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Airports and Catastrophes: Understanding Preparations for the Response Phase After Catastrophic Incidents

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AIRPORTS AND CATASTROPHES: UNDERSTANDING PREPARATIONS FOR THE RESPONSE PHASE AFTER CATASTROPHIC INCIDENTS

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AIRPORTS AND CATASTROPHES: UNDERSTANDING PREPARATIONS FOR THE RESPONSE PHASE AFTER CATASTROPHIC INCIDENTS

A Master Thesis

of

American Public University

By

Luke 'Io William Balthazar

In Partial fulfillment of the

Requirements for the Degree

of

Masters of Arts

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American Public University

Charles Town, WV

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DEDICATION

I dedicate this thesis my wife and children. Without their patients, understanding, support, and love, the completion of this thesis would not have been possible.

ABSTRACT OF THE THESIS

AIRPORTS AND CATASTROPHES: UNDERSTANDING PREPARATIONS FOR THE RESPONSE PHASE AFTER CATASTROPHIC INCIDENTS

by

Luke 'Io William Balthazar

American Public University System, May 1, 2016

Charles Town, West Virginia

Doctor Michael Charter, Thesis Professor

The low income of Haiti and Nepal inherently make them more likely to experience a catastrophic incident compared to wealthy nations with robust emergency and disaster management capabilities. Both of these nations have experienced a catastrophic event in the last decade and the speed of the international responses were significantly different. Part of the difference in the response can be contributed to logistics and the ability of the affected nation to open their airports for international aid and first responders. Airports are vital to the response phase of catastrophic incidents because speed can mitigate impacts. This thesis analyzes the preparedness of Haiti's Toussaint Louverture International Airport and Nepal's Tribhuvan International Airport to support the influx of humanitarian aid during the response phase of the emergency management cycle, utilizing the 2010 Haiti earthquake and 2015 Nepal earthquake as case studies. It recommends that developed nations increase investments into the preparedness of airports of low income nations in order to set the environment necessary to quickly open the basic logistical support necessary for international aid and assistance to enter into the country. Globalization has ensured that catastrophes anywhere in the world impact every other nation in some way and it is on the international community to work together to mitigate these impacts.

Running head: AIRPORTS AND CATASTROPHES: UNDERSTANDING PREPARATIONS
FOR THE RESPONSE PHASE AFTER CATASTROPHIC INCIDENTS

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INTRODUCTION

Catastrophic incidents often severely damage or destroy the logistical infrastructure necessary to facilitate the flow of vital international assistance and aid. During the response phase of a catastrophic event, airports prove to be one of the most timely and effective critical infrastructures to support international aid and responders (DHL, 2016). But as the former director of the United States (US) Federal Emergency Management Agency (FEMA), James Lee Witt stated, "(t)he hard reality is that mega-incidents, which we now call catastrophes, are too multidimensional, too confusing, and have such broad impacts that no single plan, organizational methodology, or agency type can effectively manage the myriad of important tasks-nor, perhaps, even consider all that needs to be done-to minimize both immediate and downstream consequences" (Brissell, 2013, p. vii-viii). Director Witt alludes to the difference between disaster response and catastrophic response for governments and the international community. International aid organizations rely heavily on governments to open and maintain the logistical infrastructure to include airports which allows international aid and assistance to enter into the country. With a lack of local and regional government capabilities, the international disaster response community must be able to open these logistical lifelines.

How does the international disaster response community open airports as logistical hubs in a catastrophic incident and what efficiencies can be made to the current system to increase the speed with which international aid and assistance can flow? A study of the preparation of two international airports that have experienced catastrophic incidents reveals an inefficiency in training and planning, ultimately delaying the response time for international aid to reach victims. Answering these questions and studying past catastrophic incidents allows the

international community to better prepare for and respond to the next catastrophic disaster, increasing the potential to save lives and mitigate the effects of the incident. This study utilized the 2010 Haiti earthquake and 2015 Nepal earthquake as catastrophe case studies to identify the ability of the international airport to support the humanitarian response directly following the disaster. This study specifically focused on an analysis of the airport emergency response plans to support humanitarian response, how the actual response unfolded, and the response time for international aid to start flowing from outside the impacted area.

LITERATURE REVIEW

While there are many peer-reviewed articles, books and open sources covering catastrophes and humanitarian logistics, there are limited sources that directly address airport support to humanitarian logistics during catastrophic disasters. Definitions from the Federal Emergency Management Agency (FEMA) and other authors provides a point of departure to understand the differences between disaster response and catastrophe response, the phases of emergency management, and the importance of airports during the response phase. While there are many books written on the methods and efficacies for humanitarian logistics and the importance of air movement of goods and airports, most fail to address in detail how airports should prepare for and support humanitarian aid in a post catastrophic environment. An additional search was conducted of the ProQuest, EBSCO, and Defense Technical Information Center (DTIC) for similar topics related to catastrophe response and airports however the number of articles directly related to catastrophe management and humanitarian aid at airports was limited, either focusing on the larger topic of humanitarian logistics or on airport safety and security disasters such as plane crashes or hijackings. An open web search on the topics related

to airport preparation for international aid, opening airports in a post-catastrophic incident environment and airport support to international humanitarian aid provided the most promising source of information through news articles and social media related to the case studies.

Disasters and Catastrophes

There are a multitude of disaster response organizations around the world but a lack of a standardized definition of what a disaster or catastrophe is (McGlown, 2011). The result is a multitude of definitions which creates confusion in understanding disaster response and catastrophic response (McGlown, 2011). The International Federation of Red Cross and Red Crescent Societies (IFRC) defines a disaster as "… (a) sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origins" (IFRC, 2016, para. 1). The United Nations Office for Disaster Risk Reduction (UNISDR) defines a disaster as "[a] serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" (UNISDR, 2016). While there are differences between these definitions, both acknowledge that a measure for determining a disaster is the amount of resources a community or society has to cope with the event or incident. For this paper the UNISDR definition will be used.

Many utilize catastrophe and disaster interchangeably and while there are many similarities between a disaster and a catastrophe there are differences (McGlown, 2011). The

lack of a standardized definition of what a disaster is blurs the line for defining what a catastrophe is. The United States Department of Homeland Security (DHS) defines a catastrophe as " . . . any natural or manmade incident, including terrorism, that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions" (DHS, 2008). While this is a good definition, it does not clarify when a disaster transitions into a catastrophe. Therefore, for this thesis, the difference between a disaster and a catastrophic event or incident is the level of response and recovery required. Should the level of response and recovery efforts exceed the domestic capabilities of a nation, ultimately requiring international aid and assistance, the disaster has transitioned into catastrophe. The close relationship between disasters and catastrophes allows much of the disaster management terminology to be utilized in catastrophe management.

Emergency Life Cycle

Like disasters, catastrophes do not just happen, they are part of an "emergency life cycle" which continues to be relevant in catastrophe management (FEMA, 2011). The four phase model of emergency management life cycle utilized by The United States Federal Emergency Management Agency (FEMA) has been adapted in foreign emergency management programs like Queensland, Canada and others (Public Safety Canada, 2016) (Queensland Government Disaster Management, 2013). The four phases of Emergency Management as they relate to airports are:

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(1) Preparedness – Is often used interchangeably with "prevention" and "preparation". "This phase includes developing plans for what to do, where to go [and] who to call for help before an event [or incident] occurs; actions that will improve [the] chances of successfully dealing with an emergency" (FEMA, 2011).

(2) Response Phase – "Encompasses action taken in the immediate human needs, reduce lost property, and preserve evidence (ACRP, 2015).

(3) Recovery Phase– Begins "[a]fter an emergency and once the immediate danger is over" (FEMA, 2011). "An airport's 'full recovery' is when the prescribed safety and security standards have been regained and capacity for aircraft operations is restored to the level that existed prior to the incident" (ACRP, 2015).

(4) Mitigation Phase– "[I]ncludes any activities that prevent an emergency, reduce the likelihood of occurrence, or reduce the damaging effects of unavoidable hazards. Mitigation activities should be considered long before an emergency. (FEMA, 2011)"

Figure 1 depicts the emergency management cycle with an associated timeline for how long the actions in those phases are actionable. While the actions in each of the phases are inherently linked they can also overlap and be conducted simultaneously. For instance, once the response phase has transitioned to the recovery phase rebuilding damaged buildings could require new mitigating factors like building codes, essentially addressing the mitigation and preparedness also.
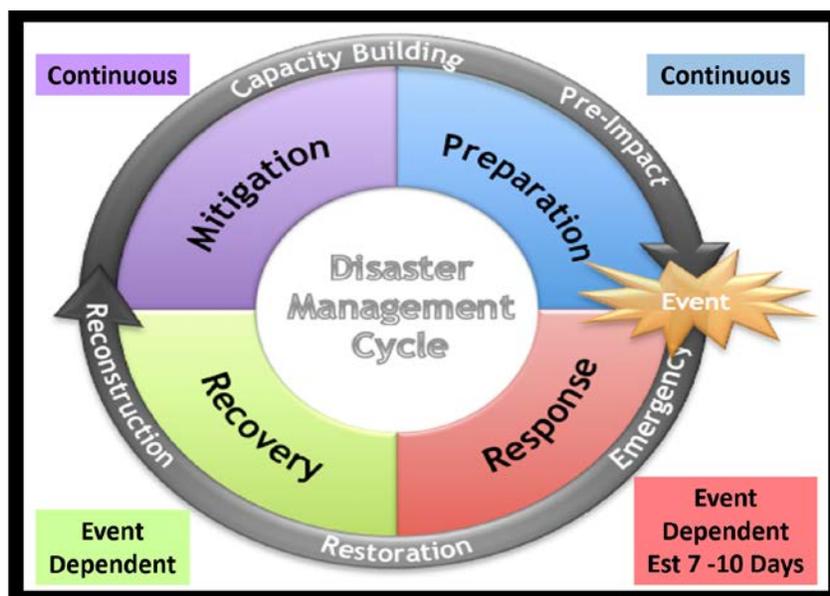
Figure 1: Phases of Disaster Management Cycle with overlay of projected timeline for specified activities which fall in the specific phases (Gour, 2013).

Of the emergency management phases, the response phase is the most time constrained as the focus is on saving lives and mitigating the immediate impacts of the incident. The human body can only survive approximately four days without water depending on the temperature and close to six weeks without food (Fox, 2013). These basic human needs for survival significantly limit the timeline of the response phase and indicate that time is a critical factor during catastrophic response. It is in the response phase that airports are most vital to supporting the arrival of international aid and assistance because of time.

Catastrophic incident response inherently requires international political coordination compounding the complexity of the situation when time is a factor (Bissell, 2013). Immediately following a catastrophic incident the need for aid and assistance is urgent and this is when the value of preparation and prior coordination significantly impacts response. As governments,

non-government organizations (NGOs), and private organizations work to respond to the catastrophe, airports become the critical infrastructure necessary to support timely and effective logistical movements for humanitarian aid and assistance. Assuming that the political coordination is complete, it falls to the emergency management efforts at airports to support the large amounts of inbound aid.

<div style="text-align:center">Airports Categories and Classifications</div>

For a better analysis of airport preparedness it is necessary to review the categories, roles and types of airports per the Federal Aviation Administration (FAA). Airports fall into three classifications: Commercial, Primary and non-primary and sub-categorized by the annual number of passengers that travel through the airport (FAA, 2016). Figure X is a chart identifying the categories of airport activities and the percentage of the different types of airports around the world (FAA, 2016).

