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Instantiating global crisis networks: The case of SARS

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ABSTRACT

In this paper we build a multi-theoretical and multi-level framework for analyzing Global Crisis Networks (GCN). These information-centric, heterarchically structured networks are instantiated in response to major disasters with global impact. The instantiation of GCN is conceived as a problem of collective action. Its success depends on multi-level preparedness, and network orchestration and participation. With this framework we analyze the SARS outbreak in 2002 and its successful containment in 2003. We analyze two individual country cases, Canada and China and discuss the role of the network orchestrator, the World Health Organizations. The paper concludes with implications for research and practice.

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1. Introduction

Increasingly, organizations are expected to rapidly organize as global networks in response to urgent and major causes such as earthquakes, terrorist attacks, hurricanes, global infectious diseases and short term business opportunities. These pressing causes exceed the (dynamic) capacity and resources of single organizations or even alliances and partnerships [53,65]. In the private sector, well known examples of (global) interorganizational networks include clothing, aviation, car manufacturing, electronics and service [14] industries. Examples of public networking are disaster relief [70], global aviation security regulations, healthcare [34], disease control management, military (coalition-based) campaigns [2,86], and international law enforcement. These interorganizational networks – coined as Hastily Formed Global Networks [24] – have been enabled by globalization and the advancement of Information and Communication Technologies (ICT) [77]. These resources do not guarantee successful performance at the network level. The multi-agent US government response to the Katrina disaster was considered unsuccessful [19,36], as were many international relief efforts to a certain degree [23]. Other unexpected major disasters such as the Tsunami in the Indian Ocean in December 2004, and the devastating earthquake in Kashmir in October 2005 revealed the global need for a deeper understanding of network coordination in response to unexpected major disasters.

Current literature seems ill equipped to handle the challenge of what we refer to as Global Crisis Networks (GCN). For the most part, research has provided anecdotal evidence and strategic-level concepts of organizations acting as a network. Research on interorganizational cooperation remains focused on relationships with only one or a few partners, with often a limited geographical area (e.g. [47,48,69]). Limited insight is provided in the process of successful instantiation of networks operating at a global scale.

The objective of this study is therefore to improve our understanding of GCN instantiation, and specifically to examine mechanisms leading to their successful performance. Theoretically, our study starts, introduces and builds on the notion of *instantiation*. This concept distinguishes our conceptualization of networks from frequently used concepts like *building* and *emergence* in network research. *Building* explicitly refers to the human act of creation, and *emergence* connotes a result from indeterminate, evolutionary forces. By instantiation, however, we mean the evocation of available resources in an unprecedented way to achieve a common (network) goal. In this process, information sharing plays a pivotal role: representations of actors, issues, opportunities, and constraints are shared instantaneously, on a global scale, allowing network actors to adjust and fine-tune their activities [20]. We therefore call GCNs information-centric. Empirically, we analyze the SARS (Severe Acute Respiratory Syndrome) case in order to learn how GCNs can be successful. We focus on the relationships between two countries as individual network participants (Canada and China) and the global network (World Health Organization).

This paper is structured as follows. First, we discuss the relevant literature on crisis management and organizational crises. We then build a conceptual framework for analyzing Global Crisis Network responses, followed by a brief section on our research methods and data collection. Next, we present the SARS case and analyze in closer

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detail the experiences and roles of Canada, China and the WHO. We conclude this paper by discussing the implications of our case study for studying Global Crisis Networks.

2. Theoretical background

2.1. Distinguishing crises

Crises increasingly attract scholarly attention in management and organizational science. In crisis situations organizational routines are overridden and authority structures are changed. Often, new and conflicting measures are taken and legitimized [13,24,64]. There is a pressing need to understand the dynamics of crisis situations as it may help to prevent, prepare and respond in proper ways. While early experiences emphasized ad hoc improvisation, in the current era this does not appear acceptable for stakeholders and the general public.

In order to study crises many scholars have distinguished different types of crises. A general distinction can be made between natural and human-induced crises [60,68]. Human-induced crises differ from natural crises with respect to the extent to which they can be controlled and prevented. The former are caused by human, communication and technical failures. The causes of human-induced crises are not just triggered by one event but are also closely related to the way organizations respond. Inadequate or unprepared responses may deteriorate the crisis situation. Shrivastava and Mitroff [68] therefore argue that crises are caused by two interacting sets of failures. On one hand a complex set of human, organizational and technological (HOT) factors trigger the crisis, and on the other hand organizations encounter regulatory, infrastructural and preparedness (RIP) failures. Vaughan's [78] analysis of the disaster with the space shuttle Challenger in 1986 provides an interesting example of the intricate interplay between the HOT and RIP factors. The impacts of natural crises are mostly limited to a geographic region and specific time periods. Human-induced crises may transcend geographic boundaries and even may have trans-generational impact (e.g. Chernobyl, Bhopal).

2.2. Communicable crises and information processing

Recently the concept of communicable crises was coined to refer to the potential of rapid global diffusion patterns of crises, such as the Asian financial crisis, avian bird flu and SARS [31]. These new types of crises differ in two important aspects from other types of crises. First, although the trigger event may be very small and local, its impact may be global, hence the need for organizing a global response. Second, while all crises are information-intensive, with communicable crises the Internet has come to play a pivotal role in all relevant crisis information processes.

The global nature of communicable crises emphasizes the high information processing needs. In earlier literature on crises, Turner [73] has emphasized the informational character of crisis situations in the development of disasters. Similarly, Wilensky [89] stressed the need for high-quality intelligence, referring to clear, timely, reliable, valid, adequate and wide-ranging information. At the same time, building high-quality intelligence for crisis response is problematic as crises are characterized by low probability/high consequence [9,84] (Table 1).

Table 1
Crisis probability and impact.

