



DSCA: General Population Evacuation of Texas and Louisiana

GRADUATE RESEARCH PROJECT

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AFIT/IMO/ENS/10-08

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Abstract

United States Transportation Command serves as the source for transportation needs within the Department of Defense. During hurricanes Katrina, Gustav and Ike contracted commercial passenger aircraft were used almost exclusively to evacuate general population members from the coastal regions of Texas and Louisiana. Senior leadership requested a further analysis regarding the use of military aircraft in support of general population evacuation preceding hurricanes. Collection of data from previous hurricane evacuations and interviews of senior leaders and planners in various agencies allowed for a comparison in selection of military versus commercial assets.

By analyzing both cost and non-cost factors in a course of action analysis the best mix of resources can be posited. It was determined that military aircraft should be used in conjunction with contracted commercial carriers in order to execute the most effective evacuation of general population personnel prior to hurricane landfall in the gulf region of Texas and Louisiana. Research revealed that further research is necessary regarding cueing of passengers from various communities and during late night hours.

Acknowledgements

First, I must thank my wife and kids for giving up time with their husband and father this year to allow me to pursue advancements in my academic life. I would also like to thank my sponsor for giving me the idea and providing me insight into the world of Defense Support of Civil Authorities. I would also like to express my appreciation to my faculty advisor for his guidance throughout the course of this research effort. Finally, research would not have been possible without the support of the individuals who provided their personal experiences and insight into the aspects that affect the Department of Defense aid to persons in the path of oncoming hurricanes. Thank you for your time and support.

Jason T. Mills

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DSCA: General Population Evacuation of Texas and Louisiana

I. Introduction

Background/Motivation

Defense Support of Civil Authorities (DSCA) encompasses an ever expanding field of requirements that are becoming increasingly important to Department of Defense (DoD) agencies. While policies and procedures have been developed to execute DSCA events, there are many areas that required further research. When requested by the lead federal agency, the Secretary of Defense, through the Joint Staff, tasks United States Transportation Command (USTRANSCOM) to support general population hurricane evacuation events. Further analysis of USTRANSCOM's requirements during a population evacuation that precedes projected landfall of a major hurricane was required to make military response more expedient and accurate. Without clear guidance, the DoD risks negative public scrutiny if DSCA missions are not executed in a timely and efficient manner.

Military leadership must decide whether to use Air Force owned aircraft, contracted Civil Reserve Air Fleet (CRAF) qualified commercial partners, or a combination of both as required to support the given evacuation. The leader's choice is weighted by various benefits and risks. By identifying as many of the benefits and risks as possible, the correct allocation can be defined to a level that provides the best support

to the civilian population while effectively employing military assets and conserving money under Federal and DoD budgetary constraints.

Problem Statement

This study analyzed the various benefits and risks associated with use of military assets and/or commercial CRAF partners in support of general population evacuations prior to hurricane events in the continental United States. Specifically, focus was placed upon the coastal regions of Texas and Louisiana. By comparing and contrasting historical data with personal interviews, the researcher presents the best possible allocation of assets for future events while conserving monetary assets and most effectively supporting the DSCA mission at hand.

Research Focus

USTRANSCOM has been tasked by the Joint Staff within the past few years to provide general population evacuation capability in direct support of United States Northern Command (USNORTHCOM), in-turn supporting the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security (DHS). Weighing historic data against personal interviews and lessons learned allowed for determination of the best future composition of forces. Interviews of leadership present during past events combined with the opinions of current decision makers provided lessons learned and helped determine definitions, weight, and relevance of various benefits and risks.

Research Objective/Hypothesis

As a result of research, the author is providing a recommendation to the reader and current commanders on selection of resources to support general population

evacuation events within the DSCA mission set. The weighted benefits and risks of using each course of action are presented and the best solution is highlighted. By using historical data and presenting options in a case study format, options are presented that meet both humanitarian evacuation needs and military objectives.

In order to successfully present the best possible option, three likely courses of action (COAs) are compared and contrasted:

- COA 1 – Utilizing only U.S. DoD owned military assets to conduct evacuation of all necessary personnel.
- COA 2 – Utilizing only contract commercial airlift acquired through agreements as provided for in the CRAF peacetime business model.
- COA 3 – Utilizing military assets upon initial activation and nearing the completion of the evacuation while using commercial contracted carriers for a majority of the evacuation requirement.

The compilation of weighted factors will determine the best possible use of assets in the Texas and Louisiana coastal regions during future hurricane evacuation events.

Methodology

See Chapter III. A brief summary of the methodology is provided here for the benefit of the reader. Research was primarily focused on a compilation of literary works and historical data, tempered by personal interviews and military leadership perspectives; the result is a comprehensive presentation of possible positive and negative effects of choosing a specific COA.

Personal interview was the primary method of communicating with senior leaders. Military leaders who were responsible for general population evacuation activities conducted during hurricanes Katrina, Ike, and Gustav provided key insight into the challenges of evacuation and the potential choices to make future events more

seamless. In conjunction with personal interviews, data was collected from previous hurricane evacuations.

After conducting all interviews and collecting available data, COAs were weighted and cost estimates made in order to provide insight into the differences of each. Comparison was made both on monetary costs and non-monetary aspects of each COA.

Assumptions/Limitations:

The scope of research was intentionally constrained to scenarios involving the Texas and Louisiana gulf coast region because of availability of recent data and leadership opinions. The time constraints placed upon the researcher required exclusion of other regions, types of evacuation other than hurricane, and international evacuation events. While added limitations present during international evacuations may directly affect the capability to use commercial or military resources, the researcher focused only upon gathering data for recent Texas and Louisiana gulf coast events. Long term research conducted to encompass all hurricanes, tsunamis, typhoons, and similar events may be of great benefit to USTRANSCOM and other agencies wishing to prepare for unforeseen events such as these. Material discussed may be useful in preparation for generic large scale movement of personnel in support of military operations, state situations, and the like.

Further, the researcher had to assume the immediate availability of contingency response elements (CRE) to handle aerial port of embarkation (APOE) operations, enough available military aircraft and aircrews in order to execute the chosen COA, enough available commercial aircraft and aircrews in order to execute the chosen COA,

and that Texas and Louisiana provide the resources allocated towards hurricane evacuation as presented in each state emergency plan.

Additionally, it must be assumed that any aircraft or aircrew would be promptly replaced due to maintenance, crew illness, or other unforeseen issues. The last assumption was made given the relative high visibility and importance of a natural disaster type of mission to the United States people and the DoD. Based upon the high priority of such an event, it is assumed that Air Mobility Command (AMC), its subordinate wings, and the CRAF partners will all have a vested personal interest in supporting the evacuation event with any and all available resources.

The research excluded plans for aeromedical evacuation as these activities require a very different type of planning, coordination, type of aircraft, and planning/execution timeline. The aeromedical evacuation field has been challenged many times since hurricane Katrina. Therefore, research related to medical evacuation is beyond the scope of the material presented within.

Implications

The result of research on the subject of general population hurricane evacuation provides better understanding of, and possible remedies for, challenges presented in the selection of available resources under federal channels. The combatant commanders and their subordinate execution arms have a large collection of knowledge to pull from in making a selection between military airlift and commercial contracted airlift. Research results provide a compilation of many aspects of the available knowledge and provide insight into the interactions of the various aspects when combined.

Overall, the implications of the research was to further the body of knowledge present in selection and sourcing DoD airlift support to the evacuation of personnel preceding a hurricane that impacted the coastal regions of Texas and Louisiana.

II. Literature Review

Relevant Background

Hurricane Katrina served as a catalyst to change in many areas of the nation. More specifically, it highlighted a distinct lack of comprehensive planning for such a catastrophic event within federal support agencies and the state of Louisiana. USTRANSCOM, USNORTHCOM, and their subordinate agencies were not immune to this predicament. Response to the request for support was slow, disorganized, and ill prepared for an event of such magnitude. According to an interview with an airlift planner, the DoD was exercising a “consequence management” plan rather than a proactive, well-prepared response during the events leading up to, and throughout, the evacuation of personnel from New Orleans following hurricane Katrina. Military leaders and planners may be granted a reprieve, because both state and federal offices preceding them were conducting the same consequence management plans. This reactionary, rather than proactive, approach made it hard to plan evacuation operations and even more challenging to coordinate the response as the events were occurring.

