Advantages of a Future Amphibious Tiltrotor Craft: An Angel in the Sky

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1.1 Introduction and Review of Literature

Overview - The Amphibious Tiltrotor:

Off in the distance, an engine roars. A shadow rises in the midst of a sunrise, quickly advancing to the heavens above with two arms uplifted. The arms tilt forward, as if signaling the direction where the craft will move. With stunning speed, the shadow swiftly flies into the sunrise, on a mission to a place somewhere in the horizon. Soon, other shadows join the leader, some three dozen perhaps. The time is the future, and each shadow an invention that may one day save millions of lives from worldwide disasters. They are the amphibious tiltrotors, on a mission for the greater good.

On the civil front, amphibious tiltrotors carry many advantages. First of all, amphibious tiltrotors have a relatively long design range. This allows them to not only carry on longer missions, which could save more lives, but also start at distant and more advantageous points to allow efficient restocking and refueling of the craft. The size of the amphibious tiltrotor also enables it to carry many personnel, evacuees, and cargo—more than most small aircraft—while the ability to siphon water can make it a useful tool for firefighting. An important aspect of the amphibious tiltrotor, though, is its speed. At 400 knots, missions that may take half a day may, with an amphibious tiltrotor, only take a couple of hours. Though the speed may not be fast compared to fixed-wing planes, planes cannot takeoff or land without a landing (or takeoff) strip, and it is impossible for many planes and helicopters to land on water (and those that could are not known to common military rescue operations). Because of the amphibious tiltrotor's ability to land on both land and water, they are suitable for going where no other aircraft can go. Amphibious tiltrotors are beneficial for their ability to travel to harder-to-reach places with considerable speed and from a considerable distance.

Point-by-Point Discussion and Brief Review of Literature:

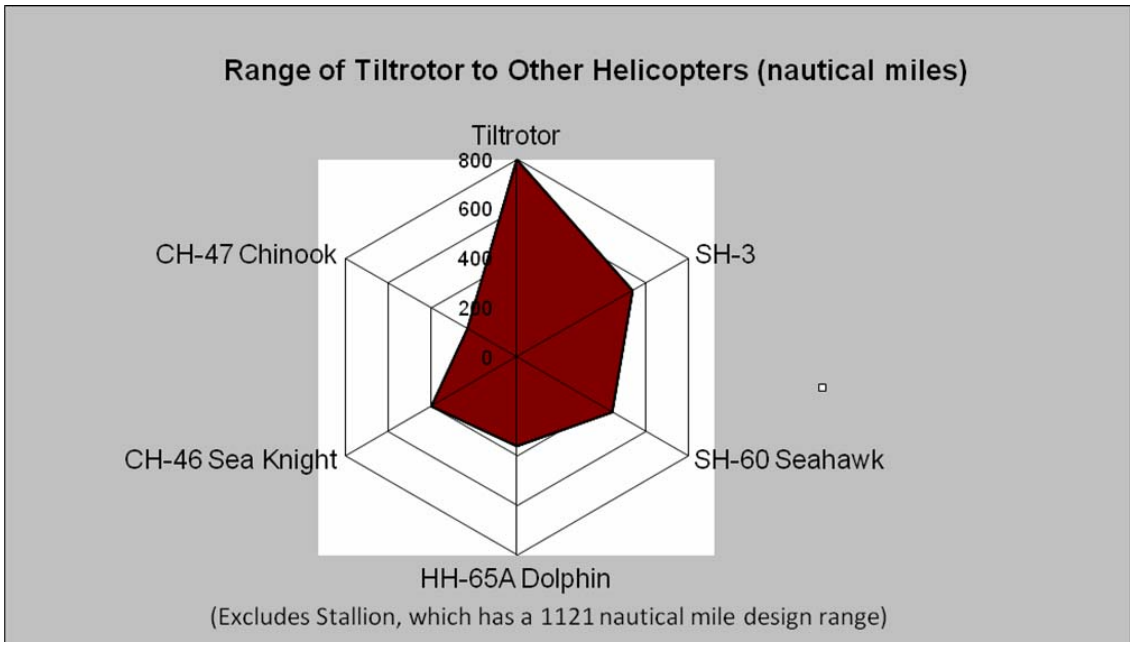
In the following essay, I have summarized the advantages of the amphibious tiltrotor in three sections: how it compares to today's fixed-rotor helicopters, how it could have benefitted past disasters, and how it applies to domestic issues. The helicopters were from either Sikorsky or Boeing, and almost all common natural disasters were used, from cyclones to fires to tsunamis.