		Probability of crises	
		Low	High
Consequences of crises	Low	Rare event, limited impact (e.g. geographical scope), limited repertoire.	Predictable crises with limited impact. Focused preparation suffices.
	High	Rare event, massive, often global, impact. Early signals ignored or misinterpreted. Anticipation hardly feasible, limited connectivity and repertoire. Central role for technologies and information processing. Fusion of action, understanding, learning and frame development.	Predictable crises with large scale impact. Anticipation is feasible, early signals are interpreted correctly. Elaborate information infrastructures are connected and available. Emphasis on action within existing frames.

Because of their low probability, crises create uncertain situations in which repertoires for action are missing. Weick [83] points here to a unique problem of crisis situations as opportunities for a major learning strategy, trial and error, are not available. Moreover, because of their low probability, early or weak signals of crisis occurrence are often not taken seriously. Weick [84] points to the fundamental problem in creating this high-quality intelligence. He argues that action is instrumental to understanding a crisis. People enact the environment which constrains them at the same time. Only through action one learns to understand the nature of the crisis, while at the same time it affects the unfolding of the crisis itself. While most of this research deals with local, single site crises, recently the global reach and capability of pooling and disseminating information has become apparent. Media play a pivotal role in communicating crises as they shape public perceptions and responses to crises [68]. In most crisis situation, however, the quality of intelligence is put under pressure: coverage of crises by the media, individuals and groups is often fragmented. Objective data is lacking, leaving stakeholders merely with equivocal impressions [68].

2.3. Crisis preparation and response

While crisis management literature emphasizes the role of preparation for crisis situation, less attention has been paid to responses and action [60]. The ability to prepare adequately depends on the nature of the crisis situation. Preparation presumes the ability of foresight and prediction. In the case of small-scale disasters, emergency agencies can rely on protocols, network infrastructures and professional, highly trained teams ready to respond [24]. With large scale, unprecedented disasters the required response exceeds beyond the control and capabilities of one or more emergency agencies. A response organization still has to be created in the terms of a series of interlocking routines, habituated action patterns that bring the same people together around the same activities in the same time and places [85,87]. Prediction and preparation become difficult because of low probability and the complex nature of the tasks that must be carried to control the crisis [73]. Most large scale disasters are the result of separate, small events that become linked in unpredictable ways. The more tightly activities are coupled the less linear they become [58,68]. During the preparation phase (which in fact can be considered a ‘phase’ only after the crisis happens), most tasks are loosely formulated and ill-defined. They are directed to possibly conflicting ends, while missing unequivocal criteria for deciding when and how objectives are to be achieved. Turner [73] argues that in those situations problems are often solved by creating ‘small areas of certainty’ which can be handled. Another frequently used solution is to simplify the assumption of the complex environment, thus allowing for an oversimplified set of actions. This could lead to a situation in which crisis managers assume they control the crisis while they are in fact fighting only a small part of it. In fact, through inadequate sensemaking of the environment [84] they may even contribute the crisis spinning out of control.

In large, global crises, sensemaking and information processing are constrained because information sharing between network participants is problematic. Conflicting interests may hinder the sharing of relevant information. In the next section we will discuss these issues

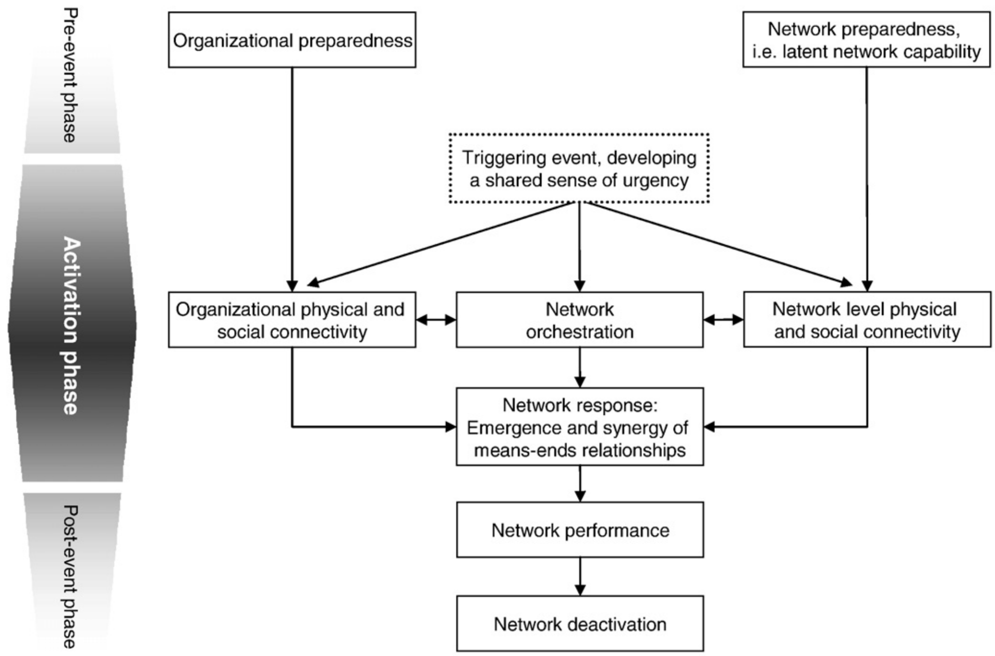

Fig. 1. A multi-level framework for Global Crisis Network (GCN) instantiation.

in more detail and build a conceptual framework for analyzing network response to emergency situations. To emphasize the global impact of crises – and related to this the need for a global network response – we prefer to speak about Global Crisis Networks (GCNs).

