Parallel theme A: International Research Infrastructures, the way forward

Parallel theme B: Practical steps toward effective Global Research Infrastructure (GRI) governance

Parallel theme C: Impact (socio-economic and beyond) of RIs

Parallel theme D: Enabling collaboration between academic and public sector research

Moderator:
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Panellists:
Frédéric Sgard, Project Administrator, OECD Global Science Forum
Dr. Heidi Bandulet, Senior Programs Officer, Canada Foundation for Innovation (CFI)
Matthew Hawkins, Head, Large Facilities Office, U.S. National Science Foundation
Daan du Toit, Deputy Director-General, International Cooperation and Resources, South African Department of Science and Innovation (DSI)
Martha Crago, Vice-Principal, Research and Innovation, McGill University

Moderator: Good morning, everybody. It's my pleasure to welcome you to the parallel theme summary session. We have a number of very interesting speakers with us today who are going to be summarizing the discussions that occurred in the different themes.

My name is Michael O'Neill. I'm the director of policy and strategic engagement at the Canada Foundation for Innovation and I'm going to be the moderator for this session.

Our speakers today are summarizing theme A, which was on international resource infrastructure as the way forward. We have Frédéric Sgard, who is the project administrator with the OECD's Global Science Forum; and we have my colleague, Heidi Bandulet, who is the senior programs officer here at CFI but she is also an important contributor the Global Science Forum.

After Heidi and Frédéric, we will be hearing from Matt Hawkins, who is the head of the U.S. National Science Foundation's Large Facilities Office. He's going to be representing theme B, which focused on practical steps towards effective global research infrastructure governance.

Following Matt's presentation, we will hear from Daan du Toit, who is the deputy director-general of International Cooperation and Resources of the South African Department of Science and Innovation. He's going to be summarizing panel C, which was on the impact of research infrastructures and their contribution to societal welfare.

And we're going to close with Martha Crago, who is the Vice-Principal of Research and Innovation at McGill University, who will be summarizing Panel D, which was on enabling collaboration between academic and public sector research.

What we're going to do is we're going to hear from each of our speakers in order of panel, so starting with theme A and ending with theme B. After a short summary from each of our panelists, we will have a very short discussion among the panelists on some of the themes that they've heard and we will follow that with a Q&A session, which I invite you now to start thinking about some questions as you hear from our speakers that you can communicate to me via chat so that we ensure that there's an opportunity for feedback and exchange in this panel.

Without further ado, I'm going to take a step back and I'm going to invite Frédéric and Heidi to begin the discussion by summarizing theme A.

Thank you.

Dr. Heidi Bandulet: Hello, everyone. I'm really delighted to be here this morning. Like Michael said, I'm Heidi Bandulet from the CFI, just a few words on the overall theme to start.

We were interested in understanding the changes in the global context and the dynamics of international research infrastructure stakeholders, so mainly their diversity and their interconnectedness. So changes would certainly have manifested more clearly in light of the pandemic and discussed throughout this conference and we wanted to see what their implications were for international infrastructures going forward. Therefore, we wanted to discuss with a range of stakeholders, namely a variety of global infrastructures from the very large to the small infrastructures, single-sided infrastructures and distributed. So how we can adapt and evolve our models to reflect that new reality? Government structures, partnerships, financing, and the role of data management and policy so that research infrastructures meet the needs of the whole of society both locally and globally.

Session A was exploring how different infrastructures are impacted by changes and approaches to data management of increasingly large and sometimes sensitive datasets and how they can capitalize on these changes.

Here's a slide representing the case studies and the panel members, I won't get into that for the sake of time. We did have a very productive discussion so it's quite difficult to condense the messages in a few bullets. So for those panelists listening, please forgive me if I have skipped some really important bits. Time does not allow me to develop all of these points, but I welcome you to get back to any of those.

For data, I wanted to start with a short and amusing analogy our moderator initiated and to which the panel contributed of what the future holds in terms of data.

The promised data revolution is like a high-speed train set in motion by researchers and the world, meaning the public is onboard for the ride. So the train is progressing on track, that's the good news to a yet uncertain destination but all are in agreement that this destination is international and global. And the next generation is not only onboard but is driving the train, and COVID certainly accelerated that train. Meaning that the acceleration of discovery and application that will be made possible by our gold mine of data, will only be fully realized by the next generation of young researchers who being born into it, will be the ones to unleash that full power.

Issues that were discussed: equity and inclusiveness, of course, is very important; discussing barriers to availability of data; to emerging nations; to exploit the wealth of that data. Many countries do not have the basic infrastructure in data connection. Secondly, you need digital training. So you need investment in those capabilities. Making data fair, findable, accessible and interoperable and reusable and across borders. And then of course, a lot of discussion about data sharing and open data. But one important message was that there is a shift from the way we think about data. Instead of sharing data, we should think about sharing of access to data and that really touches on the topic of solving the risk-reward tension from open access to a controlled access. One way to circumvent the problem of these issues of privacy of data control, sensitive data, is to actually circumvent it all together. So we should manage sharing the access rather than the data itself.

Frédéric, I think I will leave you to A2.

Frédéric Sgard: Thanks a lot, Heidi.

The second session from this theme was about financing international research infrastructures. Obviously, this is a very sensitive issue not only because the infrastructure are increasingly costly, they bring together a diversity of partners. So the financing management, the funding management of international research infrastructure is a complex issue. We had excellent case studies, they are still online. I really invite everybody who had not the opportunity to attend these parallel sessions to look at all the case studies. They are extremely informative and they are still online. They are fairly short, very interesting. We had a great group of speakers for this A2 parallel session coming from mostly physical infrastructure but with a diversity of topics and diversity of challenges, quite different challenges regarding the funding.

One key element, obviously, is that long-term strategies are very important. Research infrastructure, particularly the international one, they are built for a very long period of time. So you have to develop a funding model which has to take into account this long period of time and it's much easier to develop these long-term funding models if you have long-term consensus strategy as you have seen, for instance, with S3 in Europe or with the decadal survey for astronomy in the U.S. It does help actually, bringing together all the funders on an agreement on the priorities.

The initial phase of any international project is always a challenging element because you have to build a port for your funders. You have a lot of actors, you have a lot of countries and in each country quite often, you have different funders playing. Here, people agree that we need better models to involve the different funders at the beginning. Right now, the scientists who are involved in initiating and seeding the project, they have to ring all the bells trying to sell their project to so many partners and this is an issue quite often, it increases delays in realizing the research infrastructure.

I think a concentration among all the players, societal benefits is increasingly important for infrastructure and that needs to be integrated into the business case as early as possible; it adds a value of infrastructure. Again, because they are long-term projects, business cases need to evolve over time and sometimes it's an issue because funding partners, they are happy with the business as usual. They know what the infrastructure is providing to their community, etc., and they don't necessarily like new things which may be risky. And there is a need for a better risk tolerance culture and flexibility among the stakeholders so that you can adapt to new priorities and opportunities.

