



Localizing Complex Scientific Communication: A SWOT Analysis and Multi-sectoral Approach of Communicating Climate Change

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ABSTRACT

This paper argues that a SWOT analysis (Dyson, 2004; Helms & Nixon, 2010; Holtzhausen & Zerfass, 2015; Houben, Lenie, & Vanhoof, 1999; Noble & Bestley, 2011) and a multi-sectoral approach (Okware, Opio, Musingizi, & Waibale, 2001; The World Bank, 2000; Uganda AIDS Commission & UNAIDS, 2000) to strategic communication can provide communication designers with a conceptual framework for localizing climate prediction and risk management information. The overarching idea is to use a multi-way communication model, such as suggested by McQuail (1987), to downscale climate data in a way that better addresses the communication expectations of the public in different locales. Such approaches can reduce barriers that often inhibit the international transfer of technical and scientific data for public consumption in different global contexts. To examine these issues, this paper uses a SWOT analysis for considering strategic communication planning in international settings. In so doing, the paper examines the work of the Intergovernmental Authority on Development (IGARD) Climate Predictions and Applications Centre (ICPAC) in its efforts to respond to climate extremes and ensure disaster risk management in the Greater Horn of Africa.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Documentation, Design

Keywords

climate change, strategic communication, SWOT analysis, multi-sectoral approach

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Communication Design Quarterly. ACM SIGDOC, New York, USA.

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INTRODUCTION

Researchers have increasingly investigated visual representations of climate change information (see, for example, Manzo, 2010; DiFrancesco, & Young, 2011). Among these studies, several scholars agree that addressing the visual aspects of scientific communication is central to understanding how climate change information might be framed, mediated, perceived, and designed for international and local audiences (Anderson, 2009; Doyle, 2011; Sheppard, 2012; Igna, 2013; Thompson, Devis, & Mullen, 2013; O'Neill, & Smith, 2014; Wozniak, Luck, & Wessler, 2014). Within this context, communication design and technical communication researchers have contributed to these discussions by investigating ways of visually depicting information on risk, science, and climate change (Wickliff, 2000; Dobrin & Morey, 2009; Kain & Covi, 2013).

Given this increased interest, Cagle and Tillery (2015) argue that “opportunities remain for [technical communicators] to leverage... expertise in visual appeals,” as well as rhetorical approaches to digitally communicating climate change (p. 159). Following ideas noted by Grabill and Simmons (1998), Cagle and Tillery suggest that technical communicators can “play a role as advocates in wicked problems like climate change,” as well as “in the process of constructing and communicating risk” (p. 160). Related research can reveal important strategies for producing and disseminating effective materials for communicating climate predictions and related risks in different international contexts.

Despite the relevance of this research, the contextual environment wherein visual artifacts of climate change are produced and distributed has been considered a “scale of systems, and not simply as cognitive (framing) processes or the construction of meaning in individual subjects” (Cox, 2010, p. 130). Hence, there is a need to develop strategic approaches for communication design in complex, organizational settings and for audiences from different cultures (Hayhoe, 2012). Within this context, this entry seeks to

- Extend recent communication design research on climate change information

- Demonstrate how Strength Weaknesses Opportunities and Threats (SWOT) analysis and a multi-sectoral approach can be used for understanding contextual factors of localizing and downscaling climate change communication

By using the Intergovernmental Agency for Regional Development (IGARD) Climate Prediction and Applications Center (ICPAC) as a case study, this entry presents the results of a situation and audience analysis of localizing climate prediction in a complex, socio-technical system.

In examining these issues, the authors advocate for the development of a multimodal, multi-sectoral strategy (O'Neill, & Smith, 2014) for localizing scientific information to meet the information-seeking needs of different groups. To do so, the authors use SWOT analysis to review the complex internal and external environment within which ICPAC operates so as to design an effective strategic communication plan, as suggested by a number of scholars (Dyson, 2004; Helms & Nixon, 2010; Holtzhausen & Zerfass, 2015; Houben, Lenie, & Vanhoof, 1999; Noble & Bestley, 2011). In so doing, the authors also examine how a multi-sectoral approach can serve as an effective mechanism for localizing complex information for public consumption in different cultures.

CHALLENGES AND OPPORTUNITIES FOR LOCALIZING CLIMATE CHANGE INFORMATION

Historically, communication design research on internationalization and localization has focused on adapting information for end users in specific cultural contexts. Within this context, a number of scholars have suggested conceptual frameworks (e.g., the use of metaphors or the creation of personas) for understanding how messages and products might be designed for cross-cultural audiences in local and international settings (de Castro Salgado, de Souza, & Leitao, 2011; Getto & St. Amant, 2014). Additionally, researchers in communication design have suggested using conceptual frameworks, such as activity theory (Sun, 2007), to develop effective communication by understanding how artifacts function in larger systems of communication activity (Sun, 2009).

While research on cultural usability abounds, research based on understanding the “series of complex and constantly evolving cultural discourses” has been acknowledged as most critical for climate change communication (Hulme, 2007). The studies cited here indicate that internationalization and localization require strategic planning prior to designing audience-centered messages. Researchers working in this area have, in turn, identified three major challenges that affect communication strategies for localizing climate change information:

- *Challenge 1: Natural and social systems:* By “natural,” we mean the “natural environment” while “social systems” refers to societal organizations such as political or government and non-governmental organizations.
- *Challenge 2: One-way communication model of transferring information:* Here, “one-way communication” means a message comes from the sender to receiver, and the sender receives no feedback from that receiver – this is as indicated in the Sender-Receiver (S-R) model sometimes referred to as the hypodermic needle theory (McQuail, 1987).

