Boundary spanning between organizations in the healthcare sector,

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BOUNDARY SPANNING BETWEEN ORGANIZATIONS

IN THE HEALTHCARE SECTOR

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Abstract
Over the past decade, healthcare organizations were confronted with major challenges: increased costs, greater pressure towards accountability and transparency, as well as a diminishing labor supply pool. Consequently, across the health sector, new initiatives that focus on interaction, collaboration and increased sharing of information and knowledge are taking place. Although the fragmented or distributed nature of knowledge is not specific to healthcare organizations or the healthcare sector, it seems to be particularly relevant in this setting. Healthcare organizations are professionalized institutions in which different groups with specific practices, job representations, and values converge (Tagliaventi and Mattarelli, 2006). Similarly, Van Beveren (2003) asserts that healthcare organizations could be viewed as a collection of professional specialists who contribute to the delivery of patient care. They are deliberately referred to as "*collection*" as often these specialists work in discrete divisions within the organization, thus fragmenting the delivery of care. This situation impacts on the ability to create, disseminate or share knowledge throughout the organizations: data are held in a number of locations, managed by a variety of people and agencies, and stored in every imaginable format (Aldred, 2002).
While there has been some research on the use of boundary objects and the role of boundary spanners at group boundaries (Carlile, 2002, 2004; Star and Griesemer, 1989; Levina and Vaast, 2005; Bechky, 2003), the emergence, use, and influence of boundary objects and boundary spanners between organizations is not fully understood. This paper investigates the strategies used by boundary spanners in the healthcare sector to encourage agents from different organizational settings to join a new joint field by drawing on the concepts of boundary spanner. Using data from a qualitative field study, we argue that while some agents join the new field spontaneously, others may be reluctant to join the new joint field. Thus, boundary spanners have to find strategies to convince them to join the new joint field. Our data illustrate that boundary spanners operating in a network of organizations have to span the same boundaries than boundary spanners who operate within a single organization. However, we show how boundary spanners use various organizational and professional resources to create the new joint field. The conditions necessary for inter-organizational boundary spanners to emerge are outlined and discussed.

Keywords: Boundaries, boundary spanning, boundary spanners, knowledge management, emerging infectious diseases surveillance system.

INTRODUCTION

Most organizational work is heterogeneous, conducted by extremely diverse groups of actors. The ability of an organization to build practices that drawn on diverse bases of expertise constitutes one of the key organizational competencies in knowledge management (KM). According to the knowledge-based view of the firm, integrating various sources of expertise requires overcoming obstacles associated with knowledge embeddedness and tacitness (Levina and Vaast, 2005). Nevertheless, doing so can become a source of sustained competitive advantage (Grant, 1996; Kogut and Zander, 1992; Tsoukas, 1996). Recent studies of organizations (i.e., Ideo, General Electric and Nasa's JPL) have suggested that the success of these organizations is due in large part, to their ability to effectively engage their members in practices that allow them to span the boundaries of diverse settings (Carlile, 2004; Orlikowski, 2002; Levina and Vaas, 2005).

Academics, policy-makers and practitioners are increasingly interested in the contribution that effective management of knowledge across organizational and professional boundaries can make to improve the healthcare sector. Although the fragmented or distributed nature of knowledge is not specific to healthcare organizations or the healthcare sector, it seems to be particularly relevant in this setting. Healthcare organizations are professionalized institutions in which different groups with specific practices, job representations, and values converge (Tagliaventi and Mattarelli, 2006). Similarly, Van Beveren (2003) asserts that healthcare organizations could be viewed as a collection of professional specialists who contribute to the delivery of patient care. They are deliberately referred to as "*collection*" as often these specialists work in discrete divisions within the organization, thus fragmenting the delivery of care. This situation impacts on the ability to create, disseminate or share knowledge throughout the organizations: data are held in a number of locations, managed by a variety of people and agencies, and stored in every imaginable format (Aldred, 2002).

While there has been some research on the use of boundary objects and the role of boundary spanners at group boundaries (Carlile, 2002, 2004; Star and Griesemer, 1989; Levina and Vaast, 2005; Bechky, 2003), the emergence, use, and influence of boundary objects and boundary spanners between organizations is not fully understood. For example, Carlile (2002) provides an informative typology of boundary objects that work at different types of boundaries: syntactic, semantic, and pragmatic. This research dovetails with Carlile's (2002) findings, but also suggests some additional conditions under which boundary objects will or will not be useful. Additionally, we investigated boundaries between organizations while previous studies focused on boundaries at the group level. For example, Bechky (2003) examines how engineers, technicians and assemblers work together within the same company. Whereas the conceptualizations and loci of practice of these engineers, technicians and assemblers were different, they all had the goal of producing the same product. When members of different organizations are trying to work together, they might not have the same goal. We expand upon the current research on the strategies used by boundary spanners to span boundaries between multiple organizations, rather than solely concentrating on boundaries within a single organization.