A clear element was in-kind contribution. I think everybody agrees that it plays a critical role for most international projects. It's much easier to manage everybody. Everybody finds sort of a return for its own country or it's a return for its own institution. But on the other hand, it has a number of challenges and people agreed that having some funding cash in cash, in reserve would really be useful because it provides some flexibility to adapt to contingencies and this was a strong message. You have to be able to adapt during the construction phase, during the operation phase and for that, having some cash available is really useful.

And finally, an element which is a more political element, which is it's easier to approach international collaboration if you have a portfolio approach, meaning a strategy where you just don't look at who is getting what from one project but you look at the whole portfolio project and then you can distribute leadership. You can say okay, maybe on that project, I will heave the leadership, more involvement and more cash, more return, but then I will share that with maybe less involvement in another one, the bonding for this other project because I can spread both the risk and the reward over a group of research infrastructures.

Now going to A3, this was probably the parallel session which was most attended. It was about stakeholder expectations. Again, because of the complexity and the diversity of stakeholders in international infrastructure, the challenge here is how do you mange stakeholder expectations which may be different within the same infrastructure. Again, we had very interesting case studies ranging from a traditional mostly national infrastructure from Spring Gate to much a more diverse international infrastructure in Africa or in Europe, a good range of projects presented by our speakers on the panel.

The first element that emerged from that discussion, there is an overall trend of more expectations from stakeholders. Stakeholders expect more than just producing knowledge. It has been reinforced by the COVID crisis and research infrastructures are really seen as catalysts for scientific response. There is also this increasing diversity of stakeholders, including from civil society and that's probably new because citizens themselves now produce data for research infrastructure. We had a very good example from biodiversity but also in Arctic research with local communities both providing data and being interested in using the data. The question here is: How do you facilitate the access of research infrastructure data? So the access model must be redesigned for non-experts. There is also a need for

inclusiveness in the governance structures itself because you have different stakeholders and everybody must have a seat at the table. It's derived from the previous point, you have to take into account the new diversity of users and research infrastructure must produce a return for all the stakeholders and there are different ways to develop governance structures that are not just based on who pays the most decides all. Everybody needs to have a voice at the table and for that. A different type of membership can be developed.

Then, very interesting messages which really were developed and stemmed from the COVID crisis, is that networks of research infrastructures facilitate a better response to various demands. I think people realize that it can be difficult for a single infrastructure to provide responses to complex challenges. They are much better equipped if they are networked, but it does require an integrative process and that requires resources. I think that was also a main message from the COVID crisis, proving that transformation of knowledge into practical use could be carried out faster but this capacity must be nurtured in between crisis, not during the crisis.

Thank you.

Dr. Heidi Bandulet: Session 4 was in a way, a conclusion on the way forward for this whole parallel session and the goal was to look at new models of partnerships of international infrastructure that take into account this diversity with different expectations. In particular, we were looking at mainly at governance models and ways to manage and organize these partnerships and the best ways to bring people together and also, of course, examining the COVID crisis which was in many ways a catalyst for new ways of partnering.

Basically, I think one very simple message that boiled on at the end, finding the right structure for the partnership starts with the initial vision. So many explained that once they had their vision in place and determined what their goals were for the partnership, it is only then that they started to explore and compare different types of governance models. So basically start looking beyond the structures and resources that are available to start from a basis of establishing meaning. You want to determine what your partnership wants to look like and its aims before you start the process and of course, there's no one-size-fits-all approach to governance structures. Each has pros and cons and its own set of challenges and it can evolve over time so a lot of discussion was spent on those pros and cons.

Clearly, like Frédéric said, there's a need to integrate broader stakeholders beyond the traditional scientific communities and funders. We had several good examples of this that we could discussion in the question period. But one common message, too, was that it was essential to develop several modes of participation embedded in the structure, to allow an access of a variety of partners based on their different needs and different levels of contribution and embed that flexibility for change in status with time. That's a way to engage emerging countries. It was seen as an essential route for any governance structures to have these multiple entry points. I think going into a more strategic aspect, and I think that touches upon what Frédéric just said, that we should maybe start going over a partnership centred on a single large research infrastructure, for example, and build a wider agreement around that, a broader collaborative agreement. Focus on training and skills and technology sharing that goes way beyond that infrastructure and that could evolve also to include multiple research infrastructures so that we start looking at the big picture of the portfolio and being able to capitalize on complementary strength to really maximize the impact and value of our infrastructure given all the pressures on each nation's budget. And perhaps even going further, seeing the world as a complex ecosystem of research infrastructure.

But I think our time is really up, so I'm glad to answer question on any of those points.

Thank you.

Moderator: Merci, Heidi and Frédéric.

We're now going to hear from Matt Hawkins, who will be presenting on the findings from theme B.

Matt Hawkins: Thank you, Michael.

Good day, everybody. As Michael said, my name is Matthew Hawkins and I am head of large facilities office at the National Science Foundation and it's a real pleasure to be with you here today to summarize the outcomes of theme B, where we talked about practical steps towards effective GRI governance. And I'm not only speaking for myself, obviously, I'm speaking for my co-leads from Germany and France: Andrea Fischer and Nicolas Dromel. So I want to thank them also as well for all of their hard work and all of their inputs, as well as all of the participants in theme B.

To give you the overview, as both Heidi and Frédéric mentioned in theme A, governance is extremely for the effectiveness of a GRI, its resilience to crisis like the global pandemic and also to its long-term sustainability. So what you'll hear, I think, in the outcomes from theme B are a lot of parallels to what you heard Heidi and Frédéric talking about, it'll reinforce a lot of the topics that were just discussed. We sort of got more into the nitty-gritty, more into the nuts and bolts of governance than theme A did and we sort of drilled down into three topics of the importance of GRI governance, a bit of the theoretical background where we had details on organizational structure and the legal frameworks that backed them up. And then we had an interactive session in a world café setting, where we actually worked with participants and talked about details of creating and implementing the right governance model. And B4 was a summary session and we actually conducted a couple of polls and I think you'll find the outputs from those polls interesting as well.

We found it really important ahead of the session to provide some reference materials and so this theme is obviously building on a whole body of knowledge so we thought it important to share the OECD and GSF reports that previously addressed governance so we provided all of those links to our participants. We also provided the latest text from the Group of Senior Officials (GSO) Framework Criterion 2 which references partnership management. And we also put together a rather extensive matrix showing a whole list of GRIs and listing them in order of formality in their governance from most formal to least formal and a number of columns that showed all of the legal frameworks that are used in those particular infrastructures. So we hope those were useful reference materials for everybody that participated and to those who may want to look at the ICRI material following the program.

I wanted to put up on the screen here one of those reference materials. This is directly from the Group of Senior Officials Framework which you can find online. And I highlighted a couple of key words here that I think you'll hear often that it's important in these governance structures that roles and responsibilities are clear for all of the partners involved. I believe as Heidi mentioned, that governance framework needs to be set up such that it can evolve over time. And one thing that was consistent across all of the governance models we looked at is these independent scientific oversight bodies to help us steer the direction of the GRI. There's good alignment with most of the facilities that we looked at with this GSO framework of good practice criterion, too.