3. Global Crisis Networks: a conceptual framework

GCNs do not represent a particular network form or organizational type. Proposing network configurations therefore seems not quite useful. Instead, we focus on the organizing processes constituting the network. A GCN can be understood as an instantly formed, heterogeneous configuration of organizations, varying with the kind of events to which they have to respond. In the process of instantiation, organizations and networks undergo a 'phase transition' [43]: from a defined state into another state in response to changing levels of urgency awareness. By instantiation we mean an organized, concerted effort to configure (information) resources into a means–end relationship within a short time span. Without these configuring efforts – for which network actors rely on the enactment of their cognitive frameworks [5] – means–ends relationships at the network level hardly exist, they remain diverse, and they have therefore no value-generating strength. During the phase transition, the existing, rather loosely and sometimes non- or decoupled network should be instantaneously transformed[1] into a more or less tight coupled, hierarchical structure. Globally distributed information must be centralized and integrated into a central information and conversation space [24]. We developed a conceptual framework on the basis of these ideas (Fig. 1) which will guide the following conceptual and empirical sections.

The main driver behind the rise of GCNs is the shared sense of urgency. The extent to which this sense of urgency is truly shared among potential network actors is of crucial importance and a precondition for successfully instantiating a GCN. Urgency enables (temporary) alignment of interests [25]. Different levels of this sense of urgency between network actors might impede the successful instantiation of the network. Following Monge and Contractor [53], we argue that the dynamics of networks should be analyzed from a multi-theoretical and multi-level perspective. A multi-theoretical perspective is needed to understand and explore network dynamics across levels. Elements from resource dependence theory, collective action theory and loosely coupled system theory are used here to build our framework for analyzing GCN. The multi-level perspective emphasizes the dynamic interaction between individual network actors and the network as a whole.

3.1. Networks and resource coordination

In the management literature some authors have tried to conceptualize the notion of global networks. Bartlett and Ghoshal [7] coined the term 'transnational solution', referring to the integrated network format in which the corporate center guides the process of coordination and cooperation between subsidiary units for shared decision making. A main reason for network formation is resource dependency and hence the need for coordination [21]. Child and McGrath [17] argue that networks are value creating systems of several organizations possessing complementary strengths and resources that are often coordinated by a leading member. Such coordination processes generates synergetic value that exceeds the value derived from isolated resources [29,61]. The process of combining resources in response to an event depends on the preparedness of the network.

3.2. Preparedness, instantiation and network coordination

As business and societal structures tend to become more complex, global and risky, the importance attached to network preparedness increases. Preparedness concerns the organizational and network level (Fig. 1). The level of preparedness determines the extent to which an organization is able to respond and contribute to GCNs. It refers to the alert (for event-driven activation) and response capability to mobilize a wide range of tangible and intangible resources. Tangible resources encompass material tools, instruments, equipment, physical locations, provisions, material stocks, and infrastructure that should be available at the time a response is

[1] This process bears resemblance to the micro process of adrenaline-enabled flight/fight response to urgent events in which humans become highly more responsive to their threatening environment [67].

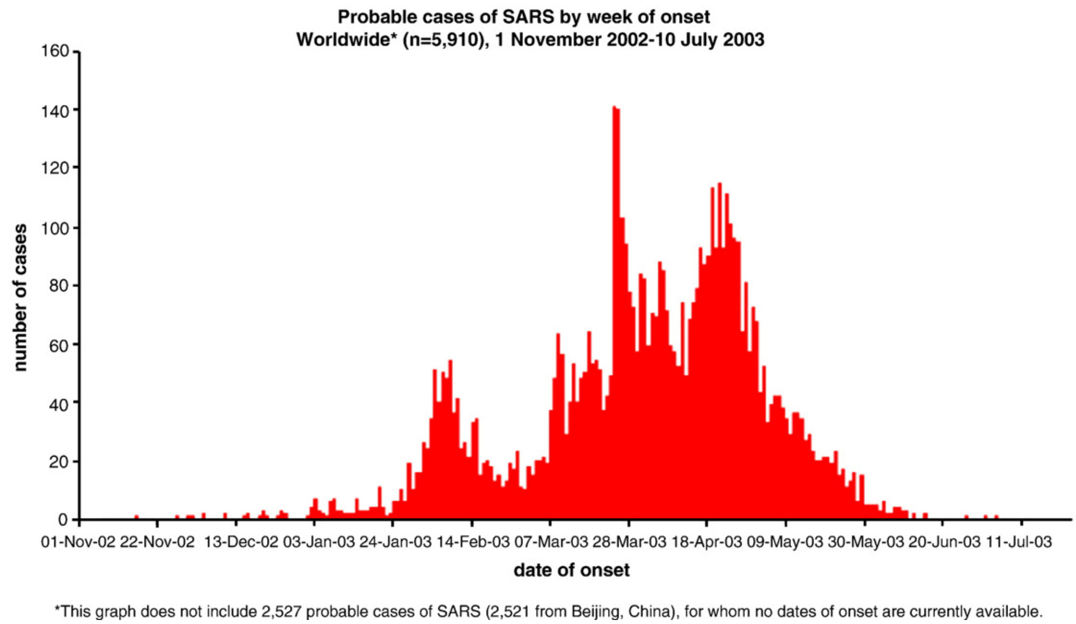

Fig. 2. Epidemic curve SARS worldwide.

required. Intangible resources include procedures and protocols, specialized knowledge, information resources, training programs, and common (interoperable) standards for operations.