To understand boundary spanning in a multi-organizational setting, this paper uses and extends upon a practice-based view on knowledge management (Carlile, 2002, 2004; Orlikowsky, 2002; Levina and Vaast, 2005) and data from a qualitative field study. It

contributes to KM literature by developing a dynamic perspective of the emergence of boundaries between organizations and on the ways to span them.
The paper is organized as follows. First, we review and extend a practice-based perspective on KM in organizations and then tie this perspective to the existing literature on boundary spanners. Next follows the details about the case study method and the research site. Then, we present our empirical approach and our analysis of the case study. The discussion section then expands our theoretical model on the basis of these findings. We conclude with the implications of our study for the theory and practice of KM in the healthcare sector.

THEORETICAL BACKGROUND

A practice-based perspective on KM in organizations

The proposition that spanning boundaries of diverse professional and organizational settings can become a key organizational competence has received extensive theoretical support (Grant, 1996; Kogut and Zander; 1992; Nonaka, 1994; von Hippel, 1998; Levina and Vaast, 2005). More recently, researchers have investigated the kind of organizational practices that actually allow firms to claim such competence (Carlile, 2002; Orlikowski, 2002; Levina and Vaast, 2005). We draw on these recent developments in the knowledge management (KM) literature while borrowing original ideas from Bourdieu's theory of practice (Bourdieu and Wacquant, 1992) in order to determine the actual practices used by boundary spanners to convince others to join the new joint field.

Existing approaches to studying distributed organizing tend to focus on the importance of knowledge transfer across boundaries, and the value of generating a set of "best practices" that can be propagated through the dispersed operations. A view of knowing as enacted in practice does not view competence as something to be "transferred", and suggest that the very notion of "best practices" is problematic. When practices are defined as the situated recurrent activities of human agents, they cannot simply be spread around as if they were fixed and static objects. Rather, competence generation may be seen to be a process of developing people's capacity to enact what we may term 'useful practices' – with usefulness seen to be a necessarily contextual and provisional aspect of situated organizational activity (Orlikowski, 2002). This perspective makes a distinction between knowing and knowledge, and emphasizes knowing as "an ongoing social accomplishment, constituted and reconstituted in everyday practice" (Orlikowski, 2002: 252).
This perspective allows us to understand the nature of boundaries in practice. As agents develop continuity in their local practices, it allows them to act knowledgeably in a given, material, historical and social context (Lave, 1988; Suchman, 1987; Levina and Vaast, 2005). At the same time, however, they are also distinguished from others who do not practice in a similar fashion (Wenger, 1998: 1003). Practice theorists have conceptualized this phenomenon as the emergence of fields (Bourdieu and Wacquant, 1992). By engaging in fields, agents pursue joint interest, but also differentiate themselves from outsiders who do not do the same.

Through their engagement in fields, agents produce different kind of resources (capital), which they can accumulate, and use as bases of power in any given field. Bourdieu distinguishes four key sort of capital: economic capital (e.g., money, time, technology), cultural capital (e.g., professional expertise, education, ownership of information), social capital (which social networks an agent can draw on), and symbolic capital (the ability to

name any other resource as valuable, the power to name and classify things). Agents in every field are engaged in producing a unique subspecies of either the economic, cultural, or social capital (Bourdieu and Wacquant, 1992: 119).

Discontinuities in practices (*boundaries of fields*) create opportunities for organizations to develop a knowledge-based competitive advantage. For example, as engineers engage in their professional practice, a boundary simultaneously emerges and grows between them and, for example, the field of practice occupied by those in marketing. Organizations that successfully engage engineers and marketing specialists in relating practices of these fields (which we will refer to as boundary spanning) develop a knowledge-based competence in product development (Carlile, 2002; Levina and Vaast, 2005).

Managing boundaries in the organization theory literature

Drawing on Shannon and Weaver's (1949) three levels of communication complexity – syntactic, semantic and pragmatic – Carlile (2004) scale the relative complexity of the circumstances at a boundary.

First, at a syntactic boundary, knowledge is transferred according to a common lexicon. When common lexicon sufficiently specifies the differences and dependencies of consequence at the boundary, the boundary proves "unproblematic"; the primary concern is one of "processing" or transferring knowledge across it (Carlile, 2004). Simply transferring knowledge, however, proves problematic when novelty arises because the current lexicon is no longer sufficient to represent the differences and dependencies now present. The transition from a syntactic to a semantic boundary occurs when novelty makes some differences and dependencies unclear or some meaning ambiguous.

Second, at a semantic boundary, a process of learning about and translating domain-specific knowledge establishes common meanings that become adequate for the actors involved to share and assess their knowledge. When new requirements and/or new actors are present, interpretive differences in what a word measurement, or outcome means limits the effective management of knowledge between actors. Researchers in this vein emphasizes processes that help create "shared meanings" (Dougherty, 1992) or mechanisms "to reconcile discrepancies in meaning" (Nonaka and Takeuchi, 1995) like cross-functional teams (Ancona and Caldwell, 1992), colocation, and the use of various shared methodologies. Others have focused on the role of particular individuals as brokers and translators who enable the flow of knowledge (Hargadon and Sutton, 1997). If a semantic response doesn't resolve the problem, then a pragmatic boundary is faced. The transition from a semantic to a pragmatic boundary arises when the novelty presents results in different interests among actors that have to be resolved.