So now the individual sessions, for session B1, we talked about the importance of the governance model and several key takeaways here for folks to look at. And the general consensus was that despite all the complexities, the more members that a GRI had, that were seen as a greater benefit stemming from potential financial capacity, capabilities that are brought to the table, improving the impact of the GRI. So more was considered better and so that was a very interesting outcome from it.

As far as the governance model itself on things like who has the right to vote, how much their vote matters. And we use the term vote in the sense of who has the decision-making authority at what level in the governance structure and it's a challenge, obviously, on a lot of these given how heterogeneous they are with regard to things like financial contributions and scientific contributions. But it's essential that people reach consensus and have an understanding of what those weights and roles and responsibilities are.

As far as resilience, governance in itself is not enough. It also depends on the legal structure but probably more importantly, on how proactive and how transparent the management team is and the level of trust with all of the stakeholders involved. And that really became clear as a result of the pandemic and we'll maybe get a chance to talk about that in the panel session at the end.

The next bullet is very closely related, the importance of the human touch and governance. As Heidi discussed, all the stakeholders are becoming more and more important and it requires a mutual understanding and trust, as I mentioned. And it's highly dependent on human relations. But to have good governance, it really is about human relations.

And lastly, I noticed that these benefits can be exploited through federals of infrastructures like the GERI model, using very, very informal governance models. So it doesn't only have to be formal, you can just drive extensive benefit from very informal governance models.

In B2, we asked this kind of probing question: Where do folks think they should start? Should they start with the governance model or should they start looking at hey, how am I going to codify this through the various legal frameworks? Is it an international organization? Do I use MOUs? Do I use contracts or other kinds of arrangements like ERICs? And so our panelists really helped delve into this and so they key takeaways are around the necessary level of formality, is that they range greatly from very formal, highly structured and centralized like LBNF/DUNE to very decentralized and

loose like GERI or even the LIGO Collaborative, but they can still be highly effective. And as far as answering that question on which comes first. Generally speaking, everyone agreed that they more or less run in parallel but if you had to start with one, you should really think about governance as the primary focus. What was also very clear in the matrix that we put together is that single GRIs can employ multiple legal tools from international agreements, all the way down to contracts and MOUs, a wide variety across the facilities. And it can be very challenging when, for example, technical changes occur in a project during implementation when you have this mix of binding and non-binding agreements. So it requires a lot of attention. You really have to understand where your levers are and how that impacts the outcome of the project. What was clearly identified as well is that some of these legal frameworks can really restrict important operational elements for things like, for example, staff mobility, staff pay structures can really be hampered by these legal frameworks and people's understanding of them.

And lastly, building this sense of common purpose, again, going back to that human element to build that sense of common purpose around GRI and to tie it to governance really is about leadership and really understanding the human elements and bringing those things together.

So those are the key words, I think, here are really what Andy Smith used in his presentation from the famous architect, Frank Lloyd Wright, is on the end governance is like architecture: form follows function. And so there's no one-size-fits-all, as Heidi and Frédéric mentioned and that was very clear in all of the elements of discussion. So just need to be thoughtful about how the function of your GRI is working and then craft the form accordingly.

The world café was a very interactive format and hats off to all of the facilitators and all the table leads that organized this program. It was very intensive and a very good dialogue. They delved into three key areas: creating the governance model, implementing the governance model and then talking about resilience and opportunities in response to crisis.

With regard to the right government model, obviously you need to define the goals specific to your GRI. As we've talked about, one-size does not fit all and that you have to consider the entire governance GRI lifecycle. What we found is that governance evolves through design, implementation and then into operations but that generally speaking, it doesn't change considerably over time and it's a slow evolution based on those at the lifecycle stage and what the goals of that stage are.

In implementing the governance model, I highlighted some keywords, again, all related to the human element: working together, communication, training and education for the upcoming workforce, as again, as theme A focused on as well.

There are opportunities in crisis and governance can play a huge part in resilience and obviously, response to crisis can lead to new funding opportunities and potentially new fields of research. And what we saw clearly is that governance bodies and managers within GRI reacted quickly to overcome administrative burdens in crisis. And so the governance structure has to be able to react to that and it did, that's what we've seen across the board. And so the key takeaway here I wanted to point out is that governance is not just about org charts and things like MOUs, it's really becoming more and more related and more intertwined with the human elements that we've been talking about.

So very quickly, a couple of polls we did during B4 and to sort of bring it all together. We talked a little, we wanted to get a sense of whether or not again, high numbers of countries was looked at as a plus or a minus and we've talked about some of these. But I wanted to point this one out to you. Do you think about the development of networks of infrastructures around common goals, common objectives that mission statement, if you will, is important. And it was really clear that the vast majority of our respondents felt that was a critical element to governance.

For B2, the poll, again, we wanted to a little sort of figure out how the GSO was doing and how effective the framework was. Doing okay, but like the little bit of work that we can do there. You can see in question three that most folks believe that these governance and legal forums should be done in parallel but governance was probably of the two, the more important part of it. And on these last two questions, I'm going to basically what Frédéric talked about in session A that we seem pretty comfortable with legal instruments and governance. The issue today seems to be financial structure and commitments and obviously theme A dealt with that. So these things are informing our recommendations at the end.

And then finally, do you feel that we need some more follow-up on this? Yes. So obviously, it's an important subject and we can continue on with governance and maybe emphasize financial structure more in the future.

Here are our recommendations from theme B. We need to continue to leverage these global forums like the Group of Senior Officials, the GSF and

ICRI in the future to bring forward these important subjects. We need to continue international discussions to modify legal frameworks where possible to reduce impediments to operability, the staffing issues that we talked about. And we need to initiate future discussions or specifically around financial frameworks as was discussed in session A.

Finally, identify means to promote workforce development and training opportunity for GRI management staff on good governance, focusing on building trust and a common purpose. So like I say, we seem pretty good at some of the nuts and bolts, but getting all stakeholders embedded in the governance structure is, I think, a key element of GRI governance going forward.

And with that, I'll be delighted during the panel session to take any questions.

Thank you.

Moderator: Thank you very much, Matthew. That was certainly very information.

Let me turn the microphone and screen over to Daan du Toit, who will be speaking for summarizing theme C.

Daan du Tois: Thank you very much, Michael for that introduction. And thank you for this opportunity to report back on a session which dealt with a theme which has been dealt with by many of the predecessor conferences to ICRI and that is impact, the socio-economic impact but not only limited to the socio-economic impact of research infrastructures. We really ask ourselves the question: What is this impact? Why is it important for us to understand this impact? And then how do we use this understanding of impact to shape policy making for research infrastructures?

I would first of all like to acknowledge the very valued leadership and contribution of Dr. Jan Hrušák from the Czech Academy of Science and of course, well-known to many in the research infrastructure community as the chair of the European Strategic Forum on Research Infrastructures for his leadership in compiling in this program.

