a knowledge broker from a university gave an example of a particular knowledge transfer success story as evidence of this:

I think [the knowledge transfer] was very successful, because the researcher spoke directly to the policymakers. And the match between the research and the

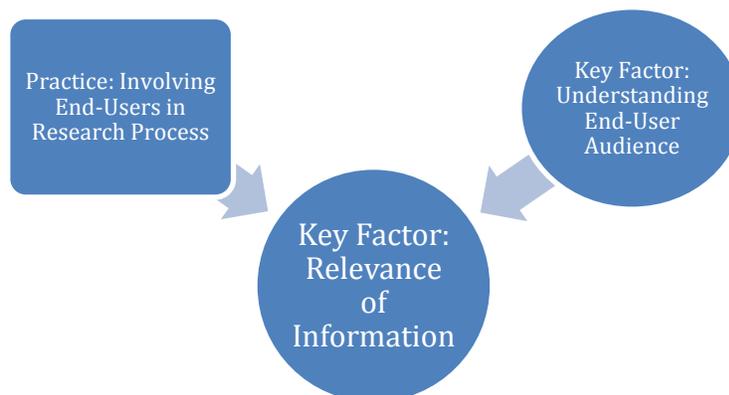
research question... not the research question, the problem and the issues the city council was facing, the match was exact. Often there is a little bit of a disconnect between the question the researcher is researching, and the community problem. The better the match there is, the better the transfer.

There is also a connection between the importance of understanding the target audience and the relevance of research. In order to be able to correctly assess the potential relevance of research to a target audience, it was necessary to have a certain level of understanding about that audience. This was explained by a knowledge broker from health organization this way:

For each of these target groups, I would think, okay, if they're researchers how can I provide them information in a way that they would find useful? And even for when I look at healthcare professionals, how can I best offer that information and what would work well for them to be able to take that and then say yes, that's a key takeaway that I got from there and I'm going to start using that information in my daily practice.

Knowledge brokers noted that by communicating research that was relevant to a particular problem or issue that an end user was making a decision on, successful knowledge transfer was more likely. The usefulness of research for a particular policy problem or potential decision that an end user is making makes intuitive sense, as research unrelated to a particular problem would not be able to inform key questions surrounding that decision. This key factor was also linked to the previous factor of understanding the target audience, as well as the strategy of fostering interactions between researchers and end users.

Figure 3.6 – Relevance of Information Transferred



3.4.4 Key Factor: Relationships

Establishing positive relationships was noted as a key factor in communication by seven of eighteen organizations analyzed. Specifically, the knowledge brokers identified establishing and maintaining a relationship both between researchers and end users as well as between themselves and their respective partners in the knowledge translation process. This key factor is related to the strategy of interaction practices, as establishing and maintaining these relationships was noted as one of the main reasons for pursuing that strategy.

Explaining the importance of relationships between researchers and end users, a knowledge broker working in environmental organization stressed the difficulty of involving end users in research without a prior relationship:

So much of this is about relationships, it's about trust, and if a researcher isn't hooked up into a network of end users, it's very difficult to cold call somebody essentially and say, hey I'm doing research on this, are you interested? Without knowing which organization you should talk, what individual at that organization you should talk to, where their interests and priorities lie.

In addition to this, a knowledge broker from a research institution noted the importance of the relationship between a knowledge broker and researchers, as well as between knowledge broker and targeted audiences:

And that's super important, it's so important, those relationships that you build with your scientists and with the media, and with those people who are supplying the information to the public, or with your relationship with the public in general. It's a lot of relationship management.

A knowledge broker from an environmental organization described how knowledge transfer to policymakers in particular required a stable relationship with the knowledge broker:

Well, so we would meet with them regularly to keep them apprised of our progress and what we were finding, so it wasn't like... it was never a one-time communication. It wasn't like, okay we're going to go, have the meeting and then there, we've communicated. We're done. It was a long project so it was a long

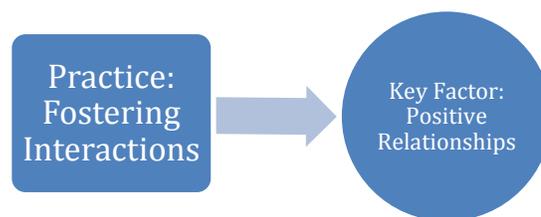
process, so we met with them regularly to keep them up to date, we were also very responsive if they have questions, sometimes questions would come through their constituents to them, and they would contact us, and we would explain or would have to respond to both the constituents and the policymaker.

