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# Modeling Cross-Border Regions, Place-Making, and Resource Management: A Delphi Analysis

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# Modeling Cross-Border Regions, Place-Making, and Resource Management: A Delphi Analysis

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**Abstract:** Along international borders, spillover of resource management issues is a growing challenge. Development of cross-border regions (CBRs) is seen as an emerging means of addressing these issues. A set of theoretical models, *geo-economic mobilization* and a resource-focused *territorial program of place-making* have been proposed as a lens for understanding why such change could occur. From this theory, we identify three C's as critical initial or necessary conditions to start the process: *common* territorial identity, *convergence* of knowledge and values, willingness for *cooperation*. We then utilize results of a Delphi study in the Fraser Lowland, a sub-district of the American-Canadian Cascadia borderland, to test if these three are present and actively working together. Our analysis based on both cumulative logit and mixed-effect modeling confirms the active existence of the three C's demonstrating the value of these theoretical models. However, the Delphi also shows that not all in this region are convinced of cross-border convergence and case studies provide mixed signals of successful cross-border resource management, indicating that sufficient conditions are yet to be fully met. Thus, our results confirm the value of these models as a lens to view events, but leave many questions to be researched.

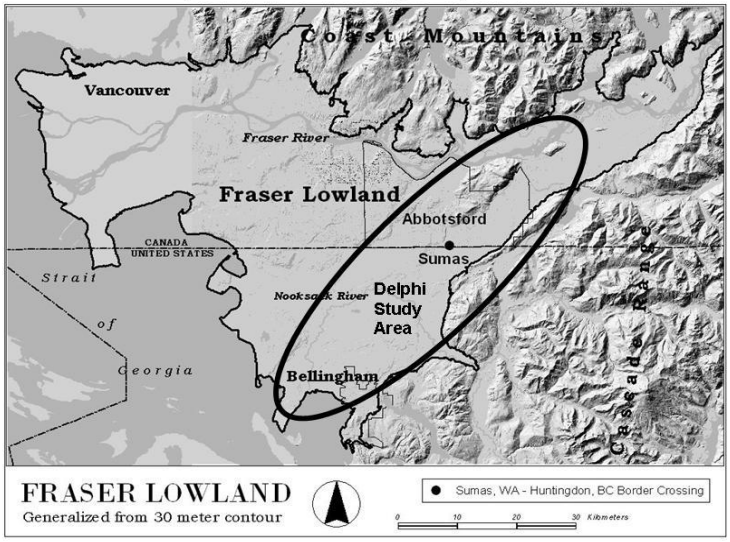
**Keywords:** cross-border region; cross-border cooperation; Cascadia; resource management; environmental geography; Fraser Lowland; borderlands

## 1. Introduction

The cross-border region (CBR) concept has emerged as a preeminent object of study in the social science literature. A recent (23 June 2017) search on Google Scholar yielded 5680 articles that employed the term. This study occurs within the context of a CBR. It is beyond the scope of the article to provide a detailed review of the concept, although a brief description is provided below. The CBR concept is especially germane to the study of trans-boundary cooperation and integration, especially as they relate to economic and resource management (Perkmann and Sum [1], Konrad and Nicol [2], and Guo [3]). The demise of the Soviet Union in 1991 initiated a fundamental realignment in global political geography, which was at least as significant as the formation of the European Union, initially as the EEC (European Economic Community) in 1957, and globalization, more widely. The meaning and significance of national borders has thus been altered, as has the operation of border regions. For one, local actors in border regions increasingly exercise "paradiplomacy", with or without support from the central state.

The Fraser Lowland (Map 1), a sub-region of Cascadia along the western Canadian-American border, faces spillover of such resource management issues [4–10]. This has occurred as the old *topocratic* era of federally-based government has moved into what Leresche and Saez have typified as

a current era of *Crisis of Governability* that is attempting to move into an era of *Cross-Border Cooperation* (CBC) and *adhocratic* governance based on Cross-Border Regions [11]. The success of such a move relies on meeting first necessary and then sufficient conditions. The former of these conditions, the necessary, relate directly to Sohn's two new theoretical models of Cross-Border Integration (CBI), *geo-economic mobility* and the *territorial project* [12]. Both models focus on *why* cross-border integration occurs but not *how*. The former model provides a framework for understanding cross-border integration from an economic perspective and the latter from that of place-making and issues such as joint cross-border resource management. Both models tend to co-exist at a given location with a large degree of over-lap.




**Map 1**: Fraser Lowland and Delphi Study Area

The primary focus of this study is on meeting the necessary conditions for the territorial project. This relates to developing a common agreement and understanding on the issues and opportunities that face a CBR and the confidence that they can and will be addressed. Based on our careful reading of Sohn's work, we define these necessary conditions as three C's: common territorial identity, convergence of knowledge and values, and willingness for cooperation. We explore this issue by employing a rich database previously developed by the authors for the Fraser Lowland through a Delphi study centered on a group of local experts and decision-makers from both sides of the border involved in cross-border issues. This group was tasked with first identifying major resource management issues with spillover potential in the Fraser Lowland and then evaluating the potential impact of each and the probability of successfully addressing them over the near-term. As part of this exercise, and relating back to the three C's, panelists were additionally asked to report on the current and expected future level of cross-border consciousness in the region.

In this study, the data is explored using two different statistical methods: a cumulative logit model and a linear mixed-effect model. In each of these, we are looking for an underlying latent structure indicating whether the above necessary conditions (three C's) are present, to what degree, and hence if the potential for cross-border integration (CBI) is present. Two methods are used in our analysis because each has its strengths and weaknesses relative to our database, thus, each relates well to the data but neither is a perfect fit, as will be discussed later. It should be noted that our data includes several ordinal variables and one binary variable. One of the ordinal variables is clearly bimodal, and the others are somewhat skewed. Given that the data was collected soon after a contentious cross-border resource management event (briefly discussed later), from a small number of well-connected decision-makers and experts, it is not possible to easily duplicate or augment it. Thus, recognizing the limitations of our database, the two-technique approach seems appropriate.

We prefer the cumulative logit model, but are worried about sample size, and so we ran the linear mixed-effect model to see if it produced similar results, which proved to be the case.

