

# Exploring the Influence of Contextual Distances on Transnational Public Sector Knowledge Networks: A Comparative Study of AIRNow-I Shanghai and the Hajj-MDSS Initiatives

Mohammed A. Gharawi  
Computer Programs Department  
Institute of Public Administration  
PO Box 205, Riyadh 11141, KSA  
+9661 474 5629  
[algharawim@ipa.edu.sa](mailto:algharawim@ipa.edu.sa)

Sharon S. Dawes  
Center for Technology in Government  
University at Albany  
187 Wolf Rd., Suite 301, Albany, NY 12205  
+1 518 442 3892  
[sdawes@ctg.albany.edu](mailto:sdawes@ctg.albany.edu)

## Abstract

*Transnational public sector knowledge networks (TPSKNs) are becoming crucial for addressing global problems in the environment, public health and other areas that require knowledge and information sharing among nations. This paper explores and compares a set of contextual distances that separate network participants and discusses their influence on network success. Based on previous research, we introduce nine contextual distances and compare and discuss their influence on two cases. We conclude with a discussion of the findings and suggestions for future research on knowledge and information sharing across national and cultural boundaries.*

## 1. Introduction

Governments around the world are increasingly engaging in Transnational Public Sector Knowledge Networks (TPSKNs) to deal with a host of global problems that no one nation or single government can address individually. Environmental quality, public health, international trade, and disaster relief are just a few areas where technology, information, and knowledge need to cross national and cultural boundaries through channels and mechanisms that are more agile and less controlled than the formal interactions among sovereign states [1]. While these networks represent a novel approach to critical global concerns, they also provide governments with opportunities to build and diversify their capacities in various domains. Several authors have discussed these networks conceptually and described the possibility of empowering them to build governance capacity around the world [2-4]. However, little empirical investigation has addressed the complexities surrounding the main function of these networks: the sharing of knowledge, information, and technical content.

This paper presents preliminary findings of a comparative study of two TPSKNs. This work is part

of an ongoing exploration of this phenomenon and the ways to conceptualize and understand it. We employed nine “contextual distances” that separated the participating organizations and resulted in different forms of challenges. One case involves the United States and China in a partnership called AIRNow-International (AIRNow-I) while the other involves the US and the Kingdom of Saudi Arabia (KSA) regarding the Hajj Mobile Disease Surveillance System (Hajj-MDSS). We address three questions: What are the main contextual distances influencing TPSKNs? How do the distances influence TPSKNs? Which strategies, tools, and behaviors are more likely to address these distances to overcome the challenges they generate?

The Hajj-MDSS is led by the KSA Ministry of Health (MoH) and US Centers for Disease Control and Prevention (CDC). It allows rapid detection of infectious diseases among Hajj pilgrims and enhances prevention and control measures through real-time surveillance information for public health decision-making. The initiative was launched during the period when swine flu (Pandemic Influenza A, H1N1) had been declared a global pandemic. The conditions of the Hajj magnified the risks associated with H1N1 because it is one of the largest, most culturally and geographically diverse mass gathering events in the world, attracting more than 2.5 million people to Makkah. The guiding vision was to ensure the well-being of Hajj pilgrims and therefore maintain global public health security. When H1N1 was declared a global pandemic in June 2009, the Saudi MoH organized an international workshop of leading global public health organizations including the World Health Organization (WHO), the US CDC, and similar institutions in Europe, Australia, and China. The goals were to pool public health knowledge about mass gatherings and review the KSA preparedness plans, focusing on prevention and control of H1N1 [5]. One recommendation was to implement a Mobile Disease Surveillance System (Hajj-MDSS) to monitor the

epidemiology of swine flu among Hajj pilgrims. Saudi MoH turned to experts in CDC's Global Public Health Informatics Program (GPHIP) for assistance. After five months of technical exchange, professional visits, and joint work, the system was implemented for the November 2009 Hajj. The system enabled public health officials in KSA to monitor nine infectious diseases and provided access to timely and accurate information in both planned and unexpected situations. By the end of the 2009 Hajj, only 73 confirmed cases of H1N1 were reported.