We constructed the program around four key questions. First of all, starting by interrogating how do we broaden our perception of the impact of research infrastructures beyond the traditional understanding of the socio-economic impacts? And then really, what role does that understanding play to inform policy making? And the specific topic we interrogated there was to specificities of the territorial impact of research infrastructure.

And then in the fourth session that all concluded in how do we use this understanding to promote transdisciplinary collaboration in response to global challenges. Like all the other sessions and what I should say at the outset is that there is significant interface and synergy which our colleagues in themes A and B discussed. We also had a diverse and a rich group of international participants helping us to understand the broadening of the understanding of research infrastructures. We had Dr. Shamila Nair-Bedouelle, who is an assistant director-general at UNESCO; [00:35:50], who is the deputy director-general in the Chinese Ministry of Science and Technology responsible for research infrastructures; as well as Allen Weeks from the Extreme Light Infrastructure and this session was very ably stewarded by John Womersley, known to many of us for leadership roles, for example, in the European Spallation Source (ESS) as well as the Square Kilometre Array (SKA). In interrogating the role of societal impact in policy making, we could draw on a contribution from André [00:36:23] from Brazil; Rakeshnie Ramoutar from South Africa; and very significantly from [00:36:27 Elina Griniece] from the European Union's Horizon 2020 project which looked at how do we map out impact pathways for investment in research infrastructure, the RI paths project.

In looking at a territorial impact, we had contributions and there's also a chair, Xavier Barcons, the director-general of the European Southern Observatory (ESO); also another contribution from astronomy this time from India, was Professor Yashwant Gupta from the National Radio Astrophysics Centre (NCRA) in India and then also Dmitry [37:01 last name] from the Joint Institute for Nuclear Research (JINR) located in the Russian Federation in Dubna. And we also had the leak of European accelerator-based photo sources from Christina Bakari contributing so you will see a really rich group of diverse expertise and backgrounds. And in the final session, we had Yuka [00:37:25] from Japan's RIKEN Research Institute; Ron Decker from the European Consortium for Social Sciences Data Archives; and Clifford Nxomani from the National Research Foundation in South Africa.

But then moving on and to look at the key messages which came forth from these different sessions. First of all, there was consensus amongst the panelists but also the participants that in the interest of the sustainability and future support for research infrastructures, research infrastructures need to be able communicate their impact, both to politicians and the general public at large because the impact is really broad, both during construction and operation phases and we came to the conclusion simplistically but nevertheless very ably stated that impacts can be defined as always in which

research infrastructures benefit society. So that can be direct in terms of being drivers for economic development creating employment opportunities, for example, driving industrialization but also very valuably indirect. For example, serving as an inspiration for awakening and promoting the interests of the youth and science or serving as vehicles for science diplomacy and of course, this is all in addition to the key scientific impact of the science mission.

What is also revealing is from the discussions and we were privileged that we had research infrastructure managers from various facilities across the world participating that they are increasingly very comfortable with these developments and gaining experience as part of their day-to-day work engaging with local communities, engaging with different stakeholders, engaging with public authorities to manage these impact dynamics.

And then the session concluded with some important advice or lessons in terms of how do we understand the impact of research infrastructure. It really starts with the data and that data is starting to be collected at a very early stage. Research infrastructures should also not do themselves a disservice by defining such impacts too narrowly and then really adopting a broad definition and then use the success stories. The success stories to communicate and promote understanding of the impacts they are achieving and a critical component is also alliances with decision makers, with policy makers to support the investment case because of these impacts.

We then discussed the role of the impact assessment in policy making and it was a consensus that policy making from a research funding, a research management perspective really depends on meaningful and feasible impact assessment methodologies and that requires the development of indicators which can be used as proxies for determining this impact, of course, qualitative indicators but also indicators which can speak to the genetic societal impacts I spoke about before, such as innovation impact, community development, or science diplomacy.

As others have also mentioned, of course, every research infrastructure is unique. It's located in its own geographic, political, societal, scientific context and it's important that these methodologies are flexible and can be adapted to this unique nature. And of course, this indicator system should be developed in close collaboration with the broader research infrastructure stakeholder community. There was general support and consensus that the well-known OECD reference framework is a very valuable tool which can be

used to assess the various impacts of research infrastructures because what we really want to do is to explain to policy makers their return on investment. And to do that, you need to have evidence-based arguments. You need to have scientific advice for policy making, specifically looking at a cross-sector of policy agendas, not only the science agenda but economic, environmental, public health and other agendas.

As I've said, we had this very specific focus looking at the territorial impact of research infrastructures. For example, starting with the requirement when one decides where infrastructures should be located. What is the balance between the driving criteria of achieving scientific excellent and then specific local and or regional or national priorities which would be more closely associated with economic or social agendas. And of course, that brings into consideration the so-called site premiums which should or could be paid by the host of such infrastructures. Crucial to maximize territorial impact, is close cooperation and consultation between policy makers at the different levels of government, specifically within the context of how the hosting and support for the research infrastructure aligns with economic and industrial development programs. Critical for all research infrastructures and from those who shared was in order to maximize this territorial impact what is needed in addition to the legal and other permissions to operate is the social permission to operate. Research infrastructures need to understand the community needs and practices the local rules of engagements of the environments where they're located. This could, for example, pertain to human capability or supply chain. And in this context, the important point was made that when we speak in this session and thus far, I've mostly spoken or almost exclusively spoken about the positive impact of research infrastructure but of course, they're not only positive. They also can call, for example, for sacrifice, for example, for those communities located close to radio astronomy facilities which have to have radio quiet zones. So there's a need for compromises and understanding how these compromises for coexistence are made and for that real partnership is required.

It was emphasized during the session, the need for both [00:43:50 *ex ante*] and exposes their socio-economic impact assessment, as well as the understanding that often a significant part of this impact will not be planned. We then concluded also just a discussion on territorial impact with a look at global partnerships and whether international partnership, whether there should be a limit to the membership. And the conclusion here was that key really, and this was said in the governance session as well, that it's the efficiency of governance which has primary importance to enable the

sensitive objectives but of course, being sensitive at the same time diplomacy.

And then where did this bring us? This brought us to the last session, which was really to see then how do we use the understanding of this impact of research infrastructures to promote transdisciplinary collaboration in response to global challenges. Again, a key conclusion was that it all starts with the data. Data is the enabler and that calls for standardization of metadata and protocols for the sharing of data if we're going to unlock this potential of research infrastructures.

The urgency of science responding to societal challenges and the need for the sharing of knowledge and data across domains also is seen to be driving collaboration between different infrastructures in different scientific disciplines and this is because collaboration is needed to speed up research to respond to specific problems, as we have very clearly seen during the COVID-19 pandemic and there we've also seen the results which can be achieved if across disciplines there can agreement on different problem solving approaches but bringing the different and unique perspectives and methodology from those disciplines.