Establishing trust between targeted end users of research information and researchers was also a part of establishing relationships. When asked what the key to successful communication was, a knowledge broker for an environmental organization said this:

Having that relationship and having the trust between the researcher and the end user is huge. I'm sure... there's a number of researchers and partners in our network for whom collaborations have not always gone well. There can be a number of negative perceptions you know, sometimes especially if you work with smaller first nations communities, sometimes research is done but they don't hear from the results of that research or see the benefits from that research, so trust gets broken there, it's gone.

Establishing relationships between researchers, end users, and knowledge brokers was noted to be an important factor in knowledge transfer. Establishing these relationships was also linked to fostering interactions between researchers and end users, as this was one of the reasons that this particular strategy was employed by knowledge brokers.

Figure 3.7 – Relationships



3.4.5 Summary

Four factors were identified as key to successful knowledge transfer: establishing the trustworthiness of the communicator, understanding the end-user audience being

communicated to, the relevance of the communicated research to the end-user, and maintaining positive relationships between knowledge brokers, researchers and end users. Each of these identified key factors in knowledge transfer was also associated with a particular communication strategy identified previously. Establishing the trustworthiness of the communicator was associated with each of the communication strategies identified, as well as being noted as a key factor by knowledge brokers working in controversial political settings. Understanding the target end user audience was linked with using appropriate language when communicating as well as fostering interactions between end users and researchers. Research being relevant to end users was linked with the interaction practice of involving end users in the research process to create this relevance, as well as understanding the target end user to know what research would be relevant. Finally, maintaining positive relationships between researchers, end users and knowledge brokers was linked with fostering interactions between these groups in order to establish and maintain these relationships.

Having explored the both the strategies utilized by knowledge brokers in pursuing knowledge transfer, as well as the perceived key factors by knowledge brokers that impact this process, we now turn to the question of how these strategies utilized by knowledge brokers are perceived by the different groups involved in knowledge transfer.

3.5 Findings: Perceptions of Purity and Pollution

The third research question asks, how do different audiences perceive knowledge transfer practices? Analysis of focus group transcriptions revealed three main factors impacting the perceptions of purity or pollution of science from participants: the credentials and reputation of researchers responsible for the science in question, the source of funding behind the research, and the level of perceived ideological interference in the research. These themes were present throughout the four focus groups, however there were key variations as to how each of these themes were conceptualized and applied by each group.

3.5.1 Government Focus Group Respondents

Participants noted that it is particularly difficult to determine if science is trustworthy in an area like nuclear science. The focus group participants thought this was because discussions regarding nuclear issues have “so many untruths and barriers and biases”. In the case of nuclear policy, one participant noted the presence of “activism using a lot of untruths to drive an outcome”. Ideology was identified as a major source of pollution associated with these “untruths, barriers and biases”. As a result of this high level of pollution in nuclear science, participants noted that it was sometimes difficult for the public to ascertain the independence of researchers. In addition to this, participants communicated the general sense that in the particular case of nuclear science, a significant amount of polluted science is being utilized by politically motivated actors. The problem of ideological pollution was not limited only to nuclear science; participants also made mention of certain renewable energy topics as also being rife with polluted misinformation that created a necessity for governments to conduct their own in-house analysis to create pure research. Participants felt that this problem of political controversy fostering pollution was a significant problem in controversial topics, and that the sheer amount of pollution from ideology has rendered much science suspect in the eyes of the public.

In reaction to this high level of ideological pollution, participants made mention of education in schools as an effective means of increasing scientific literacy, to help members of the public resist accepting polluted science as was being pushed by a “vocal minority”. In addition to higher scientific literacy, another way to counter the influence of (perceived) polluted science in public debates that focus group participants specifically mentioned were partnerships between mining associations and public education to teach science related to industry. Interestingly, such a partnership between industry and the education system was not viewed as a polluting boundary violation. In fact, it was viewed more as an answer to pollution, as a method to counter the political use of polluted scientific information

Participants made a distinction between their personal views and what they perceived to be public perception when speaking about potential pollution from industry sponsored research. The government focus group participants did not hold that this research was polluted, yet noted that the general public was likely to feel this way. Universities were noted as a source of purity in comparison to this, and that the science emerging from it being more able to “advance a debate in an effective way than a company with a specific interest”. In terms of research produced from academia, participants also noted that university research that was geared towards “helping advance specific strategic goals” as being worthy of support. While there was no specific mention of this sort of research being more pure, there was also no indication that this sort of directed research would be viewed as a potential polluting boundary violation. When discussing partnerships between industry and academics, or between government and academics, the government focus group participants noted that different needs in terms of publishing results, versus keeping results secret, serve to frustrate collaboration. This was not noted as a source of pollution by participants. An interesting distinction was made by the government scientists (as opposed to the non-scientist government officials) participating in the focus group: government scientist participants reported that they felt that scientific peers in academia criticized science produced in government departments without fully understanding how such research worked in relationship to policy. One participant noted that as government scientists, they only make recommendations, and are not involved in decision-making, a fact not widely appreciated by academic scientists.