The capability of the federal government to respond to urgent needs is clearly outlined in the Stafford Act (as highlighted within the text presented in Figure 1). The clear delineation of Presidential power to utilize any federal agency’s resources to protect lives, property and the public health and safety is the basis for DoD involvement in

hurricane evacuation operations. Participation is further defined within the Department of Homeland Security's National Preparedness Guidelines and National Response Plan. Responsibility for execution of evacuation events is passed to FEMA at the national level.

Sec. 502. Federal emergency assistance (42 U.S.C. 5192)*

(a) Specified - In any emergency, the President may -

- (1) direct any Federal agency, with or without reimbursement, to utilize its authorities and the resources granted to it under Federal law (including personnel, equipment, supplies, facilities, and managerial, technical and advisory services) in support of State and local emergency assistance efforts to save lives, protect property and public health and safety, and lessen or avert the threat of a catastrophe, including precautionary evacuations;

(FEMA 592, 2007, p. 64)

Figure 1. Stafford Act: Federal agency participation

Following hurricane Katrina, many agencies began drafting new plans to prepare for such catastrophic events and others pulled their old, out of date plans off the shelf to begin the update process. The revisions occurred at all levels including participation by DHS, FEMA, USNORTHCOM, USTRANSCOM, and state governments. Additionally, many investigative agencies began looking into the failure of the system in order to prevent future loss of life and promote more rapid and effective equipment utilization.

The United States has experienced many hurricanes since Katrina, namely Ike and Gustav. In these two cases, the DoD support for general population evacuation became progressively better, but there is always room for improvement. In response to the need for planning guidance, the logistics and engineering directorate at USNORTHCOM produced a planning guide titled, "General Population Evacuation by Air." Rear Admiral

Lilli, who served as the director of the logistics and engineering directorate at USNORTHCOM, highlighted the need for a clear and concise plan by stating,

With a well coordinated plan the federal government can assist, when requested, in the air evacuation of specified regions/areas utilizing the most appropriate combination of contract and military air service in order to move persons out of a defined danger zone to a location of safety selected by that state or territory. (2008, p. iii)

The evacuation guide emphasized the need for states and regions to prepare an air support annex to their general population evacuation plan. It further emphasized that the preparation of such a document should be done during the planning phase and not during an actual catastrophic event to allow for a less confusing planned evacuation. The USNORTHCOM guide was created in order to allow states to standardize their annexes and know what they can and should ask of the federal government when its support is needed. (Logistics and Engineering Directorate, (N-NCJ4), 2008)

Applying Lessons From Hurricane Katrina to the DoD

As mentioned earlier, hurricane Katrina served as a catalyst for many agencies to reinvigorate or create their hurricane evacuation plans. USNORTHCOM was not immune to the need to revise its planning documents. After various reports were released from the House of Representative, Senate, and White House citing lack of planning within the government at all levels, USNORTHCOM took a very proactive stance and worked to expand their interoperability with agencies at all levels.

Major General Richard Rowe, serving as the Director of Operations, USNORTHCOM at the time, presented the House Committee on Armed Services with a synopsis of actions being taken within his command to encourage success during future events similar to Katrina. One of the first key points he made was that DoD support is

provided at the direction of the President or Secretary of Defense in accordance with the National Response Plan. The importance of this point is discussed in greater detail later in this document. As in all military operations, General Rowe highlighted the fact that, “When requested, USNORTHCOM will be fully engaged in supporting operations to save lives, reduce suffering, and protect the infrastructure of our homeland.” (2006, p. 2)

General Rowe presented many advancements in NORTHCOM that would enable more effective hurricane response. These actions included: establishing a standing execution order (EXORD) that allows for the deployment of Defense Coordinating Officers (DCOs), the capability to place heavy lift helicopters, search aircraft, and communication support packages on 24-hour prepare to deploy orders, and integrating DCOs into each FEMA region. He also highlighted various capability improvements including: pre-scripted requests for assistance with FEMA; purchase of large cellular, satellite phone, and unclassified, internet-based networks to provide connectivity to many locations; establishing liaison officers within DHS, the National Guard Bureau (NGB), and FEMA/Joint Field Offices; preparing response personnel by conducting Exercise ARDENT SENTRY 06, which included a simulated Category 3 hurricane impact in the vicinity of New Orleans; establishing mobile training teams to teach the proper use of collaborative tools and information sharing processes with DoD and interagency partners. Further USNORTHCOM hosted a Federal/Defense Coordinating Officer conference as a forum to review lessons learned and enhance relationships among response agencies. (2006)

Much of the material currently present on hurricane response notes the distinct lack of communication among various agencies in response to Katrina. It was apparent

to many participants in Katrina and Gustav that the largest hindrance to effective response was lack of communication aggravated by a lack of understanding of an organization's capabilities. Even the financial offices of the Air Force, in the wake of Katrina, learned that keeping open channels of information was important. They emphasized this by pointing out a key lesson learned, "Communicate, communicate, communicate" (Lanman, 2006, p. 19). Based upon these observations, continued participation in conference and exercise events may provide a key benefit to future response activities. These events will breed familiarity with personnel and agencies that participate in hurricane evacuation scenarios and highlight the capabilities they can employ when asked.

Finally, General Rowe wrapped up his comments by stating that USNORTHCOM was making drastic efforts to improve situation awareness, invest in cooperation efforts with the NGB, participate in DHS's National Plan Review process, provide an open discussion forum for all state Adjutant Generals, and "leaning forward and ready to provide robust support to DHS/FEMA during the upcoming hurricane season." (2006, p. 6)

FEMA Region VI 2009 Hurricane Contingency Plan

The region VI contingency plan concisely summarizes the dangers of tropical storm and hurricane development to the coastal regions of Texas and Louisiana. The writers quickly point out that each state and local government has the lead during an emergency response. However, FEMA is postured to support the states and serve in the coordination role as a federal government entity when needed. It is also pointed out that storms can develop quickly (within 48 hours) in the region and prompt response is

required to protect lives of persons in the region. The plan highlights four critical considerations that merit repeating in this research document. They are:

- (1) Resources will be prioritized first for life saving and then for life sustaining for all mission areas of prevent, protect, response, and recovery efforts.
- (2) Federal response efforts are designed to complement and supplement, rather than supplant, the State, local and Tribal response
- (3) An incident or simultaneously occurring incidents present competing resource requirements; adjudication will be required.
- (4) The private sector and State, local, and Tribal governments possess varying degrees of capability to prevent, protect against, respond to, and recover from a severe weather event. (DHS-FEMA Region 6, 2009)

The document goes on to detail out a synchronization matrix for response to hurricane type events. Key points in that matrix are at H-120 (market survey for commercial transportation asset availability), H-96 (mission assignment {MA} to DoD for general population movement), H-80 (MA for request for proposal – Louisiana, DoD assets in place at APOEs – Texas), H-72 (evacuation begins – Texas, DoD assets in place at APOE – Louisiana), H-18 (general population evacuation complete), and H-12 (all support personnel evacuated). (DHS-FEMA Region 6, 2009)

Within the execution portion of the plan, the need for evacuation of 10,000 people from New Orleans and 17,500 from the Rio Grande Valley in Texas is highlighted. The respective target evacuation time periods for the two regions are 32 hours (starting at H-50) for the former and 54 hours (starting at H-72) for the latter. The document points out that USTRANSCOM has a responsibility to provide aircraft for evacuation, provide liaison officers that provide in-transit visibility of resources, provide an aircraft schedule to supported APOEs and aerial ports of debarkation (APODs), and provide CRE equipment and personnel to support ground operations at the APOE(s). (DHS-FEMA Region 6, 2009)

The document also highlights the large populations present in the coastal regions of Louisiana and Texas. Hurricane season runs from June through November and, on average, there are 6 hurricanes that develop in the Atlantic Ocean, Caribbean Sea or Gulf of Mexico. Planning is of utmost importance to save lives in these potential danger zones.