Research infrastructures also very crucially have the ability to bring different technical and management skills together to facilitate transdisciplinary collaboration. And from those managing global facilities, there was a strong feeling that these facilities can leverage their access programs to engage transdisciplinary cooperation and indeed there was a strong feeling in the sessions that such incentive programs would be necessary to promote collaboration.

We concluded with the question whether sustainable transdisciplinary collaboration should best be driven both top down or bottom up. And the answer, and this was not a diplomatic answer, was that we need both approaches but certainly need to find champions.

What we conclude is that by better understanding this broadened perspective of the impact of research infrastructures including the territorial impact, we are in a position to make important contributions to inform policy making for research infrastructures, which then should result in them playing their rightful enabling role to advance transdisciplinary collaboration addressing global challenges.

Thank you very much and thank you again, to all the speakers who contributed to these sessions as well the audience for their valuable input. Thank you very much.

Moderator: Thank you very much, Daan.

We're now going to turn it over to the final speaker representing theme D. I'm going to turn the microphone and screen over to Martha Crago.

Martha Crago: Well thank you for having me here. And it's been very interesting to listen to what happened in the parallel themes of A to C because I feel like I'm now summing the summaries, because many of those same issues came up in theme D in all four of its sessions. So I'll use this to briefly then, review some of what was in common and some additional points that came up across our four sessions.

Here we had a set of people and what we were talking about was data sharing in the academic public sector collaborations; however, people repeatedly raised the issue of data sharing with the private sector. And I think this is going to come across in all four of the sections of this theme, so let's go on and see what we said here about the kind of data sharing, much of which has been emphasized in some of the other presentations.

I've changed some wording here and I've just taken the liberty to do so. This first phrase is often, "Be as open as possible and as closed as necessary." However, there are counter currents in the world today that we have to consider and we have to consider them very carefully. There are counter currents by people who are engaged in what is both cyber hacking and theft of intellectual property, and data and information. So I think we have to nuance ourselves here. We certainly want to be as open as possible, but there will be some situations in which we have to protect more. And so people talked about multiple levels of data platforms and I think that's one of the ways that we can go that allows us to do two things at once. I will come to another issue, though, about protecting later in these points that has to do with Indigenous people.

Openness basically has to be premised on a lot of security and trust and this was, I think, one of the big things that we discussed. And furthermore, if you have data security, it will encourage good integrity of data.

Our group was starting to use a term that I wasn't familiar with, but honestly I come from a cattle ranching family and so when I heard data wrangling, it

reminded me of how cattle ranchers talk about cattle wrangling. And what people said is, there's a lot of wasted time that could be put into research by trying to get data properly curated, properly sorted out, and that data sharing is going to have to facilitated, and we're going to have to have infrastructure and tools and data science experts. And we're going to have to have the money to do this data wrangling. The curation of data is not an insignificant thing, but it must happen and it must happen if we're going to share successfully.

Finally, Indigenous rights, this is, of course, a big issue to Canadians, to Australians, and people elsewhere in the world, namely let's say, for example, Brazil. You can gather all the data, and I did my own research in Indigenous communities, you can gather all the data you want but we may have a different interpretation of that data than Indigenous people do through their own knowledge and their own understandings and their interpretations are key. And furthermore, they frankly need to own this data and work with them will require very important data management procedures to be in place.

And finally, I gave everybody a list pop quiz question when I moderated this panel. I said, "Okay, is data, infrastructure?" And everybody said, "Yes." But nobody knows what that means about how it gets funded. I said to the Canadian colleague, Gail Murphy, "Are we going to go to CFI now and say hey, it's infrastructure. We need infrastructure money from CFI to fund this." So I think everybody's got to look into this aspect of data as being a very important new way forward for everyone and it will be the thing that will bind us in times of crisis if we can sort things out properly and we've got to have operating money put to it.

Moving on to the next group, this one was how do you solve future crises through collaboration? And it had a number of people from science funding agencies, government global affairs and policy people. It's an extremely interesting panel and I can share with you some of the things that out there.

If we go onto the next slide, we can see that one of the most important things was thinking about how the global North and South are able to work together in a time of crisis. As somebody pointed out, the G20 has the bulk of all the research funding in the world, but there are 174 other nations that were affected in this pandemic. So how do we put together the capacity of the global North to serve the global South? And it means people have to set priorities. We have to have the equivalent of our COVAX project that's going to deliver vaccines to other places. We have to have that project in place to

deliver the infrastructure and the data that is going to be necessary in a time. And partnerships only work if everybody contributes and it can be all kinds of contribution. As I said, Indigenous knowledge is a very important contribution and a form of expertise. The most critical thing is probably the smallest pot of money and that is glue money and it's also the hardest to find. How do you get amounts of money that are needed to catalyze people and to coordinate networks? And how do we get the data frankly, curated in commonality in ways that it can be shared across the global North and South in a time of crisis.

I can tell you that in Canada, it has not been a pretty picture to try to integrate the provincial health data with the federal health data and this is something I'm not proud of. But it has been really a very difficult piece and that's in one country. So we have to work hard to be ready to create the glue, to create the data bases that can serve us in a major way.

Also constant innovation has to be a part of the culture. We have to constantly be looking forward. What are the next crises? Well we certainly know climate is on the way and here, so we have to begin to prepare now to say have we got the right infrastructure? Have we got it shared across the world? Have we got the data it will produce accessible and available and well standardized so that we can respond quickly? And the other thing is the public messaging. There's a great role for people here in communication to help us figure out how we convey messages. One of the most complicated things in this crisis was science evolves and people, the lay public, get frustrated that it evolves. And they want the answer and they want it now but we don't have all the answers. So it has to be some very important work on messaging out to public so that you can engage the populations in how to help manage the crisis.

Next group was more on COVID. What have we learned from COVID-19? And this was a very interesting group because as you can see, somebody came from the EU where people had been collaborating across countries. Someone else came from a very small centralized country and two people came from very geographically large countries but who've approach things in different ways. So this was an interesting complementary set of people.

And if we go onto the next slide and what came out of this was. First of all, open science isn't free. It has to have been trust in collaborations that were built up. So what happened to a person like Art McDonald? Canada's pride as a Nobel Laureate, who runs a particle physics infrastructure called

SNOLAB, was that he decided he was going to team up with his best colleagues around the world, relationships that have been established over the years, to create ventilators. And they had to team up with the private sector and the government to help get these out there. They've been working recently how to get them to India. So this was a phenomenal pivot from a man who's studying particles underground to figuring out how to put ventilators together. And he did it with people at various infrastructures sites around the world.

One of the challenges was not the shift and the pivot but the speed and the pressure that fast solutions bring and they have to be based on well-established partnerships. So these partnerships for one reason can be used for another reason.

Very interesting initiatives in Australia about remote operations, they noticed that the people who were best able to keep up their research were people at a telescope site that were working remotely anyway. And then they started to think what are future labs going to look like? How much can we be running them remotely if we think far ahead into the future? So they've got a very interesting national initiative called Labs of the Future, to envision and plan for a future that will be quite different. And so foresighting then, needs to be an enormously important part of the planning process and planning needs to happen.