3.5.2 Community Focus Group Respondents

Throughout the community focus group, subjects engaged in boundary work, identifying pollution and purifying sources as elements distinguishing “independent, uninhibited” science from “presupposed conclusions” science that have “corporate strings” attached to them. While participants noted pro-industry government interference as a source of pollution for science, the source of pollution most readily and commonly identified was industry funding, or politically motivated funding. Subjects felt that research funded by industry became tainted in their eyes by the funding, and that those

researchers are being pressured to produce certain results favourable to the particular interests of that industry in order to maintain this source of research funding. As a result of this perceived pressure, the research was viewed as tainted and not credible. One participant explained this view regarding scientific journals polluted by industry associations:

Subject: But there's also, there are reviewed papers of peer reviewed research that are not necessarily peer reviewed themselves which are useful. And at the same time, I'm very suspicious of any journal which is clearly dominated by one industry. Even if it is peer reviewed.

Moderator: Can you give an example? Like there are some engineering journals, that's not necessarily what you're...

Subject: No, no. I think a lot of the nuclear engineering research is likely to be to contain bias.

Subjects engaged in boundary work that made efforts to separate out this polluted science, noting that they did not find fault with the scientific process, rather they found the perceived interference and influence of industry on the scientific process to be the objectionable issue. In this way they drew boundaries around pure science, placing industry or politically motivated funding outside these boundaries as polluted. As one member put it, "I think the problem is not with the science, but it's with the manipulation".

Subjects noted that the amount of pollution that came from industry association was severe; with one subject saying that even the research done by a proponent used in a government based environmental assessment process was likely polluted. Although subjects identified universities as a source of purification for research, they felt that industry associations with the university at which the focus group was being conducted are so widespread and malignant that this source of purification was suspect. One member went as far as to suggest that the university was being used as a public relations wing of the uranium industry:

And so therefore any of the information in studies that come out that have been done, including those that have come out in this prestigious organization, from our perspective ... have no credibility whatsoever. I mean basically, you are perceived as a marketing and public relations agency for the nuclear industry.

Interestingly, one subject of the community focus group who was part of an advocacy organization also claimed that pollution boundary work was being used *against their organization* in the wider political setting, finding that their charitable status was being denied for tax purposes because,

Another thing in regards to funding and these issues, ... but the other thing that has been going on for a lot of the NGOs, is they've come under review and assessment by the Canadian Revenue Agency, for example, our organization, we're an educational cooperative, however we are considered too political to get charitable status, because anyone who would speak out and be critical of current mining practices or whatever in terms of this industry is political. So you see there again, if our science and our scientific conclusions were to disagree with that of the industry ... that makes us political. We're no longer scientific, we're no longer concerned citizens about trying to get the truth out about these things, we're political and therefore and even alternative sources of funding are significantly curtailed, that prohibit us from doing what we try to do.

In this case, the subject reported that a supposed violation of the political / science boundary by engaging in too much political advocacy had resulted in their organization being branded as no longer scientific, and therefore losing its charity status.

In terms of purity, sources identified by the community focus group participants tended to gravitate towards a conception of science as disinterested, non-financially motivated and essentially truth seeking. One participant, answering a question on how they accessed scientific information, outlined this:

Luckily there are people out there who have devoted their lives to not making their money by doing it, but by doing it anyway. And so there is all kinds of research out there, and there people who are all over the world who are trying to make the truth known. But, as [other participant] just said, she's been a volunteer for twenty five years in her organization. And that's how a lot of its happening, people are volunteering their time, they haven't ever gotten a slim nickel. That how most of us function, as volunteers within various groups that we can...

access information that other volunteers have been doing or that people manage to eek out a living in one way, and they also do their important research they need to do.

One purifying source noted by the community focus group was a lack of funding or financial interest in the matter to which the scientific information related. Participants praised volunteers as being a particular group highly purified by this factor, finding that volunteers devote time and energy to discovering or pursuing science without receiving “a slim nickel”. In relation to this, subjects noted that pure science was available for such volunteers to find due to the activities of unpolluted sources of research, that was identified as existing but less prominent than research polluted by industrial association. As one member put it, “There is all kinds of research out there, and there are people who are all over the world who are trying to make the truth known.”