- *Challenge 3: Probability:* By “probability,” we mean the fact that there is always a chance of error in climate predictions

Individuals working in communication design can mitigate the aforementioned challenges of climate change information by:

- Facilitating communicative interaction through activities such as dialogue between scientists and the intended audience.
- Promoting a participatory localization process by engaging in practices such as research that includes the intended audience and forums that promote dialogue between the scientists and the local citizens.
- Contextualizing the contexts of uncertain environments.

Realizing these approaches requires communication designers to engage in more effective and more informed practices related to sharing information about risk and climate change in greater international contexts.

Facilitating Communicative Interaction within Complex Socio-technical Systems:

Climate change communication environments are non-linear, dynamic processes composed of natural and social systems (Welsh, 2010). This complex, socio-technical environment creates barriers for localizing and downscaling scientific communication on climate change for specific audiences, such as scientists, policymakers, and the public. According to Birkman and von Teichman (2010), climate predictions and applications are based on global or entire country or regional models. To address such factors, scientists have adopted statistical downscaling to translate global projections to local and regional contexts; however, “this operation [has added] additional uncertainty to the results” (Markandya, Galarraga, & Murieta, 2014, p. 7).

Some researchers have noted that downscaling and localizing climate change communication involves more than statistical translation (Markandya, Galarraga, & Murieta, 2014). In fact, it is a complex, socio-technical process that creates significant challenges for climate researchers (Krauss, 2009). Moreover, critics such as Spence and Pidgeon (2010) have argued for the need to localize the climate outlook to the community level. Other researchers in the area of risk and climate change have further argued that the impact of climate extremes may not always be downscaled to the local communities (Birkman & von Teichman, 2010). As a result, a number of scholars have suggested adopting communication strategies that use more dialogic models of climate change communication strategies (Carvalho, 2008; Moser, 2010). The idea is that such strategies effectively enhance audience-tailored messages for climate change communication (Nerlich, Koteyko, & Brown, 2010). Communication design research can, in turn, enhance the possibilities for localizing climate change information by facilitating communicative interaction “in the socio-technical networks where communication does work” (Swarts, 2012, p. 13).

Promoting Participatory Localization over One-Way Models of Transferring Information:

Some researchers indicate that one-way approaches to information delivery create barriers for localizing and downscaling climate change information and risk prediction (Patt & Desai, 2005; Spence & Pidgeon, 2010). Such one-way approaches can include meteorologists disseminating climate prediction information to the public through mass media without any possibility of feedback

from the public. For instance, the above mentioned scholars argue that climate scientists and prediction experts use a one-way communication model to transfer climate information and predictions to end users. Such users include farmers, fishermen, and traders—all audiences affected by such situations but who also do not understand the complex climate scientific data.

Additionally, there is often little dialogue between the climate scientists and the aforementioned most critical end users. An illustration of this situation was given by Vogel and O'Brien in their 2006 article "Who Can Eat Information?" In this entry, the authors stipulate that during the 1997-1998 climate outlook forum of the Southern African Development Community (SADC), there was a mechanism for interaction and discussion. Because of the one-way communication model used by the climate scientists involved in the undertaking, the effort did not yield the intended goals. In this case, the climate scientists failed to consider the end users of the information they provided; thus, that information went, largely, unused by the intended audience.

One important way to address such problems is to consider climate and risk communication from the perspective of the audience with which one wishes to share information. In essence, user-centered design opens possibilities for designing climate change information by engaging participants in the internationalization and localization process (Verweij, Marinova, & Lokersm, 2014). And this connection has not been lost on those working in the communication fields. Communication design researchers, for example, have recently called for participatory approaches for localizing information (Agboka, 2013). In so doing, they note that end-users are too often viewed as onlookers in user-centered design rather than putting end-users at the center of the design process.

Further complicating this problematic situation is the concept of probability. In essence, probability creates a major obstacle for localizing climate change information because chances of error mean predictions might not actually happen. For instance, it may be predicted that the rainy season will start at the beginning of March. If this does not happen/if the season starts later, this delay could confuse farmers who rely on this information for scheduling the planting of crops. (As such, this situation could result in less crop production and hence less income for farmers for that season.) Thus probability creates major challenges related to planning many climate-related communication solutions in advance.

Conceptualizing the Contexts of Uncertain Communication Environments:

Climate prediction, applications, and disaster risk reduction are fundamentally complex and involve uncertainty (Markandya, Galarraga, & Murieta, 2014; Moser, 2010; Patt & Desai, 2005; Spence & Pidgeon, 2010). Additionally, as Vogel and O'Brien (2006) suggest, climate predictions take place in an uncertain environment where science cannot make perfect predictions and where there is always a chance of error. Vogel and O'Brien go on to note that this complex environment is often not well understood by climate scientists themselves. Thus, while advances in scientific research have led to improved climate science, communicating climate change has suffered from uncertainty "because it is insufficiently understood and never entirely predictable" (Moser, 2010, p. 35).

The first step in rectifying this situation might be getting both climate scientists and end users to comprehend and accept this

fact. Hence, there is dire need to better understand the complex environment within which climate prediction, applications, disaster risk reduction operates as a system. In this realm, communication designers are well poised to make important contributions.