The next thing we toyed with is what happened with peer review in the pandemic? We saw lots of pre-print, open archives. I saw people have complications in Canada when they announced something and actually the proof didn't hold up so it was a little bit embarrassing. I think the peer review is still very much needed in the backbone of the system, but there was also an ability to look at things in real time, which is perhaps useful too, and will be something that we will outlast this particular pandemic.

Onto the next and final group of the four, this one was how do we build talent and connections to foster new collaborations and really looking at younger researchers and how they get engaged. So you can see they came from government agency, a multi-university initiative called TRIUMF and then CERN which is known world-wide. So if we can move over to there, lots of concerns.

First it was called attracting talent, but the panelists soon said, "Look, this isn't only about attracting. This is recruiting, attracting and retaining." On the other hand, younger people are concerned about what's going to happen to

them post postdoc? Where are they going to leak out of the pipeline? And so one of the issues is also how you make it attractive to be in the place where they have been hired. How to be more welcoming, more mentoring, more inclusive once you have attracted them in order to retain them. Although I'll say, a number of the questions that came in in this session were people concerned about what am I going to do now? My postdoc is over.

COVID changed really, how we looked at the pipeline. One, you have to look at the whole person, their wellbeing. Make sure that they stay engaged even though they're working remotely. On the other hand, people did say that though it's the chemistry and the excitement comes from working together in a lab setting, they think that the flexible future is here to stay, where people won't always want to be in one particular place to do work and that certainly these international projects will go on using Zoom meetings instead of putting a bigger carbon footprint around the world.

Importance of the diversity and inclusion, so very interesting examples out of CERN, where they feed right into the undergraduate and even high school level in countries in Africa and elsewhere around the world to interest people in the kind of work that CERN does. They also have a big alumnae club. Once you have been at CERN, they keep in touch with you and those people stay in touch. CERN also has a number of programs that they let anybody tune into and encourage young researchers to do so. So a lot of ways to get people engaged and to reach out across other diverse populations.

And then the concern by people about what happens to me if I can't find a job where I came out of or if I was at CERN but I can't go on being at CERN? So the importance of skill set versus job setting. The skill sets are transferable but people's lives aren't always transferable so one has to keep that in mind.

Finally, a belief that some of the STEM disciplines should be, and I put it this way, making required courses in social science and policy so that evidence-based policy becomes a way of life and people learn how do you address policy with the evidence that you're creating. And I would say that's where these four sessions ended up. Some people referred to social science as the new "bell of the ball" going into the future because the large data sets that are now available, particularly in European Union, will be mined for very interesting information that nobody was capable of putting together. On the other hand, interpretation of that data will require some smaller number, more ethnographic type information.

Moderator: Thank you very much, Martha. That was a very interesting summary of your session.

I'm going to invite all the panelists now to have an opportunity comment on what they heard from everybody. I'll give you all approximately two minutes, so that's approximately 10 minutes for everybody. Perhaps we could start with Frédéric and Heidi. Now that you've had a chance to hear the summaries from your colleagues and really for the first time, do you have any thoughts that you'd like to share?

Dr. Heidi Bandulet: We've heard so many parallels between all our sessions and I think the governance issues were certainly something we will be interested in looking at. I mean, a lot of issues were raised, but we did not go in maybe so many details. But addressing the preparedness of facilities for future crises, one example that really stood out for us was the case of the Joint Nuclear Institute in Russia, the way they operated and it's an intergovernmental organization that's been alive for 60 years so we would think those very formal organizations as very rigid and not being able to be agile. And what we were really surprised to hear is that the way they function, is that they do have this central authority but really interconnected with the science community. And because they see their portfolio of large research infrastructure as modular and part of the same ecosystem, they were able to react very, very quickly. They said almost instantaneously to reorient and work together. So it's not just what one facility can do, but how can they all work together and complement each other to arrive at a solution for that crisis. So that was a really impressive study case for us. It wasn't in a case study, but it was one of our panelists. So I'm thinking maybe this is a model going forward for Canada for our major science initiatives, for example, working also in tandem with of course, all the support laboratories that we have in Canada. I'm going to end there because I could continue.

Moderator: Thank you Heidi, we can see you've got some passion for the issue. Let me ask Matt but before I do, I'd just like to remind everybody that you can start posting questions for the panelists. As soon as everybody's had their turn to comment, we're going to turn this over to Q&A.

Now that you've heard from everybody, Matt, what do you think?

Matthew Hawkins: I think it was really interesting to see all the similarities. In theme B, we really started about thinking that we would really focus on the nuts and bolts that people would get into legal models and governance structures and org diagrams, but very quickly people segued to that human element. And I think

it's because it's on everybody's mind as a result of the pandemic. What is it going to look like going forward? How are we going to be involved in decision-making? What's the common goal and objective of what we are all engaged with that with the scientific endeavour. So it was interesting to think that we thought we would be talking about a bunch of technical details, but really very quickly everyone really segued to the human element. And I really liked Martha's last point about the importance of teaching the social sciences in the technical fields. Where I went to school, my backgrounds actually in civil engineering and of all the engineering fields where I went to school, it was the only one that required four, three-credit hour courses in humanities. It's because civil engineers tend to work with people more. And so I'm a huge advocate of that in the technical fields, that intersection with the social sciences. Good point Martha, happy to hear that.

Moderator: Thank you very much, Matthew.

Daan, any observations?

Daan du Toit: I can be very short Michael I agree completely with everything Heidi and Matthew has just said. And I think it shouldn't come as a surprise that in the end, even though we had different themes, our sessions started to interrogate really, the same questions because that's what's really at the heart of ICRI. The heart of ICRI is for us to learn from each other how we best make research infrastructures as part of the overall global science enterprise work for society. And if you consider the impact on society, then it's unavoidable. You're going to interrogate governance. You're going to interrogate data. You're going to interrogate the public-private partnerships. A key message, which perhaps for me has also been much more visible in this year's ICRI, as opposed to earlier events and then also from the feedback from the other sessions, is really the emphasis of global collaboration and understanding how do we really bring the North and the South, as someone speaking from the global South, together into real partnership? If COVID-19 has shown us anything, we share the same challenges, but it's also understanding that also from a science response, it needs to be a joint response. And I think these four tracks have all contributed to us better understanding on how we develop real global partnerships for science.

Thanks.

Moderator: Thank you very much, Daan.

And now over to Martha, you had the benefit of speaking last and hearing some of your colleagues, but perhaps you have a last observation on everybody's summaries.