Useful websites include GlobalSecurity.org, the Boeing and Sikorsky websites, the International Federation of the Red Cross website (World Disasters Reports), DoSomething.org, news websites such as Time, BBC, and Fox News websites, and the GLIDE Search to find the disasters used in the essay.

1.2 Amphibious Tiltrotor Specifications in Comparison to Other Aircraft

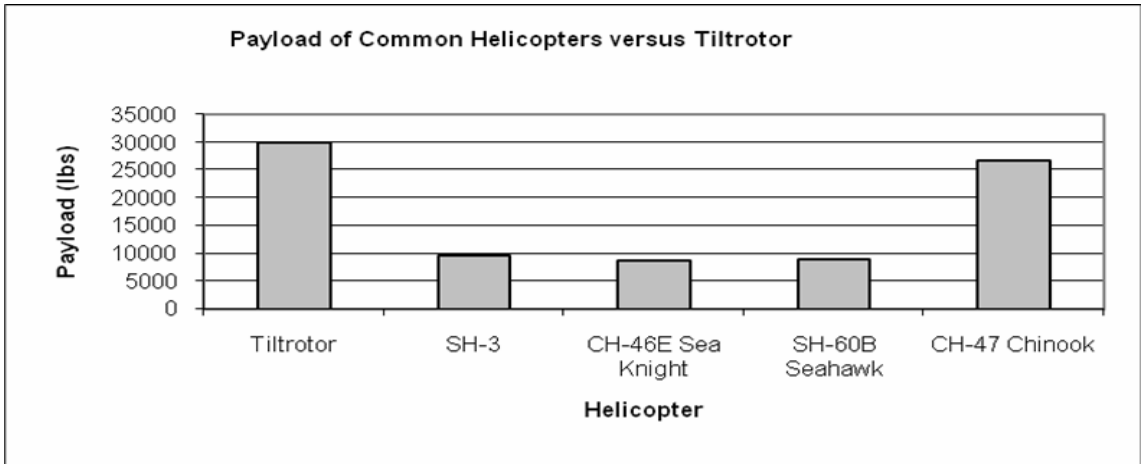
Comparison to Helicopters - Range, Payload, and Speed:

Amphibious tiltrotor craft have several advantages to the traditional fixed-rotor helicopters. Although several helicopters exist, some common helicopters used are the SH-60 (or HH-60H) Seahawk, a variant of the Sikorsky H-60 (CH-3) Black Hawk series; the SH-3, another Sikorsky helicopter; the HH-65A Dolphin; the CH-53 Stallion, a long-range helicopter by Boeing; the CH-46 Sea Knight, another Boeing helicopter; and the CH-47 Chinook, a widely used Boeing helicopter with a large payload and high passenger capacity. The amphibious tiltrotor is ahead of almost all of these helicopters in design range at 800 nautical miles. Most of the helicopters have a design range between 300 and 500 nautical miles (except for the Chinook at 230 nautical miles, based on "CH-47D/F Chinook-Specifications," and the Stallion at 1121 nautical miles, based on "CH-53E Sea Stallion, CH-53D Super Stallion, MH-53 Sea Dragon, MH-53J Pave Low III"). The 150-350% longer range of the amphibious tiltrotor to most other helicopters allows it to travel much farther to transport supplies or personnel from place to place.