Thus, Sohn has proposed the territorial project as a theoretical model for CBI, focused on place-making with the ability to address issues such as cross-border resource management. From this theoretical construct, we have extracted three C's, as noted above, that encapsulate the necessary conditions for stimulation of such integrative activity across a border. In addition, it should be noted that these three C's do not work in a linear evolutionary fashion but instead are based on circular cumulative causation. In the Delphi database, we identify four sets of variables for studying the presence of the three C's. We then test for the existence of a significant relationship between these variables as hypothesized by the territorial project. As will become clear from our analysis our results support Sohn's theoretical territorial project model, but also leave additional areas for future investigation.

In summary, the primary focus of this study is to explore the utility of Sohn's theoretical cross-border territorial project model. The significance and importance of this work is the utilization of this theoretical model of CBI in order to test its relevance in the context of a specific CBR, the Fraser Lowland along the Canada-US border. In particular, the paper seeks to examine the determinants (the necessary conditions) that drive the emergence of a territorial project and looks for them in the Fraser Lowland. Such research will expand our understanding of not only this particular CBR, but also help validate Sohn's territorial project and, through the three C's, provide a better understanding of the necessary conditions for stimulating CBI.

We organized this paper in the following fashion. The next section discusses the geographic setting of the study area, the Fraser Lowland. Section 3 then turns to a broader discussion of CBR's along the American—Canadian borderlands, and especially Cascadia, while further reviewing Sohn's theoretical models and the three C's we have abstracted from his efforts. With this lens, it then focuses specifically on cross-border activities and strains within the Fraser Lowland that led to this study. Section 4 introduces the Delphi methodology and explains how it was conducted in the study area. A summary of important results from the Delphi are presented in Section 5. Our next section then turns to our cumulative log linear modeling and mixed-effect modeling efforts to investigate and then discuss the relationship between responses from the Delphi and the three C's of Sohn's territorial project; hence testing the value of this approach in understanding the trajectory of cross-border relations in the Fraser Lowland. Our last section summarizes our major conclusions, the value of Sohn's theoretical models, and indicates the need for further studies similar to the Delphi drawn upon here.

## 2. The Geographic Setting

The spatial focus of this study is the geographical region known as the Fraser Lowland (see Map 1). The name, and much of the description that follows, is derived from Armstrong [13]. The Fraser Lowland is relatively flat terrain, measuring approximately 3500 square kilometers (1350 square miles) in area. It is delimited by the Coast Mountains to the north, the Cascades to the south and east, and the Strait of Georgia shoreline to the west. This geographical setting has resulted in a confined air shed. The rich soil and mild climate make this prime agricultural land, as well as the site of major economic and urban development. The dominant physical feature of the region is the Fraser River, whereas the dominant human features are the United States-Canada international boundary, the Vancouver metropolis, and the much smaller city of Bellingham on the Washington side of the border. The boundary itself divides the Lowland into approximately two halves.

With regard to population, the Fraser Lowland is dominated by the Vancouver metropolis, which includes the City of Vancouver in the extreme west and is functionally integrated with suburban communities in the eastern periphery. This western portion of this Canadian region is roughly equivalent to the Greater Vancouver Regional District (GVRD—now officially known as "Metro Vancouver") which also corresponds with the Vancouver Census Metropolitan Area (CMA). It has a current population of 2.46 million. A second population base on the Canadian side of

the border, to the east, is the Fraser Valley Regional District (FVRD), with a population of 277,593. Three communities dominate the FVRD: Abbotsford (population: 141,397) and Mission (population: 38,833), which together constitute the Abbotsford CMA, and further east, Chilliwack (population: 83,788). Although distinctly more rural in character than the Metro Vancouver, the FVRD is nevertheless rapidly urbanizing as its connections to Metro Vancouver expand. The average five-year percentage change in population (2001–2006) for the three dominant centers of the FVRD was above nine percent and, for the FVRD as a whole, 8.2 percent.

The 2.7 million people that occupy the Canadian portion of the Fraser Lowland dwarf the 208,351 south of the border. The American portion of the region is entirely contained within the jurisdiction of Whatcom County, dominated by Bellingham (population: 83,365). Despite the population imbalance, the Fraser Lowland as a whole is characterized by high rates of population growth and attendant economic activity. Whatcom County's six-year growth rate (2000–2006) of 11.5 percent is similar to the communities of the FVRD, presented above.

## 3. North American Cross-Border REGIONS (CBR's) and a Models of Cooperation

Cross-border resource management remains an ever-challenging issue, especially regarding natural resources that extend across international boundaries [3,14]. In a Canadian-American context, this has become doubly difficult due to the fact that the two national governments, while relaxing local oversight, have left solutions to local areas with little in the way of centralized guidance or resources, with a few exceptions, such as the International Joint Commission's binational water boards [15].

However, along this border integration is occurring, but in a uniquely North American form of policy parallelism through a process of transactionalism [16]. Sohn cautions that simply relaxing constraints along any international boundary is not by itself sufficient to induce an effective Cross-Border Region (CBR) capable of dealing with the myriad of issues at a variety of scales that continuously overflow the border [12]. In addressing such issues, Sohn introduces the border as a resource into the process, a tactic that we refer to as the *border effect*, and differentiates between two theoretical models, the geo-economic mobilization across a border and the territorial project.

Of these two models, the former focuses on economic gains, while the latter represents place-making strategies as defined by our three C's: common territorial identity, convergence of knowledge and values, and willingness for cooperation. Together these focus on underlying principles such as mutual understanding, trust, cooperation, and the convergence of values and identity to which we would add Nadalutti's emergence of a common ethical code [17]. Even though Sohn states that " . . . cross border integration derives first and foremost from knowledge and ideational ties" such as " . . . mutual affection, trust between local actors and a sense of belonging to a common place . . . " [12]; he also states that willingness to cooperate is *essential*. What this somewhat confusing set of statements indicates is that there is not a causality or linearity between the three C's. Instead, they are entangled in a pattern of circular cumulative causality, and even contain some overlap. Surely, a convergence of values are intertwined with a common identity. On the other hand, without a willingness to cooperate there will be little to reinforce a common territorial identity and even less so a need for a convergence of knowledge and values or vice versa. In sum, he states that, "convergence between the two sides of the border is therefore primarily a matter of perceptions and attitudes . . . " and that " . . . cross-border cooperation seeks to build a shared vision and territorial identity that transcends the border" [12]. In fact, Sohn sees the border not as a barrier but a locus for innovation, hybridization, and an opportunity for creating greater spatial recognition and success. This border effect is a positive opportunity waiting to be exploited, but there is no linear or normative set of evolutionary steps that unerringly lead to successful integration [12]. This is where the three C's come in, although by themselves they do not guarantee success, without meeting such necessary conditions success will be elusive if not impossible.

