# International Workshop on Climate Change Adaptation Planning for Ports, Transportation Infrastructures, and the Arctic (CCAPPTIA)

**May 3-4, 2018**

**Fort Garry Campus, University of Manitoba**

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## Workshop Proceedings: Discussions, conclusions and the next steps

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## Organisers

The Workshop towards an International Consortium on Climate Change and Adaptation Planning for Ports, Transportation Infrastructures, and the Arctic (CCAPPTIA) was organised by the following:

Prof. Adolf K.Y. Ng of the Transport Institute and Department of Supply Chain Management, University of Manitoba, Canada

Dr. Changmin Jiang of the Department of Supply Chain Management, University of Manitoba, Canada

Dr. Jason Monios of the Kedge Business School, France

Mr. Yui-yip Lau of the Hong Kong Community College, The Hong Kong Polytechnic University, Hong Kong, China

Prof. Gary Stern of the Centre for Earth Observation Science, University of Manitoba, Canada

Dr. Mawuli Afenyo of Transport Institute, University of Manitoba, Canada

Ms. Ashley Gaden of the Centre for Earth Observation Science, University of Manitoba, Canada

# Acknowledgement

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Ms. Mingyan Yu for her administrative work as well as registration during the workshop.

Liquan Guo a visiting PhD student from Dalian Maritime University in China for his active role days prior to the workshop and the registration process on workshop days.

Katarzyna Polcwiartek, a PhD candidate at the CEOS for taking notes for the proceedings on the second day of the workshop.

Yufeng Li and Yile He, graduate students at the University of Manitoba for their help in taking photos and other administrative duties on the workshop days.

**Supported by:**

## Executive Summary

This report contains the proceedings of the 1st International Workshop on Climate Change Adaptation Planning for Ports, Transportation Infrastructures, and the Arctic (CCAPPTIA). The workshop was held over a 2-day period with the aim of bringing together experts on climate change, shipping, Arctic and oil spills. This is the first of such a meeting. The first day focused on issues related to climate change. The first half of the day included presentations from different participants with expertise in climate change. A question and answer section followed. The second half of the day was dedicated to more focused group discussions, with break out sessions. Groups were formed, and each group discussed the same questions. A wider discussion was then conducted when the bigger group met. Similar to the first day, the second day also witnessed a series of presentations on shipping in the Arctic and oil spills. This was a special day dedicated the GENICE project. Presentations ranged from ice behaviour to socio-economic impact of oil spills. This was followed by a breakout session. The focus was to find ways for social scientists and natural scientists to work together to achieve the goal of solving societal problems. The contents of this report therefore encompass the details of the programs, activities, discussions, recommendations, as well as the way forward.

## Background

The workshop is part of the academic activities and the initiative of Prof. Adolf K.Y. Ng, Dr. Changmin Jiang, Dr. Jason Monios, Mr. Yui-yip Lau (Joesph), Prof. Gary Stern, Ms. Ashley Gaden and Dr. Mawuli Afenyo to address climate change adaptation issues, shipping in the Arctic and oil spills. This has become necessary considering the current debate about the impact of climate change on the lives of people. The goal was to get inputs from both academia, government and industry. Further, it seeks to engineer ways for personnel from different fields to work together with the same resolve to address climate change issues and at the same time make use of the opportunities it presents.

## Objectives

This workshop brought together leading experts and stakeholders from academia, government, industry, and interest groups to lay the groundwork for the establishment of an ***international consortium on Climate Change and Adaptation Planning for Ports, Transport Infrastructures, and the Arctic (CCAPPTIA).*** The aim was to consolidate and coordinate Canadian and global research and development activities related to 1) understand the current decision-making process in climate adaptation planning; 2) identify attributes that catalyze collaboration between ports and other transport infrastructures, including those in the Arctic, in climate adaptation planning; 3) identify ways that can facilitate the transfer of adaptation strategies and solutions to regions under different geographical and cultural contexts; and 4) to assess strategy and policy implementation under the context of climate adaptation planning.

Day 1 focused on climate change adaptation planning for ports and transportation infrastructures. Day 2, in collaboration with the GENICE project, focused on the socio-economic impacts of intensified shipping in the Arctic, especially oil spills.

## Why Now?

Transport infrastructures are increasingly affected by the impacts posed by climate change. Because they are vital for trade and communications, this situation has significant implications for the local, national, and global economy and human welfare. Although many ports and transport infrastructures are now developing and implementing adaptation strategies, most are under time and financial constraints and undertake the 'go it alone' approach with very limited participation from other stakeholders. This complicates decisions about when, how and to what extent appropriate strategies and capacity investments should be committed, in order to successfully adapt to this new but highly uncertain reality. The time has come for a paradigm shift in how ports and transport infrastructures plan for and enact new strategies. In certain cases, adaptation to climate change can create opportunities to enhance well-being and regional

development, as exemplified by the possible openings of Arctic marine passages due to melting ice. However, this is possible only if effective solutions are introduced and implemented through efficient collaborative efforts from different disciplines and sectors.

## Expected Outcomes

- A scoping document for the CCAPPTIA consortium
- A 'critical review' paper in a scholarly journal
- Scholarly publications based on CCAPPTIA, preferably reflecting collaborative research between participants of the workshop.
- The groundwork for applications to the major national research grants (e.g., Social and Humanities Research Council of Canada Partnership Grant, European Commission Horizon 2020) to fund CCAPPTIA for the first five years.

## GENICE Project

GENICE is a Genome Canada $10.6M, 4-year project led by Drs. Casey Hubert (University of Calgary) and Gary Stern (University of Manitoba). Officially announced December 8, 2016 by Minister of Science Kirsty Duncan, the Large-Scale Applied Research Project will make use of the upcoming Churchill Marine Observatory and its Oil in Sea Ice Mesocosms.

For further information, visit: www.genice.ca.

## Welcome Remarks

The welcome remarks for Day 1 were delivered by Dr. Digvir Jayas, Vice-President Research and International, and Distinguished Professor, University of Manitoba. Prof. Digvir Jayas, in his address, outlined the strength of the University of Manitoba in the areas of climate change and ice. He took the opportunity to welcome participants to the 2 day workshop. On the second day, Dr. Norman Halden, Dean of the Clayton H. Riddell Faculty of Environment, Earth, and Resources and Professor gave the opening remarks. He was excited for the faculty and for that matter the university to host the maiden edition of the workshop. He also outlined some of his personal experiences in the Arctic area.