Categories of Airport Activities			
Airport Classifications		Hub Type: Percentage of Annual Passenger Boardings	Common Name
Commercial Service: Publicly owned airports that have *at least 2,500* passenger boardings each calendar year and receive scheduled passenger service §47102(7)	Primary: Have *more than 10,000* passenger boardings each year §47102(16)	Large: 1% or more	Large Hub
		Medium: At least 0.25%, but less than 1%	Medium Hub
		Small: At least 0.05%, but less than 0.25%	Small Hub
		Non-hub: More than 10,000, but less than 0.05%	Non-hub Primary
	Non-primary	Non-hub: At least 2,500	Non-primary Commercial Service

Categories of Airport Activities		
Airport Classifications	Hub Type: Percentage of Annual Passenger Boardings	Common Name
		and no more than 10,000	
Non-primary (Except Commercial Service)	Not Applicable	Reliever §(47102(23)) General Aviation (47102(8))

Table 1 (FAA, 2016)

The FAA describes airports as having one of five roles, national, regional, local, basic and unclassified (FAA, 2016). An understanding of the types of airports, the role an airport is described as, and the category of the airport enables the creation of a standardized system to study airports.

Role	Description
National	Supports the national and state system by providing communities with access to national and international markets in multiple states and throughout the United States.
Regional	Supports regional economies by connecting communities to statewide and interstate markets.
Local	Supplements communities by providing access to primarily intrastate and some interstate markets.
Basic	Links the community with the national airport system and supports general aviation activities (e.g., emergency services, charter or critical passenger service, cargo operations, flight training and personal flying).
Unclassified	Provides access to the aviation system.

Table 2 (FAA, 2016)

There are four different types of airports: commercial service airports, cargo service airports, reliever airports and general aviation airports (FAA, 2016). Commercial airports are publicly owned airports that have an annual throughput of at least 2,500 passengers (FAA,

2016). Like commercial airports, General Aviation airports are passenger airports however their throughput is below 2,500 annual passengers. Cargo service airports"…are airports that, in addition to any other air transportation services that may be available, are served by aircraft providing air transportation of only cargo with a total annual landed weight of more than 100 million pounds" (FAA, 2016). The last type of airport are Reliever Airports which are privately or publicly owned airports specifically designated to "relieve congestion at Commercial Service Airports and to provide improved general aviation access to the overall community" (FAA, 2016). An understanding of the categories, types and description of airports provides the common terminology necessary to organize and plan for catastrophe response.

There are two basic types of aircraft, fixed-wing aircraft such as a typical air plane and rotary-wing aircraft, also known as a helicopter (Kendall, 2012). Each aircraft provides different benefits to disaster response. Fixed-wing aircraft are essential for moving great distances with heavy loads but require airports with long runways to unload their humanitarian cargo. The ability of rotary-wing aircraft to vertically land and take off means that these type of aircraft do not require runways, therefore they can provide a unique capability to evacuate and distribute aid to remote areas away from airports. Both types of aviation assets also require a significant amount of logistical support for safe and effective operations (Bissell, 2013). This support is from ground crews often centralized at airfields or airports. Fixed and rotary-winged aircraft require, fuel, maintenance, material handling equipment or manpower, and open, debris free areas to land on. Arguably the most important support needed from the ground are the air traffic control capabilities to ensure the planes do not collide on the ground or in the crowded airspace

above. Air traffic controllers also assist planes by coordinating which planes are landing and

departing.

Importance of Airports and the Tyranny of Time and Distance

Historically, the concept of supporting a catastrophic response in time was inconceivable

due to the tyranny of time and distance (Grau & Kipp, 2000). Mr. Lewis W. Grau and Dr. Jacob

W. Kipp first wrote about the tyranny of time and distance, referring to the employment of

military forces over the vast distances of the pacific (Grau & Kipp, 2000). Essentially, traveling

any significant distance takes time, especially when it involves tons of humanitarian aid and

people. As previously discussed, time is non-renewable resource, therefore speed is valuable

during a response. Over the past 100 years, air travel has significantly evolved shortening travel

times from days to hours. The importance and value of other logistical infrastructures, such as

sea ports and train stations, increases when time is not as important, like during the recovery

phase.

When responding to any catastrophic incident, time is the most important variable in

mitigating the effects of an incident. John Laster from Harvard International review wrote that,

"(t)ime matters in an emergency, in terms of the ability to both saves lives and lessen

disabilities" (Lancaster, 2010). Catastrophic incidents quickly overwhelm local and regional

emergency response capabilities, requiring international assistance to stabilize the situation and

begin the recovery process.

While modern air travel allows the international community to effectively respond to a

catastrophic incident from anywhere in the world, it is also the most expensive method of travel.

In 2000, the cost of air based movement was five times more per a kilogram compared to moving the same weight the same distance by sea (Grau & Kipp, 2000). Air movement continues to be the most expensive, "however, it is also the fastest means of moving victims and refugees out of a disaster area and essential goods and personnel into a region struck by catastrophe" (Bissell, 2013). When time is to most important resource, air movement will become the preferred method of movement for people and goods.

Airport Preparedness

Outside of studying individual airport emergency management plans, there are minimal sources directly focused or relevant to this topic. Dr. James F. Smith has been a leading academic on the role that airports play in regional preparedness and disaster response operations, but solely in the United States. He has trained FEMA personnel on the importance of airports and the role that airports play in disaster management. A separate study related to the recovery preparedness of airports in the United States in a post disaster environment was published by the Airport Cooperative Research Program (ACRP) in 2015 which studied 37 American airports and evaluated their emergency preparedness for multiple situations. A related program was develop through a partnership between the United Nations Development Programme (UNDP) and Deutsche Post DHL.

Dr. James F. Smith's presentation and related papers present the value of airports in disaster response and the need for investment in airport emergency disaster management planning (Smith, 2013). Dr. Smith has stated that "[a]n airport can become many things during disaster response however not many things can become an airport."(Smith, 2013). Airports can

be multi-functional after a disaster although the post-event focus should be on supporting the opening of the airport for the arrival of disaster assistance (Smith, 2013). In a post-catastrophic environment, Dr. Smith successfully argues that airports are critical infrastructure for communities, regions and countries because they provide the ability to receive and send aid and assistance (Smith, 2013). Further, regional and general aviation airports allow aid and assistance to reach remote areas (Smith, 2013). Finally, Dr. Smith identifies that while ports are important because of the amount of materials they can receive in a post-disaster situation, airports are vital to the response phase due to the need for speed and a limited response period (Smith, 2013). Unfortunately Dr. Smith's focus and publications has been on airports in the United States and the concept of airport preparedness to support a humanitarian response needs to be studied on an international level.

Over the past few decades, airports in the United States have steadily improved their ability to mitigate and respond effectively to emergency situations (ACRP, 2015). A 2015 study conducted by the Airport Cooperative Research Program (ACRP) surveyed 37 airports in the United States to study airport disaster recovery preparations and to identify airport disaster resiliency proved to be very insightful and identified that the United States as one of the wealthiest nations in the world with its robust emergency disaster management system is only now starting to truly research the value of airports that support disaster response and recovery (ACRP, 2015). The study consisted of interviews with airport personnel and analysis of airport emergency response plans. After analyzing the airports, varying in size from National to General Aviation airports, ACRP concluded that the primary focus of airport emergency management programs was on safety and security at the airports (ACRP, 2015). The results identified that

some of the emergency management plans completely lacked any concept of support for responding to a catastrophe incident (ACRP, 2015). The ACRP evidence showed that the role of airports in the recovery phase of a disaster management scenario is often overlooked and marginalized (ACRP, 2015).

Get Airports Ready for Disaster (GARD) was launched in 2009 and is a leading international program focused on increasing the preparedness of airports to support disaster response (DHL, 2016). The program is funded and ran through a partnership between the UNDP and Deutsche Post DHL Group and focused on training, evaluating, and coordinating airport disaster response capabilities (DHL, 2016). In addition to the training of airports, the program organizes workshops that support the coordination between airports and first responders in order to build relationships prior to having to support each other in humanitarian response (DHL, 2016). The program focuses on identifying potential issues that could occur in a disaster to include the significant increase in throughput that occurs in major humanitarian response operations (DHL, 2016). Since 2009 the program has supported the training of 500 personnel at 29 airports worldwide (DHL, 2016). While this is a good start, the Central Intelligence Agency (CIA) identified over 30,000 airports around the world in 2013 (CIA, 2016, a). The GARD program has focused its training on airports in the most disaster prone areas however, more needs to be done in this area and unfortunately the funding for such programs are a limiting factor from ensuring all airports receive training (DHL, 2016). The European Commissioner for humanitarian response, Kistalina Georgieva, stated that only four percent of all spending for natural disasters goes towards prevention and preparedness with the other 96 percent being spent on disaster response (Associated Press, 2014). Of this meager four percent, the funding for

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airport preparation for a catastrophic incident is minimal if any exists at all. The reality is that entities like USPACOM have to fund such programs in order to allow for preparedness to occur.

A separate study conducted by the ACRP in 2014 which summarized and highlighted the flight delays at airports in order to "assist airport planners in their capacity/delay analyses" (ACRP, 2014). The findings of the report suggest that each airport has a maximum capacity and that delays occur more often as an airport approaches max capacity (ACRP, 2014). The report specifically focused on American airports and the accompanying delay information collected by airlines, the FAA and the airports themselves (ACRP, 2014). The report utilizes data from the Aviation System Performance Metrics (ASPM). This is a "FAA database that contains detailed out, off, on, in times for flights at 77 U.S. airports" (ACRP, 2014). ASPM analyzes eight data points in order to calculate delays and develop recommendations to maximize efficiencies (ACRP, 2014). The eight data points are:

1. Actual gate-out time,

2. Actual gate-in time,

3. Actual wheels-off time,

4. Actual wheels-on time,

5. Average taxi-out time and average taxi-in time,

6. Unimpeded taxi-in time,

7. Unimpeded taxi-out time, and

8. Matching flight schedule data to flights in ETMS (ACRP, 2014).

The report defines capacity as "the number of aircraft that can land/depart on a runway system during a specified time period" (ACRP, 2014). The time period can be measured hourly, daily or

annually and the data can assist in identifying the maximum efficiency levels possible for a single airport (ACRP, 2014). Utilizing the ASPM data points, airport FAA classifications and airport capacity information, the study was able to provide recommendation's to planners to improve efficiencies (ACRP, 2014). Unfortunately, the study was limited to airports within the United States and there has not been a similar study conducted on the two case studies used in this thesis. However, there is a relationship between the data points used by the ASPM and the basic needs for running an airport supporting humanitarian aid.

Marine Corps and Expeditionary Airfields

A final related source is the Marine Corps (USMC) aviation doctrine which discusses the minimal requirements to operate expeditionary airfields. The worst case scenario, post-catastrophic environment would be trying to respond to a closed environment, meaning that the majority of critical infrastructure is damaged or destroyed and there is no assistance from within the nation to coordinate the receipt of international aid. The actions necessary to provide aid in these types of environments closely resembles the military actions necessary to invade another nation, minus the aggression. There is a requirement to establish a logistical hub from which additional aid can enter and flow from. A primary asset to conduct such missions in the United States military is the United States Marine Corps (USMC). A primary mission of the United States Marine Corps is the seizure of forward naval bases and logistical lodgments to support follow-on forces (99th Congress, 1986). When a requirement emerges to establish a foothold for logistical supplies to flow through the USMC is an ideal force to provide Humanitarian Assistance and Disaster Response (HADR) (Peterson, 2015). In the response phase immediately

following a catastrophic incident, airports provide the most valuable and fastest foothold for

immediate response as international aid begins to flow into the country.

Since the invention of the plane, the Marine Corps has developed an aviation capability

to support ground combat operations. After more than 100 years of development, Marine Corps

Doctrinal Publication 3-2 (MCDP 3-2), Aviation Operations provides the Marine Corps with a

basic doctrine to support the opening of expeditionary airfields in a closed environment to

support combat operations (USMC, 2000). These expeditionary airfields are established in a

closed environment, similar to the environment present after a catastrophic incident. MCDP 3-2

identifies a requirement for command and control of airspace utilizing trained air traffic

controllers and communication capabilities (USMC, 2000). It also identifies the need for

maintenance and refueling capabilities at the expeditionary fields (USMC, 2000). The final

requirement of any airfield is this base necessary for runways or landing pads and aircraft

parking (USMC, 2000). Utilizing these identified airfield requirements, one can begin to

develop a vision of the basic standards necessary to run an airfield after a catastrophe incident.