The alert and response capability includes the ability to mobilize tangible and intangible recourses into concerted order [38]. Van de Ven and Walker [75] discuss the concept of 'mobilization coordination', referring to the activities that are set in motion by a single organization that has a particular objective for which it must gain support, cooperation, or resources from other organizations. The activating organization here is the network coordinator who collects resources and transforms the non- or loosely coupled ties between network actors into tightly coupling relationships for a particular period of time.[2]

Network coordination is complex because of the heterogeneity of the network actors' interests, routines and technologies in use. Network actors are involved in causing, communication, and mitigating the effects of crises [68]. Crisis network response exceeds the formally structured arrangements of coordination. Instantiation of a GCN aims at achieving a collective goal that cannot be attained by the network actors individually. Hence, network instantiation can be conceived as collective action. This perspective proposes situations in and conditions under which cooperation appears beneficial to actors [16,56]. Mediated by the network coordinator, GCN as a form of collective action gravitates towards the sharing of information between the networks actors on all sides, and the forming and calibrating of means–ends relationships [5,25].

3.3. Network information processing

For network response to emerge, information collected within different organizations has to be turned into a 'global public good' [1,27]. Globally shared information serves as the key resource for GCNs to act and respond in a proper way. In a situation of resource dependency, sharing information of one organization's activities and resources enables other organizations to understand opportunities for coherently interrelating means–ends structures in and generating value [29,59,71]. Not sharing information may result in cooperation dilemmas [15,45,56] which occur when behavior that seems reasonable (rational) at the individual level leads to a situation in which everyone is worse off than they might have been otherwise [45]. A particular organization or government may have good reasons for *not* contributing to or participating in a GCN at its individual level. Yet the consequences may turn out to be dramatic at the collective level.

GCNs encompass a divers set of organizations that are partially nested in other national or international organizational structures. This nesting makes GCNs complex, multi-level structures that cannot be easily instantiated. Following Kontopoulos [46], GCNs and the contributing organizations can be classified as "tangled composite structures" or "heterarchies". A heterarchy, originally a notion from neurophysics, is defined as a network form of organization where authority is determined by knowledge and function rather than structure [49]. Applied to the study of organizational networks, this implies that GCNs are partially included and semi-autonomous. They are partially determined from below (the organizations), and partially determined from above (the network coordinator) due to the fact that GCNs involve multiple points of access, multiple linkages, and multiple determinations [46,53]. In order to centralize information into a central information and conversation space two types of information sharing relationships are needed.

3.4. Physical and social connectivity

Extending Monge and Contractor [53], we distinguish between preparedness at the organizational and network level. Differences in the level of preparedness at these levels might impede or obstruct GCN instantiation and consequently may cause or fail to avoid the occurrence of a collective disaster. A central element in GCNs is connectivity [24,38]. Considering the multi-level nature of GCNs, connection refers to vertical (between levels, usually the network orchestrator versus network actors), and lateral connections (between network participants). As Fulk et al. [28] point out, connectivity has two components. The first is the physical component which can be understood as the technological infrastructure, including people's access (e.g. Internet connection, radio, TV, mobile phones). The second is social connectivity, which refers to the trust-based relationships between the levels of the network and between network participants [28].

Social connectivity can be further interpreted in terms of tight and loose coupling. Loose and tight coupling can be specified in terms of

[2] This coordinating role may also be performed in a distributed manner [63].

presence or absence of and interaction between joined or shared variables [35]. Both loose and tight coupling imply that the interacting actors in a network share meaning [51], in the case of crisis situations – see also [79] – on the urgency of the event conditions instantiating the network. This meaning emerges as the crisis becomes worse and interaction between the actors involved increases [74,82]. Orton and Weick [58] distinguish two defining characteristic dimensions of organizational systems: responsiveness and distinctiveness of system elements. If there is neither responsiveness nor distinctiveness there is not really a system, and it can be defined as a non-coupled system. If there is responsiveness without distinctiveness of the elements, the system is tightly coupled. When there is distinctiveness without responsiveness, the system is decoupled. If there is both distinctiveness and responsiveness the system is loosely coupled.

From a crisis management perspective the loosely coupling of a network can be viewed as a quality. It refers to the ability to respond quickly to disaster alerts and it depends on the establishment of trust-based relationships prior to the alert. When the network is not activated the connections remain loosely coupled [58,81]. During the phase transition towards activation, these connections become, under the leadership of the network coordinator, temporarily tightly coupled. Decoupled and non-coupled networks, in combination with a low level actor and or network preparedness form serious threats to contain crisis situations. We illustrate these ideas with studies on the SARS crisis.

4. Methods

In this paper we seek to improve our understanding of the instantiation of a Global Crisis Networks. Case study research is appropriate when (a) the topic is broad and highly complex, (b) there is limited theory available, and (3) “context” of a topic is very important [26]. We selected the SARS case as it illustrates the complex and dynamic nature of GCNs. It represents a unique type of a GCN because of its global impact, its success to contain the spread of the corona virus, and the use of the Internet to inform the public and to facilitate worldwide cooperation between experts. Moreover, the SARS outbreak caused a ‘breakdown’ of the existing international and national systems and procedures for responding to epidemic diseases. From a methodological point of view, breakdowns are interesting episodes to investigate as they reveal the current nature of practices, tools and equipment, customs [90]. The instantiation of the GCN to fight the SARS virus should be understood against the background of existing response and alert systems and procedures. The routines of the current systems that broke down provide the contextual backdrop for the SARS outbreak [62].

The SARS case is presented here as an embedded case study, which allows for analyzing different (embedded) units, processes and levels within the larger case [91]. In the paper we focus on the pivotal role of the World Health Organization which coordinated the network, and on two ‘extreme cases’ China and Canada. In the Canada case we review the preparedness aspects, in the China case we focus on collaboration processes, and in our analysis of the role of the WHO we pay special attention to response and coordination at the network level. The embedded case study design fits the multi-level framework that is developed in this paper as it allows for analyzing both the country and global network level.

For our research we collected data from different sources — scientific research, public documents, case stories, reviews and websites. Our analysis of this collected information followed an iterative process common to qualitative studies [37]. It revealed the multi-level nature of the crisis network that was instantiated during the SARS outbreak. Moreover, we examined the first steps of a major transition from national oriented health systems towards a global alert and response system, accompanied with the need for global information sharing.