Communication design researchers have created an array of resources for contextualizing information – particularly complex information – such as that associated with discussing climate change. Such resources can be invaluable when attempting to address complex and difficult-to-predict situations such as those associated with climate change. Applying such resources effectively in international contexts, however, requires us to reconsider existing approaches to communication design. Such reconsideration is needed, for the contexts associated with adapting information for different international audiences are often not the same. Thus, information needs to be contextualized according to various user expectations couched within the additional complexities of cultural and organizational settings (St.Amant, 2015).

Communication in such environments, moreover, is not a one-way conveyance of information. Rather, it is a continual process of give and take. As Cagle and Tillery (2015) explain, the challenges of this situation mean communication designers might "lose a sense of how global topics such as climate change are shaped by national events and discourses, including political shifts, institutional cultures, and mass media coverage" (p. 159). Thus, opportunities exist for communication designers to investigate how they might adapt climate change information to share it effectively with audiences in different international settings.

The aforementioned challenges and opportunities illustrate strategic approaches for localization that occur at the design planning stage. As Aaron Marcus (2001) suggests, researchers should investigate the "challenges or opportunities for globalization," as well as "establish objectives and tactics" (p. 53). To address such factors, Marcus provides general guidelines for globalizing information. These include "determin[ing] the appropriate media for the appropriate target user categories" (p. 54). The challenge in these situations becomes finding different frameworks, approaches, and practices for realizing such factors.

One mechanism for addressing this situation is through the use of a SWOT analysis and a multi-sectoral perspective. In combination, these approaches can form an approach that communication designers can use to understand and address complex international interactions among multiple actors. As such, SWOT analysis and the multi-sectoral perspective can help communication designers to develop effective strategies for participation in the localization process and in contextualizing internal (strengths and weaknesses of the organization) and external (threats and opportunities in the environment) factors affecting internationalization and localization strategies. The next section outlines the research context and questions that are addressed through SWOT analysis. Following the results of the SWOT analysis, the researchers demonstrate how the multi-sectoral perspective can further help communication designers to strategically develop climate information for multiple audiences.

RESEARCH CONTEXT AND QUESTIONS

A number of scholars have suggested climatic conditions involving too little or too much rainfall has left sub-Saharan Africa prone to chronic food insecurity and famine (Vogel & O'Brien, 2006). Moreover, extreme variations in climate can lead to poor agricultural

production and economic stress. Communicating the complexities of climate change, prediction, applications, and disaster risk reduction information in relation to such contexts has presented significant challenges to a number of organizations. These include ICPAC, country meteorology officers, and governments in the sub-region of the Greater Horn of Africa. ICPAC's mission is to provide residents of the region with early warning climate information that can allow for timely decision-making. It is also responsible for supporting specific sector applications designed to enable the region to cope with various risks associated with extreme climate variability.

The idea, in this case, is to facilitate the kinds of change associated with poverty alleviation, environmental management, and sustainable development in member countries (ICPAC, n. d.). During the 36th Climate Outlook Forum of the Greater Horn of Africa (GHACOF 36), the first author of this entry was invited to deliver a presentation on building mass communication resilience to climate extremes. A majority of the participants at both GHACOF 36 and later GHACOF 37 agreed that while the science of climate prediction by climate scientists has made tremendous progress, there is dire need to communicate the complicated science information to all stakeholders and end users in the sub-region. During GHACOF 37, for example, a representative from the World Meteorological Organization (WMO) recommended that there is need to take the issue of communication seriously.

In response to the various ideas and contexts noted in the earlier sections of this entry, the researchers sought to address the following research questions in relation to expanding communication design to more effectively share complex, climate information in global contexts:

RQ1: What communication design aspects constitute strengths and contribute to effective communication design practices about climate in international contexts?

RQ2: What communication design aspects constitute weaknesses and limit the effectiveness of communication materials designed to convey climate-related information in international contexts?

RQ3: What opportunities are there for enhancing or improving communication practices associated with the external environment surrounding organizations dealing with climate-related issues in international contexts?

RQ4: What are the greatest threats to effectively communicating climate-related information by organizations in international contexts?

Using these questions as a guide, the authors sought to investigate these issues via a research process involving a combination of the methods noted earlier in this entry. Whereas SWOT analysis was used to analyze the internal and external factors of ICPAC's strengths, weaknesses, opportunities, and threats, the multi-sectoral perspective was used to determine how communication designers might develop audience-centered messages and campaigns.

METHODOLOGY

A number of scholars have suggested that the SWOT analysis approach is a central component in strategic planning for organizations in business management (Helms & Nixon, 2010; Houben, Lenie, & Vanhoof, 1999). Recently, scholars in the field of communication design have noted that the SWOT analysis approach

also has a great deal to offer researchers and practitioners in the field (Karjaluoto, 2014; Noble & Bestley, 2011). For instance, the SWOT analysis approach is deemed as the first step in the research phase in the public relations campaign planning process (Houben, Lenie, & Vanhoof, 1999). The authors further explain that the SWOT analysis process represents a natural start to developing a strategic plan, for such an analysis helps individuals to identify the complex and dynamic environment within which any organization or business operates.