METHODOLOGY

A qualitative approach was used to analyze the effectiveness of the selected airports

ability to support humanitarian relief operations after a catastrophic incident or event.   Utilizing

the airport emergency response plans created prior to the catastrophe, an analysis was conducted

to identify how effective the response plans were at supporting the reopening of the airports after

a catastrophic event or incident. A within case study was then conducted analyzing the initial

response of the airport personnel to reopen the airports and finally a multiple case study analysis
was conducted.

Research Questions:

Research Question 1 (RQ1): How do the selected airports prepare to support
humanitarian response operations after a catastrophic incident?

Research Question 2 (RQ2): Do the emergency response plans address the minimum
requirements for an airport to be reopened, specifically focusing on space, logistical support and
traffic control?

Research Question 3 (RQ3): What were the causes of the closures at the airports?

Research Question 4 (RQ4): When did the airports reopen?

Research Question 5 (RQ5): Were the emergency response plans effective at supporting
the response phase of the catastrophe response?

Data Sources

This study collected data from multiple sources to answer the research questions. Data
for RQ1 it was found using open source searching on the internet. The United States Marine
Corps Doctrinal Publication (MCDP 3-21) Aviation Operations provided the minimal
requirements to run an expeditionary airfield which was utilized to answer RQ2.   The social
media site Twitter was utilized to answer RQ3 and RQ4 by conducting an advanced search on
the opening and closing of the specified airport for seven days after the incident. A post-incident
analysis of each airports support of the humanitarian response was then conducted against the

same criteria in RQ2. Sources for the post-incident analysis consisted of information from the Twitter timeline verified against open source information. No interviews will be conducted during this research.

Research Design

The catastrophes analyzed in this paper are the 2010 Haiti Earthquake and the 2015 Nepal Earthquake. The catastrophes that struck these nations each had a different level of impact on the governments and therefore the research spans the spectrum from a non-functional government in Haiti to the functional government in Nepal. The analysis focuses on the response phase, which is limited to the first seven days following the incident. This is the time period where lives can be saved and arguably the most difficult time period for international responders and aid to reach victims.

Data Analysis Strategy

A within-case analysis was conducted for each catastrophe. This analysis consisted of identifying the preparedness of the plan to see if it addressed the primary requirements needed to open an airfield for operations. The criteria for opening an airport consisted of three categories, space, logistical support and traffic control. These are basic requirements to support humanitarian efforts. Each of categories consisted of sub-categories. The "Space" category addresses the open space necessary for landing airplanes and helicopters, parking areas for aircraft, and maintenance and fueling areas. The "Logistical Support" category consisted of the necessary material handling capabilities which could be manpower intensive, heavy equipment intensive or both. It also included the fuel service required to refuel planes to allow for departing

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flights and maintenance capabilities necessary to fix broken aircraft.   The last category focused on "Traffic Control" which was split into two separate categories. These categories consisted of Air Traffic Control (ATC) capabilities such as communication with the planes, other airports and the radar necessary to guide the planes in to the airport safely. The other sub-category was the control of ground traffic around the airport, specifically the security of the airport to ensure people or items did not impede runways and taxiways and coordination between the movement of planes on the ground, landing aircraft and aircraft taking off. Essentially this sub-category addressed the safe movement on the ground. With the exception of the staging areas, each of the categories support the functioning of a safe and efficient airport. An example of the data analysis is below. The same categories and sub-categories were used to analyze the effectiveness and efficiency of the airport's ability to open after the catastrophe struck.

Example of Airport Disaster Response Plan Analysis

Space	*Addressed or Not Addressed*	*Logistical Support*	*Addressed or Not Addressed*	*Traffic Control*	*Addressed or Not Addressed*
Landing areas		**Material Handling Capabilities**		**Air**	Addressed
Runways	Addressed	Manpower	Addressed		
Rotary-wing Landing area	Addressed	Heavy Equipment	Addressed		
Staging Areas		**Fuel Service**	Not Addressed		
Loading	Addressed				
Unloading	Addressed				
Storage	Not Addressed			**Ground**	Addressed
Aircraft Parking					

Rotary-wing	Addressed				
Fixed-wing	Addressed				
Aviation Maintenance Facility	Not Addressed	**Maintenance Service**	Addressed		
Fuel Containment area	Addressed				

Table 3: Example Data of Airport Disaster Response Plan Analysis

In addition to a review of the airport disaster response plans and an analysis of the actual response from the airport, a review of Tweets related to the airport opening, closing and situations, supported the creation of a timeline of events which identified when the airports opened and closed to air traffic, why the airports closed and what the situation at the airport looked like. The picture that materialized relating to the airport was then verified utilizing news articles. By identifying the preparation prior to the catastrophic event, analyzing the preparedness against the minimal requirement to support a functional airfield, analyzing the actual response against the same pre-incident criteria, and finally identifying the amount of time it took to open the airport, a measurement of the effectiveness for each airports preparedness emerges.   After conducting an individual analysis with each case study, a cross-case analysis was conducted which identified similarities and difference of the case studies and identified trends.

Assumptions and Limitations of the Study

Among the assumptions related to this study is that a response to a catastrophic man-made event would have similar impacts as a natural disaster at an airport, such as damaged runways or collapsed airport facilities. It can be assumed that the response for a natural

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catastrophe or a man-made catastrophe would be similar. Among the limitations of this study is the fact that Twitter does not identify the exact timing of the Tweets that are published. While some people may sometimes post the time within their Tweets, the closest to understanding when an airport opened is by the date of the post.

CASE STUDIES

Haiti Case Study

Basic Facts and Economics

Haiti is an island nation approximately 600 miles south of the Florida Peninsula. The nation covers approximately 27,750 sq km and shares a single border with the Dominican Republic (CIA, 2016, b). The World Bank listed Haiti's 2009 Gross Domestic Product (GPD) to be approximately $6.585 billion (World Bank, 2016, a). In 2009 the World Bank estimated Haiti's population at 9.852 million people, resulting in a GDP per a capita of $662.30 (World Bank, 2016, d). Prior to the 2010 earthquake, Haiti was ranked 145th of the 169 countries in the United Nations Human Development index (DEC, 2013).   Finally, the World Bank classifies Haiti as a "Low Income" nation (World Bank, 2016, a). These economic facts labeled Haiti as the poorest nation in the Western Hemisphere (Kent, 2010).

Haiti Incident Preparedness

The earthquake that struck Haiti on January 12, 2010, was a "poignant and heartbreaking reminder for the U.S. and international community of the need to invest in disaster preparedness" (Winthorp, 2010). Approximately 86% of the population lived in poorly constructed concrete buildings that were very susceptible to damage from earthquakes (DEC, 2013). The lack of building codes extended to the public facilities such as the Toussaint Louverture International

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Airport. As with most poor nations Haiti's government inherently relied on the international community and NGOs for its disaster response system (Bissell, 2013). Ten months before the earthquake, then Secretary of State, Hillary Clinton stated that Haiti was a priority for the United States Department of State (DOS) (Guha-Sapier & et. al., 2011). The result was a Memorandum of Understanding (MOU) between the President of Haiti and the President of the United States allowing the United States to take control of airports and ports to support international aid if necessary (Guha-Sapier & et. al., 2011). The Haitian government simply did not have a disaster management plan to identify critical infrastructure and address how to open the infrastructure in a catastrophic incident to support humanitarian aid because they immediately defaulted to the United States to open the critical infrastructure in a catastrophic event. The Haitian Government had no other plan in place to support the nation in a catastrophic event.

Haiti has two international airports, the Toussaint Louverture International Airport, located at Port-au-Prince, and the Cap-Haitian International Airport in the North of the country (airportsbase.org, 2016,). The Toussaint Louverture International Airport is the focus of this study due to its location and proximity to Port Au Prince and the epicenter of the earthquake however a universal plan could have been created to guide both airports in a humanitarian response. As the poorest nation in the Western Hemisphere, the emergency and disaster management of Haiti was minimal at best and definitely incapable of addressing an incident such as the earthquake that struck it in early 2010 (Kent, 2010). Without an emergency response plan to support humanitarian assistance, neither airport was prepared to support a humanitarian response. Figure 5 depicts the critical issues that should have been addressed in order to open the airport and the issues that were not addressed by the Toussaint Louverture Airport.

Haiti Toussaint Louverture International Airport Disaster Response Plan Data

Space	*Addressed or Not Addressed*	*Logistical Support*	*Addressed or Not Addressed*	*Traffic Control*	*Addressed or Not Addressed*
Landing areas		**Material Handling Capabilities**		**Air**	**Not Addressed**
Runways	Not Addressed	Manpower	Not Addressed		
Rotary-wing Landing area	Not Addressed	Heavy Equipment	Not Addressed		
Staging Areas		**Fuel Service**	Not Addressed		
Loading	Not Addressed (18 Parking areas)				
Unloading	Not Addressed				
Storage	Not Addressed				
Aircraft Parking				**Ground**	**Not Addressed**
Rotary-wing	Not Addressed	**Maintenance Service**	Not Addressed		
Fixed-wing	Not Addressed				
Aviation Maintenance Facility	Not Addressed				
Fuel Containment area	Not Addressed				

Table 4: Analysis of the Toussaint Louverture International Airport Disaster Response Plan

Haiti Incident Description and Effects

On January 12, 2010 at 11:53 local time, Haiti was struck by a 7.0 magnitude earthquake

and a series of strong aftershocks (Taft-Morales & Margesson, 2010, a). The epicenter of the

earth quake was approximately 15 miles north of the Haiti's capitol city, Port-au-Prince (Taft-Morales & Margesson, 2010, a). Of 29 government buildings, 28 were destroyed, leaving Haiti's government incapacitated and unable to coordinate any response effort (Bissell, 2013). Initial reports estimated the amount of damage as high as $13.2 billion in damage (Luhnow and Dugan, 2010). The earthquake killed an estimated 250,000 to 300,000 people and injured another 300,000 (Kent, 2010). The effects of the earthquake resulted in a complete collapse of government services and quickly escalated into a catastrophic incident.

Logistical infrastructure was severely damaged. Roads were severely damaged or choked with rubble, making land transport difficult (Beiser, 2010). The main seaport was severely damaged requiring the United States military to establish alternate port facilities (Taft-Morales & Margesson, 2010, b). Airport facilities were damaged however the runway was still intact and functional (Taft-Morales & Margesson, 2010, b). While the single runway was still functional the air traffic control tower had collapsed and the airport lacked the ability to safely coordinate the airspace for all of the incoming aid being flown in (Taft-Morales & Margesson, 2010, b). The airport main terminal was flooded and full of cracks that snaked through the building, bringing into question the stability of the building (Beiser, 2010).

Haiti Incident Response

Fortunately, Haiti is located only 600 miles from Florida and 200 miles from Puerto Rico, ultimately allowing the United States to launch the largest international disaster response in history (Bissell, 2013). While the response efforts started immediately, the necessary formal request for assistance was not made until 24 hours after the event due to the destruction of the Haitian government (Taft-Morales & Margesson, 2010). The lack of any communication with

the Haitian Government forced Haiti's Ambassador to the United States, Kenneth H. Merten, to request the aid and assistance (Taft-Morales & Margesson, 2010, a).