Supporting Homeland

Key lessons learned from Katrina abound. Movement beyond interagency communication to mutually beneficial collaboration is probably the largest point made by Castle in his article. The United States Constitution, National Response Plan, and the Building Partnership Capacity Roadmap of the 2006 Quadrennial Defense Review all highlight the independence of the states to act in the process of protecting their constituents. Within that context, states must be aware of resources available to them in the DoD and already be in a collaborative environment where response can be tailored to meet the needs of the state effectively and efficiently. (Castle, 2008)

The article points out that the creation of the Department of Homeland Security finally provided a counterpart at the national level to the DoD allowing for support of homeland security events. Castle highlights the involvement of non-governmental organizations in disaster response and the important role that National Guard forces play in response scenarios. (Castle, 2008)

Castle summarizes the entire article well by saying,

The goal is a more seamless environment in which there are no barriers to the free flow of information needed to protect the Nation and its citizens. Ultimately, only personal relationships and experience will allow these essential relationships to grow into a powerful force that will serve a deserving and demanding American public. (Castle, 2008, p. 50)

The key to the working relationships necessary in domestic events is long term commitment and planning for the possibility of such disasters.

III. Methodology

Research is built upon personal interviews and data collection summarized in a case analysis format. In order to maintain result validity and relevance, the COAs were established in three different levels of participation. Based upon historical analysis, the tendency toward use of mostly commercial contract airlift validated the need to include COA 2 (use of only contract commercial carriers) in the study. As a counterpoint to COA 2, COA 1 (use of only military airlift) was included to show the drastic differences in capability if only these DoD resources were utilized. Finally, COA 3 (utilization of a mix of commercial and military resources) was necessary to provide a moving data point between COAs 1 and 2. The position of COA 3's cost value between the other two COAs would be determined by the command authority present at the time of the execution of the evacuation. For the purposes of the study, it was assumed that passengers were equally distributed between military and commercial resources. Cost data was assumed to be non-linear between COA 1 and COA 2. In order to keep the number of COAs relatively low and make the comparison easier for a reader, multiple COAs at different locations between the two end points were not included in the analysis.

Data collection included: costs of commercial contracts, flight changes, and cancellations from hurricanes Gustav and Ike; APOE and APOD locations used during Katrina, Gustav, and Ike; contingency response resources used during Gustav and Ike; cost per flight hour utilizing military aircraft for 2009; estimated costs of commercial evacuation by commercial contract carrier for 2009 and 2010; expected APOE and

APOD locations for future evacuations; and expected number of required general population evacuees required for future evacuations.

Data collected was compiled and formatted to determine an approximate dollar cost to execute mass evacuation of major coastal population centers in Texas and Louisiana. The segment of that population slated to move by air transport is estimated annually by the state authorities based upon previous hurricane evacuation events and population estimates. By using the predictive numbers for the 2009 hurricane season, the researcher was able to calculate data that approximates the actual costs if an evacuation event were to become necessary.

Once all cost data was combined, the three COA estimates were compared and contrasted against each other. The results were then weighted and compared by including non-cost factors as determined by the researcher. The researcher determined the weight and relative importance of the non-cost factors through personal interview with parties involved in previous hurricane evacuation events. Interviews were conducted with members of multiple military agencies including: USTRANSCOM DSCA representative, USTRANSCOM liaison to USNORTHCOM, USTRANSCOM commercial contract planner, USNORTHCOM Chief of mobility division (served as the operations center chief during hurricanes Gustav and Ike), TACC contingency airlift planners, and USNORTHCOM air operations center planners.

IV. Analysis

How General Population Evacuation Requests Work

In order to better understand some of the limitations placed upon the DoD in responding to hurricane evacuation events, it is imperative to understand how the formal request process works.

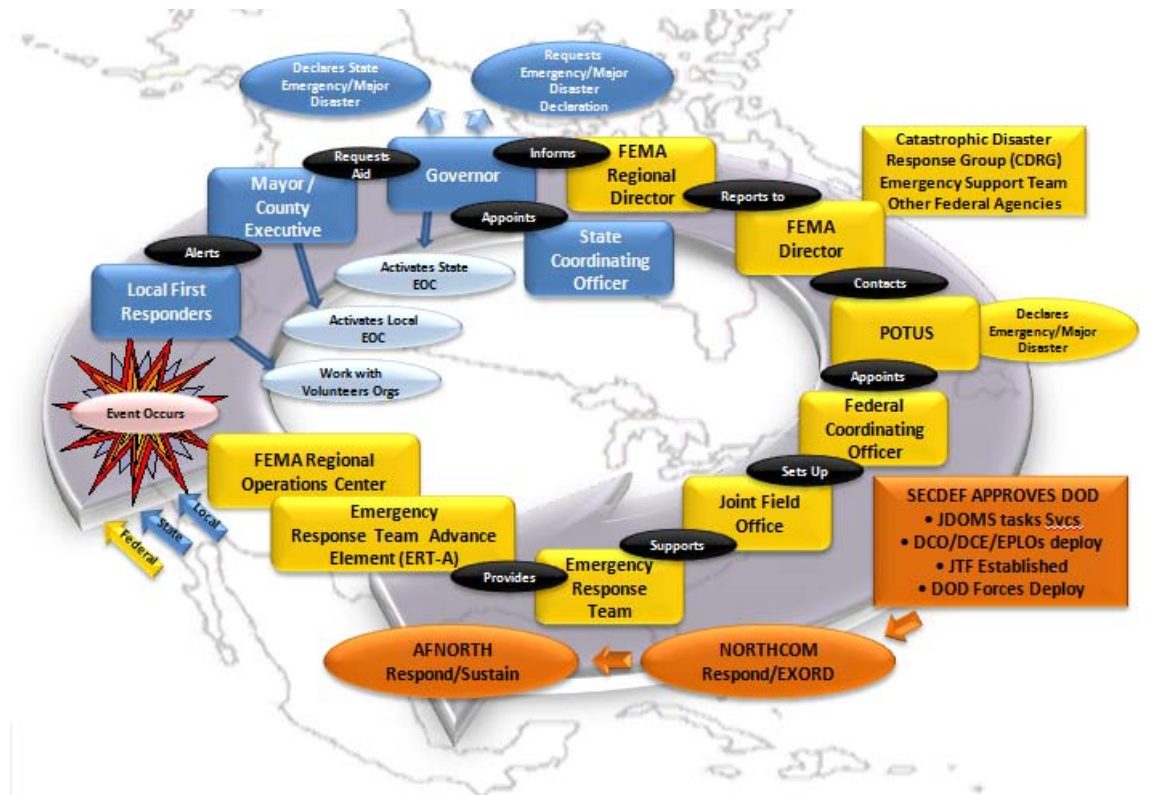
Governors and local leaders have a responsibility to their constituents to have plans for evacuation and natural disaster response that are dynamic enough to react to the expected and unexpected events that might occur in that district. Since hurricane mass evacuation plans had not been used in quite some time prior to Katrina, the plans had probably become outdated or inaccurate. Additionally, plans cannot totally account for human nature. Even with the best local plan, it may not be possible for the state to know exactly how many people will not be able to depart an area on their own (because of physical limitations, lack of transportation, resistance to leave their home, etc.).

Because the plans cannot account for all of these factors, the local leadership will almost always ask for state support. The state will provide support as much as it can through other cities and its state National Guard forces. If the governor believes he/she is unable to meet the need of the disaster area, the decision is made to ask for federal support. At this point the President, DHS, and FEMA are all contacted and support is requested. Once the President decides that federal support is required, FEMA is empowered (under the Stafford Act) to provide financial and physical support to the area. In the case of airlift support, FEMA will make efforts to coordinate with civilian air providers (must use United States commercial carriers according to the Economy Act) for

movement of persons out of harm's way. Based upon the experiences of more than one person interviewed, it is apparent that FEMA spends very little time attempting to contract carriers themselves. Rather, they pass these needs off to USNORTHCOM and expect them to provide the necessary services. USNORTHCOM is the combatant command responsible for the geographic area covering Texas and Louisiana. However, they do not possess or manage the capability to task airlift assets. USTRANSCOM is the combatant command tasked with the responsibility to plan for and provide all transportation assets as a supporting command.

USTRANSCOM receives the requirement from USNORTHCOM and determines a best sourcing method in coordination with the 618th Tanker Airlift Control Center (TACC) and AMC. During this step of the process, planners are required to look at commercial carriers to determine if they are financially/physically capable to meet the requirement (IAW the Stafford and Economy Acts as well as the Joint Federal Travel Regulations). If, due to time or location constraints, commercial carriers are not available/capable then military resources are used. This cycle is graphically depicted with other interim steps in Figure 2.