AIR-Now-I involves the US Environmental Protection Agency (EPA), the Shanghai Environmental Monitoring Center (SEMC), and several other US and Chinese partners, including EPA's main contractor Sonoma Technology (STI). The Shanghai initiative is based on the US AIRNow program which provides the public with easy access to air quality information for over 300 cities via a public Web site. It also disseminates information to the news media and other outlets including *USA Today* and the Weather Channel (AIRNow, 2010). AIRNow-I represents EPA's efforts to update and enhance AIRNow for global use in collaboration with international partners. AIRNow-I was the first specific project conducted under a bilateral Memorandum of Understanding (MOU) to collaborate on environmental issues. Development and deployment of AIRNow-I in Shanghai involved four years of technical exchanges followed by two years of system development. During this period, EPA, SEMC, and their partners completely revamped the US AIRNow technology, including replacement of the domestic US system. They also collaborated on air quality forecasting and linkages with local data analysis modules. The AIRNow-I Shanghai air quality reporting system was launched in May 2010 as part of the Shanghai World EXPO, an international event of great importance to China and Shanghai. [6].

## 2. TPSKNs and contextual distances

In previous research [8, 9], we defined TPSKNs as two or more governmental sub-units located in different countries involved in the exchange of knowledge, information, or both in order to address a mutual concern. We further characterized them as multidimensional organizational phenomena of interdependent components that include political, social, organizational, and technical dimensions which influence performance. In order to understand TPSKN success, we considered performance in terms of structure, sustainability, interactions, and results [30]. We also considered what internal and external factors make success more or less likely. In this work we

observed that a fundamental challenge for network actors is the fact that every participant is deeply embedded in layers of context. Every individual and organizational participant, communicates, acts, and understands the world through well established, but mostly invisible, contextual lenses. We conceptualize the differences between participant contexts as "distances" that they must shrink (i.e. become more alike) or bridge (i.e., find ways to mitigate) in order to succeed.

The "distances" concept has been widely used in international management research. Cultural distance, for instance, has been applied to most business functions such as knowledge transfer, marketing, accounting, and human resource management [31]. Other research identified and explored the influence of physical, organizational, relational, and knowledge distances on knowledge exchange [7]. Distances also offer a useful way to identify and observe the presence and influence of contextual factors in the performance of TPSKNs. They further help us observe the influence of sharing, collaboration, and learning processes as means to shrink or mitigate them.. Accordingly, the following paragraphs introduce the nine contextual distances employed in this research: cultural, political, intention, organizational, relational, knowledge, resource, physical, and technical [9].

Cultural distance is created by differences in beliefs, values, and practices. As cultural distance increases, more time is needed for communication, development of common managerial approaches, and design of compatible work routines [10]. Cultural distance may lead to misunderstandings which minimize the multi-directional flows of information and learning [11]. Similarly, intercultural interactions are often filled with second guesses and misunderstandings due to differences in language, communication styles, and value orientations [12]. In short, cultural distance may lead to fundamental misunderstandings, can extend the time and effort required to achieve desired goals.

Political distance reflects gaps and conflicts among laws and policies, political interests, and agendas of the home countries of the participating organizations. Political distance can affect the ability of participants to create a stable collaborative environment and restrict their ability to carry out specific kinds of activities. Laws governing intellectual property, trans-border data flow, privacy protection, contracting, and other topics may not match. Moreover, distance between political philosophies can present competing or conflicting views and agendas [8]. Moreover, when interaction in a TPSKN involves both developed and developing countries, the legal systems and infrastructures may be

well-established on one side, and either underdeveloped or missing altogether on the other.

Intention distance is shaped by goal dissimilarities. While some goal differences are to be expected, compatibility of the primary goals of the participants seems necessary to establish and maintain useful relationships. When shared or compatible goals are present, mutual understandings, accommodations, and exchanges of knowledge, information, and other resources are more likely. The degree to which participants perceive a match in their goals may impact the nature and amount of knowledge and information they are willing to share [13]. In addition, shared vision and goals serve as a bonding mechanism that helps network participants integrate knowledge [14].

Organizational distance is shaped by the degree of dissimilarity between the partners' business practices, institutional heritage, and organizational cultures [15]. Organizational differences, such as decision-making processes, norms, and structures that define authority and responsibility are likely to affect how employees interact and, consequently, the effectiveness of the knowledge sharing process [16]. Moreover, differences in absorptive capacity—the ability of organizations to evaluate, assimilate, and use external knowledge—also influences learning and knowledge sharing [17].