Third, at a pragmatic boundary, interests are in conflict thus, the knowledge developed in one domain generates negative consequences in another. When actors have different interests, the dependencies between them are not indifferent, and these pragmatic differences generate costs to the actors involved. Here the costs for any actor are not just the cost of learning about what is new, but also the cost of transforming "current" knowledge being used (i.e., common and domain-specific knowledge). These costs negatively impact the willingness of en actor to make such changes. Research that acknowledge these pragmatic differences frames knowledge processes as "creative abrasion" (Leonard-Barton, 1995) and focuses on the negotiation of practice (Brown and Duguid, 1991) and the transformation of knowledge (Carlile, 2002). In addition to the importance of teams, this work also recognizes the role that shared artifacts and methods play in providing the capacity to negotiate interests and

transform knowledge. Boundary objects (Star and Griesemer, 1989; Carlile, 2002; Bechky, 2003) such as drawings, prototypes (Wheelwright and Clark, 1995), and "trade-off" methodologies (Carlile and Lucas, 2003) have proved effective in providing a concrete means of representing different functional interests and facilitating their negotiation and transformation in product-development settings (Carlile, 2004).

Boundary spanners and boundary objects

The literature on KM has emphasized the importance of relying on individuals to perform boundary-spanning roles (Cross and Parker, 2004; Davenport and Prusak, 1998; Pawlowski and Robey, 2004). Cross and Parker (2004), for example, characterized boundary spanners as vital individuals who facilitate the sharing of expertise by linking two or more groups of people separated by location, hierarchy and function. Numerous research studies have identified and classified the roles boundary spanners are expected to perform (Cross and Parker, 2004; Friedman and Podolny, 1992). For example, the boundary spanner's roles have been classified according to representative versus gatekeeper, advice versus trust broker (Friedman and Podolny, 1992) as well as scout, ambassador, sentry, and guard (Ancona and Caldwell, 1992).

In practice, however, multiple roles of boundary spanners often come into conflict, thereby leading to stress and burnout (Singh et al., 1996). Moreover, it is often hard to find individuals willing to perform these roles as they are expected to be both sensitive to social cues (Caldwell and O'Reilly, 1982) and complement in multiple domains (Nochur and Allen, 1992). Indeed, some may prefer one side over the other rather than endure the suffer from the discomfort of spanning both (Wiesenfeld and Hewlin, 2003). Levina and Vaast (2005) suggest distinguishing *nominated boundary spanners* to *boundary spanners-in-practice*. Nominated boundary spanners are agents who occupy dominant positions in a field, use the symbolic capital of their own positions to appoint themselves or others to various positions endowed with symbolic capital (Bourdieu, 1998). However, formal structures may not coincide with actual practice that involves diverse interests and in which actions (e.g., nomination) have unexpected consequences (Wenger, 1998: 80). In contrast to nominated boundary spanners, however, boundary spanners-in-practice must actually engage in boundary spanning, relating practices in one field to practice in another by negotiating the meaning and terms of the relationship (Levina and Vaast, 2005).

METHODOLOGY

Drawing on practice theory, we analyzed and interpreted data from an empirical case. Prior works (Orlikowski, 1992, 2002; Levina and Vaast, 2005) have demonstrated how practice theory can be used in data analysis to understand the dynamics of organizational life. Following the same tradition, our investigation relied on interviews with key participants regarding their intentions and perceptions of practice. My understanding of practices comes primarily from interview data and from traces of work evident in project documentation. However, the findings of this initial study offer an interesting starting point for understanding how boundary spanners use boundary objects to span organizational boundaries. In this, I follow Gidden's (1984) insistence that people are knowledgeable and reflexive, and that they tend to know more about (and can give a reasonable account of) what they do than researchers give them credit for.

Field setting
After the large dengue fever epidemic in Cuba in 1999, the Association of Caribbean States (ACS) recognized emerging infectious diseases as a major challenge and made a call for proposals to design an epidemiologic strategy and a regional program on emerging and reemerging diseases. The Regional Council of Martinique gathered a panel of experts to generate a proposal for this request on behalf of Martinique (Ducharme, 2011).

The Regional Council of Martinique, and more specifically the International Center for Medical and Health Cooperation in the Caribbean and the Americas (CICOMSCA), was subsequently awarded the project as well as initial funding for preliminary stages (CICOMSCA n.d.). CICOMSCA, established in 1994, aims to "contribute to the development of relations and international trade in the field of medicine, health sciences, and health policy in the Caribbean and the Americas" (CICOMSCA n.d.).

A preliminary study, entitled VIGILIA, was launched in 2005 from Martinique to test strategies, models, and hypotheses for integrated surveillance in the Caribbean. This project, funded by the European Union (EU), was estimated at costing €500,000 (approximately $696,850 USD) after completion (Ducharme, 2011). First a panel of experts decided on which diseases to monitor resulting in the choice of dengue fever and influenza for the preliminary stages (Ducharme, 2011). Dengue fever was chosen as a model for a vector-borne disease while influenza-like illnesses were chosen to represent man-to-man transmission (Bucher 2010). Then the computer science team created a pilot system including data collection points and a date warehouse for data storage. Most data for Vigilia was collected from Martinique; however, limited data sets from St. Lucia and Dominica were eventually available for analysis (Ducharme, 2011). An informative website for data visualization and reporting was generated for eventual use an interface for the stakeholders and the public (Bucher, 2010). The pilot system demonstrated early warning capacity based on inference from collected data by correctly predicting an upcoming outbreak. It also proved cost-effective and fared better than the existing systems for retrospective analyses. While sentinel surveillance took three months to complete, the reports generated through Vigilia took an hour to create for dengue fever and influenza, respectively. After positive results from the Vigilia project, the team was ready to progress by expanding the system (Bucher, 2010).