3.5.3 Industry focus group respondents

Industry focus group participants tended to answer questions in two different ways: focusing first on what they held to be public perception, then answering on their own perception. Amongst participants there was broad agreement that in the eyes of the public, industry is viewed as a polluting factor for science. However participants did not view this as a source of pollution themselves, they felt that the science that was produced within the industry was acceptably pure. The pollution boundary work with regards to association with industry was noted only insofar as the participants perceived it to be a position held by the public. Focus group participants also held that the larger public viewed medical doctors as credible source of information, and that in the eyes of the public, being a medical doctor itself is a purifying factor for an individual presenting science. Participants also noted that independent third parties outside of industry, such as consultants or universities, were viewed by the public as a purifying element for science, and that:

In so far as credible, in the public, things that come directly from a company are seen as very... at the lowest level of credibility. So [when] getting scientific work done we're much better off farming something out to a university or a third party

researcher and let them run independently then to try to do things in house, and state that it is our work. It impeaches us from the start.

Industry participants held ideology as a source of pollution. They noted that while they were limited to maintaining scientific accuracy in their communications concerning scientific information, “extremists” and “opponents” who were not limited to accuracy in their communication efforts utilized polluted “fringe” science, or outdated science in order to pursue political objectives. These “opponents” utilized polluted science in their communication efforts, and industry focus group members felt hampered in their ability to answer against what they felt was truly polluted science because of a supposed public perception of their position in industry polluting their science. As one member stated, “It always gets back to... when you’re trying to get across some credible information you’re limited by the truth. And your opponents aren’t”. Participants referred to these opponents as “anti-uranium”, and distinguished them as a group from the general public.

Participants also noted that there could be competing priorities between academic science and industry science in terms of publishing the results of research. A particular instance of this noted was that industry science may produce proprietary outcomes that industry can profit from, which precludes the sort of open publishing that academic science would pursue. Participants did not note this issue to be a large barrier, but rather merely noted it as a complication to collaboration.

With regards to purifying elements, focus group participants again drew a distinction between their own beliefs and what they perceived to be the wider public’s beliefs, and commented on both. A member noted that for the wider public, a purifying aspect for science was involving the community in the research process. The group also felt that the public views certain government sources of science, such as arm’s length regulatory agencies, as purifying, but drew a distinction between the general public and “extremists”, who were thought to not find these agencies as purifying. As for their own beliefs regarding purifying elements, members noted that the quality of the researcher involved with the research was an important factor, with a good professional reputation as well as credentials properly corresponding to the scientific subject being a purifying

element. As previously noted, while the focus group participants had mentioned that the public viewed the university as a purifying element, the group did not place any special emphasis on universities as purifying elements when speaking of their own perspectives.

3.5.4 Researcher Focus Group Respondents

Researcher focus group participants answered questions in a similar manner to that of the industry focus group, offering their own perspectives as well as what they believed to be the beliefs of the wider public. Researchers, like industry participants, felt that the public viewed industry funding as a source of pollution for science.

Transparency in the science was viewed as a counter to this perceived pollution, a way to purify the science in question to demonstrate that supposed violations of the boundary didn't actually taint the science. Regarding their own views on purity/pollution, researchers communicated a general sense that there wasn't so much an issue with funding as a polluting influence on science, but rather it was a matter of public perception. Insofar as there was pollution from industry funding (or any source of funding), it could be remediated by the scientific community. One participant had this to say, which was agreed to by other participants:

When you do any research, any message, any fact that is published, reported, as a scientific evidence must be transparent irrespective of who is funding the researcher. It may be oil industry, some nuclear industry, or even green public organization, whoever. If you're a scientist it doesn't mean, well it doesn't matter for whom do you work if you're an honest scientist, you're just making your science honestly, irrespective of the source of funds. In an ideal world I mean. Your conclusions must not depend on the funding source. It's obvious that while sometimes it's very difficult psychologically because well... there is conscious and mental conclusions and there are some subconscious which may affect scientists way of thinking and final conclusions as well ... that's why there is scientific community that should check the results according to a very clear process... and the more detailed the description of your experiment or the way you come to the conclusion, the better for your peers.

Again, transparency was identified as a method to counter pollution boundary work, in order to demonstrate that there was no actual pollution of the science in question from

the funding source. What's more, researchers also noted that industry funding of university science was becoming more likely given decreasing options for other sources of funding.