5. The SARS outbreak

The SARS outbreak shocked national health care systems worldwide. Commencing in Guangdong (China) on November 2002, it

Table 2
SARS cases worldwide (November 1, 2002–July 31, 2003).

Areas	Date onset first probable case	Date onset last probable cases	Infected female	Infected male	Infected total	Number of deaths	CFR[a]
Australia	26-Feb-2003	1-Apr-2003	4	2	6	0	0
Canada	23-Feb-2003	12-Jun-2003	151	100	251	43	17
China	16-Nov-2002	3-Jun-2003	2674	2607	5281	349	7
China, Hong Kong SAR	15-Feb-2003	31-May-2003	977	778	1755	299	17
China, Macao SAR	5-May-2003	5-May-2003	0	1	1	0	0
China, Taiwan	25-Feb-2003	15-Jun-2003	218	128	346	37	11
France	21-Mar-2003	3-May-2003	1	6	7	1	14
Germany	9-Mar-2003	6-May-2003	4	5	9	0	0
India	25-Apr-2003	6-May-2003	0	3	3	0	0
Indonesia	25-Apr-2003	6-May-2003	0	3	3	0	0
Italy	13-Mar-2003	20-Apr-2003	1	3	4	0	0
Kuwait	9-Apr-2003	9-Apr-2003	1	0	1	0	0
Malaysia	14-Mar-2003	22-Apr-2003	1	4	5	2	40
Mongolia	31-Mar-2003	6-May-2003	8	1	9	0	0
New Zealand	20-Apr-2003	20-Apr-2003	1	0	1	0	0
Philippines	25-Feb-2003	5-May-2003	8	6	14	2	14
Rep of Ireland	27-Feb-2003	27-Feb-2003	0	1	1	0	0
Rep of Korea	19-Mar-2003	19-Mar-2003	0	1	1	0	0
Russian Federation	5-May-2003	5-May-2003	0	1	1	0	0
Singapore	25-Feb-2003	5-May-2003	161	77	238	33	14
South Africa	3-Apr-2003	3-Apr-2003	0	1	1	1	100
Spain	26-Mar-2003	26-Mar-2003	0	1	1	0	0
Sweden	28-Mar-2003	23-Apr-2003	3	2	5	0	0
Switzerland	9-Mar-2003	9-Mar-2003	0	1	1	0	0
Thailand	11-Mar-2003	27-May-2003	5	4	9	2	22
United Kingdom	1-Mar-2003	1-Apr-2003	2	2	4	0	0
United States	24-Feb-2003	13-July-2003	14	15	29	0	0
Vietnam	23-Feb-2003	14-Apr-2004	39	24	63	5	8
Total					8050	774	

Source: Adapted from [1].
[a] Case fatality ratio.

spread to other countries – such as Singapore, Hong Kong, Canada – following travel patterns of infected individuals (Fig. 2).

SARS was a new corona virus not previously identified in humans and animals. There was no knowledge about how to identify, diagnose and treat SARS. Once SARS reached Hong Kong it spread out within a few days internationally "with the speed of an airplane" [54]. China (including Hong Kong) was severely attacked. As of early June 2003, the World Health Organization (WHO) counted 8098 people that were infected, 774 died. Table 2 shows that China (including Hong Kong and Taiwan) and Singapore were severely hit by SARS.

Most countries in the western world were hardly hit by SARS. A striking exception here is Canada (Toronto and Ontario) where 251 people were infected and 43 of them died. In July 2003, WHO declared that SARS had been contained and was no longer viewed as a global threat. Considering the potentiality of the threat of SARS as a 'globalizing disease' the impact remained modest. In the western countries the spread of SARS was limited to a few cases. New was the fact that many (1707) health care workers were infected, 21 of them died. SARS revealed the successful orchestration of globally distributed medical research laboratories in identifying the SARS virus by the WHO. This international scientific cooperation was unusual. International health treaties were dominated by state sovereignty. In fact, international intervention in another state's internal activity used to be unthinkable [80]. Next, we analyze how two countries and the WHO prepared for and responded to the crisis.

6. The SARS case: analyzing global network response

6.1. SARS in Canada: failure of national preparation

Western countries were hardly hit by the SARS outbreak. While poor regions were and are a problem as they have limited surveillance capacity and inadequate laboratory expertise [3], western health care systems were timely alerted by the WHO and able to respond in an adequate way. Canada was a clear exception: about 10,000 individuals were forced into quarantine, 251 people were infected, while 43 people died. The SARS outbreak revealed the unpreparedness and therefore the inability of the Canadian health care system (esp. Toronto and Ontario) to respond to the outbreak. An evaluation report on the failed response of the health care system in Ontario reported:

> "SARS showed Ontario's central public health system to be unprepared, fragmented, poorly led, uncoordinated, inadequately resourced, professionally impoverished, and generally incapable of discharching its mandate … SARS was only contained by the heroic efforts of dedicated front line health care and public health workers and assistance of extraordinary managers and medical advisors" [66: 1]

The Canadian health care system failed in many respects. The fragmented structure of the national health care system appeared to be a main explanation for this failure at the operational level. The state of emergency (Code Orange) was declared in Canada in March 2003. This threatened the Canadian health care system. Code Orange is part of the Uniform Emergency Codes, which has been adopted by the Ontario Hospital Association in 1993. It indicates an external disaster, which alerts hospitals to prepare for a rapid influx of patients being brought to hospital by ambulances. The code is intended to be applied to a specific area and to be used for a limited period of time. However, it soon appeared that the Code Orange was not the appropriate response for an infectious disease outbreak such as SARS. The code paralyzed the health care system because there was in fact no extraordinary number of incoming patients, as would be the case during natural disasters. In fact, the challenge in controlling SARS was to significantly restrict access to healthcare facilities. Moreover, Code Orange was not meant for such a broad geographic area and for a sustained period of time. As a consequence, many hospitals unaffected by SARS were forced to reduce their service level significantly. They delayed current procedures and thereby put critical patients at risk.