At the airport, the runway was still functional however the destruction of the air traffic control tower left the airport closed without anyone to provide air and ground traffic control (Beiser, 2010). All air traffic over Haiti was being controlled from the United States until the arrival of United States Special Forces at 1900 EST on 13 January 2010 (Taft-Morales & Margesson, 2010, a). The Air Force Joint Terminal Attack Controllers (JTACs) were able to open the airport and took control of the airspace utilizing portable radar systems (Cecchine & et. al., 2013). Even with the JTACs coordinating the landing of planes, some planes with aid were diverted to the Dominican Republic or completely denied to land (Taft-Morales & Margesson, 2010, a). Twitter posts quickly communicated that aid and responders were arriving at the Port-au-Prince airport however the aid was not making it very far from the airport. Most of the aid started to build up on the tarmac of the airport (Taft-Morales & Margesson, 2010, a). With only eighteen positions to park large aircraft, the lack of space on the tarmac became an issue. Within 24 hours of opening the airport the JTACs had to close the airport due to lack of space for the landing planes to offload their aid and a lack of fuel to support the return trip for the planes that did land. There were also planes that required maintenance after landing, ultimately taking up valuable room on the tarmac and requiring a capability that was not available to the airport at the time (Taft-Morales & Margesson, 2010, a). By 22 January 2010 the arrival of fuel and additional logistical support provided by the United States and Canadian militaries, the airport was functional, landing approximately 150 flights a day arriving and departing from the airport (BBC, 2010).

Haiti 2010 Earthquake Timeline

Appendix 1 is a timeline developed from Twitter covering seven days following the disaster. From this timeline the Tweets were categorized into three different categories for each day: Airports Open, Airports Closed and Airport Situation. The information from Appendix 1 was then verified and coupled with open source information which ultimately materialized a picture of the situation and actions that occurred during the first seven days of the Haiti response at the Toussaint International Airport. Below is a summary of the daily situation that emerged from the Haiti Twitter Timeline:

12 January 2010.

The earthquake struck at 11:53 local time and lasted over 30 seconds. Following the earthquake the airport was closed and the international community started coordination to fly aid to Haiti however, with a closed airport and a collapsed air control tower the United States took control of the air space around Haiti from the air control towers located 600 miles away in the continental Untied States. The airport remained closed due damage to the airport facilities although the runway was open and intact.

13 January 2010.

The airport remained closed at the start of 13 January 2010. At approximately 6:00pm local time when the United States military was able to insert an Air Force Special Operations team to control and manage humanitarian aircraft to land at Toussaint Airport. The area quickly became congested with planes both in the and on the tarmac. The lack of logistical support such as fuel and maintenance services shut down the airport as planes that landed did not have enough fuel for the return trip. Before shutting down the airport again it is logical to assume that the 18

designated positions and other available space for aircraft to park and unload their valuable goods would have been utilized. Due to the closure flights were diverted 173 miles away to the Santa Domingo Airport in the Dominican Republic in hopes that the goods could be driven over land routes.

14 January 2010.

By the morning of 14 January 2010 the airport was again open however it was still having trouble with the congestion. Throughout the day the airport opened and closed intermittently. The number of planes landing was limited and the airport was only open to humanitarian flights. There continued to be a fuel shortage at the airport and this ultimately limited the number of planes that were able to land. Planes could only land when another plane had taken off to make space. Many humanitarian flights were still being diverted to the Dominican Republic. Alternative options were also considered by humanitarian agencies such as the consideration to employ boat planes or boats, however Haiti's port remained closed due to damage.

15 January 2010.

The morning of 15 January 2010 the airport was closed again due to congestion. The search for alternate methods continued with requests for sea planes and boats. The frustrations of first responders, responding organizations, and people in the United States donating money to support the response started to become apparent as reports of the slow arrival aid became a focus of media reports in the United States. A few military flights were able land however the flow of humanitarian aid was still limited (Willwork & et al., 2010). The Air Force controllers focused on only allowing planes to land that had enough fuel to take off and make the return flight

(Shaughnessy & Ahlers, 2010). This meant that many humanitarian flights were diverted due to the lack of fuel to take off.

16 January 2010.

The airport continued to process humanitarian flights and military flights as space become available on the tarmac. Another issue started to become apparent, the unloaded aid started to take up valuable space at the airport as the airport became a staging area for the humanitarian goods awaiting delivery. The number of arriving flights remained limited and the airport remained closed to commercial traffic.

17 January 2010.

The airport remained closed to commercial traffic on 17 January 2010. There continued to be a limited number of military and humanitarian flights landing at the airport. Fuel continued to be an issues as well as space. The alternative routes for humanitarian aid to get into Haiti continued to be through the Dominican Republic.

18 January 2010.

The airport continued to remain closed to commercial traffic. Humanitarian flights started to ensure that planes had fuel and aid started to flow in to the airport at a faster pace. By 22 January 2010, the U.N. reported that the airport was landing 150 flights a day to include commercial flights (BBC, 2010).

Haiti Case Study Analysis

Haiti did not have a plan to open the airports after a catastrophic incident, with the exception of the MOU with the United States. The Twitter Timeline and open source reporting align to show that the Toussaint International Airport runway was functional to support the

landing of aircraft after the earthquake however the airport structures, to include the air traffic control tower, were severely damaged. The lack of traffic control capabilities initially closed the airport after the catastrophic incident. The airport initially opened the evening of 13 January 2010 with the assistance of the United States Special Operations Forces (SOF) however, due to a lack of space and logistical support for the landing planes, the airport was quickly overwhelmed and closed. While some aid had landed when the airport initially opened, the airport was not fully opened to support the humanitarian response. It was not until 18 January 2010, six days after the earthquake and well into the response phase, when the airport was able to consistently support the number of international humanitarian aid flights arriving to assist the response.

Table (4) represents the analysis of the Toussaint Louverture international Airport Disaster Response plan or lack thereof. The chart analyzes the plan as it relates to the requirements for an airport to function and to support aircraft. Relying on the MOU with a nation that is 600 miles away as the primary method to open an airport in a disaster inherently adds time and risk in any catastrophic incident. While the United States is an extremely capable partner, the tyranny of time and distance coupled with the preparations necessary to open critical infrastructure from 600 miles away accepts that international assistance and aid will not arrive until late in the response phase or early in the recovery phase without a functional airport. Utilizing the same data points as in Table 4, Table 5 utilizes the information from Twitter and open source documents to present what actually happened during the incident and what issues delayed the airport from functioning.

Haiti Toussaint International Airport Disaster Response 13 January 2010

Space	*Functional or Cause of Closure*	*Logistical Support*	*Functional or Cause of Closure*	*Traffic Control*	*Functional or Cause of Closure*
Landing areas		**Material Handling Capabilities**		**Air**	Cause of Initial Closure
Runways	Functional	Manpower	Functional		
Rotary-wing Landing area	Functional	Heavy Equipment	Minimal		
Staging Areas		**Fuel Service**	None		
Loading	Functional				
Unloading	Cause of second Closure				
Storage	Cause of second Closure				
Aircraft Parking					
Rotary-wing	Cause of second Closure	**Maintenance Service**	None	**Ground**	Cause of Initial Closure
Fixed-wing	Cause of second Closure				
Aviation Maintenance Facility	None				
Fuel Containment area	Empty				

Table 5: Analysis of Haiti Case Study for Opening Airport

Nepal Case Study

Nepal Basic Facts and Economics

Nepal is a landlocked nation bordered by India and China (CIA, 2016, c). The high Himalayan Mountains in the north and the flat plains of the Ganges River in the South make it a very steep and difficult nation to reach via land routes (CIA, 2016, c). The nation covers approximately 147,181 sq km which is relatively the size of Arkansas (CIA, 2016, c). The World Bank listed Nepal's 2014 Gross Domestic Product (GPD) to be approximately $19.77 billion (World Bank, 2016, c). Nepal's population was estimated to be 28.174 million people in 2014 by the World Bank, resulting in a GDP per a capita of only $701.71 (World Bank, 2016, c). Nepal is also classified by the World Bank as a "Low Income" nation (World Bank, 2016, c).

Nepal Incident Preparedness

The remote nature of Nepal and the mountainous terrain that surrounds the land locked nation make it a difficult to support in a catastrophic event. In Nepal the Tribhuvan Airport is the only airport that can support the landing of large jet aircraft (Associated Press, 2015). The Officiating Director of Nepal's Department of Aero Safety and Standards said "[g]iven Nepal's primary lifeline to the outside world runs through the Tribhuvan International Airport, it is critical that we ensure we are ready to respond in the wake of [a] catastrophic [incident]" (CAAN, 2012). In 2012 the Civil Aviation Authority of Nepal (CAAN) published the Tribhuvan International Airport Disaster Response Plan (TIADRP) (CAAN, 2012). The creation of the document was funded through the United States Pacific Command (USPACOM). Multiple international agencies to include the United States Agency for International Development (USAID), the University of British Columbia and the Federal Aviation Authority assisted in the creation and development of the document. More importantly the document was nested and

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coordinated with Nepal's National Disaster Response Framework (NDRF) and aligned to the UN logistics cluster plan. The document establishes a plan to reestablish the airport as soon as possible after a catastrophic event in order to allow humanitarian aid and assistance to enter the country (CAAN, 2015).

In 2010 five of Nepal's airports received GARD training (Bonn, 2010). The training specifically focused on on-site assessment capabilities, "the training of local government employees and airport personnel and development of detailed action plans for emergencies" Bonn, 2010). It was estimated by DHL that training these five airports would support approximately 30 million people in a catastrophe incident (Bonn, 2010). In 2015, this projection became a reality with the humanitarian response efforts in support of the earthquake.

Prior to the earthquake Nepal had two plans prepared. Nepal's Airport Emergency Plan (AEP) which addresses how to respond to aviation safety and aviation security emergencies such as emergency landings, an airplane midair collision or a high-jacking to name a few. The TIADRP is considered a stand-alone document for earthquake emergencies however the response can be tailored to other potential incidents like severe storms (CAAN, 2012). This purposeful separation between the two plans assists in clearly delineating between addressing internal airport specific emergencies and assisting the national response and recovery in a catastrophic event.

Within the TIADRP were definitions of the three different levels of events that could impact the airport:

A. Significant earthquake in the country with no or minimal damage: No functional loss to the airport (CAAN, 2012).

B. Major earthquake with moderate to significant damage: Moderate to high damage to the airport facility requiring immediate repair of emergency flight operations where the runway is available but may require rapid runway repair (CAAN, 2012).

C. Catastrophe: Severe damage or destroyed critical facilities. The runway is destroyed or severely damaged beyond capabilities of rapid runway repair. No flight operations are possible for an extended period of time in the aftermath of the earthquake (CAAN, 2012).

By addressing these three different levels the TIADRP communicated the alignment between the severities of damage to the level of response required.

The TIADRP assumptions focused directly on the availability of the manpower and equipment necessary to open up the airport in the response phase of the plan. The TIADRP identifies the airport response phase as the first 24-72 hours while the recovery phase covers a period from 72 hours post-incident to 30 days.

Along with these assumptions the TIADRP identifies the priority of response goals for responders (CAAN, 2012). The following were the identified goals of the TIADRP when the 2015 earthquake struck:

A. Restore Airport Perimeter Security

B. Restore taxiways, runways, Navigational Aid (NAVAID) and Air Traffic Control (ATC) Systems

C. Restore Fuel Operations

D. Establish Emergency Customs and Immigration

E. Restore Terminal Facilities

F. Support Logistics Cluster Operations

G. Maximize Airport throughput

With priorities for recovery the TIADRP supported the pre-coordination for airport personnel to identify individual duties in a post-incident event which was tailored to the necessary level of response. Once deemed clear a Notice to Airman (NOTAM) notifies inbound pilots that the runway and airport is open.