Relational distance is shaped by the duration and type of historical interactions. The distance is greatest when participating organizations collaborate for the first time. With repeated interactions the distance tends to decrease. Organizations that have worked together in the past are more likely to have a basic understanding of each other's skills and capabilities, which provides impetus for learning [18]. Previous positive ties can establish an adequate level of trust, allowing participants to forgo the relationship-building processes necessary for those collaborating for the first time. Over the course of long relationships, participants develop behavioral expectations and understandings, and norms of reciprocity, that enhance collaboration, help resolve conflicts, and contribute to the overall success of the relationship [19].

Knowledge distance refers to differences in the existing knowledge bases of the participating organizations. An appropriate overlap of knowledge promotes knowledge transfer as research shows that what can be learned is significantly influenced by what is already known [20]. Organizations that possess similar knowledge bases encounter less difficulty transferring knowledge to each other [21]. However, as knowledge distance shrinks, the chances to locate and access new knowledge from each other decrease. This may reduce willingness to collaborate further along with their ability to solve novel problems [18].

Resource distance is shaped by differences in the amount and type of resources participants need from or contribute to the network. When participating organizations are at different levels of development, have different relative statures in their countries, or enjoy different amounts or kinds of funding, staff, physical plant, or discretion over spending, their ability to contribute to the work of a TPSKN reflects those differences. Perceptions of resource dependence and equality or inequality have strategic implications, including dealing with interdependence and uncertainty [22]. For the network as a whole, good performance tends to be associated with the ability to marshal a variety of resources, ranging from finances to diverse skills [23]. Thus, collaboration among organizations with complementary strengths and weaknesses will probably yield greater benefits than will relationships among highly similar peers [24].

Physical distance refers to the geographic locations of participating organizations. Wide distance presents difficulties for working face-to-face, which is necessary to establish relationships, transfer tacit knowledge, and build social capital which are all crucial for development of good communication and sustainability of the network [25]. The problem of physical distance is a frequent focus for applications of information and communication technology, but there is strong evidence that face-to-face engagement remains essential for group formation and for complex communication and group-level creativity [26].

Finally, technical distance is the result of differences in existing ICT infrastructures and incompatibility among existing technologies and systems. Information systems research points to different levels of complexity of IT infrastructure and telecommunications as a pressing concern for systems that cross national boundaries [27]. Differences in hardware, software, and data schemes can threaten the success of transnational data-sharing networks [28]. These differences may also exacerbate sociopolitical and sustainability issues by preventing the deployment of IT services that are essential for interoperability.

### 3. Research methods

The research data consist of documentary evidence and interviews with individual members of the participating organizations in both cases. Two dozen semi-structured interviews were conducted for AIRNow-I and ten for the Hajj-MDSS case. Data related to AIRNow-I were collected as part of an NSF-funded project while data related to the Hajj-MDSS were collected as part of a PhD dissertation conducted by one of the members in the AIRNow-I study team. In

both studies interviews focused on transnational knowledge and information sharing from the point of view of each organization, country and culture. The data were analyzed according to a conceptual framework based on contextual distances [9].

Certain data quality approaches were followed to deal with the main challenges associated with cross national comparative research: the language of data collection, the translation process, the matching of samples, the timing of data collection, and the consistency of the research process and instruments [29]. The two cases used the same interview protocol to ensure consistency and respondents were interviewed in their native languages. The AIRNow-I case involved researchers from both the US and China; the researcher for the Hajj-MDSS case is a native Arabic speaker and fluent in English and therefore interviewed all participants in their native languages. Data analysis was conducted by researchers who are fluent in the languages in which data were collected. In addition, a high level of role matching between respondents across the two cases was sought by interviewing all key participants in both cases. Finally, data were collected after both systems were implemented although data collection for AIRNow started right after project completion while data collection for the Hajj-MDSS case took place eighteen months after implementation.

Given the goals of this research, the cases were purposively selected for several essential characteristics. First, both cases involved complex sharing and exchange activities at the transnational levels. In both cases our research team included members who were native to the involved countries and native speakers of the languages used for interviews. In addition, case similarities (e.g. both involved the US and developing country, both involved ICT) and differences (e.g., different policy domains and time considerations) provided both anchors and points of departure for testing the robustness of our concepts.