## Opening Remarks

Prof. Ng, as the main host, took the opportunity to welcome scientists, government representatives, academics and students to the workshop. He outlined the history of the workshop and how it happened. He also thanked the organizers, supporters, and all the participants who took the effort in attending the CCAPPTIA workshop. He indicated his hope for CCAPPTIA to become a consortium that would promote collaborative research on climate change adaptation planning and Arctic shipping, and that the CCAPPTIA workshop would be organized periodically.

## Presentations

The presentations for the two days are discussed in this section. These presentations mainly focussed on issues related to climate change adaptation to ports and Arctic shipping as well as oil spills. Presenters were drawn from different backgrounds and this is reflected in the topics and details of the presentations given by each presenter. The first day's program was held on Thursday, May 3, 2018, at Lecture Theatre 118, St. John's College. The theme for the first day was "Climate Adaptation Planning for Ports and Transportation Infrastructures". For the second day (Friday, May 4, 2018), the program was held at the Klaus Hochheim Theatre (Room 545 Wallace Building). The theme for discussion was the socio-economic impacts of intensified shipping in the Arctic. The next sections describe the details of discussion for each day.

**Day 1:**

The first presentation was delivered via skype by Regina Asariotis, who works at the United Nations Conference on Trade and Development, Switzerland. Her presentation was titled "Climate change impacts and adaptation for coastal transport infrastructure in the Caribbean". It was focussesd work that has been done since 2008 at UNCTAD. She gave an overview of a recently completed technical assistance project on climate change impacts and adaptation for key coastal transport infrastructure (seaports and airports) in the Caribbean. She went on to outline some of the major issues arising as well as key study findings and outputs.

The second presentation was by Adolf K.Y. Ng of the University of Manitoba. His presentation was titled "Attitude of port and transport stakeholders to climate adaptation actions". The presentation detailed the perceptions of port decision-makers on the effectiveness of climate adaptation actions. He emphasised in his presentation that port decision-makers are aware of potential climate change impacts and feel that more adaptation actions should be undertaken. He said they were however sceptical about their effectiveness and value. The presentation also showed the complexity of the problem of climate change in terms of planning the involvement of port decision-makers under the current circumstances.

The third presentation was by Austin Becker of the University of Rhode Island and titled "The leadership void for climate adaptation planning for ports". Austin's presentation explored the Port of Providence (Rhode Island) stakeholder community's perceptions around the responsibility to lead in resilience planning and systemic transformational change, specifically evaluating how differences in perceptions between stakeholders and assumed leaders may influence adaptation. His presentation highlighted the need for pre-planning dialogue to develop consensus and build momentum for resilience investment strategies.

The final presentation for the first half of the day was by Ying-En Ge, of Shanghai Maritime University, and titled "Adaptation strategies for port infrastructure and facilities under climate change: a case study". In his presentation, he underlined how a risk management matrix approach is applied to a vulnerability assessment and identification of desirable adaptation strategies. After collecting and analysing the data, adaptation strategies are identified for port

infrastructure and facilities at the port of Kaohsiung under the impact of climate change. The importance of his work as presented included the following: i) identification of ten vulnerability assessment criteria for the impact of climate change on port infrastructure and facilities, ii) ground roads and access roads in the port area, and drainage facilities in flooding-prone areas were shown to top moderate risk areas potentially impacted by typhoons, and iii) a set of adaptation strategies has been identified for the moderate risk areas impacted by serious typhoons.

The second half of the day began with a presentation by Tianni Wang of the Liverpool John Moores University. Her presentation was titled "Rail network adaptation to climate change". Her presentation encompassed the use of an advanced Fuzzy Bayesian Reasoning model for assessing the climate risks in the UK rail network. This approach, according to Tianni, helps to overcome the high uncertainty in data. A survey was conducted for the implementation of the model. The findings of the study provide rail planners with useful insights on prioritising climate hazards and selecting cost-effective climate.

Following this presentation was one from Mark Ching-Pong also of the Liverpool John Moores University. His presentation was titled "Development of Climate Change Risks Indicators (CCRIs) for seaports and airports". In his submission, Mark presented a review of literature on climate change and seaport and airport adaptation, CCRIs hierarchy development, the concept of Evidential Reasoning (ER) and its possible application to evaluate CCRIs.

The next presentation was by Jason Monios of the Kedge Business School. The title of the presentation was "Institutional challenges in climate adaptation management". His presentation explored the challenges faced in the development of informal institutions for climate change adaptation and provided policy recommendations for overcoming this institutional stalemate.

Anming Zhang of the University of British Columbia was next, and his presentation was titled "Port adaptation policies for the impact of climate change: theoretical modelling". His talk focussed on the theoretical modelling of port adaptation policies for the impact of climate change. He presented two models currently under consideration by himself and two of his students. The first model deals with disaster adaptation investments made by two landlord ports with each severing its captive market while competing for shippers in a common hinterland. One key observation from the presentation is that high expectation of the disaster occurrence probability encourages port adaptation, while high variance of the disaster occurrence probability discourages port adaptation. Also of note is the fact that a higher expectation and a larger variance of the disaster occurrence probability, and a higher inter-port competition intensity would strengthen both the competition effect and the free-riding effect. The second paper extends the first model to a dynamic setting.

Gordon Wilmsmeier of Universidad de los Andes in Columbia was the next to present and his talk addressed the topic "Ports and climate change adaptation and mitigation in Colombia". He gave an overview on the current challenges to projects and implementing the defined strategies in the areas of adaptation and mitigation.

Faisal Khan of the Memorial University of Newfoundland presented a view on conducting risk assessment in a dynamic mode in harsh environments like the Arctic. He linked the presentation to how such an approach could be used in oil spills and shipping in the Arctic.

Dr. Grace Wang, from Texas A&M University Galveston, has pointed out the similarity of the workshop to the PIANC. A forum comprised of professionals, PIANC is the world association for waterborne transport infrastructure. Working group 178 focuses on research climate change adaptation for ports. Guidance on climate change adaptation has been provided in a concise clear way by four stages such as understand the context, understand climate-related impacts, understand vulnerabilities and risks, and identify and implement measures.

The final presentation for the day was by Luming Wang of the Asper School of Business, University of Manitoba on the topic "When climate change happens in your backyard: The effects of Virtual Reality (VR) on consumer's psychological distance to climate change". Her presentation addressed the effects of VR on four theorized dimensions of psychological distance—temporal, social, geographical distance, and uncertainty—toward climate change. According to the presentation, lower psychological distance leads to higher levels of concern. The study also predicted that VR will lower psychological distance. Another key finding is that the Levels of concern is positively related to consumer's preparedness to act on climate change.

The presentations were followed by a question and answer session.

**Day 2**

The second day started with a presentation from Casey Hubert of the University of Calgary. He gave an overview of the GENICE project and the progress made so far. He also took the opportunity to describe the way forward with regards to the project.