Nepal Tribhuvan International Airport Disaster Response Plan Data

Space	*Addressed or Not Addressed*	*Logistical Support*	*Addressed or Not Addressed*	*Traffic Control*	*Addressed or Not Addressed*
Landing areas		**Material Handling Capabilities**		**Air**	Addressed
Runways	Addressed	Manpower	Addressed		
Rotary-wing Landing area	Addressed	Heavy Equipment	Addressed		
Staging Areas		**Fuel Service**	Addressed		
Loading	Addressed				
Unloading	Addressed				
Storage	Not Addressed			**Ground**	Addressed
Aircraft Parking					

Rotary-wing	Addressed		Maintenance Service	Addressed			
Fixed-wing	Addressed						
Aviation Maintenance Facility	Addressed						
Fuel Containment area	Addressed						

Table 6: Analysis of Nepal's Tribhuvan International Airport Disaster Response Plan

Nepal Incident Description and Effects

At 11:56 Nepal Standard Time (NST) on 25 April, 2015, Nepal was struck by an earthquake that measured 7.8 the Richter Magnitude Scale (European Commission, 2015). The Nepal Disaster Risk Reduction (NDRR) portal reported strong aftershocks measuring 6.7 on 26 April and 7.3 on 12 May 2015 (NDRR, 2016). The epicenter of the earthquake was located approximately 80km northwest of Nepal's capital city of Kathmandu near Lamjung, Nepal impacting rural towns and the large capital city (European Commission, 2015). The earthquake caused significant damage in Kathmandu, impacting the one million people living in the city. By 11 May the Ministry of Home Affairs in Nepal identified that there were approximately 8,000 deaths with another 16,000 people requiring medical attention (Ministry of Home Affairs, 2015). A later report published by OCHA on June of 2015 reported that 8,700 people were killed, 500,000 homes were destroyed and another 279,330 homes were damaged (OCHA, 2015). Also of note in the OCHA report was that an estimated 2.8 million people were in need of humanitarian assistance following the earthquake and there were still rural communities that were difficult to access due to the terrain and weather which required helicopters to continue to

support recovery operations (OCHA, 2015). Economically, it is estimated that it will cost over $10 billion to rebuild Nepal after the earthquake (Beck, 2015). Fortunately, as the largest employer in Nepal, the farming industry experienced limited impacts (Beck, 2015).

Although the airport shut down for a short time following the earthquake. The Nepalese government released to the public that commercial flights were expected to resume early on 26 April 2015 (Cohen, 2015). After shutting down for a short period, per the disaster response plan standard operating procedures (SOP), the airport reopened. Within 24 hours of the earthquake, the airport was supporting a large amount of aid flights and commercial flights (Associated Press & Ravid, 2015). The strong aftershock on 26 April shut down the airport again for an hour before reopening (Channel News Asia, 2015). During this time inbound flights were diverted to other airports or returned to the points of embarkation (Channel News Asia, 2015). Although the airport was functional, supporting the incoming international aid was challenging with only nine designated parking areas for large jets at the main terminal and a handful of parking areas for medium to smaller planes around the airfield (Khan & Grimson, 2015).

Nepal Incident Response

The Government of Nepal (GoN) requested international assistance within hours of the earthquake on 25 April 2015 (USAID, 2015). This started a large international push to fund and send humanitarian aid to Nepal. The GoN immediately established an Emergency Operations Center (EOC) and convened its Central Natural Disaster Relief Committee (CNDRC) after the earthquake on 25 April 2015 (USAID, 2015). The IFRC as well as the Nepal Red Cross Society (NRCS) personnel already in Nepal supported Search and Rescue (SAR) operations immediately following the earthquake. The United Nations (UN) coordinated aid to begin arriving on 26

April 2015 through its Cluster Program (USAID, 2015). The UN Assistance and Coordination (UNDAC) and UN Office of the Coordination of Humanitarian Affairs (OCHA) coordinated to dispatch teams, equipment, supplies and aid to Nepal and were set to arrive on 26 April.

Tribhuvan International Airport only closed for a few short hours after the initial earthquake (All India & Press Trust of India, 2015). Tweets from passengers at the airport reported that the earthquake had caused some damage to the runway, ultimately requiring the employment of rapid runway repair capabilities. After the initial repairs, the airport experienced sporadic closures due to aftershocks and tremors and to ensure the safety of the runway, taxiways and other facilities (CAAN, 2012). This meant that the airport needed to close down, conduct assessments and then reopen multiple times as the international community attempted to fly in.

Supporting the response phase proved to be very busy and challenging for airport personnel, passengers and responders as there is only one runway at Tribhuvan International Airport (Lewis, 2015). Among the first international responders was an elite Chinese Search and Rescue (SAR) team who arrived at approximately 0730 NST on 26 April 2015 and pushed out to conduct SAR operations in Kathmandu (Xinhua, 2015). Air India and other commercial carriers resumed flights to Tribhuvan Airport that same day (All India & Press Trust of India, 2015). At 13:15 NST on 26 April 2015, the airport closed due to impacts of consistent tremors on the ATC tower, interrupting the airports ability to control both air and ground traffic (Sinha, 2015). The airport was reopen at 1630 NST on 26 April only to shut down again due to weather (Sinha, 2015). A severe thunderstorm created unsafe conditions for planes to land (Sinha, 2015). The airport opened later that night as the storm subsided and commercial flights landed at the airport the next morning.

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Tweets from passengers and the media report a chaotic environment at Tribhuvan International Airport. Travelers awaiting flights out of Nepal became stranded when the earthquake struck and started to establish small camps, sleeping outside while they awaited a flight due to the fear of the instability of the airport buildings. Foreign nations immediately started to develop plans to evacuate their citizens from Nepal after the quake in an attempt to alleviate the number of people that humanitarian aid needed to support (Laskar, 2015). Shortly after the airport reopened late on 25 April 2015, four planes from India were able to evacuate 540 Indians from Kathmandu via the airport. On 26 April, the Indian military mounted Operation Maitri which focused on moving large amounts of humanitarian aid in to Nepal and evacuating Indian nationals from Nepal (Laskar, 2015). While this operation provided Nepal with the humanitarian aid it desperately needed, it also contributed to the chaotic situation at the airport as Indian citizens overwhelmed the airport for flights home (The Canadian Press, 2015). Ultimately the airport became a bottleneck for the majority of logistical support entering Nepal and refugees and stranded foreign nationals leaving the catastrophe stricken nation (Fischer & et al., 2015).

By the end of 29 April 2015, the airport was supporting over 80 flights a day, twice as many as its typical 40 flights a day (Plautz, 2015). This high level of traffic coupled with heavy weight of the incoming humanitarian aircraft and commercial jets started to damage the only operational runway at the airport. The result was that a restriction was placed the types and weight of plane landing at the airport. On 3 May 2015, a NOTAMs was released denying unscheduled large aircraft weighing over 196 tons from landing at Tribhuvan International because the significant weight of the heavy planes were damaging the airports single runway

(Kahn & Grimson, 2015). The airport did remain open for medium and small aircraft to support response and recovery operations (Associated Press, 2015).

Nepal 2015 Earthquake Timeline

A Twitter timeline was also created for the Nepal earthquake and is represented in Appendix 2. Just as with the Haiti Twitter Timeline the Tweets were categorized into three different categories for each day: Airports Open, Airports Closed and Airport Situation. This information materialized a picture of what occurred at the Tribhuvan International Airport during the first seven days of the Nepal response phase. Below is a summary of the daily situation that emerged from the Nepal Twitter Timeline:

25 April 2015.

The airport struck at 11:56 local time. The airport closed for a short time to check the damage to the airport, its runways, taxiways and facilities per the SOP. During this shutdown rapid repairs were conducted on the runway. With the repairs and checks complete the airport reopened to humanitarian flights and first responders. The same actions were repeated post aftershocks and the airport reopened quickly. The situation at the airport was reported to be chaotic as many passengers did not want to reenter the airport facilities and many were stranded until the airport reopened. During the closures flights were diverted to airports in India although the overland routes into the country were also damaged or blocked by rubble.

26 April 2015.

By the morning of 26 April 2010, the overland routes were being cleared and reopening. Tribhuvan Airport was intermittently open due to multiple factors such as aftershocks and weather. When the airport was open it was open to both humanitarian and commercial traffic.

An elite team of Chinese search and rescue arrived early that morning and commercial flights from India were evacuating Indian citizens. The airport shutdown at approximately 1:15pm local due to concerns about the structural integrity of the air traffic control tower. The airport reopened for a short time until 6:30pm when the weather closed the airport due to safety concerns. Weather issues at Tribhuvan airport such as high winds and significant storms are a constant safety concern. During the closures, flights were diverted to airports in India. The situation at the airport continued to be chaotic as a mix of tourists and foreign workers awaited flights back to their home countries and first responders and aid flights started to flow in at a significant rate.

27 April 2015.

The airport was open and the flow of aid and commercial flights was constant.

28 April 2015.

The Airport was opening and supporting a consistent flow of incoming aid. The airport had to shut down for a short time to repair the runway from damages caused by the number of heavy planes landing at the airport.

29 April 2015.

The airport was supporting approximately 80 flights day, twice its normal amount. Again the airport had to shut down for a short time to repair the runway from damages caused by the number of heavy planes landing at the airport. Restrictions were emplaced on the weight of inbound planes in order to mitigate the damage to the runway. The situation at the airport terminal was still chaotic as people attempted to flee the danger in Nepal and the aid workers worked to enter Nepal.

30 April 2015.

Although the situation was still chaotic at the passenger terminal areas, the airport was open and supporting the response.

1 May 2015.

The airport was open supporting the humanitarian response and commercial flights. United States and Indian citizens continued to evacuate the area on commercial flights.

Nepal Case Study Analysis

Nepal is a developing nation. Before USPACOM funded the creation of a functional TIADRP, it would have been doubtful that they could have afforded to invest into a robust emergency management capability to support humanitarian aid response. The speed at which Nepal's airport was able open and support the increased number of flights supporting the humanitarian response is evidence of the relevancy of the TIADRP. Nepal's government officials and the USPACOM understood that Tribhuvan International Airport is the lifeline for Nepal to reach the rest of the world. As the only airport in Nepal to handle the large jets used in both commercial flights and humanitarian aid flight it was vital that it had a plan in place and that the airport personnel understood and trained to execute the plan.

Tweets and open sources validate that the airport closed after the earthquake occurred, just as the TIADRP directed. The earthquake was classified as a "Major earthquake with moderate or significant damage" because the runway required rapid repair however it was still usable by the commercial and international aid flights within 24 hours of the original incident. Humanitarian aid flights were authorized to land shortly after the initial earthquake. While commercial flights were initially diverted from Tribhuvan Airport, commercial operations were

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able to resume the day after the initial earthquake. By opening the airport within the original 24 hours, Nepal was well within their desired response window. While commercial flights may have been diverted or delayed, the airport was open within 12 hours of the original quake to support the flow of humanitarian aid.

An important note related to the TIADRP and the opening and closing of runways is that immediately following an earthquake the ATC Services first task is to "[c]lose the runway to all fixed wing operations" (CAAN, 2012). While this may seem like this would delay the initial response, it is a necessary action in order to ensure that the runway is clear and safe to land on. Closing the runway to ensure its integrity can prevent a potential airplane incident that could shut down the runway for a prolonged period of time. This pre-emptive precautionary measure ensures the safety of the airline pilots and crew as well and ensures the most effective and efficient response possible.

There were clearly challenges for such a small international airport to support the primary logistical lifeline for humanitarian response. The single runway needed to be used for both takeoff and landings, therefore creating a bottleneck for the multitude of inbound and outbound planes. With only had nine designated parking spots for large planes, improvised parking areas needed to be identified in order to maximize the space on the ground for planes to load and offload.

Another challenge faced was the structural stability of the ATC tower. If the airport is considered critical infrastructure for the nation, the ATC tower is critical infrastructure to the airport. When the structural integrity of the tower is question, the functioning of the entire

airport is threatened as seen during the three hour closure on 26 April 2015. This could potentially be mitigated by ensuring a redundant capability that can be operated at ground level.