## 4. Case comparison

The Hajj-MDSS and AIRNow-I cases are similar in five aspects. First, the goals of both networks were centered on capacity building and adaptation of advanced technologies to deal with a pressing global concern, air quality in the Shanghai case and a potential health crisis in the Saudi case. Second, both cases involve the US as one network partner working with a developing country with a substantially different approach to government administration. While the AIRNow-I case involves China and the Hajj-MDSS case involves Saudi Arabia, government organizations

in both countries are similar in terms of their usually strict hierarchical arrangements and formal relationships between one level of organization and another. Third, both cases are centered on adapting an existing system to suit a new context. In both cases, the focal information systems were initially developed by US companies under contract to the government and each case involves a US federal agency that had already applied these technologies and had expertise in adopting and using them. Last, both cases took advantage of highly visible domestic or international events, the Shanghai World EXPO and the 2009 Hajj. These events provided strong incentives to innovate, accept new forms of cooperation, and find the resources to support the work.

The cases also have major differences. First, they tackled issues related to two different policy domains: air quality and public health. Second, while participants in both cases were working under time pressure as the dates for EXPO and the Hajj were fixed, the time available in the Hajj-MDSS case was much shorter. Third, the Saudi and US organizations had a long-standing relationship including the fact that CDC had stationed a US public health representative in Saudi Arabia for a number of years. In the AIRNow-I case a high-level MOU had been in place at the diplomatic level for some years, but the working level relationships were being built for the first time. Fourth, the Hajj case was dealing with a near term crisis, while AIRNow-I addressed a long term problem. Finally, funding was a serious challenge in the AIRNow-I case with both US and Chinese participants repeatedly seeking funding, while all funds to ensure successful adoption of the Hajj-MDSS were provided by the Saudi government through the CDC Foundation, an independent, nonprofit organization established by Congress in 1995 to connect CDC with private and public entities to improve global health.

The following subsections discuss similarities and differences in contextual distances in the cases.

### 4.1 Cultural distance

Cultural distance and language differences were evident in both cases but their influence differed. In the Hajj-MDSS case, recruiting participants who were able to work in multiple languages and cultures contributed significantly to bridging cultural distance. For instance, most participants from CDC had a long history working across different cultures and some of them were fluent in Arabic and shared the Islamic culture. At the same time, all participants recruited by Saudi's MoH were fluent in English and several had been educated in the US or Canada. Accordingly, everyday communication was not difficult among participants.

However, lack of Arabic-language support in the software was a major challenge. Because of time limitations, Saudi MoH leaders agreed to use English for the software while temporarily maintaining the existing paper-based surveillance system in Arabic. This decision placed a burden on Saudi public health practitioners who then had to work with both systems. Language differences also increased work for both sides during the training phase. While one participant translated the CDC's training materials into Arabic, others who were fluent in both languages acted as translators during the sessions conducted by CDC trainers for health care practitioners who were not fluent in English.

Cultural distance also had negative effects. Saudi national law rests on religious foundations and prevents non-Muslims from entering the holy cities of Makkah and Al-Madinah. Most, but not all, CDC experts were Muslim-Americans. Those who were not were unable to conduct training or to provide direct assistance during the execution phase in Makkah but could only be available via phone or email from a distance. The ability of the Saudi participants to identify, assimilate, and exploit knowledge from their CDC counterparts substantially mitigated this distance as they were able to conduct the planned training session in Makkah their own.

Everyday communication was a major challenge in the AIRNow-I case. Although several SEMC personnel understood English, only one US participant, a native of Hong Kong educated in the US, understood Mandarin. Thus, by virtue of his technical background and personal history, he became an indispensable link between the two teams. Among the Americans, he spent by far the most time on the project, making trips to Shanghai that lasted several weeks each. He helped bridge the two parties with technical knowledge, cultural understanding, and language skills. These were important not only in face-to-face communication, but especially in the bi-weekly phone calls between the two teams when he served as technical expert, troubleshooter, and translator for both sides.