Following Dr. Hubert's presentation was a presentation by David Barber of the University of Manitoba, on Arctic marine transportation and ice hazards. He made a case for the opportunities the ice melting has presented. This he backed by data from the past ten years or more. He also used the opportunity to present work that is ongoing in the faculty as well as some of the exciting opportunities that will be coming on board. The opportunities include hiring academic related personnel.

Changmin Jiang of the University of Manitoba gave a presentation on "Cost-effectiveness analysis of Risk Control Options for Oil Spill in Arctic Shipping". His presentation is part of the subcomponent of the GENICE project on the socio-economic impact of oil spills in the Arctic. His presentation made the case for the use of risk-based methodologies to assess the preparedness before an oil spill. He further presented the formal risk assessment framework.

Following Jiang's presentation, Mawuli Afenyo of the University of Manitoba's Transport Institute presented a socio-economic impact model of an oil spill in the Arctic. In order to demonstrate the model, he used a hypothetical case study involving shipping through Churchill.

The next step for this model according to Mawuli is to conduct a customised study by collecting data and executing the model for a particular Arctic area. Mawuli's presentation ended the mainstream talks for the first half of the day. They were followed by questions for clarification.

After the break, the Mayor of Churchill, Michael Spence, gave a presentation on the effect of climate change on the Churchill township. He further made a case for investment in the town. He showcased the infrastructure available, tourist attractions and the challenges funding is posing.

Following Mayor Mike Spence's presentation was a presentation by Paul Tae-Woo Lee of the Zhejiang University. His presentation was titled: " Impacts of China's Arctic Policy (CAP) on the East Sea Economic Rim". He gave an overview of the CAP and its possible impacts on the East Sea Economic Rim (ESER) region including China, Russia, North and South Korea and Japan. His presentation has provided useful insights on better understanding of the possible changes of port connectivity, economic and trade corridors across the associated regions due to the introduction of the CAP.

Di Zhang of the Wuhan University of Technology, China, gave a presentation on the "Research Topics on Maritime Safety in Arctic Ice-covered Waters". He also took the opportunity to present his school and their capabilities and expertise in maritime transport.

After Zhang's presentation, Ying-En Ge of the Shanghai Maritime University, presented a preliminary empirical analysis of Arctic Shipping. He presented a series of empirical analyses on the ship trajectory data recorded in 2016 in the north latitude 66.67 degrees in the Arctic, with the passage through the Pari Channel, the Dove joint Straits and the Vilkitskogo Strait. He reiterated that the essence of the analysis was to identify the types and quantities of vessels going through the Northwest Passage and the Northeast Passage. The passenger vessels were mainly assembled in the Davis Strait and Baffin Bay area. The navigable periods of the Northeast Route are May, July, August, September, October, November and December, among which the number of vessels during August, September and October are the most according to his presentation.

Finally, Steve Messner, gave a presentation on work he is currently doing, tittled: "Future Arctic shipping, black carbon emissions, and climate change". According to the presentation, increased black carbon (BC) emissions from fuel oil combustion from shipping could have a noticeable local warming effect – warming from the dual effects of BC solar radiation absorption and albedo reduction from deposition on snow and ice. However, considerable uncertainty remains on the actual impacts that could occur and what kind of policies will best address these impacts.

## Breakout sessions

### Day 1: **Climate Adaptation Planning for Ports and Transportation Infrastructures**

The break out session on day 1 was done in groups. Each group had a leader. The questions for discussion can be found in the Annex. A summary of these discussions follow in the paragraphs below. The members for the various groups included the following:

**GROUP 1:** Changmin Jiang, Faisal Khan, Tianni Wang, Zaili Yang, Stephen Cahoon, Raj Appadoo
**GROUP 2:** Joseph Lau, Gordon Wilmsmeier, Mark Ching-Pong Poo, Paul Tae-Woo Lee, Ying-En Ge, Barry Prentice

**GROUP 3:** Steve Messner, Anming Zhang, Yile He, Anh Tran, Di Zhang, Suresh Bhatt, Ge Gao

**GROUP 4:** Austin Becker, Naima Saeed, Travis Lin, Al Phillips, Grace Wang, Marta Gonzalez-Aregall, Brock Cordes

*On the question of identifying potential new research area direction and how collaboration could be fostered, the following had these suggestions*:

Cahoon suggested that since we already have a well-established engineering approach, there is need to focus on a Supply Chain Management (SCM) approach. This view was supported by Messner. Cahoon's discussion on the above subject stems from the diagram he developed shown in the appendix as climate change agenda. This diagram had very good feed back from the particpants. Due to its popularity among participants, it was suggested that, the diagram be adopted as a reflection of the workshop as it gives a snapshot of the work done in the workshop.

There is also the question of who is going to take the mantle of leadership for climate change related issues and what is going to be the incentive for this. Further, it is also important to have a scale in mind. Thus, whether we are going to be dealing with a regional issue or is it going to be global in nature. Finally, he suggested that there is an urgent need for an integrated approach. Thus, it would require that the social scientists, politicians, economists and engineers work together.

Yang, on the other hand, suggested that there is need for models developed to be guided by policy in order for the value to be appreciated. In this regard, he stressed on the need to build a connection between natural scientists and social scientists. For model creation, therefore he advised that there is need to create a framework first and then fill in data. Data may be engineering, economic and other aspects in nature. Zaili also made it very clear that different disciplines view problems as such, and therefore their corresponding solutions differ. For example, environmentalist versus engineers, or engineers versus social scientist. Because of the nature of the climate change problem, there is a need to learn from other fields and

jurisdictions. Finally, he suggested that an optimization perspective will be cost rationalisation and the incorporation of positive impact of climate change in models and policies.

Appadoo, was of the view that a meaningful index and measurement should be developed to quantify the impact of climate change. He however admitted that it would be complicated. He is also of the view that it is imperative to re-educate people about climate change. Currently, the approach that has been adopted is to scare people, thereby working on their psyche. If people get educated on the implications of climate change, they can better contribute to it.

Wang, another participant of the workshop, was of the view that the new direction for climate change research is going to be science based. He further said that public awareness is key to addressing issues related to climate change. Just like his previous colleague, he suggested that a standardised approach to measure climate change needs to be developed.

Another group of the participants including Austin Becker, Grace Wang, and Marta Gonzalez-Aregall on the above question suggested that there should be a landscape scan of shipping/port industry conferences for student project and/or publication. Such information should include the name of conference, time of year, place, key sponsors, mission statement, short and long-term objectives. Some topics to note include the following: resilience, extreme weather, adaptation, and mitigation. By doing so, researchers will have a basic understanding of what the local practitioners care about the most and where to approach them. Any collaboration or business opportunity through climate change also needed to be considered.