Population control was an issue at the airport. Travelers at the airport when the earthquake struck evacuated the airport onto the tarmac creating a security issue for the airport. Even after this issue was addressed, the people did not want to stay inside the airport, choosing to stay outside the airport until they were able to board their flights. Supporting the amount of people trying to depart out of the airport with food and water would have also presented a challenge as the large amount of Indian citizens awaited a plane ride back to India.

The final challenge this case study identified is related to crisis communication. While NOTAMS provided the information for other airports and inbound flights to understand the status of Tribhuvan Airport, the public did not seem to know when or what was actually going on at the airport unless they were at the airport. Communications needs to include local, national and international media coverage in order to ensure that people understand what is going on and why certain decisions were made. This is evident when you have frustrated responders and organizations trying to understand why the airport is closed or why certain planes can land and others cannot. The Twitter timeline shows that there was confusion related to when the airport was opened or closed and the types of flights, commercial or humanitarian, that were able to land. Providing information to the public about the situation at the airport should be a part of any catastrophic communications plan and unfortunately it was missing in this case study.

Ultimately, the Nepal case study provides an excellent example of how effective a catastrophic response can be when an airport is open to support the humanitarian response.

While there are always areas for improvements like in how to logistically handle stranded

travelers or engage the media, the overall response was efficient and effective.

Nepal Tribhuvan International Airport Disaster Response 25 April 2015

Space	_Functional or Cause of Closure_	_Logistical Support_	_Functional or Cause of Closure_	_Traffic Control_	_Functional or Cause of Closure_
Landing areas		**Material Handling Capabilities**			Cause of closure on 26 Apr 2015
Runways	Functional / Required Rapid Repair / Weight dependent	Manpower	Functional	**Air**	
Rotary-wing Landing area	Functional	Heavy Equipment	Minimal		
Staging Areas		**Fuel Service**	Functional		
Loading	Functional				
Unloading	Limited				
Storage	Limited				
Aircraft Parking					
Rotary-wing	Limited	**Maintenance Service**	Functional	**Ground**	Functional
Fixed-wing	Limited (9) designated spots				
Aviation Maintenance Facility	None				
Fuel Containment area	Empty				

Table 7: Analysis of Nepal Case Study for Tribhuvan International Airport

CASE STUDY COMPARISON

Similarities

Even before the catastrophic incidents struck there were clear similarities between Haiti and Nepal. Both were, and still are, low income nations, and had relatively equal GDP per a capita before the catastrophes struck. Neither nation employed building codes to mitigate the effects of an earthquake, arguably, due to their poor economic situations. Their poor economic situations also limited both nations ability to invest in robust emergency management capabilities resulting in an attempt by both nations to rely on the United States for preparation and mitigation assistance.

After the catastrophes, Haiti and Nepal relied heavily on the United States and the international community for assistance and aid. The remoteness of Nepal and Haiti's island location made overcoming the challenges of time and distance difficult for both responses and proved the importance airports extremely valuable. As previously discussed, planes were diverted and the response was delayed as both airports opened and closed multiple times. The conflicting Tweets and questions about the status of the airport serve as evidence that both nations struggled with crisis communication. In a catastrophic incident, information about the airport such as its status and limitations must be clear to everyone, to include other governments, NGOs, and the public.

Material handling capabilities at both airports were also similar, each would have plenty of manpower but minimal heavy equipment support. This would also impact the amount of time it would take to load and offload a single aircraft and decrease the efficiency of the response. With each airport facing challenges related to space available and the high number of flights

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participating in the response, logistical support in both location were related. Another similarity between two case studies was that both airports were single runway airports. Utilizing a single runway to support the number of air planes landing and taking off is a difficult mission to coordinate, especially during a humanitarian response when flights could double or more the amount of normal flights into the airport, like it did in Nepal. The single runway creates a bottleneck however, it is better to have a bottle neck into a closed off nation than no access at all.

The finale commonality that caused delays in both case studies was the difficulty of maintaining consistent traffic control in both the air and on the ground. In both case studies a lack of air control caused a closure of the airport for a period of time. In the Haiti case study, the destroyed air traffic control tower left the airport without an ATC capability. This was the initial reason why planes could not land. In Nepal the ATC capability shut down the airport for a couple of hours on the 26 April 2015 because of the perceived instability of the air traffic control tower.

Differences

There were clearly more differences than similarities to the case studies. The largest difference was clearly in the preparation and mitigation efforts of Nepal and the lack of preparation at the Haiti airport. While both case studies turned to the United States for assistance and guidance for planning and coordinating of disaster response efforts before the catastrophe occurred, how the United States supported the preparation and mitigation phases was where the divide began. The MOU between Haiti and the United States Department of State arguably left Haiti with the belief that the United States would conduct the work for Haiti in case of a catastrophe and not that the United States would be a partner to their own efforts. In the Nepal

case study, Tribhuvan Airport personnel received GARD training, five years prior to the 2015

earthquake. In addition to the GARD training, USPACOM assisted Nepal with the development

of the TIADRP. This plan was not reliant on an MOU or a belief that another nation would do

the work for the Nepalese. This training arguably persuaded the Nepalese airport personnel to

understand that the airport was the lifeline to their nation and that they were responsible for

keeping this lifeline open, unlike in the Haiti case study where there was a hope that another

nation was going to take care of opening the infrastructure for them in a catastrophe incident.

This preparation can be shown specifically in the difference in response to the high number of

flights participating in a catastrophe response. The GARD program works with airports to train

airport personnel to manage the influx of flights and planes during a humanitarian response.

This program actually launched a Disaster Response Team (DRT) to Nepal within 48 hours of

the initial earthquake to assist in the management of the influx of flights. While Nepal only had

9 designated slots for large jets to park, load and offload, the airport did not have to shut down

although it did have to divert aircraft to manage the flow of aircraft landing at the airport (Bonn,

2015). In Haiti, the airport was shut down and the flow of aid was reduced to a slow trickle due

to limited space on the ground.

A clear difference is also the function of the government. In the Nepal case study, the

Nepalese government was still functional and taking action to coordinate the emergency

response operations and manage responding organizations and governments. This was not

possible in the Haiti earthquake where 28 of 29 governmental buildings were destroyed. This

was a critical factor in supporting the response coordination and ultimately added to the

inefficient response at the ports of entry.

Although the single runways were functional at both airports after the earthquakes, the construction of Nepal's runway ultimately resulted in restricting the weights of planes landing. This complicated the response of the international responding organizations who now had to go back and redistribute the weight of aircraft and not maximize the space and weight capacities of the different types of aircraft. While the runway was functional in Haiti immediately after the earthquake the collapse of the ATC tower and its radar capabilities were the driving factors in the closing of the airport. When operations did resume in Haiti the runway did not cause any issues however in Nepal the cracking of the runway could have been prevented by better construction practices. Related to the runway issues Nepal understood and maintained a rapid runway repair capability. This planning ultimately supported opening Tribhuvan Airport even after the earthquake damaged the runway.

The logistical capabilities at each airport were also different. Haiti had no fuel support, leaving planes stranded if they did not land with enough fuel for the return trip. With the number of planes in holding patterns awaiting for space on the ground to open use of the single runway, precious fuel was being used up requiring the humanitarian planes to either divert to the Dominican Republic or risk running out of fuel. If planes with low fuel were permitted to land in Haiti, they would take up valuable ground space until the fuel capabilities could be flown in. Nepal did not have this issue, as it was able to retain its fuel capability even after the earthquake. Maintenance problems were another logistical issue. In Haiti, any plane with maintenance issues eventually took up valuable ground space and the plane could not take off because of a lack of maintenance capabilities at the airport. Just like the fuel, Nepal's airport staff understood what the minimum requirements were to ensure the airport was able to support the large throughput

because of the GARD program. They were able to support minor maintenance requirements in order to get the planes to larger hub airports.

DISCUSSION & RECOMMENDATIONS

Overall, the planning, preparation and efforts by Nepal, USPACOM, and the GARD Programme allowed Nepal to mitigate the impacts of the earthquake on the airport. With the exception of the precautionary shutdown period for assessment, the airport reopened the same day as the incident allowing India and China to begin support operations. Although there were a couple of intermittent shutdowns for aftershocks, an issue with the ATC tower, and weather issues, the Tribhuvan Airport personnel response was close to ideal with regards to opening the airport. Other items such limited space were not something that could have been fixed during the response phase. The best option to mitigate the limited space was to maximize turnover of every plane that landed. The lack of planning and preparedness by Haiti and the United States Department of State significantly impacted Haiti's ability to open the Toussaint Airport. Although the airport was open by United States Special Forces within 24 hours after the initial earthquake, the airport was not able to fully function compared to Tribhuvan Airport, until six days after the initial earthquake.

Ultimately, a cycle emerges similar to that of the ASPM data points. Each plane has to go through a cycle in order to support a constant flow of aid and assistance through the airport. The cycle consists of landing, offloading, reloading, refueling and then taking off in order to allow the cycle to restart with another plane. These factors ultimately effect overall throughput of an airport. Interruptions to this cycle result in the delay of additional planes from landing.

The size and space of airport tarmacs and the number of runways significantly contribute the maximum throughput of an airport. When the Haiti airport opened, space quickly became an issue. Both case study airports were single runway airports which make up the majority of airports in low income nations. With the limited space, it is vital that each inch of the tarmac be utilized to maximize the throughput of aircraft during a humanitarian response. This would suggest that each airport disaster management plan must include a layout of how the entire tarmac would be utilized, beyond the normal designated parking areas, to support the influx of aircraft. Similarly, airport tarmacs should not be used as storage or staging facilities for humanitarian goods because these areas take up a large amount of space, potentially denying hundreds of additional planes from landing with aid. These staging areas should be located away from, but close to, the airport in order to support the response and maximize available airport tarmac space.

The time to offload aircraft directly depends on the method in which the plane is offloaded, whether that be with heavy equipment or manpower. This offloading time can also be impacted by the distance to the humanitarian aid storage and staging areas. Heavy equipment can move large loads quickly to and from humanitarian aid areas, allowing planes to park in any available position on the tarmac and allow the heavy equipment to transport the aid to the storage areas. However, if the unloading is being done with manpower it may be practical to offload each plane in the same vicinity requiring planes to move about the tarmac and potentially lengthening the process. The downside of utilizing heavy equipment is that it requires fuel and maintenance whereas manpower does not. This is one area airports need to consider when preparing to deal with high turnover of response assets.

The Haiti case study identified the importance of logistical planning and the need for the logistical assets to support the throughput of aircraft. The lack of fuel significantly hampered the disaster response, causing the airport to close because planes did not have fuel for the return trip. Areas such as fuel storage and the supporting equipment need to be protected and kept operational post-catastrophe. If these logistical capabilities are damaged or destroyed these assets need to be among the first assets arriving after a disaster to support the continuous cycle of aircraft. On the same note, the first aircraft sent from aid organizations should also arrive with enough fuel to allow the plane take off and fly to another airport to top off and support the return trip.

Rapid runway repair became vital in the Nepal response. Catastrophe and disaster management plans at all airports should ensure that this capability is maintained to support the reopening of a damaged a runway. This is especially vital at airports with only one runway. On the same topic the quality of the runway needs to be maintained to support heavy loaded aircraft supporting the response. This should become a standard of any airport identified as a national or regional airport as these are the airports likely to support the influx of large aircraft.

Haiti and Nepal both had air traffic control issues that delayed their responses. The primary methods of air traffic control were damaged during the incidents and neither airport maintained secondary measures in order to fill the gap of air traffic control. Developing a plan and secondary capability of air traffic control at airports could assist in mitigating this issue. The secondary capability would need to be self-powered, have the communication capabilities to talk to aircraft, and have some sort of radar capability. In a catastrophic incident when the ATC

buildings are damaged the secondary capability would allow airports to reopen faster instead of waiting for specialty teams or another nation to open the airport from outside the country.