In addition, the territorial project resonates highly with CBR literature. Specifically it relates well to the ad hoc, bottom-up, and flexible geography of emerging CBC and solution building. It does this especially for resource management where spatial scale and extent is determined by a commitment to

addressing an issue, not abstract political bounds that might not be aligned with the geography of the issue [11,18,19].

Along the Canadian-American border, the westernmost border region, Cascadia, has been particularly active in creating cross-border alliances especially environmental ones [20]. These voluntary relationships have been instituted based on a variety of issues; they occur at multiple geographic scales, in various locations, and have exhibited various levels of success [4–6,8–10]. What has not been done, to the best of the authors' knowledge, is to delve more deeply into these emerging territorial projects exploring the necessary conditions as demonstrated by the three C's. That is, are we able to identify factors that indicate the simultaneous emergence of a common territorial identity along with a convergence of knowledge and values, and willingness to cooperate, which together represent key necessary provisions in developing trust and place-making. Specifically, is a territorial project emerging at the issue-dependent scale that demonstrates the existence of the necessary conditions for broadening and deepening CBC and, in the long-term, can lead to successful management strategies of shared resources throughout Cascadia? To investigate this question we draw upon a Delphi study of experts and decision-makers in the Fraser Lowland.

Our Delphi study focused on the Fraser Lowland, which comprises a small subsection of the much larger Cascadia, which is a cross-border region making up much of the far northwestern coastal portion of North America. Further, Cascadia is centered on Washington and Oregon States and the Province of British Columbia with vaguely defined extensions inland and beyond [21]. Despite these geographic unknowns, amongst North American borderlands, Cascadia is recognized as one of the most salient and enduring. Sparke and Alper separately describe Cascadia as a prominent *idea*, albeit, one with an internal division between economic and environmental priorities, a point which directly echoes Sohn's two-model focus and to which we will return below [12,22,23]. Nevertheless, the Cascadia idea has a powerful unifying effect, at least at the cognitive and discursive levels of "transnational region building" [24]. Alper, Artibise and Brunet-Jailly have supplied evidence for this, amongst others [16,23,25]. In addition, Canada's Policy Research Institute found strong evidence of shared socio-cultural values in the multiple borderlands of Canada and the United States, especially that of Cascadia.[26]

Returning to Sohn's two overlapping theoretical models focusing on *why* CBR's emerge; it is clear that both types have come into play in Cascadia and at multiple scales [12]. For the former modeling type, an excellent example at the macro-level representing an organization seeking to profit from geo-economic mobilization throughout Cascadia is PNWER (Pacific North West Economic Region)—a five state, four province construct. At more of the local scale is the IMTC (International Mobility and Trade Corridor Program), focusing on easing and speeding cross-border economic flows and interactions, specifically in the Fraser Lowland. Each in its own way seeks to benefit from the opening up and monetization of the border as a resource.

On the other hand, the territorial project represents a much more complex effort without as clear a reference point as increasing profits. If one were pressed to define the goal for this exercise in place-making, it might be stated as increasing local quality of life (QOL). Second, by its very nature as a *project*, there is the implication of a journey rather than destination.

Regarding the territorial project model in Cascadia, no macro-scale institutions have emerged to rival the breadth and focus of PNWER. However, there have been a number of state-provincial memorandums signed between West Coast American states and Canadian provinces focusing on resource management issues dependent on parallelism, for example greenhouse gas initiatives (A 2013 memorandum between the governors of Washington, Oregon, and California and the premier of British Columbia to regulate greenhouse gases represents a recent attempt at a cross-border alliance building after the failure of an earlier Western States Climate Initiative that died in 2007). However, continual and comprehensive implementation of such pacts has yet to be realized. However, such state- and province-level agreements still contain a good deal of what Leresche and Saez refer to as topocratic dictation rather than truly local bottom-up issue-based adhocratic CBC [11].

At the Fraser Lowland level, Brown provides a recent review of a number of local ad hoc cross-border attempts at CBC focused on managing a number of small watersheds within this region [6]. However, studies by Anaka and Jones raise cautionary notes regarding the level of success and longevity of such efforts [5,9]. In regards to airshed management, Belec and Buckley documented a battle over a merchant power plant (A merchant power plant is constructed at what is determined to be a low cost location based on inputs, environmental constraints, and the export of power that is sold onto the international grid to the highest bidder irrespective of location, bringing the benefits of jobs and tax base to the local area, but also the negative externalities of pollution) SE2 (Sumas Electric 2) that was proposed for an American site within a kilometer of the international border crossing of Sumas-Huntingdon (refer back to Map 1) with potential benefits and definite environmental impacts on each side [7,8]. This contested development resulted in the straining of local municipal ad hoc cross-border relationships and eventually in appeals to more distant topocratic institutions to step in, further alienating some of the local actors. Specifically, a loose coalition of cross-border opponents to the project, coalescing around local NGOs, emerged and called upon state, provincial, and eventually national institutions to halt the project, which ultimately occurred. However, the question remained, was this the start of ad hoc CBC and joint resource management outside of traditional nationally differentiated institutions spurred by a cross-border coalition or a one-time example of successful Nimbyism? With this issue fresh in the minds of local experts and decision-makers, we set about creating our Delphi study.