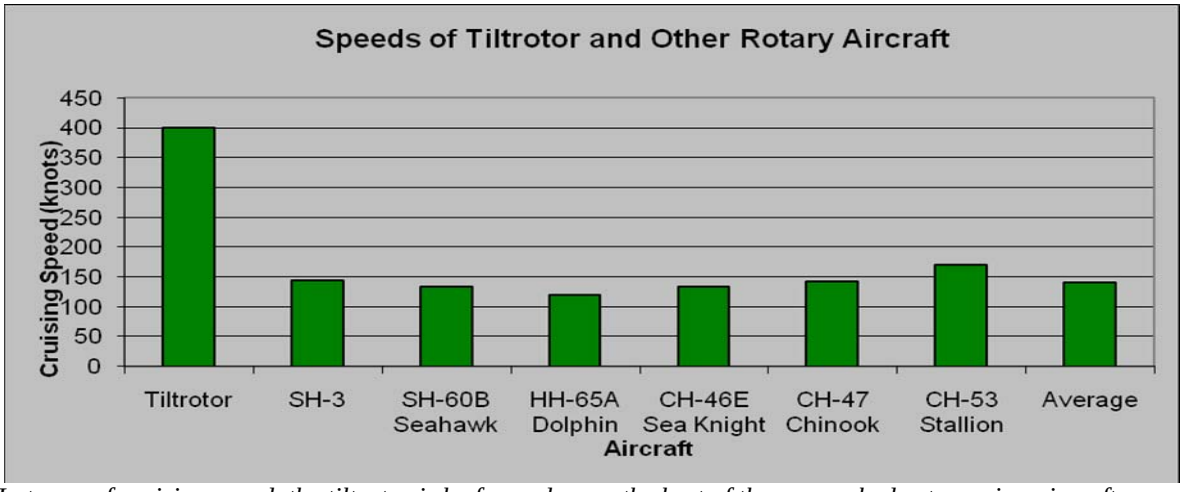
The tiltrotor has a considerable advantage over many other helicopters in terms of design range.
Sources for chart: CH-47 Chinook: "CH-47D/F Chinook-Specifications," CH-46 Sea Knight "Navy Fact File"; HH-65A Dolphin: John Pike, "HH-65A Dolphin"; SH-60 Seahawk: John Pike, "SH-60B"; SH-3: Kartsen Palt, "Sikorsky Aircraft S-61 (CH-3 / SH-3)"; CH-53 Stallion: "CH-53E Sea Stallion, CH-53D Super Stallion, MH-53 Sea Dragon, MH-53J Pave Low III"

Another advantage to the amphibious tiltrotor to this task is the ability to carry a high load of cargo. Assuming the amphibious tiltrotor is about double the size of the Boeing V-22 Osprey analyzed in the Scribd article "V-22 Osprey," with room for 50 instead of 24 passengers, the amphibious tiltrotor can carry a maximum of at least double the V-22's 15,000 to 20,000 lbs, or 30,000 lbs. Compared to the average helicopters' payload of 13,491 pounds, the amphibious tiltrotor is 222.36%, or over double, the payload of the average helicopter. To put this in perspective, the load of 75 flights of an average helicopter would take an amphibious tiltrotor only 29 flights. As for passengers, the amphibious tiltrotor's capacity of 50 is almost 244% that of the average of the above helicopters. Such a cut in the number of flights would allow supplies and personnel to be transported faster and in higher amounts, preventing starvation, dehydration, and other forms of malnourishment.