Capabilities of the government post-catastrophe are invaluable and therefore at a minimum the international community should reinforce the importance of protecting government capabilities in a catastrophic incident. In Haiti's case study, this could have been done by implementing building codes for, at a minimum, all government buildings. This can be done by ensuring that when funding is provided by organizations for construction that there are stipulations directly tied to the construction quality to include the use of earthquake mitigation in areas where earthquakes are expected to occur.

The international community such as the UN and regional organizations like the Association of South Easter Asian Nations (ASEAN) need to encourage the preparation all airports to support humanitarian response. ASEAN is a particularly important region to focus on as it often faces catastrophes and many of the nations are island nations. This could potentially be done by funding airport preparation and mitigation facilities such as ensuring runways are properly reinforced or even coordinating and conducting training for airport professionals.

A public communication effort needs to be conducted world-wide to stress the importance of opening airports as soon as possible in a post-catastrophic environment in order to quicken the ability of the international community to respond. If a situation like what happened in Haiti occurred again, where the government is not able to coordinate the opening of the airport, private citizens near the airport should have the knowledge to clear the runway and taxiways to support the ability of planes to land. This feeds into the requirement of training not only airport personnel but potentially providing a basic knowledge of training to civilians that

live around the airport. Along with the education of the public, additional training programs are necessary for all airport personnel. While the success of the GARD Programme is evident by Nepal's ability to quickly reopen its airport, the GARD Programme has trained less than .1% of the airports around the world. Training needs to be conducted at all airports because while large planes land at international hubs, smaller regional and general aviation airports can and should be able to support rotary wing operations as well as medium and small fixed wing aircraft. These smaller airports can serve as smaller hubs to reach more remote areas.

In a more extreme measure, the international disaster response community, NGOs and IGOs should consider forming a specialized non-military capability to open closed airports. This capability could look much like the smoke jumpers that are used in California to battle wildfires. Using any nation's military requires vital time to receive authorizations, plan and coordinate mission and finally execute those missions, whereas specialized airport personnel capable of jumping in as soon as the request for help is received could increase the capabilities at an airport. Couple this team with portable radar systems, money for paying locals and possibly smaller utility equipment like bobcats machines and this team could become an independent effort to open airports after a catastrophe.

Reliever airports need to have runways long enough and strong enough to support humanitarian response. While not a primary hub, reliever airports can serve as a close alternate to medium and smaller planes that are bringing in goods. This would leave the longer runways at the large hub airports open specifically for the largest of planes. Diversifying the efforts across the local and regional airports marginalizes the bottleneck effect and supports distribution to more remote areas.

It must be recognized that there are issues that will delay a response that cannot be avoided such as the weather on the second day of the response in Nepal. The response for such issues should still be coordinated and planned for in order to mitigate the amount of time the cycle is shutdown. Many of these issues would fall into the area of safety and security which many airports share. It is important that even after catastrophic incidents, there are still competent authorities tracking and making these safety decisions in order to prevent a worse situation. Had a plane crashed in Nepal due to the storms it could have delayed the response significantly.

The final recommendation is that a database be created, maintained and updated with consisting of all airport emergency response plans. In catastrophic incident response it is important for everyone to understand the SOPs and the expected response from the airport that is receiving humanitarian aid. If possible this database should be located on an open site in order to share this knowledge with NGOs and other responding organizations. If something like this existed in Nepal, it would have been understood that after every aftershock the airport would shut down for a period of time and then reopen, limiting the idea that the airport was closed for a significant amount of time. Sharing these plans will allow for implicit coordination between the airport and the responding organizations. This implicit communication is valuable in managing expectations.

CONCLUSION

In poor nations like Haiti and Nepal, the investment made by the international community during the preparation and mitigation phases of emergency management matters. The airports in these nations are vital to the humanitarian response effort in a post catastrophic event. In the

future the international community, specifically the United Nations, United States, NGOs and

other international organizations should work together to fund, train and standardize the

expectations for each nation to maintain airport emergency management plans that include plans

to support humanitarian aid efforts. These plans should at a minimum address the maximum

capacity of each airport, the logistical capabilities necessary to support humanitarian efforts

during the response phase, and finally how air traffic will be controlled during the response.

Finally these plans need to be released and collected on an open source in order to facilitate

nation specific, humanitarian support efforts of first responders from other governments and

public, private and nonprofit organizations. Coordinating and implementing these efforts

throughout the world ultimately ensures that international support can respond in a timely

manner to a catastrophe when support is requested.

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Appendix 1

2010 Haiti Earthquake Twitter Timeline

Search Topics.

- "Haiti airport open since: 2010-01-11 until: 2010-01-19"

- "Haiti airport closed since:2010-01-11 until:2010-01-19"

- "Haiti airport situation since:2010-01-11 until:2010-01-19"

- "Haiti aid reach victims since:2010-01-11 until:2010-01-19"

  12 Jan 2010.

  Open Airport.

  Lauren LaPointe @LaPointeDance 12 Jan 2010: Haiti's international airport is open.

  Travelxpert @travelxpert 12 Jan 2010: #Earthquake in Haiti lasted over 30 seconds. Int'l

airport runway is open and functioning.

  Airport Closed.

  Joe Noia @mrjoenoia 12 Jan 2010: Open the airport. #haiti

  Situation Report

  Jack Gray Verified account @jackgraycnn 12 Jan 2010: Situation in Haiti is

grave...CNN is scrambling to get our people on the ground there...the airport is shut down.

  13 Jan 2010.

  Airport Open.

  Val Lynn @vallynn_ 13 Jan 2010: Port-au-Prince airport open only for humanitarian and

relief. Need to have a broader definition of "relief" though. #haiti

Alessandra Cardinale @alecardinale 13 Jan 2010: Haiti airport is open. Dont need to go S.Domingo for relief #haiti

Breaking News Verified account @BreakingNews 13 Jan 2010: U.N. says Haiti's Port-au-Prince's main airport is "fully operational" and open to earthquake relief flights - Radio Metropole

Troopstorm @troopstorm 13 Jan 2010: airport open. U.S. military providing air traffic control replacing control tower that collapsed #haiti

Closed Airport.

Rubens Saintel @Saintel 13 Jan 2010: Only one phone company is working right now in Haiti & the coverage is worse than AT&T in NYC on New Years Eve. :(The airport is closed :(

Val Lynn @vallynn_ 13 Jan 2010: @IrishAnnieMarie I'm in South Fla. Aircraft being sent back to Ft. Laud because Cap Haitien airport is closed. Do you know why? #haiti

Andy Yardy @laxglobal 13 Jan 2010: The airport in Haiti is closed and I am flying to santo Domingo dr then port-a-prince by car

Angela Michelle ✈ @MsAwldat 13 Jan 2010: Just heard the Airport @ PAP Port-Au Prince, Haiti is closed to all commercial airlines ... no Gas for the planes to leave... smh

14 Jan 2010

Airport Open.

ale_dcbg @ale_dcbg 14 Jan 2010: Airplanes with aid having trouble landing in #Haiti. Airport is open but not made to take large plane traffic.

Freshness @freshnessmag 14 Jan 2010: Help Haiti - Port-au-Prince International Airport temporary close to flights because it reached capacity. Will open soon

68

Airport Closed.

Stephanie CrowHawk @CrowHawk 14 Jan 2010: Anyone have planes with water landing capabilities?Boats? Haiti is out of jet fuel, so fly with enough to get in and out-airport is closed.

Wildfire Today @wildfiretoday 14 Jan 2010: #Haiti airport closed to incoming flights because ramp space is full and no fuel. 11 aircraft in holding pattern waiting to land.

Lamarr J. Bauer @wlamarr2 14 Jan 2010: The amount of aid that poured into Haiti was so much that the Port-au- Prince Airport is closed because it is too crowded and no gas.

The Telegraph Verified account @Telegraph 14 Jan 2010: Haiti earthquake: crowded Port-au-Prince airport closed: The US Federal Aviation Administration has halted all civ... http://bit.ly/6OBlTX

Terry Fredrickson @terryfrd 14 Jan 2010: Haiti's logistical nightmare cont. Port closed. Airport lacks space, ground staff to handle all the flights arriving + fuel to get them out.

KTZR @ktzr 14 Jan 2010: Haiti airport has been closed to commercial traffic as airlines, military, and GA pilots switch to disaster-relief mode http://bit.ly/87fh1g

♫Nelfi Nova   @NelfiNova 14 Jan 2010: Airport is CLOSED! little space available ,too many planes. Some aid arrived already. #Haiti

Situation Report.

Robert Strunk @robstar5800 14 Jan 2010: Relief workers report Haiti is "in chaos" while port can't open and airport is maxed out.

DTJ @DTJ 14 Jan 2010: En route to the charter plane... Pray we get cleared. This will depend on the airport situation/status in PAP, Haiti.

Boots Levinson @bootslevinson 14 Jan 2010: Arrived Santo Domingo. No flights to Haiti airport (PAP) today. Helicopter in 2 days, or possible flight tomorrow - situation too fluid

Helen Barr @divbrit2 14 Jan 2010: Haiti waits while the superpowers review the transport situation??? Airport backlog??? No kidding...!!! People die while America does WHAT?

15 Jan 2010.

Airport Closed.

sharon kingdon @bobbysgirl1972 15 Jan 2010: Haiti airport closed due to overcrowding & empty fuel tankers which are needed to refuel recovery planes

Airplanetalk @airplanetalk 15 Jan 2010: Seaplanes/Amphib Aircraft r need of the hour in Haiti as airport is closed due congestion, best way to deliver aid is by waterways/seaplanes

GM RESEARCH @wwresearch 15 Jan 2010: CARIBBEAN-HAITI-SEISMOLOGY-WWR member reporters at airport: Airport is closed for all incoming traffic

Situation Report.

CBS Radio News @CBSRadioNews 15 Jan 2010: 5amET: As the suffering intensifies in Haiti, earthquake victims wait for aid to reach them

Mission MANNA @MissionMANNA 15 Jan 2010: RT @thebir: Gasoline scarcity spreading from PAP. Crazy scene @ Texaco nr airport and then no more stations open until Montrouis. #Haiti #FB

Orchid Obsession @PhototohP 15 Jan 2010: >:-(the situation in Haiti makes me really angry! Get that aid out of the airport! Why red tape at such a dresperate time!?

16 Jan 2010.

Airport Closed.

Barry Camp @pastorbarrycamp 16 Jan 2010: Just talked to Bro. Marc. His flight to Haiti was canceled. They are going to keep the airport closed until the 23rd. 24 th he leaves. pray!

Alice Backer @kiskeacity 16 Jan 2010: @jlauderdal Glad the airport has reopened but people were indeed being turned away earlier and told the airport was closed. #Haiti

Situation Report.

Hali Rederer @its_outta_here 16 Jan 2010: Haiti situation: People dying in the streets while military, supplies, medical help are just (5 miles) away at the airport. Frustrating

Richard Doell @DickTalk 16 Jan 2010: Haiti: what in hell gives with distribution over there?! The damn airport situation is starting to look like the parked buses after Katrina.

simonchambers @simonchambers 18 Jan 2010: Relief supplies are bottlenecked at airport or turned away in #Haiti by US military: http://bit.ly/6s4YA8 Hope situation improves fast!

17 Jan 2010.

Airport Closed.

tom vs the moonlight @ttfb 17 Jan 2010: @undividual just been talking to my dad who's working with the uk response team in Haiti and he says that the airport had to be closed for..

18 Jan 2010.

Airport Open.

71

Rob Stewart @rjstewart 18 Jan 2010: @hypatiadotca DR has airport facilities and an
open border. Saw success stories getting in that way #haiti

Appendix 2

2015 Nepal Earthquake Twitter Timeline

Search topics.