Following the success of Vigilia, the CICOMSCA initiated a project entitled ARICABA, meaning, "to look" in the Carib language. This project has an approximately €3 million total budget to be received in stages from the EU's Interreg IV fund; this fund was established to support regional integration of EU Caribbean territories (Guadeloupe, French Guyana, Martinique, Saint-Barthélemy and Saint-Martin) and contribute to the Caribbean region (Interreg, 2008). ARICABA formally began on March 1, 2010 and will run until approximately March 1, 2013. The first installment of funding was received October 1, 2010 and implementation activities are underway. The stated goal of ARICABA is to "establish a network for epidemiological surveillance of infectious diseases, based on information collected through a network of data sources" (Bucher n.d.). The mission of ARICABA is to heighten protection of Caribbean residents and visitors by filling the gap in existing infectious disease surveillance systems, especially emerging threats such as dengue fever and influenza (Kim et al., 2011).
It is significant that the project has a local, country-led approach to aid in future sustainability (Butler 2006). ARICABA already has substantial partnerships with both local and international organizations such as CICOMSCA, Université des Antilles et de la Guyane (UAG), public and private laboratories, National Institutes of Health (NIH), Organization of

Eastern Caribbean States (OECS), University of London, and George Washington University (Bucher, 2010).

Data collection and analysis

Typical of qualitative interpretive case studies (Klein and Myers, 1999), data collection relied in particular on semi-structured interviews. I conducted 17 interviews in total with key participants in the project. Interviews lasted from 45 minutes to over two hours in length and were conducted one-on-one with participants. All the interviews were recorded and transcribed.

In addition to interviews, I collected data by reviewing some of the extensive documentation generated by the project, including project plans and schedules, research communications, and epidemiologic reports. This provided important contextual information on the project structure, project design, data sources, information on the Caribbean zone, as well as on existing infectious disease surveillance systems in the Caribbean.

My orientation to data collection and analysis was explanatory, intended to generate insights into the conditions for effective knowledge transfers within the healthcare sector. The process of data collection and analysis proceeded iteratively, with the early stages being more open ended than the later ones. This allowed for some flexibility in data collecting, allowing themes to emerge and then be examined more deeply as relevant.

As I came to better understand the context and complexity of the ARICABA project, I became particularly aware of the importance of boundaries that the ARACABA team members routinely traverse in their daily activities. In their description, of their distributed work, ARICABA participants repeatedly referred to a number of different boundaries that shaped and challenge their activities. I discerned at least six boundaries in such descriptions: *geographic* (3 locations), *cultural* (3 nationalities, 2 languages), *technical* (differences in computer infrastructures and medical informatics among the islands), *social* (hundreds of participants engaged in the project), *historical* (three healthcare systems) and *political* (different priorities and interests). Because of the obvious salience of these boundaries to the distributed work of the ARICABA participants, I began to focus the data collection more explicitly on boundaries. Thus, I became more strategic in my choice of participants and more directed in the interviews, seeking to engage them in a discussion of the nature, role, and consequences of these boundaries in their work.

I followed a grounded theory approach of comparison and contrast (Glaser and Strauss, 1967; Strauss and Corbin, 1990) in analyzing the data. This approach entailed an iterative process of theoretical sampling, comparing and contrasting examples from the data to build theoretical categories which were then compared and interrelated to form the basis for this paper. I analyzed data and adjusted categories periodically throughout the fieldwork confirm the test categories and further focus my study.

THE IMPLEMENTATION OF AN ELECTRONIC EMERGING INFECTIOUS DISEASE SURVEILLANCE SYSTEM IN THE CARIBBEAN

PURPOSE

The aim ARICABA is to establish a network for epidemiological surveillance of infectious diseases, based on information collected through a network of sources of data. The goal of the network is to homogenize and organize the data collected from relevant stakeholders in Dominica, St. Lucia and Martinique, utilizing information and communication technology.

As a network of networks, ARICABA ideally consists of linked databases of the tree islands that connect to all public and private hospitals, public and private labs, community health centers, pharmacies, airports and seaports. Figure 1 indicates that each country's health system will be linked to its data collection points (DCPs) and the DCPs will be linked to a data warehouse where the automated early detection analyses will operate. Each DCP will be unique to the country's IT infrastructures and potential structure (ex: health units). Nonetheless, all stakeholders will provide necessary data that allows data analysis within the warehouse based on an agreed upon ARICABA charter (Kim et al., 2011).