Researchers also identified ideology as a source of pollution, but in a unique manner from the other groups: for the researchers, 'ideology' was identified as certain scientific paradigms that can almost become dogmatic for some researchers. Finally, researchers noted boundaries between different scientific disciplines. This was similar to what was noted within the industry focus group, finding that science associated with scientists working outside their particular field of expertise as a polluting factor, science that was associated with scientists working within their discipline or area of expertise was a purifying one.

3.5.5 Summary

This research has sought to explore the perceptions that various groups have of sources of purity / pollution for science, finding that while each group engaged in purity / pollution boundary work regarding scientific information, there were significant differences in the specific definitions of what constituted an unacceptable "polluting" boundary violation, and different conceptions of "purifying" aspects. While community members focused on connections to industry as a source of pollution for science, industry members focused on scientists working outside their fields as a source of pollution. Both groups identified ideology as a polluting factor, but identified different ideologies in particular as polluting; for industry members an ideology opposed to industry activity was viewed as a source of scientific pollution, but for community groups an ideology in favour of industrial activity was viewed as a polluting factor. Boundary work was used extensively by each group as a means of placing themselves and their positions within a conception of pure science, and their political opponents outside it as polluted science. The perceptions of ideological pollution were also present in the government focus group, whose participants held that the topic of nuclear science in particular was so controversial as to be filled with a large amount of ideologically polluted research. Much like the industry group and unlike the community group, the

government focus group did not view research done in collaboration with industry as polluted. For their part, researchers identified pollution boundary work as something that they are concerned with, and held that scientific transparency and peer review served as a means of purifying their work in order to protect against these sorts of pollution boundary work attacks. To researchers, the credentials of the researcher responsible for science and the methods used to obtain it were an important purifying element.

3.6 Conclusion

This chapter outlined the research methodology, and then presented the findings for the first three research questions. In answering these research questions, several factors become clear. The first is that the practices of knowledge brokers, as well as their perceptions of what constitute the key factors impacting knowledge transfer, have a particular focus on seeking to promote interaction and relationships between end users and researchers. This takes a wide variety of forms, from coaching researchers in communication skills and relying on them to engage in direct communication on their research, to involving end users in a research process to increase the relevance of produced research. This focus knowledge brokers have on interactions and relationships is consistent with the literature what has been found to be positively influential on knowledge transfer.

The second factor that becomes clear is that political context, specifically the level of controversy, has an impact knowledge transfer practices. When engaging in knowledge transfer in a politically controversial area, the issue of trust became intertwined with several strategies; this was not the case in non-controversial areas. Using appropriate language in a politically controversial area was important not only to avoid miscommunication, but to avoid perceptions of deception. Concerns from knowledge brokers that they might be actively working to deceive their target audiences was simply not a factor that emerged when communicating science that related to non-controversial political areas.

Finally, focus group data shed light on the fact that different groups had very different conceptions of what constituted sources of pollution and purity in science. Even more interesting, these differing conceptions often seemed to be directly contradictory to one another. While community members held industry influence to be a severe source of scientific pollution, government members held interactions between industry and the education system as a potential answer to ideological pollution. While both industry and researchers felt that the public viewed industry was a source of pollution for science, they did not share this view themselves.

In short, based on this research, the methods of fostering interactions and forming relationships viewed as crucial for knowledge transfer by knowledge brokers also seem to be a potential boundary violation when considered in light of the complex and contradictory definitions of pollution and purity that emerged from focus groups. When these factors are considered together, a troubling picture takes form. The next chapter will attempt to discuss the implications of this, and will address the fourth and final research question.

CHAPTER 4 - Implications and Conclusion

4.1 Introduction

To this point, the thesis has outlined both knowledge transfer theory and boundary theory, used original qualitative research to identify key strategies utilized by practitioners to promote knowledge transfer, and used original qualitative research to assess how stakeholder groups perceive pollution and purity with respect to knowledge. In doing so, the thesis answered three research questions: (1) What strategies or practices do knowledge brokers utilize in order to facilitate knowledge transfer; (2) What do these brokers think are the key factors that impact knowledge transfer; and (3) How do different audiences perceive knowledge transfer practices? This final chapter seeks to bridge this information and advance knowledge transfer and boundary theory by answering the fourth and final research question: What are the implications for the strategies utilized by knowledge brokers given their perceptions of them, as well as different audience perceptions? In doing so, the chapter argues that the use of interaction practices in knowledge transfer may be problematic when utilized in a controversial political area. Boundary organizations are then explored as a potential solution to the problematic nature of interaction practices. This chapter will also discuss the limitations of this research, as well as explore potential avenues for future research.