Martha Crago: Well there's one thing that I wanted to raise here, which is the importance of operating money for infrastructure and the way in which we glue those pieces together in our funding models. And I have to say the Canadian funding model is particularly distributed and so people have to write many proposals: one for the equipment, one for the operating money, different kinds of things for graduate students to apply for. So I think we're going to really need to think about it and I raised it in terms of data as well. I do recall once, I had a lot of data at one point that was openly shared, but I put in a grant proposal and asked for a very small amount of money. I didn't want to collect new data, I wanted to analyze and curate existing data I had. Grant agency said, "No, we don't' fund that kind of thing. You've got to get new data." I thought, "What do I need data for? I have the data." So we do have to think about how it is we fund these things. I would put some emphasis back to the funding agencies to think about how they can work collaboratively in an integrated fashion. So it's not only collaboration across the world, it's also collaboration among the different funding agencies.

Moderator: Thank you very much, Martha.

Let's go over to the question and answer session at this moment. I'm told from our technician that there are approximately 200 viewing this session right now which should make us feel very good.

Many of you have been thinking about COVID, obviously it's hard to forget about the previous 18 months that we've had. To what degree really, is an experience such as COVID, is going to change really the future of international research infrastructure? It's something that you've touched on in your presentations, but I wonder if some of you would like to elaborate.

Frédéric Sgard: Maybe I can start because when we discuss the way forward what people thought about new research infrastructure at the international level, the lessons learned from the COVID crisis were very much in their mind. The way that people took lessons from the added value of connecting research infrastructure together, be able to respond to more complex issues and the fact that when you are in the crisis, you just don't' have the time to develop new collaborations. So it has to be done in between crises and to develop connections and links so that you can sort of iron out all the difficulties and the challenge of collaborating between different regulations at the national

level, etc., was something which was very, very important. I think Martha mentioned that and we had also feedback from international distributed research infrastructures that are used to work with different regulations because they have different national notes, etc., and they were quite often, able to react more quickly than others because of that. So preparedness is really very important and putting back into the general objective of research infrastructure this potential objective as being prepared to react if necessary because it was a live stress test and it shows the pros and cons of the current response, was very, very important for the future crisis.

Moderator: Anybody else would like to speak to that question?

Martha Crago: Well there's an old adage about a friend in need and a friend indeed. And I think that the biggest thing that came out to me over and over again and what I heard this morning and what I heard on these different panels I moderated, was these friends, the trust you have among them, they will serve you in a time of need. And you may pivot to something completely different than you had all been working on, but you're all there together. You know each other. You trust each other. And the other biggest lesson to me is, the need for data that can be shared that can be shared across provinces, countries and we have to be ready for it. So we have to start now in figuring out how data portals will work and work best. And the European Union has been a remarkable example in this time. So I think people need to look at what can be learned from there.

Moderator: Anyone else?

Daan du Toit: Just to build on what Frédéric and Martha said, certainly from the South African experience, as what the real perhaps impact has been, that is it put very, very much in the public spotlight what is the benefit of long-term investment in research infrastructures? In many countries, we needed to very quickly develop advanced capabilities for data management, for analytical and modeling purposes to respond to COVID-19 and where did we turn to for that capability? It existed in our research infrastructures, it addressed it. It had existed in our Center for High-Performance Computing. We were able to deploy the various infrastructures in the social sciences and humanities to leverage their capabilities to understand how the South African population is responding to COVID-19. But perhaps the best example, we just didn't' have enough ventilators a year ago and we very critically had to start building them very quickly. So we had to look for where's the best engineers. And the best engineers in South Africa were found in those building our large

telescopes. And so I think that it sort of underlined the emphasis to us that investment, long-term investment for the best science gives you then, that capability to respond to crises which emerge.

Thanks.

Moderator: Final word?

Matthew Hawkins: When the pandemic hit, managing organizations of research infrastructures and funding agencies had to focus on two things. One was continuing operations or continuing construction, whatever phase the facility happened to be in, and also on the health and wellbeing of their employees. And combining those two things is what really opened up this human element. You can't do that without engaging everybody. You can't do that successfully without engaging everybody. And so I think that's a good positive outcome and that's going to drive things that Martha mentioned, the transition to a hybrid workforce. What is this all going to look like? What research infrastructures going forward? My only concern with regard to preparedness is that we have short memories. We tend to forget and I'm hoping that the things that are actually implemented now will naturally become part of our operations going forward so that we are truly ready for whatever that next crisis happens to be. Because in a few years' time, it will be behind us and I'm hoping the changes are entrenched enough that we can withstand the next crisis, whatever it happens to be.

Moderator; Thank you very much.

We have a number of questions that have come in. So in the interest of engaging with our colleagues, who are listening in, let me take a question here from Nigel Smith. Obviously he's heard your comments about the need to pivot and the ability to pivot and he's wondering if there are lessons that can be drawn from what you've heard in your sessions about that capacity to pivot but also the capacity to build trust with the different stakeholders that are involved in research infrastructures.

Would anybody like to begin?

Matthew Hawkins: I thought Martha was going to pick up on this one because I think it goes to the human element aspect of it and that transition from focusing on the science and technical.

We're all technical people involved with research infrastructure from the top to the very bottom and I think it goes to that importance if you're going to

build trust, if you're going to make governance more effective across the board. We're going to have to ingrain the importance of these elements in senior management. We're going to have to ingrain them in our staff and we're going to have to really rethink how all of the stakeholders are engaged in governance. I think it's a great point that Nigel brought up and I think it's changing the way we look at things, and I think we're naturally going in that direction.

Martha Crago: Okay, I'll hop in here.

We live, frankly, in an intrinsically competitive research world. There's a lot of competition. I often say to people who are not from academia who say, "Oh, you live in such a soft world." I said, "We are really good at backstabbing. We are really good at competing. We've been competing for grades for years. We have very well-honed skills in this." So I actually think a lot of this has got to go back into the way we educate people and the way we mentor them in research and the way we make them value collaboration and the way we become openly discuss things with colleagues when we feel transparency has gone astray, when we feel like process has gone astray. I think we've got to address these issues face on, instead of just getting nasty behind people's backs. And if we can do this, and if we can build strong governance structures and strong process and transparency, then I think those are things that they'll trust. But we are going to have to mentor new generations to think about collaboration as a really important tool and train them to that frankly, in the way we train because we have trained for competition for years.

Moderator: Perhaps a good segue into the question by [01:19:45]. Sorry Matt, did you want to add something?

Matthew Hawkins: No actually I was just looking for the little applause button on what Martha just said and I pushed the wrong button so my apologies, everybody. It's not the usual reactions I'm used to. I was trying to applause to what Martha said.

Moderator: That's okay, we'll take a checkmark.

So a really interesting segue raised by Martha, which goes to the question raised by [01:20:08] here, which is really about the training of highly qualified personnel, people, and how do we really valorize the investment that we put into training them. What are your thoughts, generally, about the training elements associated with the kind of work that we do?

Martha Crago: Well one thing that came up in one of the panels is, and I think it came up in a response to a question and it may have been a question by a person named Sharma, which is how could we have training that worked kind of like the Marie Curie fellowships have? How could people go from one infrastructure facility to another, taking their skill set and reapplying it and learning about different places? So how could we have some kind of support that had people rotating in the course of their training?

Moderator: Interesting. Anyone else on that topic?