While some rotary craft have a considerably large payload, the tiltrotor could still have a superior payload because of its size.
Payload sources: SH-3 Kartsen Palt, "Sikorsky Aircraft S-61 (CH-3 / SH-3)", CH-46 Sea Knight "CH-46E Sea Knight Technical Specs", SH-60B Seahawk John Pike, "SH-60B", CH-47 Chinook "CH-47D/F Chinook-Specifications

What is the most significant aspect of the amphibious tiltrotor, however, is the amphibious tiltrotor's speed. Rotary-wing aircraft, such as helicopters, tilt their rotors somewhat to create forward motion: too much tilt with one rotor, however, causes an imbalance in the craft (only one side causes forward motion), and the results could be fatal for the pilot and the craft. Because of this, even the fastest helicopter listed, the Stallion, has a cruising speed of only 170 knots according to "CH-53E Sea Stallion, CH-53D Super Stallion, MH-53 Sea Dragon, MH-53J Pave Low III," while the amphibious tiltrotor can cruise at 400 knots. The cruising speeds of other helicopters are almost all around 140 knots, the average helicopter speed being about 141 knots (140.66…). 400 knots, the amphibious tiltrotor's cruising speed, is about 2.84 times the speed of the helicopters' average. Suppose supplies needed to be sent from a source to a location 100 nautical miles away. On average, the helicopters would take over 42 minutes 39.24 seconds to reach this destination, and the Stallion, the fastest listed, would take about 35 minutes 17.65 seconds to reach the said point. An amphibious tiltrotor could travel the same distance in 15 minutes. Such an increase in speed can make supply transport missions much faster, resulting in more trips over less time.



In terms of cruising speed, the tiltrotor is by far and away the best of the researched rotary wing aircraft.
Cruising speed sources: SH-3: Kartsen Palt, "Sikorsky Aircraft S-61 (CH-3 / SH-3);" SH-60B Seahawk: John Pike, "SH-60B;" HH-65A Dolphin: John Pike, "HH-65A Dolphin;" CH-47 Chinook: "CH-47D/F Chinook-Specifications;" CH-53 Stallion: "CH-53E Sea Stallion, CH-53D Super Stallion, MH-53 Sea Dragon, MH-53J Pave Low III"

Advantages over Fixed-Wing Planes:

While the amphibious tiltrotor is not faster than most fixed-wing planes, its maneuverability and ability to land in a single spot is highly favorable in a disaster environment. Most jets used today do not take off vertically, and to take off horizontally, a strip must be used. For instance, a C-130 Hercules has to travel 5,160 feet to take off (enough to clear 50 feet) ("Lockheed C-130B Hercules Aircraft - Information and pictures of the Lockheed C-130 Hercules") and over 2,500 feet to land (*C-130 Hercules*). A disaster area, with rubble and debris littering the ground, would not have sufficient space for a takeoff and landing. If a plane cannot land, then it cannot be sufficiently used to bring supplies. Why should a plane be used if it cannot be done so efficiently? With an amphibious tiltrotor, however, there is no space required to land except for the width and length of the rotorcraft. Also, save for larger aircraft such as the 747, the amphibious tiltrotor can travel faster than smaller civilian fixed-wing aircraft (the C-130 has a cruising speed of only 325-333 knots ("Lockheed C-130B Hercules Aircraft - Information and pictures of the Lockheed C-130 Hercules"). The amphibious tiltrotor is favorable to a fixed-wing aircraft because it can move a massive weight to more remote terrain.

1.3 How the Amphibious Tiltrotor Could Be Used

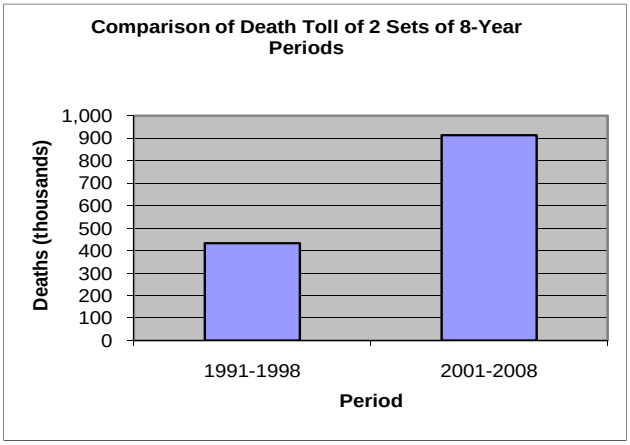
The Loading Station:

With the new craft can come several new innovations, made useful by the innovation of the amphibious tiltrotor. Because of the amphibious tiltrotor's wider design range, loading and takeoff stations could be based on land rather

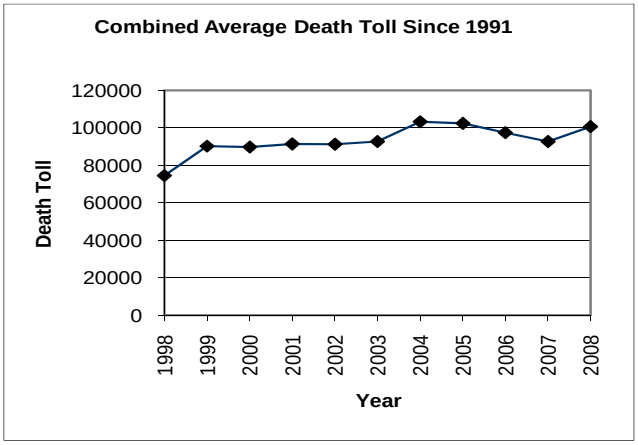
than from an aircraft carrier. The importance of this is the significant cut in the setup time. An average aircraft carrier, while sturdy and stable, cruises only at about 20-30 knots. Because most foreign countries, when struck by disasters, have to first communicate with the rest of the world before they can respond, the worldwide response is delayed. The reason for this is that all information first passes through local governments before being sent out to other countries through the government. If stations were set up on an internationally open area, i.e. a UN or other international union base, slightly under 400 nautical miles to disaster areas such as India, Pakistan, China, and Japan, and response was sent simultaneously to both the local government and these loading stations, the response both nationally and internationally (from international stations) could be immediate. Amphibious tiltrotors would be able to travel to the area to drop off supplies in under an hour, as opposed to days. If the loading takes a while, however, it can counterbalance the time saved by the loading station. The supplies, then, should be preloaded into plastic "pods" (or aluminum, as long as the substance is light and durable) that can be attached easily to the external surface of the amphibious tiltrotor. Then, once disaster strikes and the station is notified through emergency radio, the pods could then be clipped or fixed onto the amphibious tiltrotor to be lifted to the disaster area. With these changes in preparation and preloading, the response time would change from days to an hour or two. In times of disaster, the more time is saved, the more lives are saved. As apparent in the later mentioned disasters, an hour response time would have proved highly useful and would have saved several thousand lives.

Urgency of Innovative Rescue—Disasters in Modern Times:

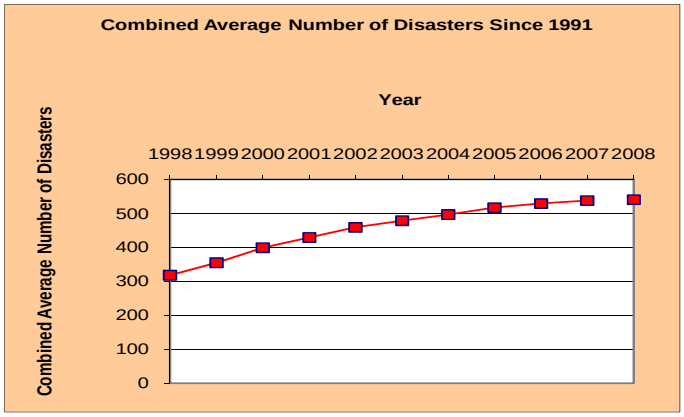
It is especially important that we find new innovations of rescue in the midst of our intensifying disaster rates. According to "World Disasters Report 2009", over 1.14 million (1,145,812) people were killed from worldwide disasters from 1999 to 2008, while "World Disasters Report 2001-Chapter 8 Summary" says that only 665,598 people died in the same amount of time from 1991 to 2000; the 1999-2008 number of deaths were over 72% greater. In fact, in the two reports, there were more deaths in the last six years (2003-2008) than the entire ten years of 1991 to 2000. The "World Disasters Report 2001-Chapter 8 Summary" recorded only 354 disasters occurring each year between 1991 and 1999; according to "World Disasters Report 2009," from 2000 to 2008, the number more than doubled to 727 disasters a year, based on the International Federation of the Red Cross and Red Crescent Societies. In the "World Disasters Report 2009," 80% of disasters that involve externally motivated supplies and evacuation (famine, heat waves, etc. use shelters instead of retreat sponsored from outside) happened within the last five years. If no innovations are created, the disasters and death toll will continue to rise. Already, in the past 10 years, the deadliest tsunami in history caused by the second deadliest earthquake within a century, the deadliest and second deadliest heat wave in history, the deadliest mudslide in history, the sixth worst earthquake in the past century, and the seventh worst bush fire in the past century. We cannot let this pattern continue.