Advocates of this method further argue that the use of SWOT analysis provides a more complete understanding of the variables that may help or hinder an organization in reaching its objectives (Helms & Nixon, 2010; Houben, Lenie, & Vanhoof, 1999). Others note that the SWOT analysis approach enables researchers to analyze the environmental strengths, weaknesses, opportunities, and threats that affect the functioning of any organization (Dyson, 2004). These scholars also argue that a key benefit of this approach is that it identifies a range of organizational strengths and weaknesses relating to key internal factors such as human resources and products. Opportunities and threats identified via such an analysis, however, are connected to external factors (e.g., such as politics, policy, the economy, and organizations in the environment). Thus the approach has its benefits (enhanced understanding of internal factors) and its limitations (minimal understanding of external factors). It does, however, provide communication designers with a mechanism for understanding the internal factors that can affect the communication of climate-related information within a given organization.

Advocates of this method explain that it involves two steps (Chang & Huang, 2006; Seker & Ozgurler, 2012). The first step analyses the internal strengths and weaknesses of the organization that may impact its strategic planning. The second step analyzes the opportunities and threats in the external environment that may impact the success of the strategic planning of the organization. These two steps were used to understand the internal strengths and weaknesses of ICPAC and the external opportunities and threats that impact the designing of effective strategies for communicating complex climate science information to various stakeholders. The SWOT analysis uses an informal process to collect and analyze data unlike other research methods such as focus groups, surveys, in-depth interviews, and content analysis, which use a more formal process. In the following sections, the researchers explain the procedures for collecting data and steps for analyzing archival material.

Data Collection

The overall data collection process began when the first author conducted informal research at ICPAC Headquarters in Nairobi, Kenya between May 13 and June 20, 2014. The purpose of these initial activities was to identify materials for analysis. This process involved less structured data collection and similarly less-structured analysis of that data (Simmons, 1983). During this data collection process, the first author conducted archival research at ICPAC headquarters and assembled the following materials for analysis:

- Ten annual reports ICPAC published between 2000-2010 (each year ICPAC publishes an annual report that documents the activities of the organization, the goals for that year, which of the goals for that year the organization accomplished and which it did not). These reports were selected for analysis because they provided organization-specific data including the

organization's goals, objectives, and activities during a given year, the organization's achievements for a given year, and the challenges it encountered during that year.

- Six quarterly newsletters published by ICPAC in 2012-2014 (ICPAC publishes a quarterly newsletter it distributes to meteorologists, agriculture officers, forest officers, fisheries officers, policy makers, and the general public in the 10 countries that cover the IGAD region – Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, and Uganda.) These newsletters were selected for analysis because they could provide additional information to supplement the data found in the annual ICPAC reports.
- Charts ICPAC meteorologists produced to display at GHACOF in 2012-2014 (meteorologists showed these charts to display the predicted and actual climate conditions in the Greater Horn of Africa for this two-year time frame). The charts were selected for analysis because they provided examples of the climate predictions ICPAC makes for and shares at each of the climate outlook forums it holds every year.

These particular items were selected because they represented materials used to share climate information across various sectors within and outside ICPAC. As such, these materials represented the kinds of multi-sectoral items communication designers should collect for analysis in order to identify factors that could affect the presentation of complex information in various international contexts. Once the materials for review were assembled, the researchers conducted a SWOT analysis of these items to identify different trends related to sharing information in international contexts.

For this research, SWOT analysis was used to analyze the external and internal environment within which ICPAC as an organization operates. By doing so, the researchers were able to identify the strengths, weaknesses, opportunities, and threats that lend themselves palatable to localizing complex climate scientific information. In turn this enabled the researchers to suggest ways that can be used by designers of complex climate science information. In the next section, we outline the SWOT analysis.

Analysis

Each of the annual reports, newsletters, and charts were read by the first author and notes were taken to address the strengths, weaknesses, opportunities, and threats. In the SWOT analysis process, the category of "Strengths" refers to the advantages that ICPAC has as an organization that produces climate change predictions and applications data. For this analysis, the researchers reviewed the documents for factors such as the scientific technical components that make up ICPAC as a system as indicating "strengths." From this analysis, the researchers were able to collect data on the scientific expertise that ICPAC possesses for producing climate prediction and applications data.

In the SWOT analysis process, the category of "Weaknesses" refers to structural components within ICPAC such as differentiated units and expertise – meteorology and meteorologists, hydrology and hydrologists, agriculture and agriculturalists, health and health officers – which leads to lack of effective communication and information flow of the complex scientific products and applications by these units and experts. For this analysis, the researchers reviewed the documents for factors such as the bottlenecks in the communication of information, products, and applications between

the various units and experts as indicating "weaknesses." From this analysis, the researchers were able to collect data on how the information, products, and applications were communicated among the units and experts at ICPAC.

In the SWOT analysis process, the category of "Opportunities" refers to the unique role that ICPAC can play among the various sectors – meteorology, agriculture, fisheries, general public – in the 10 countries under IGARD. For this analysis, the researchers reviewed the documents for factors such as the contacts and connections between ICPAC and the various sectors in the 10 countries under IGARD as indicating "opportunities." From this analysis, the researchers were able to collect data on what extent ICPAC communicated to the various sectors in the 10 countries under IGARD.

In the SWOT analysis process, the category of "Threats" refers to the challenges that the differentiated audiences and stakeholders that ICPAC'S complex information, products, and applications are aimed at serving. For this analysis, the researchers reviewed the documents for factors such as the differentiated environment within which ICPAC operates and the complex nature of the scientific climate information, products, and applications as indicating "threats." From this analysis, the researchers were able to collect data on the final recipients of the complex scientific information, products, applications were communicated by ICPAC.