Once established, significant improvements compared to existing surveillance systems will include near real time data, a "network of networks" approach, prospective modeling capabilities, and integration of data from various fields such as: weather, GIS, entomology, tourism, food, veterinary medicine, and communication. Data processes, including data mining, and the use of algorithms and mathematical modeling are key methods used in ARICABA. The system has the ability to search tremendous amounts of data and make conclusions (Ducharme, 2011). For example, if high rain, hot weather, and increased acetomenophine[1] consumption occurred during the same time period, the use of data mining and algorithms could possibly predict an upcoming dengue fever epidemic (Bucher, 2010).

After analyzing the data, the findings should be disseminated to public health officials and the public, if applicable. The findings from the disease monitoring system should be written as a report and must contain the number of hospitalized, number of deaths, and number of confirmed cases, including serotype (Kim et al., 2011). The dissemination mechanism for the data will be mainly web-based. Public health officials or professionals will log into a secure web site to update the analyzed data and post a report. Email is also suitable to send a report for key informants. Important findings also should be available to the public through a website and computerized social networks such as Facebook and Twitter (Kim et al., 2011).

DATA COLLECTION

One of the main issues is related to the data collection process. The Aricaba system relies on data collected from relevant stakeholders in Dominica, St. Lucia and Martinique, utilizing information and communication technology. In order for the data warehouse to function properly, necessary data for the data analysis must be collected in sufficient amounts. In addition, data collection should occur in a timely and complete manner while following agreed upon data standards (Kim et al., 2011). Data providers – such as public and private hospitals, public and private laboratories, community health centers, pharmacies, airports and seaport – are numerous, diversified, and distant, and they have different data systems in each country. As Max stated: "*One of the hot topics is the data collection. Without the data, nothing is possible.*"

[1] Acetomenophine is commonly prescribes to dengue fever patients.

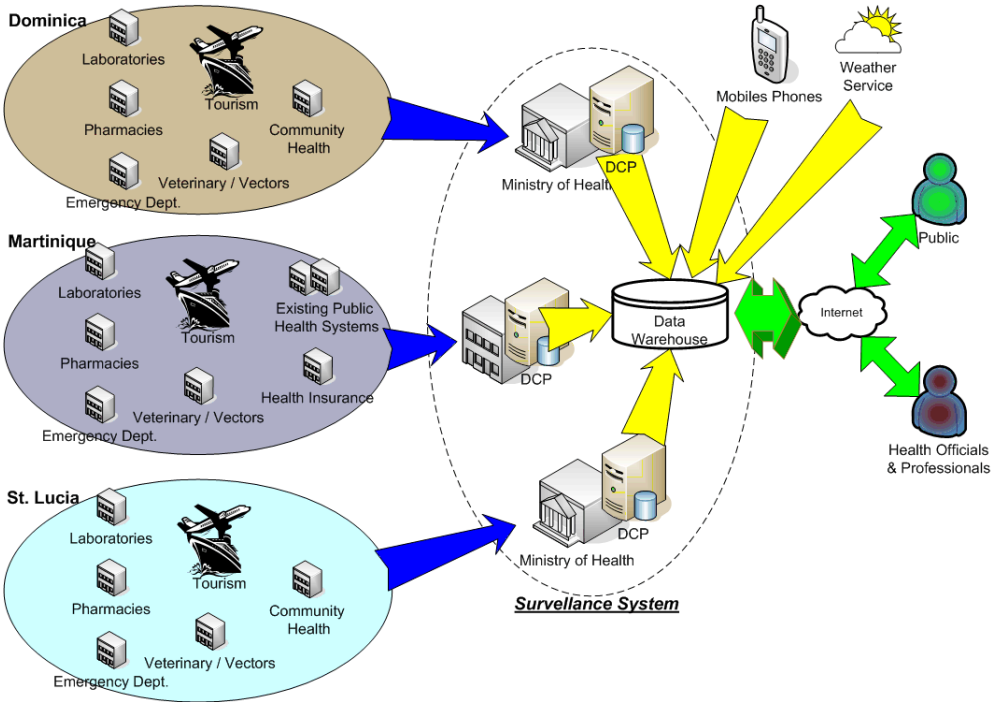

Figure 1: Network of Networks Overview (source: Bucher et al., 2009)

In Martinique, the data sources are public and private hospitals, including the Universitu Hospital in Fort-de-France, the largest hospital in Martinique. Therefore, the University Hospital of Martinique was contacted first. Because of its influence on other data providers, such as laboratories, it was critical to gain access to its database. During the first meeting with the University Hospital management, the ARICABA team exposed the project in details, but the subsequent discussion focused on the reason why they have been chosen to manage this project. According to Max: "*The first question they asked was: Why is that you they have chosen to manage this project*?". The climate of distrust between the ARICABA team and the hospital management represents a threat for the system effectiveness. Moreover, the absence of medical informatics and electronic medical record systems in Martinique remains a challenge (Kim et al., 2011).

In the fall of 2010, an ARICABA delegation traveled to both St. Lucia and Dominica to communicate to stakeholders about the project and engage in productive discussions about the future of ARICABA and its role in their country.

Within each Caribbean nation, responsibility for surveillance activities primarily falls on the national epidemiologist in the Ministry of Health (Irons et al., 2003). Reportable diseases are conveyed weekly by both public and private health facilities to the MoH usually via telephone or fax, despite steady expansion of technology in these areas. Therefore, reporting is slow and often incomplete making it inefficient in responding to outbreaks with early warning or prediction.