#### **4.2 Political distance**

The two networks were influenced in different ways by political distance. Although their governing systems and policies are different in many respects, strong long-standing national relations between the US and KSA contributed significantly to bridging political distance in the Hajj-MDSS case. These relations played a facilitating role in logistical considerations such as obtaining multi-entry visas, but more important, prior collaboration and geo-political alliance helped promote organization-level collaboration

toward the project goals. The speed at which the Saudi government approved the collaboration with CDC and the funds it provided demonstrated both internal political support and its strong relationship with the US. However, while strong political relations were clearly instrumental in achieving better outcomes, CDC participants also pointed out their commitment to assist any country to tackle a public health issue regardless of its political relations with the US.

Political relations between China and the US are constantly under development and challenged on many fronts. While there are some areas of agreement, many differences exist in governance systems and in economic, social, and other policies. In the AIRNow-I case, agreement existed on the need to reduce air pollution, but there was no agreement that informing the public about air quality measurements should be part of the strategy. The pollution measurements themselves reflected different approaches to the problem. In the US, a single stringent standard is applied nationwide and states are held accountable for meeting it. In China, different standards are applied in different parts of the country, accountability is just emerging, and none of the standards is as strict as in the US. Environmental quality and economic considerations compete in both countries, but in China economic development has clear priority, while in the US the competition between them is more balanced.

#### **4.3 Intention distance**

Intention distance is shaped by both dissimilarities and congruence among participant goals. The goals for the Hajj-MDSS were closely aligned with the visions and missions of both the MoH and the CDC. For the MoH, the Hajj-MDSS represented one element in a larger array of tools and strategies to address the challenges posed by the H1N1 pandemic. In a similar vein, the goals were closely aligned with the CDC's 60-year old vision and stated mission to use its scientific expertise to assist other countries in improving their public health capacities and conditions. At the technical level, goals were highly consistent between the two teams – to design and implement a mobile public health surveillance system effective for mass gatherings. These closely-aligned goals and similar organizational visions and missions enhanced productivity, bridged the already narrow intention distance, and provided an environment for free exchange and application of expertise.

The motivations for collaborating on AIRNow-I were clearly compatible given the histories of the participants in dealing with air quality issues, but they also differed in significant ways. Both countries were interested in modern technological systems and

software for air quality reporting and forecasting. However, their desired uses for the data were quite different: the US promotes open and broad sharing of air quality information with the public and has made expansion of this process to the international community a leadership priority. AIRNow-I Shanghai provided the opportunity to pilot the AIRNow-I concept in a real world international setting with a willing and competent partner. In Shanghai and China, the need for robust, high quality data is also clear, but it is targeted for internal government use, to help policy makers understand air quality problems and to use air quality measurements to mitigate pollution from the sources. Additionally, Shanghai has its own leadership priorities and sought to become the first international site for AIRNow-I in order to deploy and showcase a state-of-the-art air quality notification and forecasting system during the 2010 World EXPO.

#### 4.4 Organizational distance

By the time joint work on the Hajj-MDSS began, both organizations had worked together for many years and were familiar with each other's typical approaches to work, technical capabilities, and resources. The challenges they experienced resulted mainly from differences in their organizational cultures and showed up in unexpected ways. For instance, CDC proposed a system that would have allowed access to the server via the Internet. MoH obtained mobile devices that allowed access only to the Ministry's internal network. In this instance, the behavior of the MoH revealed how its organizational culture values security over flexibility and control over cost-effectiveness.

In AIRNow-I, organizational cultures created quite different contexts for the work in the two countries. Government organizations in China seek formal approval and assured funding ratified by successively higher level authorities before they take action on almost any matter. In the US, government agencies have a fair amount of autonomy and discretion as long as they are within the scope of their missions. The Shanghai team used a variety of standard and unconventional means to explain and promote the project to initially unwilling leaders. Through persistence and persuasion, they eventually obtained formal permission for an international project, as well as a special funding allocation. Once approvals were in place, they could move forward relatively rapidly toward the approved goals with limited, but assured, resources. On the other hand, because EPA has global goals but no official international portfolio, its international work is more a matter of opportunity and situation. Consequently, the EPA team began informal work under the broad terms of the existing bi-lateral

MOU, but without a regular budget appropriation. Eventually, they obtained initial funds from the R&D budget which supports innovative initiatives for international sharing of air quality information. As a result, as needs changed, EPA had the freedom to adjust its strategy and work plan, but it was also repeatedly looking for funding for its part of the work.