4.2 Implications of Knowledge Transfer Strategies

Interactions between researchers and end-users have already been noted in the literature as having a positive impact knowledge transfer. Research conducted for this thesis has also found that fostering interactions as a strategy for knowledge transfer is a common practice in the knowledge brokering organizations analyzed. The prevalence of these interaction practices makes intuitive sense when one considers the positive impacts such practices have on knowledge transfer, readily identified both by subjects interviewed and in literature. As previously stated, those benefits identified include the increased relevance of research to the end users who are engaged, forming personal relationships to foster information uptake amongst end users, as well as researchers being well suited to communicate scientific knowledge.

However, there is a potential risk in utilizing these interaction practices. The use of interaction practices to increase the likelihood of knowledge transfer for specific end users also carries a potential risk of undermining knowledge transfer more broadly. The basic idea behind interaction practices would suggest that if a knowledge broker wished to increase the likelihood of knowledge transfer by targeted users such as industry, policymakers or stakeholders (for instance, environmental groups) they ought to foster interactions between those targeted users and researchers to achieve the various benefits previously discussed. But such a direct connection between these two groups could be viewed by outside parties as being in violation of the socially constructed boundary between science and politics, leaving the researchers and research produced open to politically motivated purity/pollution boundary work attacks by other groups not interacted with.

The origins of this tension come from the fact that the boundary between scientific and non-scientific knowledge is socially constructed, rather than objectively defined. This subjective boundary is continuously negotiated by various actors with different interests. As noted earlier, the process of defining this boundary is referred to as boundary work (Gieryn 1983), and in controversial political settings, boundary work can be used in response to perceptions of 'pollution' of science, when some actors feel that the 'purity' of the science in question was compromised by a violation of the boundary.

This problem of interaction practices being viewed as a source of pollution is supported by the findings that emerged from this thesis. When exploring the perceptions of knowledge transfer practices by different audiences in focus groups, it became clear that there were a variety of significant perceived sources of pollution for science. These sources of pollution formed something of a dichotomy, with industry and government groups viewing interactions with certain ideological sources as polluting, while community groups viewed association with industry as polluting. In light of this, pursuing knowledge transfer to an industry end user might result in increased chance of knowledge transfer success while at the same time unacceptably polluting the research, researcher, or even the knowledge broker in the eyes of certain community members.

Conversely, pursuing a strategy of knowledge transfer to certain community groups viewed as unacceptably ideological to industry and government members could degrade the scientific purity of that research, researcher, or knowledge broker. Such dynamics were found in the case explored by Swedlow (2007), where researchers who had engaged with industry found themselves and their research questioned on its foundations as being polluted, and therefore dishonest or biased.

This issue of boundary work was also present in the interview data exploring the knowledge transfer practices and perceptions of knowledge brokers. For instance, the issue of scientific pollution and purity was present in the answers from subjects concerning establishing the trustworthiness of the communicator of scientific information and the organization they represented. When dealing with suspicious members of the public and targeted groups that attacked the credibility of the communicators as well as the science being communicated, subjects engaged in boundary work in order to establish their scientific purity, appealing to a lack of direct financial interest in the matter at hand, as well as to the objective nature of science and themselves as representatives of it in order to establish themselves as trustworthy.

When one considers these acts of boundary work, interaction strategies can be viewed as a problematic blurring of the boundary that such arguments implicitly construct. Research directly influenced in terms of the questions asked and involving end users throughout the research process creates the possibility of inappropriate influence on the end research product. Even those interaction strategies aimed at bringing together researchers and end users that do not directly impact research decisions can be viewed as an inappropriate association between scientific and non-scientific sources. These practices being attacked as an inappropriate boundary violation is necessarily inherent to their use; indeed, there is no reason why properly ethically inclined scientists could not involve a targeted end user group, such as a community, industry or policymaker in the research process without it tainting or unduly influencing the results, but instead better refining the research question pursued to maximize potential utilization. However, in the case of politically motivated boundary work attacks, the potential of bias or undue influence typically is enough in order to

marshal the sorts of arguments existing within pollution/purity boundary work. The resulting muddied boundary opens up research to these sorts of attacks, which become useful for motivated actors in a politically controversial context.