The following are the research areas suggested:

1) Safety and human error

2) Impacts

3) Human Resources of working conditions

4) Supply Chain Management

5) Alternative technologies

6) Business models

7)Governance

8) future port design

9) Negative impacts – Positive impacts

10) Problem – Opportunity (Paradigm shift, not business as usual)

11) Link natural and social sciences

12) Policy making, disaster management)

13) Cost-benefit analysis

14) Psychological impact on the general public

15) New development of technology and science

16) Infrastructure

17) Impacts of climate change on aviation/ air transport

18) Cruise shipping.

Overall, the group members felt that one area with significant promise that had been under-research so far was the supply chain dimension, focusing on the impact on shippers.

*On the question of how to build a successful international consortium on climate change adaptation.* The following people had the corresponding contributions.

Cahoon suggested that there should be one person from a particular field, who will be leading the group to contribute to solving climate change related issues. A working group can be formed which will encompass professionals from different disciplines. This integrated and holistic approach can be used to address the issues. Further, he believes it is important to identify all those organizations related to the issue. In terms of forming a consortium for such a purpose, a clear objective is required. He proposed a draft framework that could be used as the basis for a research agenda (see appendix). The group was in favour of using a modified form of this framework, and discussed some potential additions, e.g. outreach/education, implementation, geographical dimension, and the need to compare against other frameworks (e.g. UNCTAD, PIANC).

*On the question of potential sources of funding for the proposed consortium, types of grants available both local and international included:*

Yang was of the opinion that the European funding organisations are very keen to invest in climate change related research. Large logistics firms have also been identified as potential sources of funding. The question is how to obtain support from large logistic firms. On this issue, the second group came up with the following suggestions: i) the proposed "Consortium" needs a marketing plan to access logistics firms, ii) the proposed group would need to send academics to industry conferences (e.g. APH, PIANC), iii) create a conference that brings together firms, government, and academia, iv) conduct "industry level" research, especially surveys of industry groups (AAPA, IAPH, ASCE), v) encourage academic peer mentorship to help junior faculty meet senior faculty contacts, and vi) find an industry "champion" (e.g., shipping magnate, Richard Branson, Paul Martin, David Suzuki). Further, the group was of the view that

there is need for some form of seed money from the Associates of the Asper Institutes. The group also suggested a potential funding source could be corporate responsibility funding from large firms. Additional sources of funding could be government, shipping company and port agency.

In addition to the above, the groups came to the conclusion that a joint statement or chief statement is required so that a united front could be presented. Also, ways must be sought to deliver the outputs of such meetings to the locals, so they can feel the worth of the investment in such.

*On the question of any potential successful models to learn from? University, Corporate (e.g., Mckinsey, Boston CG, Ernst & Young, Accenture):*

The group pointed to the World Ocean Council model. This has been lauded as a very successful one.

At the end of the document, a snapshot of the discussions has been produced in the form of a diagram. As mentioned earlier this is the work of Stephen Cahoon. Readers may want to refer to this.

### Day 2: The Socio-Economic Impacts of Intensified Shipping in the Arctic

For the second day there was a round table discussion involving most of the particpants.

*On the question of how the collaboration should proceed?*

A couple of issues were further raised with respect to the question and include the following:

1) GENICE wants to deliver knowledge to the transport sector but requires equivalent knowledge in terms of what relevant problems could be solved by the GENICE group.
2) There is need to know what information and data are needed from both sides.
3) In a reversal role, there is a need to understand how the transport sector can help GENICE in achieving our research goals.
4) Participants are also of the view that there is a need to take into consideration the policy and regulations for application of dispersants and in-situ burning.
5) The group also agreed that there is need to track industrial trends in usage of different types of oil/fuels and take into consideration the possibility of the spill of different products.
6) Modeling is key to studying oil spills and this has been echoed by the group. There is a huge interest in this from the group.
7) The participants believed that there is a need to unify our understanding of policy regarding oil spill research in the Arctic.
8) Marine insurance premiums came up and the big question was, what type of data should be used?

*On the question of how mainstream scientists and social scientists can collaborate to help solve societal problems?*

The following points were raised by the group

1) The need to determine the desired type of data and the usefulness of already available data.
2) The need for thorough feedback from colleagues from different sectors.
3) The need for more effective communication between all participants.
4) The need to get relevant data from the social science side.
5) The need for a realistic and efficient plan – economic and social components are required. It is important to keep in mind that government issues will impact all of the Arctic related activities including Arctic research (governance).
6) Take into consideration the costs of these issues.
7) Prioritise research schemes.
8) The requirement of interdisciplinary approach of science and venues (conferences, workshops etc.).
10) The need for political will.
11) The need to design a strategy to sell results.
12) The need for action plan development.

*On the issue of ways to collaborate between Canadian and non-Canadian researchers:*

1. The need for international collaboration
2. To make connections between the providers and users of Arctic (in terms of logistics)
3. The need for opinions from all stakeholders e.g. in form of questionnaires
4. Considering the involvement of China (e.g., AIIB)
5. International workshops is needed to make this possible
6. Disclosure of international collaborators data (keep in mind the difficulties regarding obtaining data from countries like China, Russia)
7. Consideration of the benefits and support related to the involvement of non-Arctic countries in our research, and benefits for Northern communities
8. Non-Arctic country research: How to benefit from origin/shipping company or research collaboration

*On the question of how research can easily be made available to the public for use?*

The following ideas were put forward:

1. Action plan needed
2. Engagement of social media to get to the public
3. Creation of a mini-newsletter
4. Inviting other collaborators to the mini-newsletter

5. The need for results sharing internally on monthly basis in order to get the feedback from other specialists
6. Considering publishing a daily research report
7. Slack updating; sharing of results; creation of something like researchgate.com to get feedback and responses from other collaborators
8. Considering a collaboration with Apple
9. The need for two communication streams: one for collaborators and the other one for the public
10. Familiarity with the issues from local communities
11. General document including all the details of the project issued in several languages and widely available for Northern communities and public
12. A social media component is required in each project
13. Arctic Net model could be adopted

*On the question of considering the lack of data with regards to shipping in the Arctic, what tools are available to address this gap in transportation models?*

1. Economic viewpoint is required
2. Studying committee needs to be set up
3. A joint research agreement is required
4. Application of Shanghai Maritime University dataset
5. Questionnaire from various stakeholders

*On the question of what kind of information from the study of microorganisms and oil degradation within the Arctic is useful within the transportation and Arctic shipping field?*

The following ideas came up:

1. Are the spilled products biodegradable entirely or partially only?
2. Consider only doable ideas of research
3. The need for an idea inventory
4. The need for estimation of cost – benefit
5. Use of shipping insurance

*On the question of what about the problem of increasing black carbon emission in the Arctic? How can this be addressed moving on?*

The following was raised:

- Oil spill policy needs to be changed
- The release of greenhouse gases is very relevant to the discussion and this needs attention

- Different fuels will be used in Arctic vessels in the future. More distillates, LNG and less heavy fuel oil (HFO) will be used. Both distillate and HFO could be used, unless a ban on

HFO in the Arctic is put in effect. Better understanding of future Arctic shipping fuel is needed.