Though the design of ARICABA considered these lessons, technological aspects of ARICABA still cause significant barriers in the development and implementation, yet are integral to the project by digitizing information flow and minimizing time to rapid response of management (Ducharme, 2011). Although the government of St. Lucia, the MoH, and private and public health care facilities are supportive of operational phases of ARICABA, several

difficulties exist in implementing the surveillance system in St. Lucia. First, though automated lab machine exist in St. Lucia, they are not connected to computer systems, thus no automatic capture of data is produced; interface solution exist but are expensive. Currently, samples are tested; results electronically produced; and stored on handwritten records (Ducharme, 2011). Second, the work timeline of St. Lucia's Health Information System's team could complicate ease of cooperation and data collection with ARICABA. Though data from both public and private sectors is integral to the proposed surveillance system, these two sectors are distinctly separate throughout the country, sharing little information with each other (Ducharme, 2011).

Similarly to St. Lucia, the Government of Dominica, the Dominican MoH, private and public health facilities, and the Dominican Health Information Unit (HIU) are eager to work with ARICABA in strengthening their infectious disease surveillance systems. The National Epidemiologist and Health Information Unit, in charge of all public health information systems, already have an active role in the implementation process (Ducharme, 2011). Due to Dominica's small population and a dedicated MoH, the feasibility of ARICABA being successfully implemented is high. However, challenges still remain. Despite having over 100% cell phone coverage in the island, most still perceive technology as a luxury rather than backbone support. Since 2001, the Dominican HIU has had full-time staff working on the public health care system and is already in the process of installing electronic medical record systems in field clinics; only pilot sites have access thus far but the system will be expanded throughout the rest of the island. With regards to ARICABA, the HIU is assisting in completing assessments of various Ministries' needs and drafting a budget for requested material. The assessments include an HIU delegate touring designated facilities; noting current equipment and software; and reporting needs to the ARICABA team. Though the desire to implement a surveillance system is high in this lesser populated island, challenges including limited diagnostic capabilities and a lack of resources hamper efforts (Ducharme, 2011).

PROJECT MANAGEMENT

ARICABA, a Martinique-led initiative, is politically housed under the Regional Council; funding from the EU flows through this entity. However, all programmatic concerns are the responsibility of CICOMCSA (Ducharme, 2011). Thus, the director of CICOMSCA and the Head of International Relations at the Regional Council must collaborate as executive leadership for ARICABA. Though both have the same vision for ARICABA, priorities and methods of arriving at goals differ.

Several expertise exist within ARICABA staff such as IT and health personnel. The IT staff must constantly discuss their innovations and work with the health team and vice versa. This communication barrier can be difficult, for example, when deciding which types of data should be collected for the surveillance system to function properly. Often there are only technical answers to non-technical questions from health staff. Further, communication and priority-setting among the various political figures, health experts, and engineers can be a difficult task complicated by sporadic travel schedules (Ducharme, 2011).

CICOMSCA is headed by Bernard who also is epidemiologist at the University Hospital in Fort-de-France in Martinique. This is a small structure, created in 1994, relying on its numerous academic partners including the *Université des Antilles et de la Guyane* (UAG), the George Washington University, the Conservatoire National des Arts et Métiers (CNAM) and the National Institutes of Health (NIH). CICOMSCA manages the relations with health

experts, specifically epidemiologists and with institutional partners, including the Martinique Regional Council.

The IT staff is managed by Max, the director of GroupExperts, a small IT consulting firm. Max collaborated with data mining experts from UAG in order to create a technologically advanced system. Jean-Emile, an Assistant Professor in computer science is involved in the project as data mining expert. Max and GroupExperts represent an interface between Jean-Emile's team of data mining experts and health experts. In order to facilitate communication between the different groups of experts, Max suggest the creation of a collaborative web site and task groups.