After all of these steps occur; contract commercial carriers or military aircraft participate in the evacuation support mission. One aspect that may not be made clear is that the DoD is not the only actor at a given airfield or within the evacuation activities. They are serving a support function for the state that has requested federal support for its citizens. Because of this dynamic support role, it may not be possible for the DoD to



(AFNORTH, 2009)

Figure 2. Disaster Response Cycle

obtain access to all parts of an airfield or to monopolize arrival and departure times.

Resources must be shared with commercial carriers that are most likely still operating out of the airport, other agencies (such as American Red Cross, medical support agencies, etc.), and other local traffic. Given this extended cycle, and limitations in accessing airfield facilities, it becomes necessary to understand the overall restrictions to the process in regards to time.

Time Management Prior to H-0

H-0 is defined in multiple sources as the time when tropical storm force winds reach a given location. For the purposes of safety and protection of aviation assets, the DoD directs completion of airlift evacuation activities at H-18. A further six hours

between H-18 and H-12 are allocated in order to ensure withdrawal of equipment and personnel that were necessary to accomplish the evacuation. Simply stated, the last 18 hours before a storm are not able to be used for evacuation of general population members.

Having accounted for the last few hours prior to hurricane force winds, analysis of the early portion of the storm forecast and state requests for assistance must be accomplished. Despite their best efforts, and much advancement in technology, the National Hurricane Center's (NHC) forecasts are not very accurate in determining the landfall location. The statistics for accuracy at various points in time are indicated in Table 1. According to one person interviewed, the errors in forecast accuracy are a key contributor to late decisions by state governments to order evacuation, request declaration of a disaster area by the President, and receive federal assistance for evacuation.

Table 1. NHC Forecast Error

	Forecast Period (h)						
	12	24	36	48	72	96	120
2008 mean OFCL error (n mi)	27.7	48.3	68.6	88.2	126.9	159.8	191.8

(Franklin, 2009, p. 29)

Late decisions are most often attributed to restraint on behalf of leadership (both local and state) in regards to committing to a mass evacuation. As was seen in the media during hurricane Katrina, ordered evacuations routinely lead to looting, crimes against persons and property, expenditure of large monetary resources from a community, and

large monetary contributions by the state and federal governments. Because of the large expenses associated with such a decision, leadership must be confident in the likelihood that their communities will be affected.

However, based upon Table 1, at only 72 hours prior to landfall, the hurricane prediction could be as far off as 127 nautical miles (nm). Figure 3 represents the circular error (127 nm or 144 statute miles) of this type of forecast centered upon Galveston, Texas or New Orleans, Louisiana. (Franklin, 2009, p. 29)

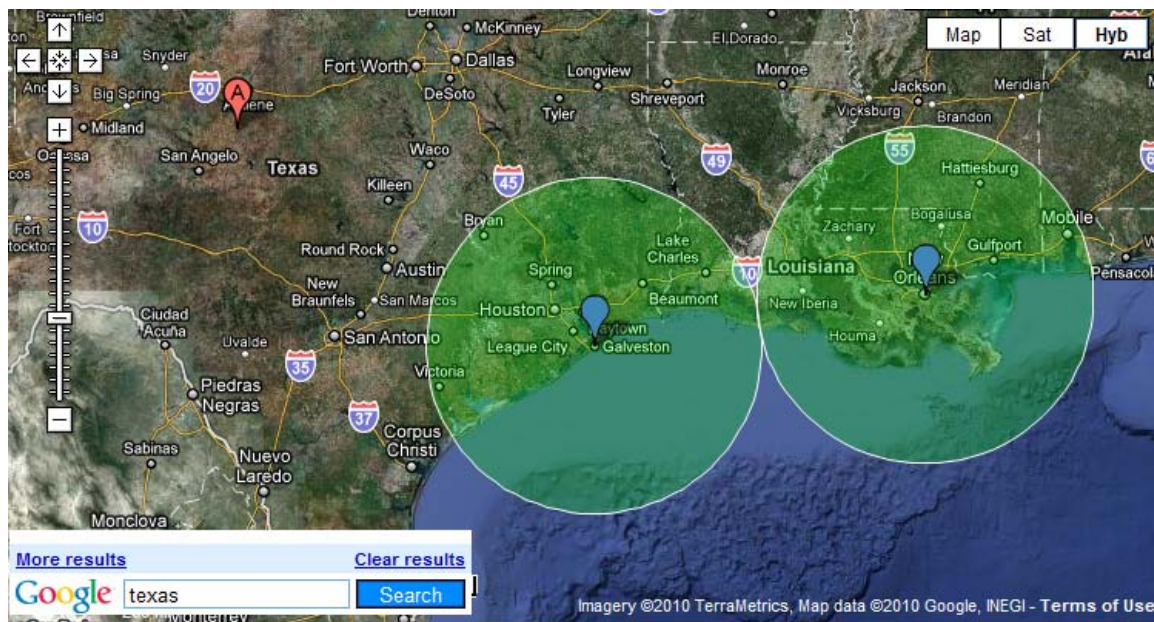


Figure 3. Circular Error of Gulf Coast Hurricane (72 hr forecast)

Based upon the possibility that an impending hurricane may not even impact a given community or state, would the local magistrate or governor order an evacuation of Galveston or New Orleans at 72 hours? Unfortunately the answer is not only dependent upon the path of the storm. The decision is dependent upon many other variables including the size of the storm, its intensity, and the population of the potential impact area. In the experience of more than one person interviewed the state will delay even

further beyond 72 hours with the hope that the forecast will change because the storm has changed path and moved away from population centers. However, as discussed later, notification in order to evacuate large population centers such as New Orleans is necessary at almost 120 hours prior to landfall (forecast error according to historical data is approximately 192 nautical miles at this time). (Franklin, 2009)

Even if the choice to evacuate is accomplished at 72 hours, the state, federal, and DoD officials have only 54 hours ($H-72 - H-18 = 54$) to evacuate. In the case of Louisiana the need for evacuation is 10,000 people from one APOE (ARNO-DCO, 2009, p. 5). Given 54 hours and 10,000 passengers, the required evacuation rate is 185 people per hour. While that number doesn't seem very challenging, it increases dramatically after other factors are weighed in. The Louisiana ARNO-DCO planning document states that notification may not be given until H-50 (2009, p. 5). Additionally, more than one person interviewed confirmed that flights were cancelled or left an APOE empty because evacuees did not show up during the late evening and early morning hours. The combination of late notification and approximately 6 hours each night where there are not enough evacuees to move, results in an available number of evacuation hours equal to approximately 26. The resultant math yields a requirement of 385 passengers processed and evacuated each hour. In order to meet this more challenging target the security, transportation, and CRE staff members would have to process 6.5 people per minute for 13 hours straight over 2 days. Based upon the author's personal experiences, it is clear that challenges in just passenger processing capability are tremendous and management of passenger arrival schedule is a subject matter that could be studied independently.

The previous discussions make one very large assumption – contract carriers or military aircraft are standing by and ready to launch from the APOE at the instant the request for help by the state is made. In reality the process of declaring a disaster area, FEMA decision making, USTRANCOM planning, contracting civilian flights, planning of military flights, pre-mission crew rest, and positioning to the APOE may take days to complete. With notification at H-50 no real evacuation would be possible if the DoD and federal agencies had not already took tremendous financial risks by prepositioning personnel and aircraft near the APOE. The costs and possibilities of “leaning forward” will be discussed under the analysis of each COA.

Course of Action 1. Use of All Military Airlift for Evacuation

While use of military aircraft only might be of keen interest to a military member and of even more interest to a military aviator, this choice is not cost effective or efficient for many reasons. By highlighting the various aspects that play into the use of military aircraft it will be made clear why it is not the most feasible choice.

First, military aircraft by design are not as useful for passenger transport as compared to civilian counterparts. Military aircraft are designed to support the movement of urgent military cargo and in some cases small groups of personnel dedicated to time-sensitive or special missions. During an interview, it was highlighted that this unique mission is by design. Since the induction of the Economy Act of 1932, military passenger transport has been executed by contract commercial carriers in order to promote the continuation of these assets that are critical components of our national transportation system. In unique circumstances military members are transported aboard military aircraft only if it is not feasible for them to use commercial transportation (i.e. a

hostile destination, unique mission requirements – special operations, airdrop, etc., or the mission is time-sensitive). Despite the movement toward use of commercial carriers, the Economy Act does allow for use of federal military transportation during life-saving activities if the following restrictions are met:

030103. Legal Authority

A. In accordance with 31 U.S.C., section 1535, the head of an agency or major organizational unit within an agency may place an order with a major organizational unit within the same agency or another agency for goods or services if:

1. Funds are available;
2. The head of the requesting agency or unit decides the order is in the best interest of the United States Government;
3. The agency or unit to be asked to fill the order is able to provide the ordered goods or services; and
4. The head of the agency decides that ordered goods or services cannot be provided as conveniently or economically by a commercial enterprise. (Department of Defense, 2008, p. 3)

Interpretations of point #4 vary widely. However, in the opinion of all interviewed there is an allowance for decision makers at all levels within the DoD to elect to use military aircraft for hurricane evacuation efforts.