A related problem was the underinvestment in microbiological research and testing capacity at the laboratories in Canada. The country decided in the early 1990s to economize on research labs. This jeopardized long-term development of local specialized knowledge and thereby participation in global knowledge networks. While researchers in Hong Kong were able to correlate clinical and laboratory features of SARS with epidemiological data, the Canadian researchers were unable to do so. Ontario lacked a critical mass of expertise at the provincial level. Teams of experts had to be formed on the run, no plans and leadership for coordinating the required expertise was available [66].

A third main problem was the lack of modern information and communication technology systems. Professor Johnson, responsible to set up a Canadian SARS surveillance system, stated that Canada was unable to provide optimal support for outbreak investigation and management. The Toronto Public Health unit, which handled most of the SARS cases, had to rely on a paper-based tracking system. This prevented researchers and health care workers tracking infectious disease and outbreaks because of "an archaic DOS platform used in the late eighties that could not be adapted for SARS" (quoted in: [54: 29]).

6.2. SARS in China: failure of cooperation in the global network

China reacted hyper-introvert on the first SARS outbreak in November 2002 [27]. The Chinese government feared that, when this information was disclosed to the rest of the world, international trade, foreign investments, and internal stability were threatened. Moreover the Chinese government feared that the public image of the Communist Party was damaged when she made information about the SARS outbreak public. Diseases and disasters are both viewed as negative news. In a similar way, the Chinese government had recently discouraged reporting publicly about the spread of HIV/AIDS in China. Disclosing information about disease outbreaks were regarded as state secrets under Chinese laws [1]. In China, disease outbreaks are investigated and controlled by local health officials who report only up the chain of command [6]. They were not allowed to publish information about diseases beyond this chain of command. By this hierarchical reporting system the Chinese government was able to control communication and information flows.

After the first SARS breakout in November 2002, it took almost three months before China was willing to disclose information about the SARS cases. The reluctance of the Chinese government to contribute to the WHO's GOARN (Global Outbreak Alert and Response Network) undermined the effectiveness of local health care organizations and of the global network to contain the spreading of SARS. It was only in February 2003 that the Chinese government informed (though still incompletely) the world through a press conference about the disease outbreak.

Until February 2003, the Chinese government was able to prevent scientists, healthcare workers, doctors, patients and media to disclose information about the mysterious disease to the outside world. The SARS outbreak was no longer under control. In early February 2003, an anonymous SMS began circulating in Guangzhou (Southern China) about this new disease. The SMS message was in the end caught up by people from the WHO global influenza surveillance network. A son of a retired WHO staff member, traveling through China, sent an email to the Communicable Disease Team Leader of the WHO in China in which he reported about "the strange contagious disease which has already left more than 100 people dead in… Guangdong province, in the space of 1 week" (quoted in [6: 75]). From then on the WHO started to put the Chinese government under pressure to open up and exchange information about SARS. In April 2003, the Chinese press was allowed to publish on the SARS and only then a WHO team was allowed to visit the province of Guangdong. Thereafter, the Chinese government declared the war on SARS. In spite of the lack of modern information and communication technology the government initiated a very effective campaign on fighting SARS and mobilizing the entire population. It used community structures and people's surveillance to contain the spread of SARS. On a press conference on June 24 China was declared SARS-free [6].

6.3. The World Health Organization: network preparation and orchestration

6.3.1. Redefining the WHO's role

In 2000, well before the SARS outbreak, the WHO launched a new vision on its role in coordinating global outbreak of infectious diseases [88]. The International Health Regulations (IHR) were the only set of international binding rules to which WHO member states were committed concerning the control and containment of infectious diseases. The old IHR dated from 1969, and relied on a passive, state-centric system for the reporting of three communicable diseases that could spread globally: cholera, plague and yellow fever [39]. This passive system reflected the dominance of the exclusive privilege of countries to report and respond to infectious diseases within their own territories [40]. The idea of national sovereignty of national health care systems prevented the development of a strong commitment to the IHR. WHO member states frequently violated the IHR obligations to report outbreaks of diseases, because they feared serious economic consequences as other countries reacted to the outbreaks [27]. However this non-reporting behavior directly influenced the effectiveness of the global cooperation according to the IHR.

The outbreak of new infectious diseases quickly spreading across countries aroused the need for revising the old IHR. Discussion about this revision started in 1996 and resulted in the adoption of a new set of regulations for the proactive collection of information about infectious disease outbreaks and the development of protocols for coordinated response [39]. This new system was formally launched in 2000 and embodied in the Global Outbreak Alert and Response Network (GOARN), a network with a secretariat within the WHO that links more than 120 individual surveillance and response networks (governmental and non-governmental) across the world. GOARN is an information-centric network, supported by advanced Internet technologies [57]. This system tracks outbreaks and spreading of SARS continually. GOARN consists of experts in various areas whose knowledge must be integrated to combat major diseases. Teams on the ground in relevant countries receive information from, and provide information to WHO. These teams work together through video- and teleconferencing. In cooperation with other agencies, WHO thus orchestrates a global network for monitoring disease outbreaks and communicating about these, mainly through its website.[3] vAn essential element within the GOARN is the Global Public Health Intelligence Network (GPHIN). This is a sophisticated, Internet-based multilingual early-warning tool for continuously collecting epidemiological information of all kinds (such as informal and formal reports) about infectious diseases [27,40].