- GHG issue is a very important one. A much bigger impact than shipping GHG emissions will occur if new ports and infrastructure are developed in the Arctic. This is a much bigger GHG concern than shipping emission alone.
-

## Conclusions, Recommendations and next steps

The two day workshop presented a unique opportunity for social scientists, politicians, natural scientists, and other academics to sit down at the same table to discuss issues related to climate change and how both parties could work together. The workshop also provided an avenue for the GENICE project to be showcased and solicit ideas on the way things should be done with regards to addressing the socio-economic implication of oil spills due to intensified shipping. Further, the workshop also presented an opportunity on suggestions as to how to form a consortium to deal with the issue of climate change and how such a consortium could be funded.

The participants were of the view that climate change-related issues are very important and also need urgent attention. It is also important to present both the benefits and the negative consequences of climate change. There are a lot of funding organisations that are very much interested in financing climate change related work. These organisations include both private, public and international entities. The need for social scientists and natural scientists to work together has never been more critical than now. The workshop showed that it is extremely difficult for these two groups to work together. This is mainly due to different perspectives about the same problem.

In moving forward, the group decided on the following: i) establish a consortium, ii) reach out to funding organisations, iii) encourage natural scientists and social scientists to work together, and iv) encourage similar meetings like CCAPPTIA. It has been suggested that other organisers outside Canada take the mantle for the organisation of the next workshop. France and China have been suggested as the next potential places to host the next program. Also, it is projected the program will be developed into an annual conference. This means the reach of the workshop should be extended.

# Annexures

## Program for Day 1 (Thursday, May 3, 2018, Venue: Lecture Theatre 118, St. John's College): Climate Adaptation Planning for Ports and Transportation Infrastructures

07:45-08:30 Registrations

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08:30-08:40 Welcome Remarks (Dr. Digvir Jayas, Vice-President Research and International and Distinguished Professor, University of Manitoba, Canada)

08:40-08:45 Photo-taking

08:45-08:55 Presentation *(Attitude of port and transport stakeholders to climate adaptation actions, by Adolf K.Y. Ng, University of Manitoba, Canada)*

08:55-09:05 Presentation *(The leadership void for climate adaptation planning for ports, by Austin Becker, University of Rhode Island, USA)*

09:05-09:15 Presentation *(Adaptation strategies for port infrastructure and facilities under climate change: a case study, by Ying-en Ge, Shanghai Maritime University, China)*

09:15-09:25 Presentation *(Climate change impacts and adaptation for coastal transport infrastructure in the Caribbean, by Regina Asariotis, United Nations Conference on Trade and Development, Switzerland)*

09:25-09:40 Q&A

09:40-10:10 *Networking Break*

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10:10-10:20 Presentation *(Sustainable road systems for remote access and remote access solutions for current conditions under climate change, by Daniel Blizzard, D. Blizzard Services Integrés Inc., Canada)*

10:20-10:30 Presentation *(Rail network adaptation to climate change, by Tianni Wang, Liverpool John Moores University, UK)*

10:30-10:40 Presentation *(Development of Climate Change Risks Indicators (CCRIs) for seaports and airports, by Mark* Ching-Pong Poo*, Liverpool John Moores University, UK)*

10:40-10:50 Presentation *(Institutional challenges in climate adaptation management, by Jason Monios, Kedge Business School, France)*

10:50-11:00 Presentation *(Port adaptation policies for the impact of climate change: theoretical modelling, by Anming Zhang, University of British Columbia, Canada)*

11:00-11:10 Presentation *(Ports and Climate Change adaptation and mitigation in Colombia, by Gordon Wilmsmeier, Universidad de los Andes)*

11:10-11:20 Presentation *(Dynamic risk management of oil spills in harsh marine environment, by Faisal Khan, Memorial University of Newfoundland, Canada)*

11:20-11:30 Presentation *(A presentation on PIANC, by Grace Wang, Texas A &M University at Galveston, USA)*

11:30-11:40 Presentation *(When climate change happens in your backyard: The effects of VR on consumer's psychological distance to climate change* by *Luming Wang, Asper School of Business, University of Manitoba, Canada)*

11:40-12:00 Q&A

12:00-13: 00 *Lunch (St. John's College, Room 108)*

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13:00-14:30 Breakout Sessions *(Rooms 114, 118, 125, and 129, St. John's College)*

14:30-15:00 *Networking Break*

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15:00-16:30 Group Reporting and Brainstorming Session *(Room 118, St. John's College, chaired by Jason Monios)*

16:30-16:45 Wrap-Up for Day 1

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16:45-18:00 *(Free time)*

18:00-21:00 Dinner

## Program for Day 2 (Friday, May 4, 2018, Venue: Klaus Hochheim Theatre (Room 545 Wallace Building), 125 Dysart Road): The Socio-Economic Impacts of Intensified Shipping in the Arctic

*08:30-09:00 Registrations*

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*09:00-09:10 Welcome Remarks (Dr. Norman Halden, Dean, Clayton H. Riddell Faculty of Environment, Earth, and Resources and Professor).*

*09:10-09:15 Photo-taking*

*0 9:15-09:30 Presentation (GENICE overview, by Casey Hubert, University of Calgary, Canada)*

*09:30-09:45 Presentation (Environmental sampling and experimental design, by Gary Stern, University of Manitoba, Canada)*

*09:45-10:05 Presentation (Arctic marine transportation and ice hazards, by David Barber, University of Manitoba, Canada)*

*10:05-10:20 Presentation (Cost-effectiveness analysis of Risk Control Options for Oil Spill in Arctic Shipping, by Changmin Jiang, University of Manitoba, Canada)*

*10:20-10:35 Presentation (Towards a socio-economic impact model of oil spill during Arctic Shipping, by Mawuli Afenyo, University of Manitoba, Canada)*

*10:35-11:05 Q&A*

*11:05-11:30 Networking Break*

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*11:30-11:40 Presentation (TBA, Mayor Michael Spence, Town of Churchill, Canada)*