- "Nepal airport open since: 2015-04-25 until: 2014-05-2"

- "Nepal airport closed since: 2015-04-25 until: 2014-05-2"

- "Nepal airport situation since: 2015-04-25 until: 2014-05-2"

- "Nepal aid reach victims since: 2015-04-25 until: 2014-05-2"

- "Tribhuvan International Airport Open since: 2015-04-25 until: 2014-05-2"

- "Tribhuvan International Airport Closed since: 2015-04-25 until: 2014-05-2"

- "Kathmandu Airport situation since: 2015-04-25 until: 2014-05-2"

- "Kathmandu Airport Closed since: 2015-04-25 until: 2014-05-2"

25 April 2015.

Open Airport.

Focus NewsVerified account @FocusNewsIndia 25 Apr 2015 : #NepalEarthquake |

#Kathmandu airport re-opens; it was closed after powerful #Earthquack hit #Nepal on Saturday

READ| http://goo.gl/FhhRt8

SmartravellerVerified account @Smartraveller 25 April 2015: The airport at #Kathmandu

is open but flights disrupted. Contact airlines for latest infor on flights out of #Nepal http://bit.ly

/tanepal

Karma PaljorVerified account @Karma Paljor 25 April 2015: Airport is open to receive aid flights – Nepal Army to coordinate with international rescue teams: Nepal Info Minister @ibnlive

RQ Skye @rqskye 25 Apr 2015: MT @ozonesn Tribhuvan Airport is Open. It was closed during dust cloud only. #Nepal #NepalEarthquake #NepalQuake #Kathmandu #Kathmanduquake

Hani Y Khellef @hykhellef 25 Apr 2015: #Earthquake #Nepal #Katmandu we are all fine airport about to open again. Many victims feared in town

CNN-IBN NewsVerified account @ibnlive 25 Apr 2015: #NepalQuake: Kathmandu airport is now open; Was closed following massive earthquake: Deep Kumar Upadhyay, Nepal's ambassador to India

Rajesh Shenoy @ranjalrajesh 25 Apr 2015Mangalore, India: #NepalQuake Nepal Ambassador to India Deep Kumar says Tribhuvan Airport's #Kathmandu is now open

Ahmer Khan @ahmermkhan 25 Apr 2015: Update: #Kathmandu airport now open. #NepalEarthquake #NepalQuake2015 #NepalQuakeRelief

Florian Witulski @vaitor 25 Apr 2015: Nepal: Kathmandu Airport authorities say Airport only open for emergencies; Commercial flights will resume after detailed runway inspection

Vikas SwarupVerified account @MEAIndia 25 Apr 2015: #NepalEarthquake Four IAF aircraft have returned from Kathmandu with a total of 540 stranded Indians. More flights planned for day

Airport Closed.

Adhirajsinh H Jadeja @adhirajsinh 25 Apr 2015: Kathmandu Airport closed & Mobile phone services affected across Nepal #Nepal #earthquake

GujaratHeadline News @GujaratHeadline 25 Apr 2015Mumbai, India: #Kathmandu airport closed due to earthquake in #Nepal

Deccan ChronicleVerified account @DeccanChronicle 25 Apr 2015: #NewsAlert: Kathmandu airport closed after earthquake measuring 7.9 on the Richter scale rocks Nepal and India. http://goo.gl/4j7QdM

Deccan HeraldVerified account @TheDeccanHerald 25 Apr 2015Bengaluru, India: #Nepal #earthquake | 14 aftershocks felt in Nepal in a span of 2.5 hours; mobile services disrupted; Kathmandu airport closed

Bob Jacob @bobmoni202 25 Apr 2015: Mobile services affected in Nepal and the Tribhuvan international airport is closed.

Trance In Delhi @TranceInDelhi 25 Apr 2015: Reports of damage coming in from Nepal. Many buildings are down, multiple tremors felt. Airport is closed.

Brianna LeeVerified account @briannaclee 25 Apr 2015: Not yet in Nepal, so not affected by the quake. On standby in Abu Dhabi while Kathmandu roads, airport closed...

Ummah Bayt-Al-Mal @ubmuiu 26 Apr 2015: ******EMERGENCY UPDATE ALERT******: #Nepal 6.8M #Earthquake: #Kathmandu to stay outdoors next 72hrs, Airport closed and airspace shut down.

Zeshaan Ali @CaptainWotsit 25 Apr 2015: Islamic Relief emergency team has been deployed to Nepal. As the airport is closed, the team are heading in via road from India.

Paul Quinn@quinnynews 25 Apr 2015: A day spent trying to get people into Nepal. Not easy with airport closed.

Vikas Mishra @vikasmishraa 25 Apr 2015: 7 flights diverted to India after Kathmandu airport closed. #Nepal #earthquake

eTN Global News @eTurboNews 25 Apr 2015: Destructive 7.9 magnitude earthquake: Kathmandu Nepal: Kathmandu Tribhuvan International airport is closed, ro... http://bit.ly/1HBd6eK

binod khawas @princ3izb3kagn 25 Apr 2015 Nepal : Tribhuvan International Airport has been closed. All flights towards Nepal are on Stand by until it receives security clearance. #Earthquake

Masidi Manjun @MasidiM 25 Apr 2015: 25/4: Kathmandu International airport closed, buildings collapsed in the capital of Nepal after an earthquake measuring 7.7 RS hits Nepal.

GCX @OnlyGCX 25 Apr 2015: #Kathmandu's Tribhuvan Airport is currently closed due to #NepalEarthquake. #Nepal airspace deserted. #earthquake

Situation Report.

Anup KaphleVerified account @AnupKaphle 25 Apr 2015: #Nepal has sent a formal request to China asking for help with rescue and relief effort, Information Minister says. Airport open 24 hours.

yogesh giri @yogesh27speaks 25 Apr 2015: Scary situation RT @EconomicTimes: Kathmandu airport shut post earthquake; flights diverted to India (Image: Reuters)

26 April 2015.

Open Airport.

CTV NewsVerified account @CTVNews 26 Apr 2015: Nepal earthquake emergency response gears up as airport, overland routes open http://ow.ly/M8RXB

Channelrt.com @channelrt 26 Apr 2015: #KTM Airport seems open - Qatar Flt 647 taxi-ing out, Indigo, Etihad and Qatar coming in. http://www.flightradar24.com/IGO031D/619a9d3 : @KanakManiDixit #Nepal

Airport Closed.

Intolerant Infidel @mvslsv 26 Apr 2015: The Kathmandu airport has been closed from 1:15pm. Flights on way to Nepal are being sent to cities like Patna, Lucknow and Delhi.

Shubhash Wostey @wostey 26 Apr 2015: #KTM Airport closed until 4 pm, per online media. #Pakistan aid took off for Nepal. Guess the closure is for commercial flights. #NepalQuake

shadab ahmed @shady2k8 26 Apr 2015: Now it's raining in Nepal. Kathmandu airport has been closed due to weather. It'd hamper relief work. #NepalEarthquake #NepalQuakeRelief

Nitin A. Gokhale @nitingokhale 26 Apr 2015: Heavy Rains compound the misery in Nepal. Kathmandu airport closed, at least temporarily

AidCom @AidCom 26 Apr 2015: #Nepal: #Kathmandu airport has been #closed for operations around 6:30 pm, India time, due to bad #weather. (TOI) http://buff.ly/1HHo0hE ?

Kareyannee @KareyAnnee 26 Apr 2015: Kirk update: It appears they are currently stuck as the KTM airport in Nepal has been closed again… https://instagram.com/p/18PicNCyOS/

Travel Watch - APAC @BCDapac 26 Apr 2015: Nepal: Kathmandu airport closed on Sunday evening due to heavy rain and thunderstorms

K Chhetri @kay_ksh 26 Apr 2015: #Nepal #Airport closed again? any news? Jet Airways scheduled flight has been diverted.

Rhona Raskin @RhonaRaskin 26 Apr 2015: Continuous aftershocks. Airport closed. Live coverage: #Nepal #Earthquake http://timesofindia.indiatimes.com/Earthquake-in-north-India/liveblog/47047920.cms …

Situation Report.

Rebecca Bamford @RebeccaBamford1 26 Apr 2015: An earthquake Saturday at 11:45am local time in Nepal. The epicenter is 81kms west of Kathmandu. Airport closed

Lara @Lara_Miller 26 Apr 2015: I'm amazed at the rampant misinformation. Either the airport is closed, or its not. Roads are completely destroyed or they are find. #Nepal

Asit Bala @asitbala 26 Apr 2015: Nepal govt to declare a national calamity. Kathmandu airport was closed on Sunday due to heavy rain, thunderstorm.

Gadgetbyte @gadgetbytenepal 28 Apr 2015: Kathmandu Airport temporarily closed due cracks on runway. Repair work going on. It must be due to heavy landing. #Nepal #Earthquake

Milan Dhungana @mildmilan 26 Apr 2015: Aircrafts arriving as far as from London and Warsa are holding up in Nepal's Sky for hours. Situation of Int'l Airport seems chaotic. :(

Craig Leeson @CraigLeeson 26 Apr 2015: Chaotic situation at the Kathmandu airport, which has been shut again as thousands try to get out. The streets... http://fb.me/1Rlt2hqxg

Paranjoy Sarkar @paranjoyz 26 Apr 2015: Situation at Kathmandu airport is not very good. Stranded ppl are facing problems with drinking water, high priced food. #NepalEarthquake

Etihad AirwaysVerified account @EtihadAirways 26 Apr 2015: With Kathmandu airport due to re-open, the flight EY292A is en-route and is expected to land at 1825 (local time) 3/5

Vishal Thapar @thaparvishal 26 Apr 2015: Flights diverted to Delhi. But appears Kathmandu Airport is open again after a brief closure following fresh tremors

Vishal Thapar @thaparvishal 26 Apr 2015: Reports of Kathmandu Airport ATC personnel fleeing after fresh tremors. Airport shut down again

27 April 2015.

Airport Open.

Sam Spickett @SamPickett 27 Apr 2015: Just arrived at Doha Airport for connection to #Nepal…airport in the country is currently open to domestic and international traffic.

Situation Report

Islamic Relief - IRW @IRWorldwide 27 Apr 2015: Our team is travelling to #Nepal by road from #India as Kathmandu airport remains closed. http://bit.ly/1IZWnir #PrayingforNepal

MERCY Malaysia @MERCYMalaysia 27 Apr 2015: Good News! Our team has just landed in Kathmandu airport. We will posts updates on the situation there as soon as we receive them.

ravelweek @TravelweekGroup 27 Apr 2015: Foreign tourists scared without food in Nepal; Kathmandu airport now open http://buff.ly/1HKY8kP #ForeignTourist #Nepal #ShortSupply

28 April 2015.

Situation Report.

Silva Paananen @SilvaPaananen 28 Apr 2015New Delhi, India: International aid flowing in Nepal, Kathmandu airport congested, authorities unable 2 manage the situation, important to channel the help well

Sanjiv Kapoor @TheSanjivKapoor 28 Apr 2015: Back from KTM. Situation at airport is improved, crowds are less / more manageable. Flow of relief and personnel into Nepal increasing

29 April 2015.

Situation Report.

Stephen Philps @stephenphilps 29 Apr 2015: "The situation at the airport is chaotic at the best of times. It's a disaster right now." #Nepal #NepalEarthquake #NepalQuake #PrayForNepal

30 April 2015.

Open Airport.

80

FCO travel adviceVerified account @FCOtravel 29 Apr 2015: #Nepal

http://ow.ly/Mh0X9 The road to #Kathmandu Tribhuvan Airport is open and commercial flights

on regular carriers are operating.

Situation Report.

Joe @Joe_planet 30 Apr 2015: Mashable reporting that situation pretty chaotic still at

Kathmandu airport

1 May 2015.

Airport Open.

U.S. Embassy NepalVerified account @USEmbassyNepal 1 May 2015: @elayneg Hi

Elayneg- Kathmandu airport has been open for commercial flights since April 26. Many US cits

are departing on commercial flights

You Belong To Me @YourLoveTalks 1 May 2015: No time to lose: Global response to

Nepal earthquake gears up as airport, overland routes open