6.3.2. Responding to SARS

With the revision of the IHR and the setup of GOARN *prior* to the SARS outbreak, the preparedness of the global network had increased dramatically. In late November 2002 GOARN was first alerted by individual intelligence networks on identifying infectious diseases from Canada and the US about the outbreak of an infectious disease in mainland China. After China disclosed information about this new disease in February 2003, GOARN issued a global alert for the outbreak of SARS in 2003. At the same time, the WHO commenced planning for addressing the risks of SARS in multiple areas. Their efforts included arranging for medical supplies, mobile teams of specialists traveling to sites with urgent situations, and organizing networks of experts trying to develop a better understanding of SARS diagnosis and treatment. WHO organized multiple networks: organizations involved in medical supply logistics; epidemiologists studying patterns of outbreaks; clinicians involved in specific SARS case were interconnected to share experiences; and laboratory staff across the world attempting to understand causes of the disease.

6.3.3. Fostering scientific collaboration

GOARN not only played a major role in alerting the world about the SARS outbreak, but it also stimulated and facilitated the worldwide collaboration of medical labs in identifying and diagnosing the new infectious disease. Acquiring deep knowledge into different, key knowledge domains requires large investments in basic and fundamental research. However, at the beginning of the outbreak of the corona virus there was no knowledge for identifying, diagnosing and treating SARS. David Heymann, a veteran epidemiologist at the WHO, stated that "… we had no cause of the disease, we thought it was infectious, no vaccine, no drugs" (quoted in: [1: 84]).

The urgency awareness put research labs under pressure which resulted in an unprecedented speed of scientific discovery and publication of research results (National Advisory Committee on SARS and Public Health, 2003). New knowledge had to be created and exchanged between globally distributed research labs in order to find appropriate methods for diagnosis and treatment. The WHO decided to set up a secure website where each research lab could post its findings. Daily teleconferences were organized to discuss the research results and to share information. Because of the firm competition between research labs, the WHO guaranteed that research data would be kept confidential and the labs and researchers were not allowed to use someone's finding without prior permission [1]. This "novel approach to science", as Abraham [1] calls it, required a lot of diplomacy and patience from the part of the WHO coordinators. On one hand, they had to ensure that knowledge and information sharing was optimized by connecting all relevant research labs to each other in order to control and contain the global epidemic as soon as possible. On the other hand, they had to cherish the competitive environment in which international reputed researchers were used to work in. The WHO coordinators hoped to publish a single scientific article in the name of all participating laboratories. However it soon appeared that the research groups started to publish their research results individually [1].

The results of this global collaboration of research labs were amazing. SARS was first identified in February 2003. The first scientific papers describing SARS were already published in March 2003 in *New England Journal of Medicine*. They came from the research labs in Hong Kong and Canada. The following weeks, papers were published in high-ranked medical and scientific journals with traditionally long lead times such as *The Lancet*, *British Medical Journal*, *Science*, *New England Journal of Medicine*, and *The Journal of the American Medical Association*. In the period March–July 8, 256 SARS papers were written by 38 countries [18]. Interestingly, only 17% of SARS-related papers resulted from international collaboration. The first scientific papers were published online in order to get immediate access to the scientific findings about the corona virus.

Getting access and mobilizing resources of various specialized organizations appeared to be one of the most important success factors in the global attempt to control and contain the spreading of SARS.

6.3.4. Full-scale multidisciplinary collaboration

Perhaps more amazing than the speed of scientific discovery of the corona virus was 'the almost instantaneous communication and information exchange' about various aspects of the network response

[3] http://www.who.int/csr/sars/goarn2003_4_16. Accessed October 19, 2007.

[30]. Hardly any modern communication tool was left unused to disseminate up-to-date information to health care workers, travelers, clinicians, health officials, researchers and so forth. Tools included websites, videoconferences, email, and various traditional publication modes such as academic journals. The WHO coordinated multiple communities of dispersed experts specialized in different areas, generating unprecedented knowledge development and dissemination [32], and application of knowledge in globally situated activities [10,11].

7. Discussion

In this paper we took a multi-theoretical and multi-level perspective for analyzing the response of the SARS GCN to the crisis alerts [53]. We characterized GCNs as information-centric, heterarchically structured networks with a variety of non-coupled, decoupled, tightly coupled, and loosely coupled connections between the actors. The instantiation of GCNs is conceived as a collective action. Success depends on multi-level preparedness, and the network coordinator's ability to transcend from a de-, non- or loosely coupled into a temporarily tightly coupled Global Crisis Network. The potential of a global infectious disease crisis revealed the need for a global response system. The SARS case showed that the 'phase transition' was driven by urgency awareness (here, the global threat of SARS). In this 'phase transition,' the WHO transformed from a traditionally slow acting, bureaucratic global organization [1] into a versatile network coordinator that was able to swiftly connect and mobilize globally distributed information sources.

Interestingly, the network did not just transformed from a non-, de- or loosely coupled into a tightly coupled system. Some elements of SARS GCN became tightly coupled (like the WHO organization) while other part became or remained loosely coupled (like the research labs network).

For complexity and efficiency reasons it would be impossible to organize the response as a global, permanently tightly coupled system. The unpredictability and complexity of the diffusion and the impact of communicable crises require global responses that meet Ashby's law of requisite variety [4,83]. This puts high demands on the global information processing capacity of the GCN.

7.1. Global information processing

Information processing consists of cycles for collecting, interpreting, sharing, applying and storing information [22,32,41]. While these processes are commonly considered at the group [32] or organizational [76] level, our study explores their relevance for network operations. The successful containment of the SARS crisis not only relied on the scientific, validated knowledge that was produced by the research labs. It also depended on a stream of informal and weak signal from all sorts of people. This sensitivity for weak and informal information enhances the requisite variety of global crisis response [83]. The intelligent, Internet-based information and communication systems of GOARN provided up to date information, not only for scientists, public health officers, and policy makers, but also directly for citizens. The sensing capacity for weak and informal of GOARN signals (like the SMS-message in the SARS case) played a determinative role in tracking and tracing the complex diffusion pattern of the SARS virus.