*11:40-11:50 Presentation (Impacts of China's Arctic policy on the East Sea Economic Rim, Paul Tae-Woo Lee, Zhejiang University, China)*

*11:50-12:00 Presentation (Research Topics on Maritime Safety in Arctic Ice-covered Waters, by Di Zhang, Wuhan University of Technology, China)*

*12:00-12:10 Presentation (Preliminary empirical analysis of Arctic Shipping, by Ying-en Ge, Shanghai Maritime University, China)*

*12:10-12:20 Presentation (Effect of Black carbon emission in the Arctic, by Steve Messner, e360, USA)*

*12:20-12:45 Q&A*

*12:45-14:00 Lunch (Galleria, St. John's College)*

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*14:00-16:00 Brainstorming Session (Room 114, St. John's College, chaired by Changmin Jiang)*

*16:00-16:15 Wrap-Up for Day 2 and the Workshop*

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*16:15-18:30 (Free time)*

*18:30-21:30 Dinner*

## Questions for discussions during the Breakout and Brainstorming Sessions in Day 1:

- Potential new research area direction and collaboration
- Suggestion on how to build a successful international consortium on climate change adaptation
- Objective of consortium
- Potential sources of funding for the proposed consortium, types of grants available both local and international
- How to obtain support from large logistic firms
- Any potential successful models to learn from? University, Corporate (e.g., Mckinsey, Boston CG, Ernst & Young, Accenture)

## Questions for discussions during the Brainstorming Session in Day 2:

- How should the collaboration proceed?
- How main stream scientists and social scientists can collaborate to help solve societal problems?
- Ways to collaborate between Canadian and non-Canadian researchers
- How research can easily be made available to the public for use
- Considering the lack of data with regards to shipping in the Arctic, what tools are available to address this gap in transportation models?
- What kind of information from the study of the microorganisms and oil degradation within the Arctic is useful within the transportation and Arctic shipping field?
- What about the problem of increased black carbon emissions in the Arctic. How can this be addressed moving on?

## TITTLES AND ABSTRACTS

### Port Decision-Maker Perceptions on the Effectiveness of Climate Adaptation Actions

By: Adolf K.Y. Ng

**Abstract:** The study explores the perceptions of port decision-makers on the effectiveness of climate adaptation actions. The findings suggest that while port decision-makers are aware of potential climate change impacts and feel that more adaptation actions should be undertaken, they are sceptical about their effectiveness and value. This is complemented by a regional analysis on the results, suggesting that more tailor-made adaptation measures suited to local circumstances should be developed. It illustrates the complexity of climate adaptation planning and of involving port decision-makers under the current planning paradigm.

### The Leadership Void for Climate Adaptation Planning for Ports

By: Austin Becker

**Abstract:** This research explores the Port of Providence (RI) stakeholder community's perceptions around the responsibility to lead in resilience planning and systemic transformational change, specifically evaluating how differences in perceptions between stakeholders and assumed leaders may influence adaptation. Here, stakeholder perceptions of adaptation leadership contribute to an institutional void, in which it is unclear who is responsible and who should pay for resilience investment. This research emphasizes the need for pre-planning dialogue to develop consensus and build momentum for resilience investment strategies.

### Climate Change Impacts and Adaptation for Coastal Transport Infrastructure in the Caribbean

By: Regina Asariotis

**Abstract:** Drawing on earlier related work, since 2008, UNCTAD has recently completed a technical assistance project on climate change impacts and adaptation for key coastal transport infrastructure (seaports and airports) in the Caribbean. Key issues arising as well as key study findings and outputs will be presented.

### Adaptation Strategies for Port Infrastructure and Facilities under Climate Change: A Case Study

By: Ying-en Ge

**Abstract:** The paper aims to apply a risk management matrix approach to vulnerability assessment and identification of desirable adaptation strategies. The data for this investigation is first collected by means of questionnaire survey of experts at shipping companies and port management offices in the port of Kaohsiung. Then, a vulnerability analysis of port infrastructure and facilities under the impact of severe typhoons are carried out. Subsequently, adaptation strategies are identified for port infrastructure and facilities at the port of Kaohsiung under the impact of climate change. One intellectual merit of this paper is that ten vulnerability assessment criteria for the impact of climate change on port infrastructure and facilities are proposed. Second, ground roads and access roads in the port area, and drainage facilities in flooding-prone areas are shown to top moderate risk areas potentially impacted by typhoons. The third merit is that a set of adaptation strategies has been identified for the moderate risk areas impacted by serious typhoon. The most favorable strategies include regular inspection and maintenance of road pressure and drainage power, pavement rising and improvement in drainage capacity in flooding-prone areas.

## Rail Network Adaptation to Climate Change: A UK Case

By: Tianni Wang

**Abstract:** This presentation aims to analyse the impacts of climate change to rail infrastructure in the UK and evaluate the corresponding adaptation plans. An advanced Fuzzy Bayesian Reasoning model is first employed to assess the climate risks in the UK rail network, which overcomes the high uncertainty in data. To examine its feasibility, a national wide survey was conducted among rail stakeholders in 2017. Evidential Reasoning approach is then applied to select the best adaptation measures by considering the risks and adaptation costs. The findings provide rail planners with useful insights on prioritising climate hazards and selecting cost-effective climate adaptation measures.

## Development of Climate Change Risks Indicators (CCRIs) for Seaports and Airports

By: Mark Ching-Pong Poo

**Abstract:** Over the past few years, the focus on climate change study has switched from just mitigation to both mitigation and adaptation. The global warming is unstoppable, and it brings extreme weathers. The accidents and failures become more frequent than the previous years. As it is challenging to compare different infrastructure situations, a tailor-made climate impact assessment for seaports and airports is therefore needed. CCRIs, including the risks from various extreme weather events and the reduction in connectivity to the other transport infrastructure, are required to be made for establishing a platform to compare the needs of adaptive actions. The presentation includes four parts: Literature summary of climate change and seaport and airport adaptation, CCRIs hierarchy development, the concept of Evidential Reasoning (ER) and its possible application to evaluate CCRIs.

## Institutional Challenges in Climate Adaptation Management: Insights from a Major Canadian Port

By: Jason Monios

**Abstract:** In cases where traditional transport and infrastructure governance structures face difficulties addressing an unprecedented challenge like climate change, informal organisations arise to fill the gap. However, they face many challenges coordinating different stakeholders and obtaining a legitimate mandate for action. This paper explores the challenges faced in the development of informal institutions for climate change adaptation and provides policy recommendations for overcoming this institutional stalemate.