While it is apparent that the Economy Act allows for this option, it may not be feasible to choose this option due to many reasons. Some of those reasons include costs, availability of military airframes, carrying capacity of military aircraft, and maximum on ground (MOG) restrictions.

Availability of military resources may be the largest limitation in choosing COA

1. Availability of military resources in the form of CREs, aerial port members, aircrews, maintenance personnel, and aircraft are directly influenced by United States participation in any kind of military conflict throughout the world. As an example, at the time this research was conducted, military forces were being utilized in support of actions being conducted within both Iraq and Afghanistan. These military activities were responsible

for high levels of deployment and operations for almost all aspects of the military. With many resources deployed or already in movement to support the forces that are deployed, the remaining assets are either not available or limited in availability.

Considering that the urgency of evacuation of personnel from harm's way would carry a high priority value in the transportation system, the remaining assets should be available for use. However, based upon the author's experiences working in TACC, AMC's air operations center, on any given day there were between 2 and 10 C-17s available for non-combat support operations. Based upon a study done by a TACC planner, transportation of the approximate 10,000 persons required to be evacuated from the New Orleans area in front of another Katrina type event would require five days notice (H-118 hours), 39 C-17 aircraft, a full CRE, and 80 aircrews to accomplish the evacuation in time (see Figure 4). Given that there are routinely only a maximum of 10 aircraft available, accomplishing an evacuation using solely military C-17s would not be feasible given their current employment in other operations.

Critics of this theory might argue that utilizing only C-17 assets is very narrow minded and excludes many other assets (C-130, KC-135, C-5, and state-owned fixed/rotary wing assets). However, based upon published values in Air Force Pamphlet 10-1403 the C-17 has the capability to transport the largest number of passengers over the least number of flights (See Table 2). Additionally, most active duty C-130 and KC-135 units have other commitments during any form of military action and have fewer tails available for evacuation operations. Furthermore, state owned assets are most likely going to be activated by their respective governor and remain in direct support of their respective states. One person interviewed pointed out that 80% of the medical evacuation

assets are owned by the air reserve components and many of these assets will be used in their aeromedical status rather than for general population evacuation.

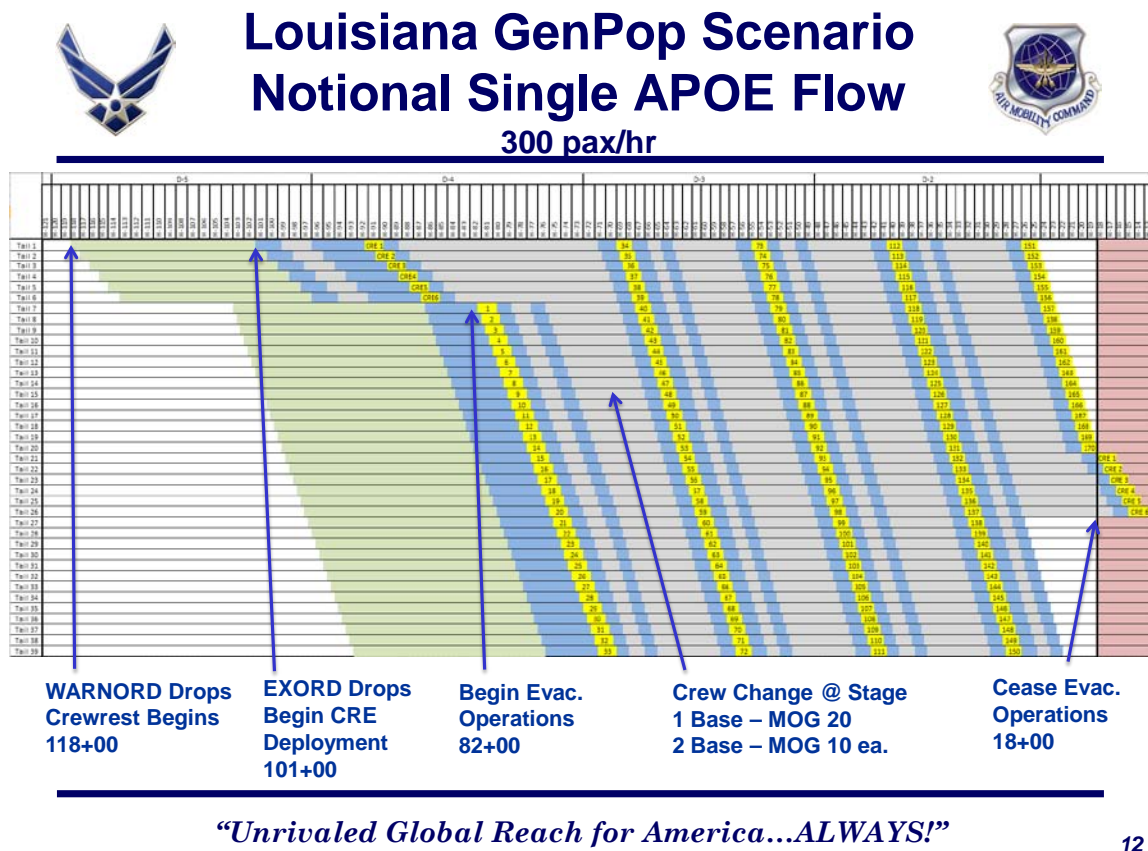


Figure 4. General Population Evacuation of LA (C-17s only)

Based upon the large number of aircraft and personnel required, the DoD may be able to serve as a supplement to commercial activities. However, operating as a standalone entity is not possible when military assets are employed in any other worldwide operation. However, in times of peace it may be possible to obtain enough military resources to execute a full evacuation using military assets if given enough time prior to the hurricane. Given current events and recent history, periods of “peace” will not exist for quite some time. For the purposes of this study it is assumed that the

military will be engaged in military operations of some sort when asked to support hurricane evacuation efforts.

Table 2. Aircraft Payloads

Aircraft Type	Pallet Positions	Cargo (s/t)		Passengers ^{4,6}		Standard NEO Passengers
		ACL ²	Planning ³	ACL	Planning	
C-9	-	-	-	40	32	40
C-130	6	17	12	90	80	92/74 ⁵
C-141	13	30	19	153	120	200/153⁵
C-17	18	65	45	101	90	101
C-5	36	89	61.3	73	51	73
KC-10 (Airlift)	23	60	32.6	75	68	75
KC-135 (Airlift)	6	18	13	53	46	53

AFPAM 10-1403

One distinct advantage military forces have is the capability to “lean forward” through the utilization of money and flight hours contained in the Air Force’s Operations and Maintenance (O&M) budget. Because money is available under this budget, military agencies, under close scrutiny of their senior leaders can prepare for predictable natural disasters such as hurricanes by placing CREs, aircraft, and support personnel near where the expected event will occur. In this way the resources are already placed in a “rested” status and are able to begin operations very shortly after FEMA and USNORTHCOM ask for their support. However, because the decision to preposition military assets is made by military leaders, the DoD carries all the monetary risk if those resources are not needed. Travel expenses and flight hour costs are essential lost if the storm changes track or the state is capable of supporting the evacuation on its own.

Finally, under COA 1 costs to FEMA and in effect to the taxpayer are quite high. Because military aircraft are designed, owned, maintained, and equipped for special

military operations, the costs to operate these airframes are quite high. Assuming that the first 10 aircraft would preposition within 1 hour of the APOE, the constructed cost of evacuating 10,000 personnel from New Orleans is \$10.98 million and 17,000 personnel from two APOEs in Texas is \$16.96 million. Calculations to support these numbers are covered in Appendix A.