The existence of boundary work that functions to categorize interaction practices used in knowledge transfer as a corrupting influence on science is related to the political controversy present in the context to which the scientific information pertains. Scientific information does not exist in a political vacuum, yet evidence-informed decision making requires that science provide factual information that describes the way the world is, as well as providing information as to potential or likely outcomes for potential decisions. For the wider public, interested stakeholders, and policymakers, scientific information provides a way to better know the existing conditions and potential outcomes that inform decision making, be it individual behavior, collective decision making, or forming law. The connection between controversial political areas and boundary work was present in the findings, specifically in the communication strategies utilized by subjects and organizations that were involved in communicating controversial scientific information. While interaction practices were used by almost every organization analyzed, interaction practice as a method of *establishing trust and credibility* was found primarily in those organizations communicating more controversial scientific information. Organizations that communicate scientific information more related to the delivery of healthcare typically had a low level of political contestation and did not note establishing trust as an important strategy, yet organizations that communicated scientific information concerning health risks from radiation, a topic which has higher level of political contestation than say, science concerning quitting smoking or research into chronic disease, noted trust to be a necessary condition for successful knowledge transfer, and interaction practices as a way to secure it.

The analysis also found that those knowledge brokers working to communicate science in more controversial political settings engaged in boundary work in the form of a communication strategy in order to establish themselves as unbiased and trustworthy sources of information. These communication strategies focused on demonstrating that the information they communicated was not unduly influenced by outside interests,

either by focusing on their own purity from polluting influences or by citing another “pure” source that confirmed the information being communicated.

A problem now presents itself. Although interaction practices have been noted as a means to enhance knowledge transfer between researchers and interacted end users, this can paradoxically also violate boundaries between science and non-science. This violation increases the difficulty for knowledge brokers to communicate science to other end users in high controversy contexts by exposing the knowledge brokers to potential pollution boundary work attacks. This raises the question: is it possible to gain the benefits of interaction practices for knowledge transfer while limiting the potential risks from pollution boundary work? Theory suggests that boundary organizations could be the answer.

4.2.1 Boundary Organizations: An Answer?

In a way, knowledge brokering organizations already resemble boundary organizations. By utilizing interaction practices, these organizations are quasi-boundary organizations, blurring the socially constructed boundaries through fostering interactions between science and society in order to pursue knowledge transfer. Recall that boundary organizations function to span the boundary between the world of science and politics while simultaneously stabilizing those boundaries. Also recall the three distinct criteria for what constitutes a boundary organization: the creation of boundary objects, the participation of various stakeholders from either side of the divide with the organization or individuals serving as a mediator, and the organization's existence between the boundary of science and politics, with distinct lines of accountability to each side. The use of interaction strategy as a means of knowledge transfer imperfectly involves two of these three criteria. The first is participation of various stakeholders from either side of the divide, while the second is the lines of accountability to either side. Participation of either side is found in the interaction itself, with researchers and end users being linked together by the organization serving as an intermediary as part of the communication strategy. The accountability is essentially found in the active participation of researchers and end users with the organization. If researchers did not find participating in conferences, symposiums, research consortia or whatever form the

interaction strategy took to be beneficial, that researcher would simply not participate. Even in the case where the interaction strategy is a stipulation of a grant from that organization, researchers do not have to accept the grant if they find the conditions to be unacceptable. In essence, participation is a line of accountability to researchers from the knowledge brokering organizations. If the organization's activities, methods, or requirements are unacceptable to the researchers, they can simply not participate. In this way, the organization is held accountable to the researchers. This also similarly true for the end users: if participating in interactions through the knowledge transfer organization does not serve their needs, whether they be strictly knowledge acquisition or otherwise, they need not participate.

Yet while interaction strategy turns these knowledge broker organizations into quasi boundary organizations, they lack the key factors that that help protect boundary organizations and the actors involved in interaction practices from pollution boundary work attacks in politically controversial scientific areas. A key aspect of boundary organizations' ability to engage in boundary spanning interaction strategies while remaining protected against purity/pollution boundary work attacks comes from the organizational structure of boundary organizations. While interaction strategy involves researchers and end users with an organization for communication purposes, it does not necessarily involve those two distinct groups within the hierarchical structure of the organization itself. Part of the potential for success of boundary organizations comes from the ability to collapse boundary work that may result from differing stakeholder interests to being mediated and resolved within the organization itself, not outside (Parker and Crona 2012). This is achieved through involving representatives from differing stakeholders within the organizational structure of the boundary organization, typically through a board of governors made up of representatives from stakeholder groups. For example, a boundary organization focusing on an environmental issue may form a board of governors from researchers, conservations, industry members as well as government representatives. In this way, the work of boundary management is a dual process of "managing relations among stakeholders while also managing the structure and inner workings of the organization itself" (Parker and Crona 2012: 273). While not guaranteeing that the conflicting demands of stakeholders can be effectively