Through this approach, the researchers noted a number of trends that have important implications for communication designers who wish to share climate change (and related risk) information effectively across sectors and in international contexts.

RESULTS

Internal Factors of Strengths and Weaknesses

Strengths: The results of the SWOT analysis indicate that ICPAC has three sub-systems—water resources, agriculture, and disaster risk management. The strengths of ICPAC lie in the human resources in form of experts that these three sub-systems possess. These experts include meteorologists, hydrologists, and agriculturists who are well-trained and are capable of executing the objectives of ICPAC and capacity building within the sub-region. These strengths can be seen in design factors such as the complex data sets, charts, and presentations that the experts at ICPAC produce for display at the various forums for downscaling of the climate outlook every year.

In addition, the results of the SWOT analysis show that ICPAC has the capacity to acquire new climate data including remotely sensed data; develop and archive national and regional climate databanks including calibration of satellite derived climate records; process and develop data and basic climatological statistics required for baseline risk scenarios, detection and attribution of climate change, processes, studies and other applications; monitor, predict, and provide early warning information of the space-time evolutions of weather and climate extremes over the sub-region; downscale and apply climate information and prediction services required by the individual climate sensitive sectors, including integration of indigenous knowledge. As mentioned before, these strengths accrue from the unique expertise that the various units that make up ICPAC as a professional organization. These experts are well-trained and are knowledgeable in their various areas. Furthermore, all the various units have international experts from all over world including Europe and the United States who supplement the experts from the 10 countries in the sub-region.

Weaknesses: The results of the SWOT analysis reveal one major weakness within ICPAC. It was surprising that there is lack of effective communication of the complex climate information, products, and applications between the experts in the three sub-systems of ICPAC. It is conventional wisdom that there would be information flow and feedback between ICPAC's subsystems. However, the results show that this is not the case. As mentioned above there are meteorologists, hydrologists, and agriculturalists at ICPAC. These professions have different goals and hence their complex scientific climate information, products, and applications are not shared until the sub-regional forums for downscaling the seasonal climate outlook. This is because the three sub-systems do not conduct meetings to discuss their research and findings on climate information, products, and applications. Hence, the various experts remain in their silos and do not communicate or discuss the complex climate information, products, and applications with those outside their profession before the sub-regional forums for downscaling of the seasonal climate outlook. Yet, in order for the three sub-systems to function properly there must be constant flow of information and feedback between them. This is a major weakness and has practical and theoretical implications for designing effective strategies for communicating complex science information in any field.

The results of ICPAC's internal aspects reveal that designers must address the multiple systems and potential lack of effective communication wherein visual artifacts and messages about climate change are developed. Though designing complex scientific data for the public stems from processes of downscaling and localizing climate change information, the experts in ICPAC's sub-systems do not share information, products, and applications throughout the process that leads to adapting communication for local audiences. One way to address the internal factors is using systems theory as guide for designing climate change communication.

According to systems theory, organizations are systems made up of interdependent parts or subsystems (Bertalanffy, 1968). The theory further stipulates that some organizations are open while others are closed. In open systems, there is information flow and feedback among the different subsystems as well within the environment in which the organization operates (Kast & Rosenzweig, 1972; Katz & Khan, 1966; Zald & Scott, 2010). This process of interaction includes internal and external environments that encompass natural and social systems and as interdependent sectors. For example, North Carolina State University (NC State University) as an organization is an open system which is composed of different colleges and departments – sub-systems - and functions within the larger environment of the University of North Carolina system. There is interaction between NC State University and other universities in the University of North Carolina system. There is also interaction between the subsystems of NC State University. Closed systems, by contrast, restrict feedback between the environment and the system nor do they allow for interaction among the different component parts—or sub-systems—within the overall system. North Korea is a perfect example of a closed system. There is little interaction between this country and other countries such that little is known about it.

Systems theory can provide insights into these internal strengths and weaknesses of information exchange (or lack thereof) in relation to the organizations at work in such contexts. As such, it can serve as a valuable mechanism which communication designers can use to understand – and address – the complex context in which climate-related information is often shared and exchanged.

External Factors

Opportunities:

The results of the SWOT analysis further indicate that ICPAC has varied external audiences: (1) country climate scientists and meteorological officers, (2) sectors officers, (3) media, (4) politicians, policy makers, and government officials, and (5) end users. These varied audiences if identified properly, offer opportunities to design tailored climate science information messages with particular emphasis for each of the audiences instead of a blanket message. While communication campaign scholars have suggested the use of multiple channels to reach a bigger percentage of diverse target groups (Kiwauka-Tondo & Snyder, 2002; Kiwauka-Tondo, Hamilton, & Jameson, 2009), there is a need for segmenting the audience and identifying appropriate channels to reach differentiated audiences (Backer, Rogers, & Sopory, 1992; Backer & Rogers, 1994; Hornik, 1988, 1989; Kiwauka-Tondo, Hamilton, & Jameson, 2009; Kiwauka-Tondo & Snyder, 2002; Woods, Davis, & Westover, 1991). Communication designers could use a multi-sectoral approach to develop a number of strategies for effectively communicating complex climate prediction, applications, and risk reduction information for the aforementioned audiences.