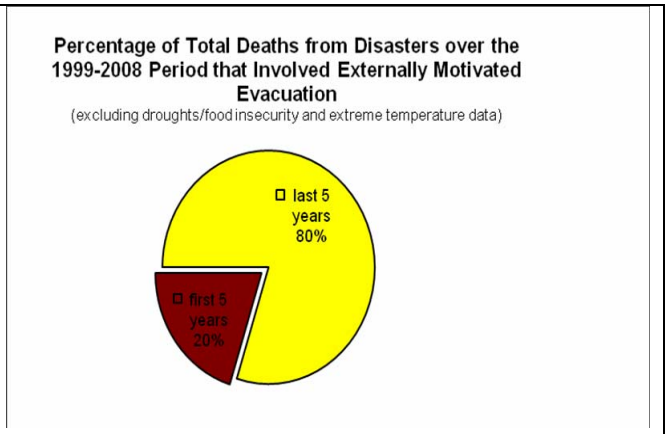
The death toll has more than doubled from 1991-1998 to 2001-2008.
Source: "World Disasters Report 2009," "World Disasters Report 2001- Chapter 8 Summary"



As we enter the 21st century, the overall average death toll continues to become greater.
Source: "World Disasters Report 2009," "World Disasters Report 2001- Chapter 8 Summary"



Overall, the average number of disasters continues to rise.
Source: "World Disasters Report 2009," "World Disasters Report 2001- Chapter 8 Summary"



The undisputed majority of deaths of this period occurred just in the last 5 years.
Source: "World Disasters Report 2009," "World Disasters Report 2001- Chapter 8 Summary"

1.4 The Amphibious Tiltrotor When Used for Recent Disasters

Earthquakes—Sichuan, Pakistan, Izmit, and Haiti Disasters:

When it comes to fatalities, earthquakes are the leading cause of deaths worldwide, next to cyclones and hurricanes. Surprisingly, very few of the people who perish from these disasters of nature died within the first few days. In the Sichuan Earthquake in China, only 13.33% of the total fatalities died within the first three days (Xu; Guobin), not even equal to 2 out of every 15 deaths. In the Pakistan earthquake, only 21.45% (1 in 5) died within the first day (Garwood; "2005 Kashmir Earthquake"). If the victims had been reached and saved in a shorter amount of time, the majority of lives lost could have been saved.