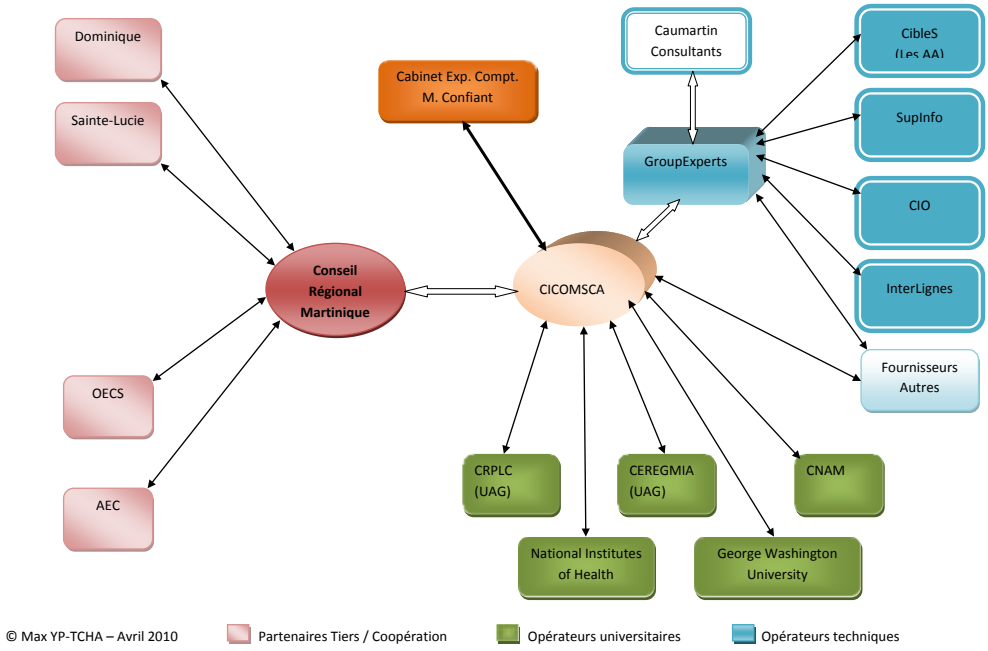

Figure 2: ARICABA Structure

Though ARICABA is managed and implemented by a small staff (see Table 1), it relies upon a large network of experts.

Position	Number of staff
Project Director	**1**
Political Liaison	**1**
IT Engineer	**2**
Administration / Finance	**1**
Interns	**3**

Table 1: Project Management Team

DISCUSSION

This section presents the different strategies, boundary spanners, in the ARICABA case, have used to convince agents from different fields to join the new joint field. These strategies differ

according to the type of boundary to be spanned. It then examines how an artifact may become a boundary object.

BOUNDARIES EMERGENCE IN THE ARICABA PROJECT

The ARICABA project appears to be a new joint field giving that the construction of the system involved actors from different fields. As Max stated clearly: "*We need to marry diverse fields of expertise. Who are the customers? Epidemiologists and healthcare authorities. It's not our problem. Our job is just to put on the computer, load the data to show them the result. We need to work together on this. We need to be able to understand what epidemiologists need, to formalize it in order to feed the system, and to work with data mining people and statisticians."* This new joint field emerged from the Martinique Regional Council, which made a call for tenders in order to respond to the Association of Caribbean States' demand. CICOMSCA made the only proposal so it won the tender and became, as a consequence, a nominated boundary spanner in charge of the construction of the new field.
The ARICABA project's structure is characterized by various boundaries according to the number of actors involved in this project (see Figure 2). Previous research investigated the nature of boundaries between functional groups within the same organization. The ARICABA case involved a large number of actors from different countries and organizations. If the nature of boundaries stills the same between organizations, strategies used by boundary spanners are different when actors belong to multiple organizations rather than a unique organization.

Overcome A Syntactic Boundary In a Multiple Organizations Setting

The Caribbean region has experienced fast and complex epidemiological changes in past decades, combining increasing rates of non-communicable diseases and injuries, and keeping uncontrolled many existing endemic and emerging diseases. Microbial mutation and adaptation, as well as human activities, such as, urbanization, deforestation, modern transportation, agricultural changes, pollution, and climate change are allowing emerging and re-emerging infectious diseases to pose serious global threats (WHO, 1998; Cash, 2000). Additionally, the Caribbean Tourism Organization (CTO) Statistical Report states that the Caribbean is the most tourism-dependent region in the world making national economies inordinately sensitive to disease outbreaks. Effective public health surveillance systems are necessary to facilitate timely detection of outbreaks, monitor changing disease trends and guide timely and relevant responses which are essential for maintaining healthy populations and stimulating productivity and economic development within the region (CAREC, 2011).
Existing epidemiological systems miss key components, lack dynamic ability and are not designed to meet demands for inter-island cooperation. Current efforts, both formal and informal, lack the integration of new technological advances in surveillance and for the most part are not strictly concerned with the Caribbean region (Leahy et al., 2001). Further, data from existing dengue fever surveillance is often incomplete, delayed, and not used in decision making due to inconsistent case definitions and laboratory capabilities (Leahy et al., 2001).

Before Vigilia or ARICABA began, PAHO/CAREC[2] was already involved with surveillance of communicable diseases in the Caribbean. Their lessons learned were valuable in project design stages but are also important to remember in moving forward. These three islands' MoH are in the habit of receiving weekly data from health centers and reporting to CAREC. Though this system has occurred for several years, this does not equate to efficiency. Despite

[2] PAHO/CAREC : Pan American Health Organization / Caribbean Epidemiology Center

steady expansion of technology in these areas, the reporting process, at most, utilizes fax machines. Reporting is slow and often incomplete making it inefficient in responding to outbreaks with early warning or prediction.
Reemergence and unexpected emergence of new diseases in the 1980's and 1990's have emphasized the need for improved global capacity for early detection and quick response. Strengthened communication and disease surveillance is an essential public health tool to curtail the spread of communicable diseases in the face of globalization and intertwined global cultures.
In the 1970's, existing epidemiological systems provided an adequate common knowledge to share and assess knowledge, but with the increasing tourism and institutional pressures for effective public health surveillance in the late 1980's, it no longer had the capacity to share and assess the knowledge that had to be identified and resolved. With the development of the ARICABA system, we see a representational tool that had an adequate capacity to represent the relational properties of knowledge and significantly enhanced early warning capacity and cost-effectiveness.
In a single organization setting, the common lexicon that actors use, as they share and assess each other's knowledge, such as the clay model in Carlile's study (2004), represents what is at stake for the most powerful group. While in single organization setting, actors have no choice but collaborate; in a multi-organizations setting, actors can refuse to participate in the new joint field if they consider that their interests are underrepresented. Therefore, the common lexicon, in multi-organizations settings, should represent each group's interests.