## 4. Delphi Method and Structure

This paper is based on information obtained through a type of anonymous discussion and interactive questionnaire technique known as the "Delphi" method [27–30]. The method is a "qualitative, long-range forecasting technique that elicits, refines and draws upon the collective opinion and expertise of a panel of experts" [29]. It provides a means for thoughtful, anonymous discussion of complex issues that are not easily addressed in other formats, while limiting the impacts of political or national bias. To accomplish this, it utilizes the technique of controlled conversation among panel members whose identities remain anonymous throughout the exercise. This guarantees that through a series of rounds, the discussion focuses on ideas rather than national origins, personalities, politics, backgrounds, or other biases, and that no group or individual dominates the discussion. This is done by submitting positions or ideas to the researchers who summarize and organize these before their submission to the group as a whole. In addition, this method enables the researchers to ask for further clarification if necessary in order for all panelists to fully express and understand each idea. As rounds progress, panelists are asked to rank and order ideas submitted by members of the group as a whole based first, on the likelihood that a given suggestion will occur, and second, if it does occur, the level of importance or its impact upon the situation. This allows for the disclosure and discussion of all positions, including contradictory or unpopular ones, and for the evaluation of their level of impact and their probability of occurrence. In addition, a Delphi does not require that the panel eventually agree on one set of answers. Ranked and ordered results are reported back as both summary averages and histograms, thus providing information on not only the most likely response, but also the deviation and whether a multimodal result is present. This enables the clear representation of not only majority positions but also minority ones.

The project began by interviewing current decision-makers and experts who were involved in cross-border issues, especially the proposed construction of the controversial power plant, SE2, and asking them to volunteer for the study and/or recommend others with similar influence and expertise. Given the location of the SE2 issue, it was decided to seek Canadian participants from the eastern portion of the Fraser Lowland, i.e., within communities of the FVRD. On the American side, given involvement in the Bellingham area, participants were recruited this far afield (refer back to Map 1 for the study area from which participants were selected). In total, eighteen panelists agreed to participate in the study (7 Canadian and 11 American) (Table 1). One American dropped out after

the first round and a second American skipped the third round, resulting in 16 to 18 valid responses per round (7 Canadians but between 11 and 9 Americans) (In Delphi studies, given their multi-round approach, it is not unusual for participants to drop out or not participate in every round, but given their ability to review information based on earlier results, it was assumed that their later responses remained valid). Panelists included past and present political leaders, planners and academics, NGO members (non-government organizations), and business private sector representatives (see Table 1).

**Table 1.** Panelist Backgrounds.

| Panelists | USA | Canada | Total |
|---|---|---|---|
| Planners and Academics | 5 | 3 | 8 |
| Elected Officials, past and present | 2 | 3 | 5 |
| NGO members | 2 | 1 | 3 |
| Private Sector | 2 | 0 | 2 |
| Total | 11 | 7 | 18 |

Between February 2005 and December 2006, four Delphi rounds were performed. Table 2 lists foci of each round related to this study (For a complete description of the Delphi Study and a summary of all the results see, "Final Report: Imaging the Future of Cross Border Environmental Resource Management within the Fraser Lowland: A Delphi Analysis", conducted by Patrick Buckley, Western Washington University and John Belec, University of the Fraser Valley, October 2007. http://faculty.wwu.edu/patrick/PapersnPublications/DelphiFinalReport.htm). Note that the bold face type indicates the round in which a line of discussion and/or evaluation began, and the plain faced type, the round in which it was repeated.

**Table 2.** Round by Round Foci of the Delphi.

| | |
|---|---|
| Round 1 | Identify and discuss pressing cross-border resource management issues.<br>Evaluate the current understanding of cross-border identity and consciousness. |
| Round 2 | Rank, score, and discuss pressing cross-border resource management issues.<br>Second evaluation of the current understanding of cross-border identity and consciousness. |
| Round 3 | For the top five cross-border resource management issues, evaluating the expected impact and likelihood of successfully addressing each over the near term. |
| Round 4 | Second evaluation of the top five cross-border resource management issues, evaluating the expected impact and likelihood of successfully addressing each over the near term. |

The purpose of the complete Delphi exercise was to identify and evaluate the current cross-border management issues occurring in the Fraser Lowland as well as the context within which they exist. This included identifying the issues themselves, their potential impact, their probability of being successfully addressed, and the degree to which addressing them will require of local or international extent. In addition, it also provided an understanding of the current level of cross-border consciousness and identity. All of this, of course, relates to the three C's of a territorial project, as will be discussed later.

While Round one served as both a brainstorming session and an initial attempt to understand the context within which these issues exist, the purpose of subsequent rounds was primarily to probe and refine the thoughts offered in Round one. The brainstorming portion of Round one enabled each panelists to state and describe up to three of the most pressing cross-border management issues faced by the inhabitants of the Fraser Lowland. Later rounds ranked, evaluated, and discussed the issues. In addition to brainstorming, Round one also had targeted questions using a ten point Likert scale to identify the current and the expected future levels of cross-border consciousness a decade into the future.

To be clear, the brainstorming section in Round one provided panelists with a blank slate on which to suggest issues for group consideration, in an open and unbiased manner. Panelists also

evaluated the current and future expected levels of cross border consciousness, which could prove to be crucial in successfully addressing the issues and pursuing the three C's of a territorial project.

## 5. Delphi Results

Figure 1 provides histograms regarding cross-border consciousness with the value of one meaning "very high" and ten, "little to none." Two time periods are represented, 2006 when the data was collected and a projected decade into the future. Based solely on statistical averages, the measures of cross border consciousness fall at the center of the range, suggesting that for the panel as a whole, consciousness was rather moderate at the time of the study (5.7 mean and 5.0 median) with not much expectation of change over a decade (5.3 and 5.0). However, strong bi-modality is evident in both histograms. There are clearly two groups of respondents, one group perceiving a fairly high level of cross-border consciousness and a nearly equal number of panelists answering that the consciousness is fairly low. A decade in the future, the spread of results increases slightly while migrating slightly towards an increasing cross-border identity, but when tested using Kolmogorov Smirnov, no significant difference was detected. Further, no significant change was found at the panelist level indicating that they did not change groups, and there was no significant relationship between a respondent's nationality and the group to which they subscribed. Finally, although the sample size by profession was quite small, we failed to find a relationship between group membership and profession.