## Port Adaptation Policies for the Impact of Climate Change: Theoretical Modelling

By: Zhang Anming

**Abstract:** This talk will focus on the theoretical modelling of port adaptation policies for the impact of climate change. In particular, it consists of two interrelated models of investigation that are conducted by the presenter and his coauthors. The first model deals with disaster adaptation investments made by two landlord ports with each severing its captive market while competing for shippers in a common hinterland. Each port consists of a port authority and a terminal operator. The probability of a natural disaster, which is related to climate change, is ambiguous at the start of an adaptation investment ("Knightian uncertainty") but will be known after the investment. We examine the impacts of such Knightian uncertainty, inter-port and intra-port competition and cooperation on the port adaptation investments. We find that high expectation of the disaster occurrence probability encourages port adaptation, while high variance of the disaster occurrence probability discourages port adaptation. Furthermore, inter-port competition results in more adaptation investments (the "competition effect"), whereas within a port there is free riding on adaptation between the port authority and the terminal operator (the "free-riding effect"). A higher expectation and a larger variance of the disaster occurrence probability, and a higher inter-port competition intensity would strengthen both the competition effect and the free-riding effect. The second paper extends the first model to a dynamic setting.

## Ports and Climate Change Adaptation and Mitigation in Colombia

By: Gordon Wilmsmeier

**Abstract:** Colombia´s Pacific and Caribbean coastal regions will be exposed to climate change in various ways. The country has been preparing a national climate change plan for ports to respond to these challenges. The presentation will give an overview on the current challenges and projects to implementing the defined strategies in the areas of adaptation and mitigation.

## Dynamic Risk Management of Oil Spills in Harsh Marine Environments

By: Faisal Khan

**Abstract:** Arctic offshore region holds a considerable proportion of undiscovered oil and gas reserves. This is attracting exploration and marine transportation activities which in consequence has increased the possibility of an oil spill. A comprehensive risk assessment based on dynamic risk assessment (DRA) method is required during the planning and operation stages of Arctic development including transportation. The DRA method considers uncertainties as well as the dependencies of processes involved in the accident, release, weathering and transport, impact and response. The core of the DRA method is the stochastic fate and transport of spilled oil in ice-infested regions. Level IV fugacity models are simpler yet useful models to estimate the time-variable concentration of oil. The Bayesian approach provides an effective mechanism to calculate the probability of exposure and impact. It also provides a robust tool to monitor and manage uncertainty in the risk assessment model. This presentation illustrates the dynamic risk assessment approach and its use in the oil spill modelling and management.

## When climate change happens in your backyard: The effects of VR on consumer's psychological distance to climate change

By: Luming Wang

**Abstract**: Our research examines the effects of VR on four theorized dimensions of psychological distance—temporal, social, geographical distance, and uncertainty— toward climate change. Lower psychological distance leads to higher levels of concern, and we predict VR will lower psychological distance. Levels of concern is positively related to consumer's preparedness to act on climate change.

## GENICE Overview

By: Casey Hubert

**Abstract:** The presentation provides an overview and progress of the GENICE project.

## Arctic Marine Transportation and Ice Hazards

By: David Barber

## Cost-effectiveness analysis of Risk Control Options for Oil Spill in Arctic Shipping

By Changmin Jiang

**Abstract:** For maritime safety management, key elements of formal safety assessment (FSA) are risk analysis, risk assessment and risk management. The latter can encapsulate regulatory measures to control and reduce the risks defined in MTS through the risk control options (RCOs). However, due to the inherent feature of risk analysis, namely uncertainty, the effectiveness of the RCOs that are defined in light of existing background knowledge for a given system can vary

significantly in real life conditions. Therefore, this study aims to develop a systematic framework for decision-making of RCOs for risk associated with oil spill in Arctic shipping, on the basis of the first two steps of FSA - hazard identification and risk analysis. The framework includes four steps: 1) investigation of risk control measures (RCMs) for the undesired event in ship navigation, 2) cost analysis of the proposed RCMs, 3) effectiveness analysis of the RCMs for reducing the risks of the undesired events, 4) multi-criteria-decision-making (MCDM) analysis of RCMs and making optional RCOs for the undesired events. Bayesian networks will be used to develop an RCOs-based risk model for the oil spill in Arctic shipping. Fuzzy sets will be incorporated into the proposed BN model to handle epistemic uncertainty involved in conditional probability tables. The results will be expected to define RCOs that enable optimal risk mitigation and improving the safety of Arctic shipping.

## Towards a Socio-Economic Impact Model for Oil Spill during Shipping in the Arctic

By: Mawuli Afenyo

**Abstract:** The Arctic is experiencing unprecedented rate of ice melt, paving way for increased activities of shipping and natural resource exploration. It contains sizable amounts of oil and gas reserves and has the potential to facilitate transport of goods in cost effective and timely manner. These advantages come with it the risk of spill from oil and gas exploration and Arctic going ships. An oil spill has social, economic and environmental consequences on the Arctic marine species as well as the populace. There is therefore need to understand and estimate the impacts associated with a potential oil spill. The Arctic is however, a complex terrain with the presence of ice, limited data, limited knowledge, regulatory restrictions, and lack of infrastructure for a potential oil spill response. This study presents a Bayesian based model for capturing the socio-economic impact of a potential oil spill from Arctic shipping. The model is illustrated using a hypothetical case. The model is particularly important for decision making, risk assessment, and understanding the processes and factors contributing to the impact of an oil spill during shipping in the Arctic.

## (TBA)

By: Michael Spence

## Impacts of China's Artic Policy on the East Sea Economic Rim

By: Paul Tae-Woo Lee

**Abstract:** The Chinese government has incorporated the Belt and Road Initiative (BRI) into the 13$^{th}$ Five-Year Plan (2016-2020) as an enabler of China's regional economic development. In January 2018, the Chinese government declared the 'China's Arctic Policy' (CAP), which means the third Silk Road as an extension of the BRI to the Arctic shipping routes (ASRs) linking China and other regions such as EU. China's interest in developing the ASRs arises from its desire to establish comprehensive the Belt and Road, including "three Silk Roads" referring to the joint promotion of land, sea, and the Arctic. It is now considered as a new concept of "the BRI 2.0". Tanker and bulk cargo flows may be activated by the ASRs and thus a new prominent ice road

may emerge from global economy, trade and environment interactions. This paper aims to overview the CAP and its possible impacts on the East Sea Economic Rim (ESER) region including China, Russia, North and South Korea and Japan. By using the data-driven technology, the connectivity through ASRs among the ESER and between the ESER and the world is visualized. The findings in the paper will provide useful insights on better understanding of the possible changes of port connectivity and economic and trade corridors across the associated regions due to the introduction of the CAP.