#### 4.5 Relational distance

The historical relationship between the MoH and CDC dates back to 1989 when the Saudi Field Epidemiology Training Program (FETP) was established as a joint venture. FETP was a training and research program to strengthen the capacity of the MoH and other health institutions in KSA and other Gulf States to use epidemiology to address existing and emerging health concerns. From 1989 to 1999, CDC worked closely with Saudi MoH to establish the program and assigned an in-country resident advisor who provided direct technical assistance. When the commission terminated in 1999, the resident advisor returned to US but the program continued its training and research activities. About five years ago, Saudi MoH and CDC signed a short term consultation agreement for CDC experts to visit the KSA to assist MoH in evaluating programs and conducting other investigations. By the time the joint work on Hajj-MDSS started, collaboration and knowledge exchange were common practices. The relationship that had lasted for more than 20 years had produced a high level of trust and mutual understanding that facilitated joint work on the project. Both parties were able to agree on the elements of the proposal in less than one month and the smooth working relationships existed throughout.

In the AIRNow-I case, both sides invested significant amounts of time in relationship building before any actual system development. During the first four years of the effort, neither funding nor political support was sufficient to enter into a formal working relationship to jointly develop a system. This delay proved to be fortuitous as it provided an extended period for familiarization and relationship building. The very narrow relational distance among participants in the Hajj-MDSS cases promoted sharing activities and facilitated easy data access by CDC experts. This was not the case in AIRNow-I where it took a considerable length of time to reach to the level of trust which allowed US participants any access to the data. Near the end of the project, STI was given access to the Shanghai monitoring data for reliability testing and assistance to the Chinese forecasters, but only after the development and signing of a data confidentiality agreement. However, while the data was not available to the Americans for their own use, the fact that they

could see and analyze the data to support the Chinese effort was a clear indication that trust was being built between the two teams.

#### 4.6 Knowledge distance

Different kinds and levels of knowledge were evident in both cases. In the Hajj-MDSS case, participants from both countries brought considerable surveillance expertise to the project. However, the Americans were more advanced in using mobile technology while the Saudis had greater knowledge of the practical obstacles to disease surveillance during the Hajj. Awareness of these knowledge differences, along with genuine openness to and acceptance of different points of view was evident throughout the project. One Saudi manager discussed dealing with conflict by “sitting at one table, where everyone from both teams had equal voice” to discuss the different points of view and seek consensus on specific actions..

Similarly, the Chinese and US participants in the AIRNow-I case both brought considerable technical expertise to the project, as well as specialized knowledge in different domains. Both sides had experts in system development and in air quality data analysis. However, the Americans were more advanced in using air quality data for forecasting and public outreach, and the Chinese had greater knowledge of local demographic and economic conditions that impinge on air quality, including the effects of rapid urbanization and industrialization. In this context, they worked together to define the core AIRNow-I data management system. The Americans then took the lead on core system development, while the Chinese simultaneously developed customized modules linked to their domestic systems and regulatory requirements. During the critical launch period, the STI meteorologists assisted the Chinese forecasters in preparing pollution forecasts for both government use and public posting on the Expo website.

#### 4.7 Resource distance

The performance of both networks was linked to the participants’ ability to marshal different types of resources including expertise, funding, technology, data, facilities, and internal relationships. In the Hajj-MDSS, the contributions of both the MoH and the CDC were commensurate with their goals and level of commitment, especially considering the importance of the Hajj to the Saudi government. While the MoH contributed all funding required for the implementation of the Hajj-MDSS, as it obtained the direct benefits of the system, the CDC still contributed hundreds of working hours by its experts. The unquestioned availability of funding was central to the speed of

agreement about the proposal. Little time was spent searching for funding, or negotiating funding responsibilities. In addition, human resources at the Saudi MoH were made available as needed and both organizations brought considerable surveillance expertise to implement the system and deal with challenges in the field. Thus, resource distance presented little challenge in this case.