Course of Action 2. Use of All Commercial Carrier Airlift for Evacuation

Based solely upon previous discussion, the reader might assume that COA 2 is the best option and should be chosen in all cases. It will be made clear that contracted commercial carriers have limitations that do not always make them the best candidate for mass evacuation activities.

The first aspect that must be looked at is availability. While many airlines do maintain some airframes in a “parked” status, the economic conditions of a given time period will drastically affect the number of airframes available. In the economic climate present during the preparation of this research, the number of parked airframes had drastically decreased because of dire financial situation of many airlines. Of those airframes that were parked, many had moved into a status where preventative maintenance cycles had been delayed dramatically. The high costs and time necessary in returning a given airframe to active service would most likely prevent an airline from using that aircraft for a hurricane evacuation event.

When asked by FEMA or USTRANSCOM to participate in a hurricane evacuation event the airline must weigh these cost factors to determine its ability to provide airframes, aircrews, support personnel, and equipment. In many cases, the decision to support an evacuation may require disruption of normal scheduled services.

In order to make this an appealing option for the airlines, the DoD acting as the federal agent must establish reimbursement rates that are adequate to compensate the airlines lost revenues and encourage them to participate.

An additional restriction on use of commercial carriers is their set support structure via the hub and spoke system. Operations within a hub and spoke system allow carriers to conduct flights of larger aircraft between major metropolitan cities and to use smaller aircraft to feed the large hubs with passengers from outlying communities. When asked to participate in an evacuation an airline must consider how their participation will affect their support costs. Factors that affect support costs are maintenance, gate availability, slot availability, fuel contracts, labor contracts, and much more.

As an example, when the request for airlift support was called for prior to hurricane Gustav, Delta airlines was a prime candidate because they had a major hub in Atlanta, Georgia. Because Atlanta had been identified as a primary evacuation location Delta agreed to help and had all of the available support resources present in Atlanta to proceed through a robust schedule that was being set by airlift planners at TACC. Due to unforeseen circumstances, the city of Atlanta decided to remove its support of evacuees and the contracted flights had to be rerouted to locations in Tennessee and Texas. Because Delta did not have as many support resources in these other locations the flow of aircraft and aircrews began to quickly unravel. During the second day of evacuation many contracted flights were not able to depart because replacement crews could not get to the aircraft locations quick enough. Additionally, Delta incurred costs that they had not planned on to pay for support resources at these other locations. (Anonymous interview, 2010)

An additional aspect that provides more confusion than necessary is the fact that the airlines supporting an evacuation maintain their own command and control centers. While these independent centers are ideal for their day to day scheduled service, they are not as adept in the activities associated with a contingency event where schedules and destination requirements change rapidly. In a solely military based contingency event, the planners at TACC have full visibility on all available military resources and can directly task any one of them to support a segment of the required mission. While TACC maintains overall management and determination of the flow during a contracted evacuation scenario, they do not maintain command and control over the individual resources employed. Without this direct control relationship, communication with employed resources can be delayed and rapid response actions require multiple levels of participation. Despite the advent of digital communication and the reliability of other forms of communication, it still takes longer to change a mission if the managing agency (TACC) is not in direct contact with the “forces” employed.

Communication is a critical component of effective employment in evacuation scenarios. The importance is relayed by an experience of a planner who commented that confused communication was a factor in the effective evacuation prior to hurricane Gustav. Airflow was planned and arrived at the evacuation location at the designated start of evacuation time. Because local authorities had not mandated evacuation, personnel had not yet arrived at the departure airfield for evacuation. Because of inexperience or lack of understanding of the airflow situation, the on-scene agencies elected to have the aircraft remain on the ground until enough passengers were available to fill the aircraft. Because the contracted carrier had a schedule based upon a set ground

time, the subsequent flights began arriving without delay. When parking and ground handling personnel could no longer support further aircraft, flights were held in the air.

According to the interviewed planner, the delay information was not relayed to the planners at TACC quickly enough to stop more flights prior to departure. The airlines control elements who were conversing with on-scene agencies were allowing the holds to occur without conferring with the managing partner (TACC). As a result of aircraft delaying on the ground, many flights had to be cancelled or depart empty to allow for proper flow of the evacuation as time progressed.

Flight cancellations and delays are a serious detriment to contract aircraft use. While a military crew and aircraft may be placed on an alert status (capable of being launched in a short period of time) for long periods of time, civilian contracted airlines do not maintain this same capability. In their everyday operations airlines do not want or need to employ this type of activity. If aircrews and airplanes had been in alert status in our prior example the crews would simply continue to wait in a crew rest location until they were needed at the departure aerodrome. Furthermore, military crews could have been positioned in an alert status on the ground at the APOE to allow for longer delays or crew changes at the APOE.

When comparing costs of service, civilian flight cancellations are very relevant as those services have already been paid for via a contract between the government and the airline. Military flights are only paid for if the flight actually occurs. Despite these prepaid costs commercial airlines have airframes that are designed to be effective and efficient in the transportation of passengers. Therefore, the costs associated with their operations are financially smaller. As a reference, costs for commercial contract flights

during fiscal year 2008 are included in Appendix B. The estimated cost of a commercial only air evacuation of passengers from New Orleans is \$2.46 million. The cost to evacuate personnel from the state of Texas using commercial air is \$4.2 million. Factors considered and calculation for these values can be found in Appendix A. While this number is drastically lower than the military only number, it does not reflect all factors in the use of only commercial carriers.

Course of Action 3. Mixed Commercial and Military Aircraft Employment

The option of combining military assets and commercial contract carriers maintains the most flexibility for airlift planners, state agencies, and on-scene leaders. The commercial contract carriers are able to employ the unique capabilities present in handling large number of passengers on a given flight at a lower cost than an equivalent military flight. The military aircraft can be effectively employed to position and deposition CRE and local passenger handling representatives. Additionally, military aircraft can preposition near the APOE and posture in an alert status in the event of problems with the commercial flights, changes in required lift, destination changes, and etc.

In order to effectively employ both resources and maintain contractual and legal stability a determination would have to be made by senior leaders related to how many of the projected evacuees should be handled by the commercial sector. The Economy Act and Stafford Act both contain enough leeway to allow for portions of the required evacuation to be conducted by military flights. Based upon interviewees past experience it would be feasible to contract anywhere between 50-75% of the requested evacuees on a state's estimate. Specific percentages would have to be considered by the leadership at

the time to ensure commercial assets are utilized to the maximum extent during the peak flow periods (i.e. during the day over the last two days prior to hurricane force winds).

Military assets could be employed during less demanding hours where an aircraft may be required to wait on the ground for a full load of passengers. In order to accommodate a waiting posture, it would become necessary for one or two crews to be positioned at the APOE in the event the wait extends to a point where the crew operating the aircraft could not continue to the APOD. Additional crews and aircraft would have to be positioned at staging locations in order to maintain a constant flow in the event of lost commercial flights or for continuous flow of the military aircraft.

Another aspect that has made a mix of commercial and military assets a requirement is media coverage and public opinion. Col. Effrece summarized this point well with his comment, “In the end we will always have some mix of military air so the population sees government involvement” (2010). Failure to show military presence gives an impression that the federal government doesn’t care about the events that are transpiring. Conversely, a military tail that appears in the media or on the ramp gives the public and the local population confidence that the military is here, things are under control, and national leadership cares about me. The psychological aspects inherent in this situation can help to calm public anxiety and maintain order in what may otherwise be a chaotic event.

Finally, cost for a mixed requirement may not be the lowest when compared to the strictly civil airlift option, but the obvious benefits gained by adding the flexibility of military airlift cannot be measured in dollar figures. Based upon the assumption that half of the resources are contracted via commercial air and the other half are provided by

military airlift the estimated cost for a New Orleans evacuation is \$5.96 million. Texas would cost approximately \$9.82 million. Calculations can be found in Appendix A.

COA Comparison

Based solely upon fiscal concerns, the COAs would be arranged 2, 3, and 1 respectively according to increasing costs. The many other factors that affect COA selection must be factored in and weighted to determine the best possible choice for a given scenario. Based upon interviews conducted, the importance of individual factors has been given relative importance. The summary of factor weighting and selection of an appropriate COA is presented in Table 2.