The scientific research labs played a unique role in the local and global network response. They formed a loosely coupled system in itself, being loosely connected to the SARS GCN. They responded very quickly and cooperatively while at the same time they were able to preserve their distinctiveness and competitive orientation. The labs agreed that they would exchange research data, and figure out by themselves the most efficient way to divide up the work. The very fact that the labs were working independently appeared also to be a particular strength in their search for identifying the SARS virus. This situation closely resembles the functioning of academic networks as described by Orton and Weick [58]. Loose coupled systems, like the academic networks, exhibit properties of both decoupled and tightly coupled systems [12]. The emphasis on knowledge specialization contributes to the distinctiveness of the research labs, while this specialized knowledge is only useful when it can be integrated into common knowledge base of the academic network. From a knowledge creation perspective the SARS case provides an extreme case of dynamic knowledge specialization and integration. Within only a few months new knowledge was created, shared, integrated and applied. While current studies explore processes of work division and knowledge integration in distributed teams (e.g. [33,44,59]), our study reconsiders these ideas for temporary networks.

There was no tight coupling of the research labs to the WHO during the response. Although the WHO coordinated the network of scientific laboratories, no one dictated top down what different labs should do, what viruses or samples the researchers would work on, or how information would be exchanged [72]. The SARS GCN remained predominantly a heterarchically structured and loosely coupled network. The WHO gained legitimacy in this heterarchically structured network not by enforcing relationships, but by successfully coordinating the global response within the context of an emerging shared sense of urgency. Spurred on by what seems resolute leadership of director-general Gro Harlem Brundland, the WHO decided to pursue an open information strategy, rather independently from the continuously conflicting national governments. It invited scientists, public healthcare workers, policy makers, travelers, and citizens to collaboratively help to control and contain the spreading of SARS. In contrasts with the closed information strategy of the Chinese government during the first three months of the SARS outbreak, this open information strategy helped to leverage untapped resources and allowed people to take responsibility. The initially weak social connections between China and the global network prevented a timely alert and response.

7.2. Network implications of national preparedness and response

Literature on crisis preparation focuses on the capability to respond. Comparison of the two embedded case studies on Canada and China demonstrates the relevance of distinguishing between the ability and willingness to respond [55]. Canada's ability to respond was bounded by an outdated IT-infrastructure, unconnected information flows, unclear responsibilities, a failing alert system, a lack of coordination, a weak analytical capacity of the Ontario Public Health Branch, and a lack of involvement of the federal government [92]. Irrespective of China's ability, the case study showed the unwillingness to cooperate in the GCN for SARS during the first few months of the crisis. This political aspect in crisis management is hardly addressed yet in the organizational literature on organizational crises, except for policy evaluation reports on for instance the Katrina disaster [19]. It underscores the role of culture and trust in crises response. Fidler (2004) argues that the SARS outbreak reflected the collapse of the classical regime on infectious disease control, which was dominated by the sovereignty of national health care systems. The SARS outbreak instantiated a new kind of global solidarity in the detection and validation of global infectious diseases [40]. Asian countries continue to adhere to the standards and norms that had been established during the SARS outbreak.

Building trust appears to be difficult in crisis situations, especially when many stakeholders are non- or decoupled to the network. The sharing of information and delegation of tasks without continuous surveillance to unknown partners turned out to be problematic. Trust relationships are not built overnight and require prior investments [8]. Moingeon and Edmondson [52] distinguish two levels of trust. The first refers to the confidence that other organizations will not abuse the information that will be exchanged. The second refers to the belief that other organizations are capable to keep up with their promises [52]. While both types of trust are important, trust in intent probes to be problematic as time shortage does not allow for establishing enduring trustworthy relationships. Hagel and Brown [38] therefore argue that when organizations operate in dynamic environments trust relationships should be mainly based on trust in competence. Jarvenpaa and Leidner [42] found that high-trust virtual teams exhibit a form of 'swift trust'. People who have never worked together and do not expect to work again act as if trust is present from the start. Meyerson et al. [50] characterize swift trust as a form of depersonalized action which may be a by-product of a highly proactive, enthusiastic generative style of action. Although we should be cautious in generalizing conclusions from research on virtual teams to global crisis response, it might help to explain how swift trust emerges in GCNs. Our study, though, emphasizes additional factors at play such as or organizational preparedness and openness. With an increasing sense of urgency in crisis situations, decision makers will calculate the risk of non-trusting and embrace a collaborative attitude.

8. Conclusion

The SARS outbreak and the way this infectious disease was contained were unique from different perspectives. First, SARS was the first truly global disease spreading all over the world through global travel [57]. Second, it also convincingly showed that the very nature of a global phenomenon requires a global understanding and approach (i.e. at the network level). Third, underlying the successful campaign to bring the spread of the corona virus under control was the instantiation of an interorganizational information network. And finally, the success of instantiating global information networks was largely determined by the contribution of individual contributors (countries) and the global coordinator of the network (WHO).

Although there is a vast amount of literature on network dynamics in the sense of who-talks-to-whom, less attention has been paid to the consequences of the 'compression of time' for the emergence and governance of networks in response to existential threats. As global cooperation between organizations will increase, it is important to understand the coordination dynamics of global loosely coupled networks. Our multi-level and multi-theoretical framework is an attempt to analyze and explain these dynamics. We think it is important to search for, synthesize and extend management and organizational concepts – such as Global Crisis Network, collective action, loosely coupled systems and network coordination, and leverage capability building – to understand new dynamics of globally operating agile networks responding to global events.

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