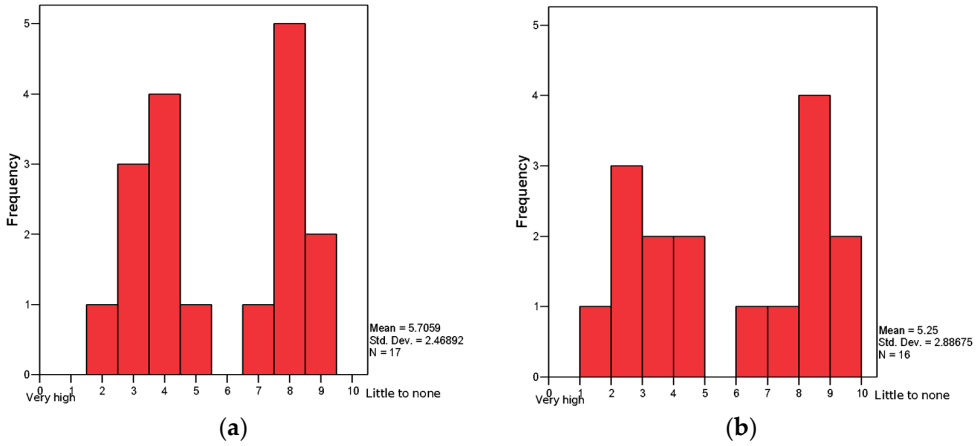



**Figure 1.** Cross-Border Consciousness and Identity. (**a**) Current level; (**b**) Expected future level in a decade.

In response to the request for spillover issues, panelists submitted approximately 80 individual suggestions. Over the next two rounds, they were pared down to five major issues, which were further analyzed. These five, listed alphabetically, are the following:

- Air shed impacts
- Conversion from open space/increase of impervious surfaces
- Economic growth impacts
- Population growth impacts
- Water resource impacts

With the core issues of cross-border resource management identified, much of the remainder of the Delphi probed panelists' opinions on the relative importance of the individual issues. Panelists were asked to rank, to score on a ten point Likert scale, and to further comment on the issues in Rounds two and three. This procedure of anonymously sharing questionnaire results is at the heart of the Delphi methodology. Panelists thus had the opportunity to revise their opinions based on the measures and ideas presented by others in the study.

The final and Fourth round of the Delphi turned to topics related to the probability of solutions and the impacts of the top five issues. Round four asked panelists to respond to three questions about each of the top issues based on a ten-point scale:

1. How local or international is this issue?
2. Expected level of success in addressing this issue over the next decade?
3. Potential degree of impact if this issue is not addressed over the next decade?

Table 3 provides more detail on these questions and Table 4 summarizes the results. One important difference between the histogram for the confidence measure (Figure 1) and the answers to these three questions is that none of these plots departed from a uni-modal pattern.

**Table 3.** Evaluation of Top Five Issues Measurement Scales.

| Variable | Question | Answer Range |
|---|---|---|
| Expected Success | 2. Expected level of success in addressing this issue over the next decade. | 1 = Little to none, 10 = Very high. |
| Potential Impact | 3. Potential degree of impact if this issue is not addressed over the next decade. | 1 = Little to none, 10 = Very high. |

**Table 4.** Descriptive Statistics for Evaluation of Top Five Issues.

| Issues | Mean | Median | Minimum | Maximum | Std. Dev. | Skewness | Cases |
|---|---|---|---|---|---|---|---|
| **A. Potential Impact** | | | | | | | |
| **Air Shed** | 8.06 | 8 | 5 | 10 | 1.25 | −0.56 | 17 |
| **Water** | 7.59 | 8 | 5 | 10 | 1.23 | −0.23 | 17 |
| **Population Gr.** | 6.76 | 6 | 5 | 10 | 1.64 | 0.52 | 17 |
| **Economic Gr.** | 6.41 | 7 | 5 | 9 | 1.37 | 0.29 | 17 |
| **Open Space** | 6.35 | 7 | 3 | 8 | 1.62 | −0.55 | 17 |
| **B. Expected Success** | | | | | | | |
| **Air Shed** | 6.03 | 6 | 3 | 9 | 1.6 | −0.6 | 17 |
| **Water** | 5.47 | 5 | 2 | 8 | 1.62 | −0.19 | 17 |
| **Population Gr.** | 4.29 | 5 | 1 | 8 | 2.02 | −0.05 | 17 |
| **Economic Gr.** | 5.18 | 5 | 3 | 8 | 1.59 | 0.2 | 17 |
| **Open Space** | 5.71 | 6 | 3 | 8 | 1.65 | −0.32 | 17 |

Two issues, air and water, were identified as most in need of an international solution (scores of 7.53 and 6.41 respectively on a ten-point scale with 1 as local and 10 as international). By contrast, the impacts of economic growth, population growth, and open space change were seen to be much more local (scores of 5.41, 4.47 and 4.12 respectively, again a ten point scale with 1 as little to none and 10 as very high). The results show that panelists recognized that the geography of air and water "resources" vis-à-vis the international border, are qualitatively different than the other three issues. This appears to reflect both the nature of the phenomenon and how it is governed. As one panelist phrased it, "(The air shed) is a 'local' problem that coincidentally straddles an 'international' border. It is local, but can only be addressed at an International level." When asked to assess the "potential degree of impact if an issue was not addressed over the next decade," air shed received the highest mean score, 8.06, closely followed by water at 7.59. The other three followed with scores well above the midpoint of the Likert scale.

It is with regard to the "expected level of success in addressing this issue over the next decade," that panelists show the greatest diversity in opinion. With the exception of population growth, panelists expect to see at least "some" success in addressing all of the top issues. Given the importance, that air shed demonstrates throughout this data, it is significant that air shed received the highest score regarding successfully addressing it (6.03 mean). This somewhat optimistic interpretation of the

results must be tempered with the fact that the "expected success" scores are nevertheless still only moderate and are the product of divergent opinion.

Given a broad understanding of the issues and the context of cross-border consciousness, we now turn to considering the three C's of the territorial project. The standard deviations and skewness values of the results in Table 4 are generally reasonably small. In addition, there is a uni-modality for the plots of these results. From all of this it is clear that the reportage reflecting an underlying knowledge base regarding cross-border issues shows a good deal of convergence. Likewise the expectation that all of these issues will be addressed to some level in the near future, even those requiring more cross-border international efforts, attests to the expectation of cooperation across borders, especially on issues regarding air. However, a common identity and cross-border consciousness remains somewhat of a puzzle. Clearly two opinions exist here which go beyond nationality. Understanding how this impact the resource issues is where we wish to utilize a form of ordinal regression, proportional odds modeling, to look for a latent structure describing our panelists from the Fraser Lowland region and helping us to better understand the potential for territorial project CBI with its accompanying CBC.