In order to facilitate comparison, all interview respondents were asked what aspects of general population evacuation missions they considered most important. All respondents highlighted the need to keep costs low. For this reason cost was given a weight factor of two. All respondents also mentioned flexibility as a key factor during the execution of an evacuation, especially during the beginning and ending stages of the event. For these reasons, flexibility was given a factor of two as well. Capability was considered important by all respondents and was weighted by a factor of two. All other factors were mentioned as relevant, but with no greater weight. If a factor was considered a benefit of a given COA, it was given a positive value. If the factor was a detriment to successful completion of an evacuation mission it was given a negative value. If the presence of a given factor made no significant contribution, it was given a value of zero.

Table 3. COA Weighted Factor Comparison

	COA #1 - Military Only	COA #2 - Commercial Only	COA #3 - Mixed
Cost	-2	2	0
Availability	-1	1	1
Flexibility	2	-2	2
Capability	-2	2	2
Public Opinion	1	0	1
Command & Control	1	0	0
Sum of Weighted Factors	-1	3	6

In the weighted factor analysis, availability reflects the likelihood that enough assets will be available to execute a chosen COA. Flexibility is related to the capability to change destination, change departure time, pre-position forces, and start or end at unique or restricted airfields. Capability is a reflection of how many passengers can be handled on a given flight and how comfortable they are during the flight. Public opinion is included to reflect how the presence of the resource chosen will affect public perception of the federal awareness of the disaster. Command and control is included to reflect the capability of USNORTHCOM and USTRANSCOM to directly task or cancel a mission through active duty military channels.

By compiling the factors as weighted, utilizing COA 1 proves to be the worst choice for a general population evacuation of Texas or Louisiana. Conversely, the mixed option (COA 3) is by far the best option. Utilizing the beneficial aspects of both commercial and military airlift provides the most capable options to a commander during a situation which is arguably complex, time sensitive, and critical to life saving efforts.

V. Discussion, Implications, Recommendations

Discussion

This research has explored many aspects of the involvement of DoD assets in the evacuation of general population members preceding a hurricane in Texas and Louisiana. Research was discussed via three courses of action: 1) Utilizing only U.S. DoD owned military assets to conduct evacuation of all necessary personnel. 2) Utilizing only contract commercial airlift acquired through agreements as provided for in the CRAF peacetime business model. 3) Utilizing military assets upon initial activation and nearing the completion of the evacuation while using commercial contracted carriers for a majority of the evacuation requirements in between. The previous sections have compared and contrasted each COA. The decision to use commercial or military aircraft need not be exclusive of the other option. However, it is clear that the decision to use one or the other is dependent upon a given situation and the conditions leading up to the evacuation.

While military aircraft have greater flexibility in their availability and delivery locations, the costs are substantially higher. Commercial aircraft provide a cheaper, more passenger friendly avenue, but are much less flexible when time is of the essence. The combination of the two resources meets the requirements set forth to conduct an effective evacuation of personnel in Texas or Louisiana. With minimal increases in cost, the flexibility of military airlift can be employed alongside the more capacity driven commercial carriers. This ideal mix of resources can accommodate the dynamic

environments that surround the days preceding a hurricane providing the most capable life saving resources to the state requesting aid.

Implications

Throughout the 2009 hurricane season USTRANSCOM pushed to find ways to utilize military aircraft in plans for general population evacuations. By working with counterparts in USNORTHCOM, AMC, and TACC the possibility of employing military aircraft was discussed. Research into the aspects affecting the choice to include military aircraft has concluded that the participation of military resources adds extensive capabilities while preserving the dynamic capabilities of our commercial partners. Therefore it is in the best interest of the DoD and USTRANSCOM to continue to employ mixed solutions to DSCA events. While not the most fiscally sound option, COA 3 provides a greater confidence level for a commander that evacuation activities will be successful. The extra costs are outweighed by the potential number of lives saved.

Areas For Further Study

While research has shown that inclusion of military assets is of value, it has also identified many considerations that warrant further study. Specifically, identification of the exact proportion of military versus commercial involvement based upon a state's requested number of evacuees was not addressed due to the time constraints of this study. Other aspects that could be studied are the mix of resources used for other types of natural disasters or emergencies in all parts of the international realm. Further research could also be conducted on the interaction between aeromedical and general population evacuation and how they affect each other preceding hurricanes. How can these valuable

resources share working space on a contingency ramp or should they remain at separate locations?

It is also clear that the definition of personnel requiring general population evacuation is variable from state to state. A common definition of the classification of evacuees is needed to allow for proper planning and execution of federally supported evacuation efforts. DHS or FEMA would then need to establish regulatory requirements for each state to participate in the new classification system when asking for evacuation support.

Finally, management of the arrival of personnel at the APOE who need transportation was identified as a major contributor to confusion and trouble during all evacuations. Study related to notification systems, time schedules, and transportation from outlying communities into the APOE would be of great benefit to future evacuation planners.

Closing Thoughts

One of the principles of military airlift is flexibility. In order to fight and win military conflicts, this principle is a necessity. General population evacuation prior to a hurricane requires this unique capability. Therefore, excluding military airlift based upon cost or other factors, limits the capability of the supporting forces to save lives. Future planners must consider this capability and include it in the most dynamic environments present in the days leading up to hurricane landfall. While the costs associated with military airlift can mount quickly, the DoD proves every day why military assets are used in unique circumstances. Hurricane evacuation is one of those unique circumstances. While we need the benefits a commercial partner can offer related to mass movement of

personnel, maintaining the flexibility available with military resources is crucial to the success of future evacuation events.

Appendix A: COA Cost Calculations

Cost calculation for the various COAs are based upon estimates made in 2009 for the hurricane season of that year. Organic airlift hourly rates were extracted from the USTRANSCOM tables, utilizing the rates for non-DoD users and contingency missions. Table 3 below depicts the applicable portion of the table and highlights the hourly rate of \$21,361 for the use of a C-17 aircraft. The minimum activity rate column reflects a guarantee of at least four hours of flight time every day the aircraft is held by a user. For the purposes of this study it is assumed that the minimum number of hours will be met each day.

Table 4. Non-DoD Aircraft Rates

FY09
Non-DoD U.S. Government
Charter Hourly Rates and Minimum Activity Rates for TWCF Aircraft

AIRCRAFT	SAAM/JCSE/ CONTINGENCY FLYING HOUR RATE	MINIMUM ACTIVITY RATE
C-5	\$35,590	\$71,180
C-130E/H	\$7,937	\$15,874
C-17	\$21,361	\$85,444
KC-10	\$15,743	\$31,486
KC-135	\$11,610	\$23,220

(HQ AMC/FMFAB, 2009, p. 10)

COA 1 Calculation

Rather than being a contract per passenger flown, military flights are charged by the number of flying hours used. For the purposes of the calculations it is assumed that the first 10 C-17s are selected from aircraft that are terminating another mission near the

proposed hurricane location (within 1 hour of the APOE). Subsequent C-17s are selected equally from Charleston Air Force Base and McChord Air Force Base and position within a 1.5 hour flight of the APOE. Staging locations chosen are within 1.5 hours flight time of the APOE and 1 hour of the APOD.

Flying hours calculation for Louisiana (LA):

Number of passengers	10,000
Number per C-17 flight	\div 100
TOTAL NUMBER OF C-17 EVAC SORTIES	100
Flight hours for 10 C-17s via in-system select (to APOE)	10
Flight hours for 10 C-17s from Charleston to stage (2 hours per leg x 20 legs { 10 position + 10 deposition })	40
Flight hours for 10 C-17s from McChord to stage (3.2 hours per leg x 20 legs { 10 position + 10 deposition })	64
Flight hours for each evacuation cycle (1.5 hrs to APOE + 1.5 hrs to APOD + 1 hr to stage)	4
Number of evacuation sorties required	\times 100
TOTAL HOURS for evacuation cycles	400
Sum of position and deposition legs	$+$ 114
TOTAL C-17 FLIGHT HOURS FOR LA EVAC	514
Cost per C-17 flight hour	\times \$21,361
TOTAL COST for LA military evacuation	\$10.98 million

Flying hours calculation for Texas (TX):

Number of passengers	17,000
Number per C-17 flight	\div 100
TOTAL NUMBER OF C-17 EVAC SORTIES	170
Flight hours for 10 C-17s via in-system select (to APOE)	10
Flight hours for 10 C-17s from Charleston to stage (2 hours per leg x 20 legs { 10 position + 10 deposition })	40
Flight hours for 10 C-17s from McChord to stage (3.2 hours per leg x 20 legs { 10 position + 10 deposition })	64
Flight hours for each evacuation cycle (1.5 hrs to APOE + 1.5 hrs to APOD + 1 hr to stage)	4

Number of evacuation sorties required	x 170
TOTAL HOURS for evacuation cycles	680
Sum of position and deposition legs	+ 114
TOTAL C-17 FLIGHT HOURS FOR LA EVAC	794
Times cost per C-17 flight hour	x \$21,361
TOTAL COST for TX military evacuation	\$16.96 million

COA 2 Calculation

Utilizing COA 2 the estimated cost per passenger moved from a hurricane evacuation zone to an airfield approximately 1.5 hours away is \$246.91 (AMC A3, 2009). This value only marginally increased in 2010 to \$264.71 (USTRANSCOM AQ, 2010). In order to maintain dollar equivalency, 2009 values are used in all calculations.