Frédéric Sgard: If I may, and Daan might come back into that, I think the example we had as new type of partnerships between the South African Funding Agency and the U.K. funding agencies for research infrastructure was very interesting because it was going beyond just building and operating a research infrastructure. It was actually developed so that all the exchanges regarding skills training, all the secondary impact and indirect impact of research infrastructures could be shared between institutions. And that's really an added value which up to now was only considered at the level of just one research infrastructure and then in this case, they are taking a more strategic view. And when we ask, "Is that just a bilateral engagement or could you consider broadening that?" They say, "Yeah, it could be considered as expanding this type of agreement." That's a very interesting new type of partnership where the training part, the skills exchange, is extremely important because it's usually just focused on just one research infrastructure and actually the training goes as a research infrastructure, ecosystem and people can move from one research infrastructure to another. So it's really an added value, I think, which is being integrated in this type of new partnership and that's really interesting.

Moderator: Let me move onto the question by Kirk Key, which I feel very strongly about because I'm a social scientist myself. What could we do to bring more social scientists, policy researchers, humanity scholars, how can we bring basically a less can we say, a hard science perspective into discussions about research infrastructures? Anybody with thoughts on that? Go ahead, Martha.

Martha Crago: Well one of the things I could point out to you. There was a set of students who were actually in a department where they were studying oncology at McGill, I think in biochemistry and they got, much to my surprise, incredibly engaged in science policy discussions and formed a really interesting network of young people interested in science policy. And I used to say to them, "What do you know about policy? You never studied policy. You just

know how you think funding should go." But what's important and there are some interesting places in the world where policy people do mix up with other people with STEM disciplines and I think increasingly, we just have to kind of start to build it in.

The other interesting piece in Canada is we do have an interchange program. I know there was a professor in economics at McGill who did an interchange with Environment Canada, worked for two years in government seeing how policy actually is rolled out. He was a policy scholar in environment but not a policy maker. So he spent two years with policy makers and then returned to the university. So that kind of program was very interesting for people and theoretically you could work out a set of internships for people in STEM disciplines who did some work with government n part of an internship and really learned about policy making because policy scholarship is one thing, policy making is another thing.

Moderator: Interesting. Anyone else?

Dr. Heidi Bandulet: Maybe I could just add something quickly. One thing we try to at the Canada Foundation for Innovation is to make sure we have broad consultations with stakeholders. So any design issues, any policies we want to put forward, we try to at least try to integrate and stimulate interest in the social science and humanities so we get participation. And we also include them in the review process. So I think the impact methodologies for assessing impact of research infrastructures that really needs to include social scientists.

And on the issue of policymakers, I would argue that a lot of policymakers do have a hard science background. So I think it's something that's definitely on the radar of many students and graduates students in the hard sciences. There is a definite interest in policy making.

Moderator: And in fact, I don't want to put Daan on the spot here, but Heidi's just highlighted an element from your summary, which is that research infrastructures obviously, have positive impacts but they also have perhaps some less desirable impacts and those are fundamentally social policy questions. Any observations you'd like to add?

Daan du Toit: Most definitely and they are also within a context, if I look at a country with an economy such as my own, where investments in research infrastructure can often be questions with regard to the utility in it and speaking to the key societal priority such as fighting poverty. And therefore, the contribution of

the social science and humanities and understanding what is the role of those infrastructures in society and how do we communicate? How do we build the alliance? How do we both support with communities are crucially important.

I think what is very important in this, and I think Martha said it; it's a policy objective we often speak about. Not only in research infrastructures across science policy, integrating, maintaining, whatever you want to call it, social sciences, policy, etc., but beyond those words, one just has to do it. You have to do it in a very deliberate way.

Moderator: Excellent.

We have one final question that I'd like to get to which was raised very early in the session among us and we haven't had a chance to visit it, which is really how do we ensure that the results and the data form our research infrastructures ultimately become accessible to non-experts and perhaps a segue to the past question about social scientists and so on, who have an expertise in policymaking and social sciences but perhaps not in the results of the hard sciences that we're talking about in big research projects. So how do we ensure that the science results and data from research infrastructures are accessible to non-experts? And how do we make that information available for people from a variety of backgrounds and perhaps we could even say maybe the public? It's been a hard year for thrust in science so what can we do to perhaps help that out?

Could I perhaps ask Heidi to comment on that?

Dr. Heidi Bandulet: Yes. Thank you, Michael.

The issue of making data accessible is one thing. You want to share it. You want to make it open. But it's usefulness if it means nothing to most communities and non-scientists and even non-experts within a discipline. We had two panelists from the Arctic that really illustrated that because we had a lot of challenges and barriers to make even the results and data relevant to these communities. So they were talking about examples in establishing a pan Arctic observatory system and how we could need funding, for example, to develop tools that would transform the data into something that is very scientific and very scary to look at and meaningless, into packaging it with analytical tools and interpretation services so that they mean something and they can be used by communities for planning the way they want to see the research going and how to integrate their views and their voice from the

beginning in those partnerships. So that was really one of the main messages because trust is a difficult issue. In the Arctic, there are multiple centers of action, a diffusion of power, and there are also very limited resources from many of those stakeholders. So bringing data, making it accessible really, is enabling some leadership to emerge from the Arctic because with limited resources, what's a barrier is that they don't know which way to turn. They want to know who has the authority that they can bring them to something more coordinated. So the issue was raised of having maybe a little bit more top-down planning for the Arctic because right now it's way too distributed, too diffuse and it's very hard to coordinate.

Another example, just to finish off of also the SuperDARN Radars Network in Canada that monitor space weather and also have three radars in the Arctic, their data is very difficult even for physicists outside of that particular field. So there is a lot of work to be done and a lot of resources and investments that are needed to transform this data to make it really useful by industry, for example, telecommunications, GPS, the aviation industry, power grids, they need to be able to make sense of that data so that it can really have the impact. So right now, it's like sitting on a gold mine but not really be able to bind it out. So really, that was a very strong point that emerged from our discussions.

Thank you.

Moderator: Thank you very much, Heidi.

Unfortunately, in the interest of time, we have to close this conversation off. On your last point, Heidi, obviously it also raised some thoughts that Martha had made about messaging and communications. I mean we could keep going on this conversation for another hour. Unfortunately, we do have to bring it to a close.

I want to thank you all for the generosity of your comments, for summarizing your panels so excellently. I attended panel D and certainly Martha's summary was exactly like being there.

So thank you very much. I want to invite the people that are still online to join us for the final plenary session which begins at 11 am Eastern Daylight Time and that will feature Simon Kennedy, the Deputy Minister of Innovation, Science and Economic Development, as well as Mr. Jean-Eric Paquet, Director-General, Research and Innovation, European Commission. And they'll be talking about possibilities and potential for global collaboration in

research infrastructure and that session will be moderated by CFI's very own President and CEO, Roseann O'Reilly Runte.

Merci beaucoup. Thank you very much for a very interesting conversation. We now have a short break until 11. Thanks again.