It was surprising that during the Greater Horn of Africa Forums in which ICPAC presents the climate seasonal outlook a number of professionals from other sectors – agriculture, fisheries, forestry, and the media – from the host country are invited in addition to meteorologists and hydrologists. This forum offers a unique opportunity for ICPAC to have a dialogue with these professionals who can help to disseminate the seasonal climate outlook to their audiences more effectively. This is important since these professionals are the ones who are in contact with the end users – farmers, fishermen, and the general public - of the complex climate information, products, and applications from ICPAC. Furthermore, it was found that there is information flow and feedback between ICPAC and the external environment within which it operates. For instance, it was found that there is information flow and feedback between ICPAC, IGARD, the 10 governments within the Greater Horn of Africa, and the World Meteorology Organization (WMO). This also offers ICPAC a unique opportunity in terms of funding and sharing expertise, experiences, and information in communicating complex scientific data.

Threats:

The results indicate that communication designers face several threats for effectively developing strategic communication plan for ICPAC. First, the organization faces challenges of having three internal differentiated sub-systems and the need for dialogic communication. Second, ICPAC exists in a complex environment with various other organizations that impact it in terms of information flow and feedback as well as public policies. For instance, the policies and politics of the 10 governments within the Greater Horn of Africa, WMO, and the United Nations Environmental Program (UNEP) affect IGARD operations, funding, and functions. Moreover, there are other intergovernmental organizations such as the World Food Program (WFP) and the Food Agricultural Organization (FAO) whose policies and operations are affected and affect climate information, products, and applications. This presents a major challenge since ICPAC has to act in concert with these important organizations let alone compete with them for funding. Third, ICPAC has the challenge of coming up with an effective strategy which addresses the challenge of communicating complex climate information, products, and applications between

both internal and external systems in the environment within which it operates. To this end, the issue of climate extremes, prediction, applications, disaster risk reduction should be conceptualized in a holistic way that involves all pertinent sectors – public and private. At the same time ICPAC faces threats such as the political, social, economic, cultural environment within which it operates. For instance, political and economic instability in any country in the sub-region can lead to less financial resources available or support for its operations. Similarly the diverse nature of the stakeholders of ICPAC including meteorologists, agriculture and fisheries officers, politicians, media, and farmers makes the delivery of its products an immense challenge.

Communication designers have long considered the importance of audience-centered messages and information. Despite this understanding for adapting information for specific audiences, ICPAC's opportunities and threats reveal that audience design must be considered in terms of an organization's audiences. Though localizing complex scientific information about climate change for the public is important, climate change information flows through multiple sub-systems and sectors. Therefore, design strategies must also increase capacities for participation among these audiences.

In most cases, the central factor to success is for communication designers to conceptualize a central topic, the related audiences, and the plan for communicating information in a holistic way to that audience. Such a plan, however, generally involves all pertinent sectors – public and private (Arnell et al., 2014; GFDRR, 2014; Holman et al, 2005a, 2005b; Holman, 2006; Kempfert, 2005; Miles et al., 2010). Thus, when it comes to conveying risk information relating to climate issues, such an approach encourages communication designers to think in terms of conveying ideas across these sectors.

In the next sections of this entry, we demonstrate how communication designers might seize the opportunity to use an organization's strengths, weaknesses, opportunities, and threats in order to develop a communication strategy for climate science messages.

DISCUSSION

As this study indicated, analyzing the strengths, weakness, opportunities, and threats provides these entities with effective strategies for localizing climate change information for various sectors in an international context. Though organizations have used strategic communication campaigns to address the complexity of climate change communication, including framed perspectives and the development of audience-centered messages (Anderson, 2009; Igna, 2013; Thompson, Devis, & Mullen, 2013), this study demonstrated that designing a communication strategy also involves "purposeful communication activities" between different institutions and actors, including strategies to advance an organization's mission (Hallahan, Holtzhausen, van Betteke, Verčič, & Srirameshe, 2007). As Hallahan (2004) suggested, organizations commonly include six particular specialties, including management communication, marketing communication, public relations, technical communication, political communication, and information/social marketing campaigns. These entities may be involved in the strategic steps of campaign development, including situational analysis, audience segmentation, defining the goals of the campaign, developing a campaign strategy, implementing the campaign, and evaluating the effectiveness of the campaign strategy (Rossmann, 2015). Hence, for any strategy to succeed, it is crucial

that the developers of the plan identify the various audiences with which they wish to share information. We suggest that ICPAC adopts the multi-sectoral approach for the effective communication of complex scientific climate information, products, and applications.

The multi-sectoral approach was first introduced by the Uganda National AIDS Control Program (UNACP) in its response to HIV/AIDS in 1992 (Okware, Opio, Musingizi, & Waibale, 2001; The World Bank, 2000; Uganda AIDS Commission and UNAIDS, 2000). The idea was to approach HIV/AIDS not simply as a health issue, but instead as a complex topic involving multiple sectors – public and private. Many other countries in Africa, in turn, have adopted this approach for responding to the HIV/AIDS epidemic. One particular benefit is that this approach can be expanded to address a range of complex topics and situations affecting a greater, international population. In the case of ICPAC, communication designers can use the multi-sectoral perspective to further identify strategies for multiple audiences.