Given this information:

Louisiana Evacuation Contract Estimate:

Cost per passenger evacuated	\$246.91
Number of passengers planned to evacuate	x 10,000
TOTAL COST for Louisiana commercial evacuation	\$2.46 million

Texas Evacuation Contract Estimate: (Assumes same flight times and pricing)

Cost per passenger evacuated	\$246.91
Number of passengers planned to evacuate	x 17,000
TOTAL COST for Texas commercial evacuation	\$4.2 million

One key aspect to remember when utilizing a commercial only evacuation methodology is that these values are contracted. The carrier that accepts the contract is paid the full amount if the flight occurs, even if less than the available number of seats are utilized. This calculation does not include cancellation fees. Cancellation fees are set at a level that marginalizes the loss to the airline. Because they are so unpredictable and

the relative cost to the government is similar, cancellation fees were not included in the calculation of COA 2 or COA 3.

COA 3 Calculation

On top of all of the assumptions used on the previous two COAs, it is assumed for COA 3 that half of the required passengers are transported via commercial carriers and the other half via military airlift. To ensure full employment of military assets it is assumed that 6 aircraft are positioned from active missions, fly the required number of evacuation missions, and then deposition equally between McChord and Charleston.

Louisiana Evacuation Commercial Contract Estimate:

Cost per passenger evacuated	\$246.91
Number of passengers planned to evacuate	x 5,000
TOTAL COST for Louisiana commercial evacuation	\$1.23 million

Military flying hours calculation for Louisiana (LA):

Number of passengers	5,000
Number per C-17 flight	÷ 100
TOTAL NUMBER OF C-17 EVAC SORTIES	50
Flight hours for 6 C-17s via in-system select (to APOE)	6
Flight hours for 3 C-17s from stage to Charleston (2 hours per leg x 3 legs)	6
Flight hours for 3 C-17s from stage to McChord (3.2 hours per leg x 3 legs)	9.6
Flight hours for each evacuation cycle (1.5 hrs to APOE + 1.5 hrs to APOD + 1 hr to stage)	4
Number of evacuation sorties required	x 50
TOTAL HOURS for evacuation cycles	200
Sum of position and deposition legs	+ 21.6
TOTAL C-17 FLIGHT HOURS FOR LA EVAC	221.6
Times cost per C-17 flight hour	x \$21,361

TOTAL COST for LA military evacuation	\$4.73 million
TOTAL COST for LA commercial evacuation	<u>+ \$1.23 million</u>
GRAND TOTAL LA EVACUATION	\$5.96 million

Texas Evacuation Commercial Contract Estimate:

Cost per passenger evacuated	\$246.91
Times number of passengers planned to evacuate	<u>x 8,500</u>
TOTAL COST for Texas commercial evacuation	\$2.1 million

Military flying hours calculation for Texas (TX):

Number of passengers	8,500
Divided by number per C-17 flight	<u>÷ 100</u>
TOTAL NUMBER OF C-17 EVAC SORTIES	85

Flight hours for 6 C-17s via in-system select (to APOE)	6
Flight hours for 3 C-17s from stage to Charleston (2 hours per leg x 3 legs)	6
Flight hours for 3 C-17s from stage to McChord (3.2 hours per leg x 3 legs)	9.6

Flight hours for each evacuation cycle (1.5 hrs to APOE + 1.5 hrs to APOD + 1 hr to stage)	4
Times number of evacuation sorties required	<u>x 85</u>
TOTAL HOURS for evacuation cycles	340

Plus the sum of position and deposition legs	<u>+ 21.6</u>
TOTAL C-17 FLIGHT HOURS FOR LA EVAC	361.6

Times cost per C-17 flight hour	<u>x \$21,361</u>
TOTAL COST for TX military evacuation	\$7.72 million
TOTAL COST for TX commercial evacuation	<u>+ \$2.1 million</u>

GRAND TOTAL TX EVACUATION	\$9.82 million
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Summary

To simplify comparison all values have been combined into Table 4.

Table 5. Summary of Airlift Cost Estimates

	Louisiana	Texas
COA #1 – Military	\$10.98M	\$16.96M
COA #2 – Commercial	\$2.46M	\$4.20M
COA #3 – 50/50 Split	\$5.96M	\$9.82M

Appendix B: 2008 Hurricane Costs

The commercial aircraft contract costs for the 2008 hurricane season are included in Table 5. Expenditures on commercial carriers through the season were just over \$3.27 million. Data is included for reference and quantification of the costs incurred by the DoD for cancelled flights.

Table 6: FY 2008 Commercial Contract Evacuation Costs

Fiscal Year 2008				
Summary of Hurricane Costs				
Hurricane Gustav - Deployment				
Total Cost of Awarded Missions				\$2,794,105.57
Total Cancellation Costs				\$77,970.28
Total Cost of Actual Missions Flown				\$1,501,105.57
Total Cost of Actual Missions Flown and Cancellations Costs				\$1,579,075.85
Hurricane Gustav - First Responders				
Total Cost of Awarded Missions				\$193,500.00
Total Cancellation Costs				\$0.00
Total Cost of Actual Missions Flown				\$193,500.00
Total Cost of Actual Missions Flown and Cancellation Costs				\$193,500.00
Hurricane Gustav - Redeployment				
Total Cost of Awarded Missions				\$1,899,723.00
Total Cancellation Costs				\$11,760.00
Total Cost of Actual Missions Flown				\$1,369,357.00
Total Cost of Actual Missions Flown and Cancellations Costs				\$1,381,117.00
Hurricane Ike				
Total Cost of Awarded Missions				\$2,385,331.41
Total Cancellation Costs				\$38,881.40
Total Cost of Actual Missions Flown				\$61,374.24
Total Cost of Actual Missions Flown and Cancellations Costs				\$117,535.64

(USTRANSCOM AQ, 2010)

Appendix C: List of Symbols, Abbreviations and Acronyms

AFB	Air Force Base
AMC	Air Mobility Command
APOD	Aerial Port of Debarkation
APOE	Aerial Port of Embarkation
COA	Course of Action
CRAF	Civil Reserve Air Fleet
CRE	Contingency Response Element
DCO	Defense Coordinating Officer
DHS	Department of Homeland Security
DoD	Department of Defense
DSCA	Defense Support of Civil Authorities
EXORD	Execution Order
FEMA	Federal Emergency Management Agency
H-(#)	# of hours prior to onset of hurricane force winds
IAW	In Accordance With
MA	Mission Assignment
MOG	Maximum On Ground
NGB	National Guard Bureau
NHC	National Hurricane Center
NM	Nautical Mile
TACC	Tanker Airlift Control Center
U.S.	United States

USNORTHCOM

United States Northern Command

USTRANSCOM

United States Transportation Command

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14. ABSTRACT United States Transportation Command serves as the source for transportation needs within the Department of Defense. During hurricanes Katrina, Gustav and Ike contracted commercial passenger aircraft were used almost exclusively to evacuate general population members from the coastal regions of Texas and Louisiana. Senior leadership requested a further analysis regarding the use of military aircraft in support of general population evacuation preceding hurricanes. Collection of data from previous hurricane evacuations and interviews of senior leaders and planners in various agencies allowed for a comparison in selection of military versus commercial assets. By analyzing both cost and non-cost factors in a course of action analysis the best mix of resources can be posited. It was determined that military aircraft should be used in conjunction with contracted commercial carriers in order to execute the most effective evacuation of general population personnel prior to hurricane landfall in the gulf region of Texas and Louisiana. Research revealed that further research is necessary regarding cueing of passengers from various communities and during late night hours.				
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