Resource distance was clearly evident in the AIRNow-I case. Neither side started with enough money to support the work they wanted to do and neither country provided funding from regular budgets. One participant noted, “From 2004 to 2008, China and the United States maintained this project only by their will and intention.” During this time, Chinese staff went to the US to learn more about AIRNow and American experts gave lectures and training programs on forecasting in China. System development was delayed until April 2008 when SEPB committed funding for the Shanghai side of the effort and the US team obtained funding from EPA’s R&D Office. However, For EPA, funding was never assured from one year to the next, making planning especially difficult. As a result, the participants used a variety of unconventional methods to get the funds they needed. .

#### 4.8 Physical distance

In the Hajj-MDSS case, participants had to deal with multiple time zones to schedule planned teleconferences. The differences in workday schedules between the US and the KSA meant that overlapping business hours occurred on only three days of the typical work week. Webinars and teleconferences were used to share ideas and discuss issues, especially during the initial phases of the project and participants were willing to conduct them outside official working hours. These virtual meetings helped establish an initial understanding of the conditions of the Hajj and the requirements of the system. E-mail was useful for routine work and for keeping informed. However, face-to-face meetings became a primary mode of interaction essential to solving complex and sensitive problems leading to quicker decisions and better outcomes

Travel costs were high in AIRNow-I but face-to-face meetings remained critical for bridging physical distance. For example, when phone calls and email could not fully resolve a problem with the US-designed user interface, a visit to Shanghai by an EPA official allowed him to see the need to rework the software so it would be more intuitive for non-technical users. As with the Saudi case, IT and collaboration tools helped bridge the physical distances. Email proved to be pivotal as the Chinese team could read English quite well and the written information could be the focus for

more precise questions and discussions. Bi-weekly conference calls over Skype were affordable and flexible. The teams also began using software that enabled the Chinese to record on their computer screens what they were doing with the software thus allowing the US team to see what steps they was following when running into a problem and making it easier to pinpoint issues and fix them.

#### 4.9 Technical distance

Technical distance was an important problem in the Saudi case because of network infrastructure limitations and incompatibilities between the Hajj-MDSS and existing software. The MDSS system relies on Extensible Markup Language (XML) to facilitate sharing of structured data across the different components of the system. Although XML is an international standard for electronic data exchange, existing Saudi software could not use it and this required time-consuming manual processing and associated delays. Similarly, uploading reports from the field to the servers was often stymied by the enormous load on cell data networks that resulted from so many people simultaneously using mobile phones in the Hajj area. Field staff usually had only a few seconds of connectivity to accomplish this critical task.

Technical distance was a lesser factor in the AIRNow-I case. When EPA sought international partners, Shanghai was selected partly because it had a well established extensive monitoring network and was already collecting and using air quality data. However, connectivity was an issue here as well. Tasks that could be done quickly in the US could take 3 or 4 times as long in Shanghai due to slow network speeds.

### 5. Discussion

Both cases show evidence of all nine contextual distances. We tentatively conclude that all the distances are present in TPSKNs regardless of policy domain or any particular combination of political systems or cultures. We further observe that the size of the distances can exhibit quite different patterns in different empirical settings and that narrow distances for some contextual factors seem to mitigate the effects of wider distances on others. We summarize below the main effects of each distance and the strategies, tools, and behaviors that seem more likely to deal with them.

- Cultural distance: A TPSKN involving different languages and cultures seems to require at least some participants who are able to speak the relevant languages and work comfortably in multiple cultures. Ideally, these people would have lived and worked for substantial periods in these different contexts. Although it is very helpful for participants to speak and understand more than one language, this is not the same as “fluency” in different cultural contexts. Because culture is embedded in thinking and behavior, it influences values, norms, and beliefs that underlie perceptions, relationships, and actions. Cross-cultural knowledge sharing therefore requires serious attention to the apparent and subtle ways in which culture shapes interactions.
- Political distance seems to have only modest influence on TPSKNs designed to address clearly acknowledged international needs. In the case of the Hajj, pilgrims come from all over the world to the largest mass gathering anywhere. Their health during the event and when they return to their homes represents a world-wide concern that is not much affected by political systems and seems to have broad support from political leaders of all ideologies. However, when a TPSKN has strong potential to affect or challenge domestic policies, as in the AIRNow-I case, political distance is more influential in setting limits on both goals and the means to reach them.
- Intention distance: Both cases show that participant intentions need to be clear and compatible, but not necessarily the same. When goals are consistent and aligned with participants’ visions and missions, the likelihood of success increases and better outcomes and faster results are more likely. However, when intentions and goals are less consistent, success depends on finding an adequate overlap among different goals such that progress is also made toward separate objectives. We expect the sustainability of the network may be affected by the degree of goal similarity. In the Hajj-MDSS case, CDC and Saudi MoH were both willing to continue their bi-literal work after the completion of the 2009 project. CDC assigned a resident advisor and country representative to continue to work with KSA on public health collaborations. In AIRNow-I, the mutual benefit of progress toward improved global air quality was served by the different national goals (improved air quality monitoring and management for China, and creation of an internationally available, standardized monitoring and public reporting system for the US). However, these different national goals make a sustained bi-lateral effort less feasible.
- Organizational distance: Many opportunities for misunderstanding and wrong assumptions exist at the organizational level. They can undermine the network by wasting time and resources, or generating conflict, confusion, and unexpected problems. In AIRNow-I, the four-year period of