In the following paragraphs, we deal with each audience that is pertinent to ICPAC and recommend strategies to enhance effective communication of complex scientific climate information, products, and applications. In so doing, we identify three variables communication designers must address when creating plans for sharing complex information with diverse audiences – particularly diverse audiences in global contexts. These variables are:

- Demographic variables: These include factors such as, age, sex, and level of formal education
- Psychographic variables: These include values, beliefs, and lifestyles
- Technographic variables: These are the different types of technologies people use to get information (e.g., Instagram, Facebook, Twitter, blogs, and e-mail)

By understanding and accounting for these, communication designers can create more effective messages for complex and diverse international audiences.

Climate scientists and country meteorological officers:

To address this audience we shall begin with the demographic variables specifically educational level. This audience is made up of highly educated men and women no matter what their age. This audience's level of understanding of the climate science information is advanced and they are on the same page with producers of climate prediction, applications, and disaster risk reduction data at ICPAC. Hence the messages to this audience can be designed in more complex scientific terms. Furthermore, since this audience is highly educated, we recommend messages such as feature articles in newsletters explaining the scientific data from the climate prediction, applications, and risk reduction information. In terms of technographic variables, this audience has access to the Internet, laptops, and desktops and has the technical skills to surf the internet. Therefore, this audience can be reached using social media – twitter, blogs, Facebook, and Instagram. The advantage of this strategy is that it allows instant flow of information and feedback if it is managed properly. A listserv can be established with all e-mail addresses of this audience. In sum, this audience presents ICPAC with a unique opportunity to effectively communicate to them the complex climate information, products, and applications since they are more likely to understand scientific data.

Sectors officers – agriculture, water resources, disaster management, energy, forestry, urban development, health, and fisheries:

Regarding demographic variables, the most important characteristic of this audience is educational level. The results of the SWOT analysis indicate that sector officers are highly educated men and women of all ages even though they are not necessarily conversant with complex climate prediction, applications, and disaster risk reduction data. In terms of technographic variables, this audience is made up of professionals with diverse backgrounds and training—some are trained as scientists while others are social scientists. This means that the scientific messages from the climate scientists and meteorologists have to be packaged in various ways to reach such an audience. Hence we recommend the use of social media because it is likely that the audience has access to internet, laptops, and desktops and has the necessary technical skills. Second, since this audience can read, we recommend messages designed in the format of features in newsletters. Third, we recommend the use of forums to promote a dialogue in which meteorologists and these sector officers meet to discuss the complex scientific information. The idea of dialogue is emphasized so that this audience is given a chance not only to get information but also to discuss what the downscaling of the climate outlook means for each of these sectors and how they will communicate this to the end users in each country in the sub-region. Unlike the previous scenario breaking down this particular audience presents ICPAC an opportunity to understand them better and hence communicate the complex climate information, products, and applications more effectively.

Media:

Like the audiences described above, the media can be segmented using demographic, psychographic, and technographic variables. The results of the SWOT analysis show that this audience is made up of educated men and women of all ages. Most of this audience have access to the internet, and computers and have the necessary skills. The role of the media in communicating climate extremes, prediction, applications, and disaster risk reduction cannot be over emphasized. Numerous scholars have suggested that the media emphasize certain issues and by doing so transfer the salience of these issues to the public agenda (McCombs, 1997; McCombs & Shaw, 1972; Scheufele & Tewksbury, 2007; Spence & Pidgeon, 2010). Other scholars suggest that the media do not simply tell the public how to think about certain issues but frame these issues in such a way that influences the way the public thinks about them and understand them (Entman, 1993; Scheufele, 1999; Scheufele & Tewksbury, 2007; Spence & Pidgeon, 2010). In the case of climate change, Spence & Pidgeon (2010) argue that the media can frame the issues in a positive way so as to influence human behavior. Hence we recommend that communication designers should work with climate scientists, meteorologists, and the media to put the issues of climate extremes, prediction, applications, and disaster risk reduction on the public agenda by framing the issues in such a way to convey the seriousness of these issues. For instance, communication designers could work with all sectors, especially climate scientists, meteorologists, and the media to explain the meaning of the complex scientific data. Unlike hard news stories feature stories offer a chance for journalists to give details and background information. As we have seen in the previous case, breaking down this audience presents ICPAC an opportunity to understand them better and hence communicate the complex climate information, products, and applications more effectively.

Politicians, Policy makers, and government officials from the sub-region:

Like the audiences mentioned above, this audience can also be segmented using demographic, psychographic and technographic variables. According to the results of the SWOT analysis, politicians, policy makers, and government officials are made up of people from various professions – social scientists, liberal arts, lawyers, accountants, administrators. This audience may be highly educated men and women of all ages. Many of them are affluent and hence have access to computers and broadcast media such as television. However, this audience might not understand complex climate science terminology. In order to communicate complex science information to this audience we recommend using a number of strategies. First, this audience should be engaged in dialogue through various forums such as radio and television panels in which complex scientific data is discussed. This can ensure that this audience participates in the dialogue and are not just passive onlookers. Second, this audience can be reached using feature stories in newspapers explaining the complex scientific climate information. In the same vain as above breaking down this audience presents ICPAC an opportunity to understand this audience better and hence communicate the complex climate information, products, and applications more effectively.