## Research Topics on Maritime Safety in Arctic Ice-covered Waters

By: Di Zhang

**Abstract:** With supports from H2020 and NSFC projects, typical navigational risks in Arctic ice-covered waters such as ship stuck in ice and collision accidents have been identified and estimated. Followed by some case studies carried out in recent years, this presentation will also address future directions for Arctic shipping safety research.

## Preliminary Empirical Analysis of Arctic Shipping

By: Ying-en Ge

**Abstract:** We carried out a series of empirical analysis on the ship trajectory data recorded in 2016 in the north latitude 66.67 degrees in the Arctic, with the passage through the Pari Channel, the Dove joint Straits and the Vilkitskogo Strait. The emphasis of this analysis is first the types and quantities of vessels going through the Northwest Passage and the Northeast Passage. It is found that 16 vessels passed the Northwest Passage and 120 vessels used the Northeast Passage. The navigable periods of the Northwest Route are between July and September in a year, and the number of ships passed in August is generally the largest among the three months. Among these vessels are mainly cargo vessels and passenger ones and only one oil tanker is found in this dataset. Second, it is found that one passenger vessel went through the Pari channel, and the other ships pass through the Dove joint Straits. The passenger vessels mainly assemble in the Davis Strait and Baffin Bay area. The navigable periods of the Northeast Route are May, July, August, September, October, November and December, among which the number of vessels during August, September and October are the most. Among these vessels are mainly cargo vessels and oil tankers, which are 67 and 15 vessels, respectively.

## Future Arctic Shipping, Black Carbon Emissions, and Climate Change

By: Steve Messner

**Abstract:** Additional environmental impacts from increased shipping through the Arctic occur from black carbon emissions from fuel oil combustion. In addition to impacts on local health from haze, several research efforts have indicated that increased black carbon (BC) emissions from fuel oil combustion from shipping could have a noticeable local warming effect – warming from the dual effects of BC solar radiation absorption and albedo reduction from deposition on

snow and ice. Considerable uncertainty remains on the actual impacts that could occur and what kind of policies will best address these impacts.

# List of Participants

| **Name** |
|---|
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| Aprami Jaggi (University of Calgary) |
| Ashley Gaden (University of Manitoba) |
| Austin Becker (University of Rhode Island) |
| Brian Lanoil (University of Alberta) |
| Casey Hubert (University of Calgary) |
| Changmin Jiang (University of Manitoba) |
| Charles Greer (National Research Council) |
| Daniel Blizzard (Blizzard integrated) |
| David Barber (University of Manitoba) |
| Denise Whynot (University of Manitoba) |
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| Diana Saltymakova (University of Manitoba) |
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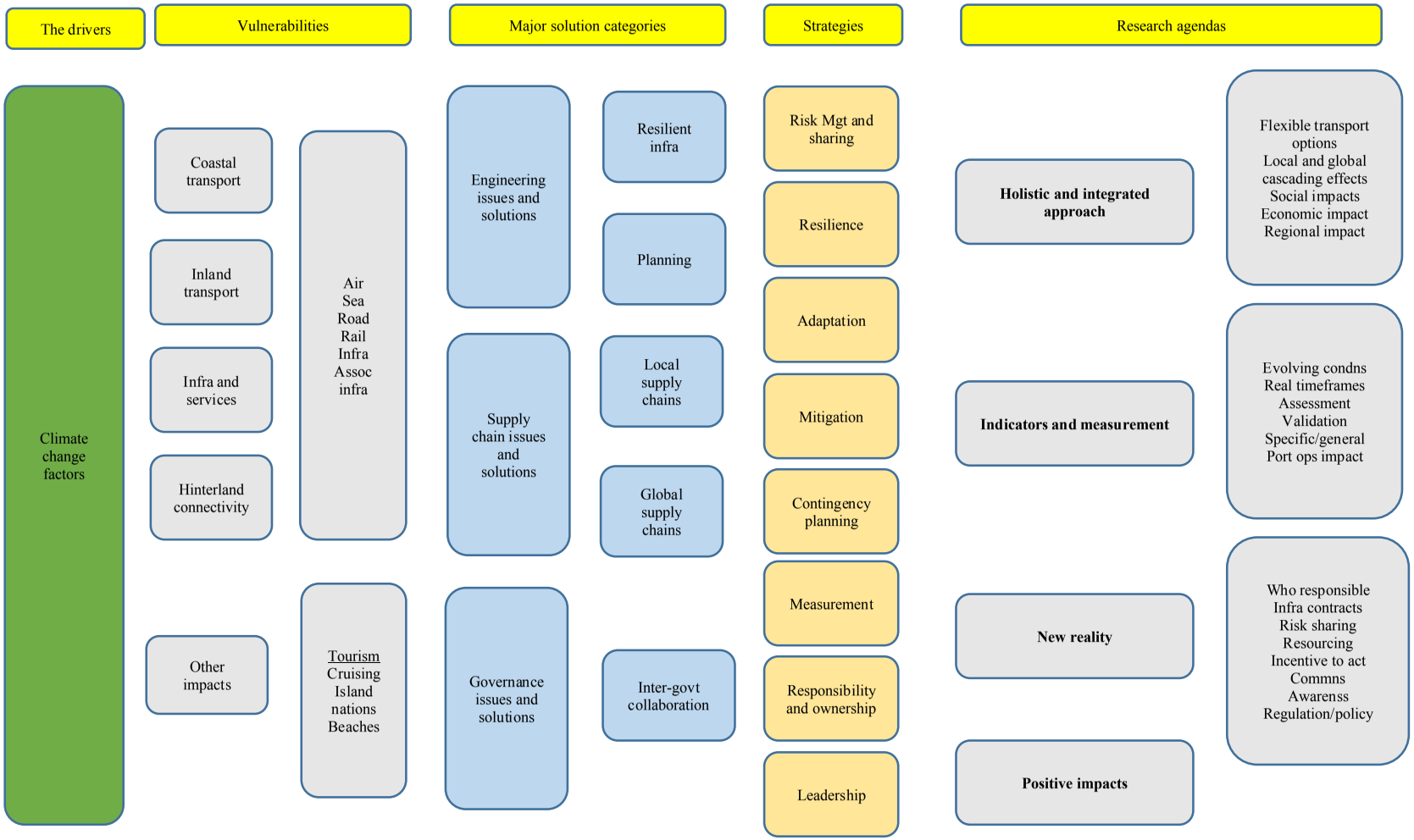
## Diagram depicting a reflection of the workshop (Climate change agenda)[1]




Credit: Stephen Cahoon of the Sense-T, University of Tasmania, Australia