informal engagement created some understanding about goals, expectations, capabilities, and resources. However, these understandings had to be revisited and refined over time as more organizational factors became clearer to both sides. On the contrary, a long history of past collaboration and familiarity helped bridge organizational distance in the Hajj-MDSS case and thus it experienced fewer of these challenges.

- **Relational distance:** Trust is vital to transnational relationships as it is the foundation for effective sharing, collaboration, and learning. Once established, participants rely on trust as a facilitator and enabler for joint activities, including conflict resolution and problem-solving. Trust comes from repeated instances of trustworthy behavior under a variety of circumstances. Thus, a TPSKN appears to need a long gestation period of relationship building before explicit goals are set or projects are launched.
- **Resource distance:** In a successful TPSKN each participant brings resources that are commensurate with its own interests and its commitment to the network goals. While most kinds of resources are readily exchanged, it does not appear necessary to exchange funds in order to succeed. However, sufficient unilateral funding to support the work of each participant is clearly needed. The AIRNow-I case demonstrates that different funding sources, rules, and cycles can make this difficult, but not impossible. By contrast, the Hajj-MDSS case showed the benefits of readily available, reliable funding from a single appropriate source.
- **Physical distance** can be a strong impediment to collaboration and knowledge sharing but it can be bridged through multiple modes of interaction. In both cases, ICT tools proved to be important means of communication, but face-to-face meetings were more highly valued for problem-solving and for achieving faster results and better outcomes.
- **Knowledge distance:** both cases demonstrate that TPSKNs are not typical technology transfer projects in which a donor builds a factory or gives a complete system to recipient. They were long term engagements to bridge distances and create mutual value by sharing knowledge, expertise, and results. Accordingly, the success of any transnational collaboration seems to depend on the ability of participants to convey, assimilate, and generate knowledge through communication and mutual learning. This ability requires genuine openness and acceptance of different capabilities and views.
- **Technical distance** may represent a serious challenge in TPSKNs when implementing a new system or a adapting an existing system to suit a

new context. While some technical challenges are can be resolved by additional resources and new solutions, others such as limitations in existing ICT infrastructure cannot be addressed quickly. In these instances, network success depends on creativity and willingness to accept less than optimal solutions, at least in the short run.

## 6. Conclusion and future research

Contextual distances represent a useful way to assess, understand, and design transnational public sector knowledge networks. This paper described and compared two TPSKNs across nine contextual distances and discussed the influence of these distances on network processes and results. We summarized the strategies, tools, and behaviors that seem to narrow or bridge these distances.

There is still much to learn about TPSKNs. Our future research will explore the relative importance of different distances and whether less distance on some dimensions consistently compensates for or mitigates the challenges presented by other, wider distances. Better understanding of the relative influence of different distances would contribute to theory and to more practical strategies for managing these networks. Measurement is another area for future work. In this early stage we consider a distance wider when observation or documentation show considerable differences or difficulties compared to narrower distances where the participants are more similar or experience less difficulty in working together. These measures are descriptive and subjective. Future work will address measurement in a more structured way. We also plan to refine our understanding and theoretical development by looking at a variety of additional cases that involve other policy domains, more than two governments, governments at the same level of development, and cases that do not involve the US as a participant. All of these situations have the potential to enrich our understanding of TPSKNs and the complexity surrounding their core activities

## 7. References

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