mediated in all cases, these demands can be often be effectively resolved through this adaptive management process (Parker and Crona 2012). Lacking a governing structure that adequately involves differing stakeholders across the science / politics divide leaves an organization mandated to broker scientific knowledge related to a controversial context unable to perform this sort of boundary management. Therefore, it leaves itself vulnerable to purity / pollution boundary work attacks, as the interests of stakeholder groups have not been necessarily considered as they would have been in the case of a boundary organization. Successful boundary management would mean that eventual boundary objects produced by the boundary organization would be much less likely to be subject to pollution boundary work attacks.

4.3 Research Limitations & Areas for Future Research

Given the qualitative method of the research conducted, the data gathered of particular communication strategies of knowledge brokers cannot be claimed to be representative of all knowledge brokers. As the sample was drawn from an exclusively Canadian context, there may also be particular cultural or national issues at play, although literature to date has given little indication that these factors play a significant role. In addition to this, the focus groups were specifically conducted within the particular scientific context of nuclear policy issues within Saskatchewan. While this was indicative of a highly complex scientific issue as well as a controversial political area, there may be certain particularities to nuclear policy or the Saskatchewan context that limit these findings.

As the focus groups explored perceptions of various groups operating within a politically controversial scientific topic, a particular avenue of future research would be to see if boundary work functions differently within a less politically controversial topic within similar groups. An additional avenue of future research would be to empirically examine whether boundary organizations are able to engage in interaction practices in similarly controversial situations, such as nuclear policy, and successfully produce boundary objects that are able to avoid pollution boundary attacks. This research could also examine how the process of managing the science / non-science boundary in a

boundary organization can be done successfully, or note certain factors that lead to failure.

An additional limitation of this thesis related to the focus group data is that the politically controversial topic was limited to one area, nuclear science. Although the findings suggest that the implications identified within this thesis likely apply to other politically controversial scientific areas, there is a possibility that particularities within the nuclear science area influenced analysis. Future research could examine other politically controversial scientific topics to further nuance our understanding of pollution and purity boundary work in a wider variety of contexts.

4.4 Implications of Thesis Findings

This thesis has expanded theory both for knowledge transfer and boundary theory by demonstrating potential unforeseen consequences when certain well regarded knowledge transfer practices are utilized in a politically controversial setting. This has significant implications for knowledge transfer interaction practice pursued by knowledge brokers given the widespread use of these practices today. This thesis has achieved this through the analysis of original qualitative research exploring knowledge transfer through the lens of the practices and perceptions of knowledge brokers as well as the perceptions of various social groups. When these practices and perceptions are viewed through the lens of boundary theory, what emerges from this analysis are questions about some potential complications that may arise from interaction practices that could threaten the credibility of science in controversial political situations, complications that have previously not been found in literature. This is an ironic situation, as it seems that one of the most effective and utilized methods of communicating science could work to undermine knowledge transfer in politically controversial areas, where it could be argued it is even more important to have scientific information informing decision making. Indeed, it is difficult to imagine successful evidence informed decision making being utilized in any controversial situation if excessive pollution boundary work muddies the potential existence of any sort of scientific consensus or even scientific plurality. What this thesis contributes to literature is that when evidence informed decision making uses highly controversial science,

laden with differing conceptions of scientific pollution being forwarded by different actors, the political debate becomes an issue of determining what is and what is not science rather than dealing with politics of likely outcomes from decisions. In such a situation, science cannot be relied upon to provide accurate descriptive or predictive information for decisions since it becomes difficult to ascertain which science can be trusted as pure science. Even if decision makers are able to determine for themselves which sources of scientific information are pure, the existence of pollution boundary attacks degrades the epistemic authority that science bestows on evidence informed policy choices.

The increasing pressure on researchers to move beyond simply publishing their research in journals to actively engage in knowledge transfer, combined with the common utilizing of interaction practices to engage in knowledge transfer, means that these problems are likely to become more pressing as time goes on. The practical implications this thesis emerge from the insights on the processes through which differing actors engage in defining the boundaries of science and how certain organizations can stabilize these boundaries. By incorporating the use of boundary organizations for knowledge transfer in politically controversial scientific areas, we can gain the benefits of these effective knowledge transfer practices while avoiding the potential pitfalls that emerge when they are utilized in politically controversial situations.

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