Overcome A Semantic Boundary In a Multiple Organizations Setting

A semantic boundary emerges between the ARICABA team and the Martinique Regional Council about the term *prototype*. The project entailed that a prototype will be presented at the initial stage. In the Regional Council vision, the prototype means a concrete tool that shows how the final system will work. In France, the legislator gives three definitions of what is a prototype; the Regional Council refers to the first one, which stipulates that "*a prototype is the first exemplary of an industrial product*[3]*"*. Max explained his vision in these terms: "*I don't use the term 'prototype' because there have been a lot of misunderstandings about this terminology. I prefer to use the term 'prototypal stage'. I will send to you legal definitions of what is a prototype, and we relied on the third definition.*" This third definition considers that a prototype is "*an original model which allows to structure something new […]. It's a experimental model which owns the main characteristics of the envisioned product*". For Max, a prototype is "*a collection of ideas, a collection of studies, a background. It's our experience that we bring into a project. […] We explored different ways, we know the type of tools we need to use, but these tools are evolving*". These divergent visions could have catastrophic consequences, given that the Regional Council could fire the Aricaba team for no respect of the contract.
In such a situation, when this kind of boundary arises between communities of practice in the same organization, researchers advocate the use of cross-functional teams, colocation, and various shared methodologies. Others have focused on the role of particular individuals as brokers and translators who enable the flow of knowledge (Hargadon and Sutton, 1997). In Carlile's study (2004) at Beta Motors, when Bill Knox and his colleagues developed the modeling tool, they were able to establish a base common language that they could use to specify critical differences (i.e., size, shape, geometry, weight, functionality, etc.) and dependencies measured (i.e., drag coefficient and "skin" of the car) (Carlile, 2004). In this case, Bill Knox and his team was asked by the company to develop a tool to make

[3] http://www.linternaute.com/dictionnaire/fr/definition/prototype/

communication and problem solving more effective across the four major groups – vehicle styling, engine/power train, climate control, and safety. Over a period of seven month, Bill and his team spent time meeting with each group and developed a *shared meaning* that was familiar to all the groups involved in the new product development. The development of a common meaning is not something spontaneous, it is a full-time activity, which requires the collaboration of each community of practice involved and the nomination of a boundary spanner. In the ARICABA case, the semantic barrier emerged between two distinct organizations with different goals and which are bound by the terms of a contract; contract which can be broken if the contractor is not able to fulfill the contract. To span a semantic boundary between two organizations, the common meaning that will bring actors to a shared understanding should originate from a higher authority, recognized as such by all parties; in the ARICABA case, Max refers to French tax authorities: "*I feel easy in my mind because this is clearly stipulated by the French and Canadian tax administrations. We agree with the definitions in both countries.*"

Overcome A Pragmatic Boundary In a Multiple Organizations Setting

A pragmatic boundary emerged between the epidemiologists and the data-mining engineers during the design stage of the ARICABA project. Epidemiologists used to work with panels and samples while data-mining engineers need large amount of data to work as Max stated: "*We are between two visions. We are between people who say that 'a sample works', and on the other side, others say 'we need everything, so we could see what is useful and what is not'. The two visions are coherent."* The large amount of data needed by data mining engineers to work, implied multiple costs: the cost of hardware and associated maintenance costs, the cost of the data collection, but also the costs associated to data preparation and storage. For the epidemiologists group, all these additional costs are not compulsory and can be reduced with the sampling method. Max is the one who suggested using data mining tools, at the beginning the epidemiologist group agreed because they didn't know what data mining methods implied.

According to Max: "*It's been two years that we ear on one side 'we need a sample', on the other 'no, I think we need all the data'* ". In order to reconcile these two visions, Max decided that ARICABA will use both methods simultaneously: "*On the one side, the data need to be sufficiently representative to satisfy the panel wanted by epidemiologists, on the other side, sufficiently numerous to allow algorithms to be efficient. This is the reason why we decided to use the two techniques at the same time. On the one side, we use the epidemiologists technic and do a sample to determine a tendency, in the same time we use data mining to determine a tendency and we compare the two, to see if the results are the same.*"

Research that acknowledge these pragmatic boundaries, recommend the use of, shared artifacts and methods, and boundary objects such as drawings, prototypes, and "trade-off" methodologies to improve the capacity to negotiate interests and transform knowledge. For example, Carlile's (2002) data shows that objects, models, and maps are the type of boundary objects that are the most effective at pragmatic boundaries. In the ARICABA case, data mining engineers and epidemiologists have such divergent conceptualizations and work practices that any tangible object could not bring them to a shared understanding of the situation. In a single organization setting, members of different communities have the same goal of producing the same product. In a multi-organizations setting, dependence among actors is reduced; therefore the willingness of actors to transform their current knowledge decreases. The boundary object should be flexible enough to integrate the two visions such as in the ARICABA case.

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