End users – farmers, women, youths, traders, fishermen:

Of all the audiences, we believe that this is the most critical to ICPAC and hence requires extra attention and effort. The results of the SWOT analysis show that this audience does not understand the complex climate science terminology. On the other hand, this audience is also diverse and needs to be broken down into smaller target groups using demographic variables, psychographic variables and technographic variables in order to reach a larger percentage of them (Kiwanuka-Tondo & Snyder, 2002; Kiwanuka-Tondo, Hamilton, & Jameson, 2009). This also means that the messages to each of the target groups have to be packaged differently and in different languages. For instance, the level of education among this audience varies tremendously and may be correlated with sex or gender as well as economic status. Similarly, age makes a difference in the channels that are most appropriate to reach this audience. For instance, educated youths from urban areas may be reached using social media. On the other hand, less educated youths in rural areas may be better reached using radio. The issue of power dynamics also plays a major role in the strategy that can be used to reach this audience. Women have less power particularly in rural areas and do not make decisions about which radio programs to listen to. The implication is that much thought has to be put into the selection of which strategy to use for this audience.

Mass media could be used to reach this diverse group, such as radio panels and specific talk shows on climate extremes, prediction, applications, and disaster risk reduction. This strategy has been used effectively in the AIDS campaigns such as in Uganda (Kiwanuka-Tondo, 2013; Kiwanuka-Tondo & Snyder, 2002). While the majority of this sector has access to radio even in rural areas where the majority of farmers in the sub-region, the radio programs should be in various languages since this audience may speak different languages in each of the countries of the sub-region. In addition to radio, it should be noted that most people in the sub-region and Africa as a whole including those in rural areas have cell (mobile) phones. End users with particular reading and writing literacies

can be reached through this form of mass media, as well as feature stories in newspapers in various languages and social media for youths in urban areas. Mass media are good at raising knowledge but interpersonal channels are the best at changing attitudes and convincing people to change their behaviors (Rogers & Storey, 1987). Hence, community forums can be organized at the district or county or regional level to create trust and synergy between all sectors. These community forums should include traditional or cultural leaders and religious leaders in order to facilitate a dialogue on the use of indigenous knowledge in complex climate science information. Furthermore, traditional media such as music, dance, drama, and folklore can be used as participatory and culturally relevant forms of science communication. Hence, breaking down this audience presents ICPAC an opportunity to understand them better so as to communicate the complex climate information, products, and applications more effectively.

SUGGESTED DIRECTIONS FOR TEACHING COMMUNICATION DESIGN

While designing messages for different audiences is important for future research and practice for climate change communication. (Moser, 2010), a barrier to developing effective communication design strategies is that climate information and risk prediction occur in complex communication environments. To this end, it is suggested that using SWOT analysis for strategic planning can also be used in the classroom for teaching communication design research focused on localizing complex public communication

More broadly, communication design has been defined as a transactional and constructive practice of communication focused on developing communication artifacts, examining holistic systems and ecologies, and creating novel approaches for resolving problems (Frascara, 2006; Spinuzzi, 2012; Swarts, 2012). As a result, the responsibility of the communication designer has shifted from translating and transmitting information to the creation of spaces of “possibilities for communication” in order “strengthen the communicational power of the messages” (Frascara, 2006, p. xii—xiv).

This shift has signaled the need for strategic, holistic approaches to communication design (Spinuzzi, 2012), and understanding the role of the communication designer as a researcher, strategist, and storyteller (Zhou, 2015). “In technical communication education,” however, as Zhou (2015) argued “design is often narrowly defined as an activity of putting content on medium in a tangible format” (p. 53). Though user-centered design methods focused on “individual users in contexts” are well established in technical and communication design programs (Agboka, 2013, p. 42), these strategies are less focused on the “space of communities” (Mattson, 2011, p. 147).

By focusing on different situational contexts of localizing complex public communication and opportunities for participatory capacity building, educators might engage students in strategic communication design. This study demonstrated that SWOT analysis and multi-sectoral analysis are analytical mechanisms that can be used in the early stages of localization and internationalization, and can lead to effective strategies for designing multifaceted communication strategies rather than a single product.

CONCLUSION

Communication design is well-positioned to examine and address communicating the complexity of climate information and risk prediction (Dobrin & Morey, 2009; Wickliff, 2000; Albers, M. J., & Mazur, B. 2002; Cagle & Tillery, 2015). A lack of attention or “understanding of the frames within which communications operate” may, however, lead to communication design failures (Frascara, 2006, p. xix). Following researchers’ suggestion that communication design must examine, facilitate, and redesign systems wherein artifacts function in socio-technical ecologies (Spinuzzi, 2012; Swarts, 2012), this research study demonstrated that climate change communication problems arise from a complex environment involving multiple sectors within which climate prediction, applications, disaster risk reduction operate as a system (Markandya, Galarraga, & Murieta, 2014; Moser, 2010; Spence & Pidgeon, 2010; Vogel & O’Brien, 2006).

While this study did not investigate the production, consumption, or reception of messages or interfaces that mediate climate change communication for multiple audiences, it did illustrate strategies for understanding the opportunities and challenges for designing information that is internationalized and localized. At the same time, this study of climate information and risk prediction in the Greater Horn of African highlighted a general concern of internationalization and localization in communication design research: the need to understand cultural, political, and social contexts in order to effectively downscale and localize climate communication, such as media channels. Communication strategies that do not seriously address the culture of the audience are likely to fail (Kiwanuka-Tondo, 2013; Kiwanuka-Tondo, Hamilton & Jameson, 2009; Kiwanuka-Tondo & Snyder, 2002). Technical communicators and communication designers can further address the complexity of climate change information by accounting for both cultural usability of visual information and strategic approaches for localizing information through multimodal, multi-sectoral communication.

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