## 6. Analytical Modeling

### *6.1. Statistical Model Choice and Structure*

This section is organized in the following manner, in the first subsection; we discuss our choice of two competing statistical techniques and especially why we have chosen to run more than one. This is followed by an outline of the structure of our statistical model and its relationship to the three C's. Next comes a brief section on data preprocessing, followed by the equations specified for each technique and the results of our statistical runs. Finally, we provide a discussion of how well this work supports the three C's of the territorial project model.

In determining which statistical technique would best evaluate the Delphi data, we came down to a choice between a proportional odds model with a cumulative logit link and a linear mixed-effect model. Each of these includes a random effect since we have multiple responses from each panelist. The advantage of applying a cumulative logit is that our data is ordinal, and hence, the resulting error term would not be normal. However, a disadvantage is our small sample size and the fact that a logit has a greater number of parameters that require estimation. This tends to favor a linear mixed-effect approach, which only requires a single intercept measure. The cumulative logit model, on the other hand, requires more intercepts, in the case at hand it is one less than the total number of our ordinal classes of responses. As will be shown below, we have five classes, which result in four intercept parameters for a logit model or three more than is the case for the mixed-effect model. Simply stated, cumulative logit tends to favor a larger sample size for ordinal data, while a mixed-effect analysis expects a normal distribution of residuals and can be applied to a smaller sample. Although we preferred to use the cumulative logit approach, we also ran a mixed-effect model to look for any variations. These concerns proved to be baseless, as both model runs support the same conclusions.

As will be discussed below, the analysis is structured to include first, a panelist's nationality and their evaluation of the current level of cross-border consciousness. Second, it also includes their responses to the questions on the expected level of impact from each of the five cross-border issues and their anticipation of successfully addressing each.

As noted previously, in terms of Sohn's territorial project we have extracted three C's, common territorial identity, convergence of knowledge and values, and willingness of cooperation. These encapsulate the necessary conditions for development of place based CBR's to address issues such as resource management.

We relate the Delphi factors to the three C's in the following manner. The factor, cross-border consciousness, appears to be the perfect stand in for the first C, common territorial identity, while significant relationships based on nationality would provide evidence for just the opposite, failure to bridge a border. Relating a factor to the second C is more complex and our choice more nuanced.

We argue that panelists reporting an increasing level of expected impact from issues that spillover a border are indicators in large part of a convergence of knowledge as well as underlying values. They recognize that the problem is real and that consequences extend beyond one's own region; international externalities cannot be ignored. We would be hard pressed to absolutely prove that convergence of knowledge and values will lead to a greater expectation of impact and of placing more value on what occurs to one's neighbors. However, the environmental field is littered with historical examples demonstrating that a lack of knowledge has led to a great deal of underestimating potential negative impacts, and even more so, impacts across borders. The failure of upstream users to comprehend or even consider downstream impacts is an oft-cited example. On the other hand, given that our Delphi panelists represent experts in their fields and are highly knowledgeable about cross-border management issues and impacts, we have a great deal of faith in this assumption. Finally, successfully addressing a spillover issue will clearly require a willingness to cooperate—the third C. Hence, we propose that respondents registering higher levels of expectations of successfully addressing issues are also demonstrating a greater confidence in a willingness to cooperate across the region. From the above, we hypothesize that nationality will have no significant relationship to any of our other three Delphi based factors, but that the three factors will have a significant and positive relationships among themselves.

### *6.2. Data and Preprocessing*

As noted previously, in the Fourth and final round, ten American and seven Canadian panelists were asked to evaluate the impact and the potential of successfully addressing five pressing resource management issues on a scale of one as very low to 10 as very high. To review, the five issues were air, water, population, economy, and open space (listed in order of expected impact). In addition, in prior rounds panelists were asked to rate the degree of cross-border consciousness (1 very high to 10 little to none), which produced a bimodal response (refer back to Figure 1). Finally, panelists were identified by nationality. We were interested in whether individuals that scored differently on these two issues would have different views on the two resource questions.

As a data-preprocessing step, we collapse the ordinal responses to our impact and success questions from the initial answers (1 through 10) to a more compact set of five classes. We do this by using 2, 4, 6, 8, and 10 as the cutoffs (e.g., any score equal to 1 and 2 was placed in class 1, any above 2 but no greater than 4 was relabeled into class 2, etc.). In the original data, there were 2 1's, 2 2's, 11 3's, 14 4's, 37 5's, 21 6's, 1 6.5, 35 7's, 33 8's, 10 9's, and 4 10's. After collapsing into five classes, we had 4 1's, 25 2's, 58 3's, 69 4's, and 14 5's. This is done to decrease the number of intercept parameters that were required for estimation in the cumulative logit model. Ten classes of data would require the estimation of nine intercept parameters, far more than we would expect our data to adequately support. Going to five classes cuts intercept parameters by more than a half to only four.

Variables in our model included the two predictors, Consciousness and Nationality, plus responses to two question about the five cross-border Issues: air, water, population, economy, and open space. The two specific Questions were: (1) whether panelists expected success in addressing the resource issue over the short term, and (2) the degree of expected impact if the issue is not addressed. The results we arraigned into five classes, 1 little to none through 5 high impact.

### *6.3. Proportional Odds Model with Cumulative Logit Link*

Equation (1): Cross-border proportional odds model with a cumulative logit link a random effect

$$Logit[P(Y_{ilm} \leq j)] = \theta_j - \beta_l - \delta\, x_i - \alpha\, z_i - \gamma_m - u_i \quad (1)$$

A cumulative logit model (Equation 1) was fit to the data. The variables are $Y_{ilm}$, $x_i$, and $z_x$. $Y_{ilm}$ is the responses by panelist $i$ to each of the two questions $m$ (success or impact) about resource $l$ (air, water, population, economy, and open space) which range from 1 through 5 based on our binning

scheme above. The notation $j$ identifies the cumulative bins, thus $j = 1$ contains only those panelists with responses in class 1, $j = 2$ cumulates panelists with responses of 2 or less, $j = 3$ is 3 or less, and so on. Nationality is identified by $x_i$ (a binary with U.S.A. = 0 and Canada = 1). Finally, $z_i$ is the current level of consciousness expressed by panelist $i$ (1 high through 10 low).

The proportional odds technique estimates a total of eleven parameters plus a random effect. The question class-related parameters are $\theta_j$ for $j = 1, 2, 3, 4$; one for each of our first four cumulative odds response levels. $\theta_5$ for class 5 is not necessary since $j = 5$ represents the complete accumulation of all odds or simply unity. Other parameter estimates are $\beta_l$ for the five issues $l$ = air, water, pop, econ, and open (air is set as the solution baseline, so $\beta_{\text{air}}$ is constrained to be zero); $\delta$ for nationality; $\alpha$ for consciousness; and $\gamma$m for question (where $\gamma_{Impact}$ is set to zero and $\gamma_{Success}$ is estimated). The model also includes $u_i$ as a random effect. This assumes that each individual's random effect was a draw from a normal distribution with mean zero and variance $\sigma^2$. This variance is also estimated and evaluated.

The analysis was run with the Ordinal package in R. Model fitting was done using the Adaptive Gauss-Hermite Quadrature method with 30 quadrature points. Output from the regression indicated that the condition number on the Hessian was 2300, which indicates that there was no problem fitting the model. Results for the parameters of interest in this model are given below (Table 5).

**Table 5.** Estimated parameter values for proportional odds model.

| Parameter | Estimate | Std. Error | Z-Value | *p*-Value | Significance [a] |
|---|---|---|---|---|---|
| $\beta_{Water}$ | −1.02 | 0.49 | −2.080 | 0.038 | * |
| $\beta_{Econ}$ | −1.67 | 0.50 | −3.370 | 0.001 | *** |
| $\beta_{Open}$ | −1.67 | 0.50 | −3.328 | 0.001 | *** |
| $\beta_{Pop}$ | −2.15 | 0.51 | −4.207 | 0.000 | *** |
| $\alpha$ | −0.23 | 0.10 | −2.417 | 0.016 | * |
| $\delta$ | 0.63 | 0.46 | 1.362 | 0.173 | |
| $\gamma_{Success}$ | −2.23 | 0.35 | −6.408 | 0.000 | *** |

Note that all but one of the parameters were significant in the model at the 0.05 level or better. The exception was $\delta$, related to the country of the respondent, meaning this variable has no significant impact on the model, as we had predicted. [a]: * sig < 0.05, *** sig < 0.001.

For the significant parameters, all signs are negative as would be expected if the three C's were being realized. Further, investigating the $\beta$ values, the negative signs indicate that of the five issues, air has the highest potential impact and greatest probability of being successfully addressed. Air is closely followed by water, then to a lesser extent econ, open, and population. These results are well in line with the values in Table 4. The significance and negative sign for $\alpha$ indicates that as cross-border consciousness increases (moves closer to 1) so too do the expected impact and success values for each issue, as we had hoped to find. Finally, the negative sign for $\gamma_{Success}$ again confirms what is shown in Table 4, that responses to questions about success have lower values than impact.

Once the model was run, we considered whether a random effects model was appropriate—whether an individual's scores were significantly correlated. We ran a likelihood ratio test comparing the model given in Equation 1 to a model that was identical except that it did not include the random effect. The resulting 1 degree of freedom test yielded a $p$-value of 0.01849, indicating that the model with the random effects does indeed fit the data better than a model without random effects.

### *6.4. Linear Mixed-Effect Model*

Equation (2): Cross-border linear mixed-effect model with a random effect

$$Y_{ilm} = \theta^* - \beta^*_l - x_i\,\delta^* - z_i\,\alpha^* - \gamma^*_m - u^*_i + e_i \quad (2)$$

A mixed-effect model with a random effect (Equation 2) is also fit to the data. $Y_{ilm}$ again indicates the responses by panelist $i$ to each of the two questions $m$ (success or impact) about resource $l$ (air, water,

population, economy, and open space) for each of the five issues. In addition, each individual $i$ is identified by nationality $x_i$ (a binary with U.S.A = 0 and Canada = 1) and by their consciousness answer $z_i$ (1 high through 10 low).

The mixed-effect model estimates eight parameters plus a random effect deviation. These include the intercept $\theta^*$; $\beta^*_l$ for the five issues $l$ = air, water, pop, econ, and open (air is set as the solution baseline, so $\beta^*_{\text{air}}$ is constrained to be zero); $\delta^*$ for nationality; $\alpha^*$ for consciousness; and $\gamma^*_m$ for question (where $\gamma^*_{Impact}$ is set to zero and $\gamma^*_{Success}$ is estimated). The model also includes $u^*_i$ as a random effect. This assumes that each individual's random effect was a draw from a normal distribution with mean zero and variance $\sigma^2$. This variance is estimated and evaluated.

The analysis was performed with the nlme package in R using maximum likelihood [31]. A series of diagnostic plots indicated that the data showed no great violation of the assumptions of the linear mixed-effect model. These plots included (1) a residual plot, (2) a barplot showing the residuals for each individual in the linear mixed-effect model, and (3) a plot of the observed vs fitted values. Results for the parameters in this model are listed below (Table 6).

**Table 6.** Estimated parameter values for mixed-effect model.

| Parameter | Estimate | Std. Error | DF | t-Value | *p*-Value | Significance [a] |
|---|---|---|---|---|---|---|
| $\theta^*$ | 8.75 | 0.57 | 148 | 15.459 | 0.000 | *** |
| $\beta^*_{Econ}$ | −1.25 | 0.34 | 148 | −3.652 | 0.000 | *** |
| $\beta^*_{Open}$ | −1.01 | 0.34 | 148 | −2.964 | 0.004 | ** |
| $\beta^*_{Pop}$ | −1.51 | 0.34 | 148 | −4.425 | 0.000 | *** |
| $\beta^*_{Water}$ | −0.51 | 0.34 | 148 | −1.504 | 0.135 | |
| $\alpha^*$ | −0.18 | 0.08 | 14 | −2.403 | 0.031 | * |
| $\delta^*$ | 0.44 | 0.37 | 14 | 1.195 | 0.252 | |
| $\gamma^*_{Sucess}$ | −1.70 | 0.22 | 148 | −7.852 | 0.000 | *** |

Note that all but two of the parameters were significant in the model at the 0.05 level or better. The exceptions were first $\delta^*$, related to nationality of the respondent, meaning this variable has no significant impact on the model. Second, $\beta^*_{Water}$ is also not significant, but this refers to the fact that air and water move together. In other words, by knowing whether the panelist is responding to questions concerning air or water has no additional explanatory impact on the overall model, not an important concern. [a]: * sig < 0.05, ** sig < 0.01, *** sig < 0.001.

For the significant parameters, all signs are negative, as would be expected if the three C's were being realized. Further, investigating the remaining three $\beta^*$ values, the negative signs indicate that of the five issues, air and water have the highest potential impact and greatest probability of being successfully addressed. However, there is a significant decrease in impact and success responses for the remaining three issues: econ, open, and pop. Again, these results are well in line with the values in Table 4. The significance and negative sign for $\alpha^*$ indicates that as cross-border consciousness increases (moves closer to 1) so too do the expected impact and success values for each issue, again as we had hoped to find. Finally, the negative sign for $\gamma^*_{Success}$ again confirms what is presented in Table 4, that responses to questions about success have lower values than impact.

Once again, we considered if a random effects model was appropriate. We ran a likelihood ratio test comparing the model given in Equation 2 to a model that was identical except that it did not include the random effect. The resulting 1 degree of freedom test for the significance of the random effects resulted in a test statistic with a value of 8.689, with a $p$-value of 0.0032.

### *6.5. Two Model Discussion*

The most important results here are a demonstration of a common latent structure regarding cross-border resource issues independent of a nationality effect. Basically, this indicates that agreement exists regarding the top two resource issues facing the Fraser Lowland (air and water) and that the other three, although important, are at a lower level with indeterminate order.

Thus, from all of the results of our two statistical models, we conclude that they both confirm the same basic result when considering the three C's. In both instances, nationality had no significant

impact on the responses of panelists. On the other hand, as factor values for consciousness increases so too does the impact and expected success responses, as we would expect with the presence of the three C's. As a sideline, responses for questions of impact produced higher value results than for success (confirming what was apparent in Table 4). Finally, regarding the five issues, air clearly has the highest impact and expected success, and water is close behind, if not equal. For the other three, the exact order is not clear, much, as is the case in Table 4. The clear difference is that they are not as important as air and water. Finally, panelist responses for expected impact is significantly higher than for successfully addressing the issues, suggesting that knowledge about the potential consequences of the issues is still greater than faith in cooperation resulting in successfully addressing them. One final note, although one might wish to prescribe a linear causation to these three factors, such as greater consciousness leading to greater expectation of impacts and willingness to cooperate, in fact the data neither supports nor requires such causation. It simply indicates a significant relationship between the three, as would be expected from Sohn's territorial project.

## 7. Conclusions

Sohn has provided an intriguing set of theoretical models for understanding why cross-border integration is occurring [12]. He breaks it down into two models. The geo-economic mobilization model focuses on monetization of benefits to be derived from spatial locations near or on a border; utilizing the border as a resource in pursuit of profit. The territorial project focuses on cross-border place-making that can better administer issues such as cross-border resource management. Its ultimate emphasis is to increase QOL. Obviously, there is a great deal of overlap between the two, but the focus of each is clearly different. Our study focuses primarily on the territorial project and specifically it's three C's: common territorial identity, convergence of knowledge and values, and willingness for cooperation. These three C's help to explain why cross-border integration is pursued; what we refer to as the necessary but not sufficient conditions for cross-border integration.

The ultimate goal of the study was to statistically test for the three C's thus demonstrating the usefulness of the territorial project approach. We utilized a unique Delphi database for the Fraser Lowland, a part of Cascadia, and successfully demonstrated the presence and a significant relationship between the three C's, evidence for an attempt at a territorial project.

However, by definition a project implies an on-going activity; pursuit of QOL is a never-ending task. In addition, our exploration of the Delphi data also indicated that for one of the C's, common territorial identity, which we identified in the Delphi database as the cross-border consciousness variable, had a clear bimodal distribution. As noted previously, an increase in this variable was statistically related with increases in the other two C's; but about half of the panelists involved in the Delphi study indicated that consciousness was low and would remain low at least over the near term. We interpreted this to mean that for this group of panelists the other two C's would also remain low. Most troubling, this would tend to indicate that CBC would also remain low, threatening successfully managing cross-border resource issues.

A review of studies (discussed earlier in this paper) focused on ad hoc attempts to provide long-term management of air shed and water resource issues provided mixed evidence for success. Further, the fact that federal level and state/provincial support, not only in the Fraser Lowland but also throughout the borderland areas in North America, has been limited creates additional challenges to successful ad hoc resource management.

What we conclude is that:

(1) Sohn has provided some excellent theoretical tools for investigating and understanding the development of cross-border integration in general and the Fraser Lowland in particular [12];
(2) In the Fraser Lowland, statistical analysis of our Delphi data show strong evidence for the existence of the three C's of the territorial project;
(3) Although necessary conditions are being met in the Fraser Lowland, sufficient conditions have yet to be met, and it is unclear when or if this will occur;

(4) Finally, more studies of this sort both at the micro and macro level throughout the Fraser Lowland, Cascadia, and other borderlands are required if we are to move to the next level, what Sohn referred to as how cross-border integration occurs, not just why.

**Supplementary Materials:** The final report for the Delphi study is available on-line at: http://faculty.wwu.edu/patrick/PapersnPublications/DelphiFinalReport.htm. The data used in this study can be found at this link: www.mdpi.com/2079-9276/6/3/32/s1.

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**Author Contributions:** Patrick Buckley and John Belec conceived, designed, and conducted the Delphi study including the summary tables and charts. Amy Anderson conceived of and conducted the statistical analytical models. Patrick Buckley served as the lead author with critical assistance from John Belec and Amy Anderson.

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