For example, if amphibious tiltrotors were used for relief efforts in the Sichuan earthquake (May 2008), the Sichuan area could have been reached in less than 3 hours, since a response was ordered for the Sichuan Earthquake only an hour and a half after the quake, according to Yang Guobin's article. The landslides that occurred would have no effect on the amphibious tiltrotors, and the victims in Tibet may not have had to be stuck for nine days before help arrived, as Yang Guobin also mentioned. *All Roads Lead to China*'s report "The Logistics Behind the Sichuan Earthquake Efforts" claimed that over 300 tons of supplies were sent per day for the Sichuan earthquake relief. If just 10 amphibious tiltrotors were used, and assuming the same passenger/cargo ratio as the V-22 Osprey, it would take only 2 missions to transport the entire load. The 100 thousand personnel total sent to Sichuan earthquake could be sent by twenty amphibious tiltrotors at four trips a day, in only 25 days, less than a month. If pods were constantly reloaded and set up for the amphibious tiltrotors, the almost 60,000 (59,951) lives lost after the first three days may have been saved, reducing the death toll from 69,170 to only 9,219; 59,951 people would still be with us, traumatized but still present in more than memory.

The Pakistan earthquake of October 8, 2005 was not considered deadly in magnitude; "New Schools for the Children of Pakistan Earthquake" states that it was only measured to be around a 7.6, under the severe level of 8 if only slightly. Paul Garwood's reported death toll of over 80 thousand, however, made this event one of the worst disasters in history. Over 3.5 million were left homeless, but only 40,000 were placed in tents ("2005 Kashmir Earthquake")—and there probably were not that many who were evacuated. Completion of the reconstruction of the earthquake is predicted to take eight years (Paul Garwood, "Pakistan Observes 1st Earthquake Anniversary); this seems too long a time to rebuild. Just five amphibious tiltrotors, in eight years, at four transports of cargo or passengers a day, working 300 days a year (counting break time), could transport 90,000 tons or 300,000 people: more than enough supplies to supply a disaster. If amphibious tiltrotors could have completed the supplies in twelve days, almost two weeks, and helped save those who were still at risk, over 40% of the total number of deaths (80,000) could have been prevented. When every living body counts, 34,000 saved lives is a very large number.

The same applies for the Izmit earthquake, which struck on August 17, 1999 (Borgna, "Earthquake in Turkey"). If enough supplies were sent on the first day so that deaths only continued to the second day, at least 10,000 lives, 71% of the deaths in the first week, could have been saved (Borgna, "Earthquake in Turkey"). Also consider the Gujarat earthquake. Only areas within a 100-kilometer (62-mile) radius of the epicenter were affected ("Gujarat Earthquake Update No. 12"); this allows the amphibious tiltrotor to save lives from a very small area, saving unnecessary fuel. 62 miles is only about 53.88 nautical miles, little over one-sixteenth (1/16) of the total predicted design range of the amphibious tiltrotor In fact, if a ground rescue team gathered local survivors for evacuation, the amphibious tiltrotor may never have to search, removing the amphibious tiltrotor's disadvantage of a lack of fuel efficiency (it can only run two hours before reloading). The 22,500 UN troops that came to the area to help ("Gujarat Earthquake Update No. 12") could be sent by ten amphibious tiltrotors in only 75 trips; this can easily be completed within a single month. Even in the smaller earthquakes, the amphibious tiltrotor could be of major use for sending supplies and personnel while being a vital craft for rescuing the homeless, injured, and sometimes starving refugees.

Just this year, on January 12, 2010, the country of Haiti was devastated by a 7.0 magnitude earthquake. The predicted death toll is reported to be over 200,000 (Murphy, "Haiti Death Toll"), making this earthquake, though only a 7.0 in magnitude, one of the deadliest earthquakes in the past century. Fox News has reported that planes sending supplies and transporting people were having trouble landing in the affected areas because of the rubble. With a tiltrotor, any small spot is suitable for landing; it can even land offshore, useful in a country with a relatively long shoreline. In a span of 24 hours, from January 30 to 31, 700 people were transported to Florida by military planes. Assuming shoreline landing stations were established and enough people were available, four tiltrotors could transport 1,600 people in the same period of time. 800 more people could have been saved in that 24 hours (Fox News.com). Spread that 800 over every day since the 12 of January, over 10,000 people could have been saved; more than the entire confirmed death toll at the end of January.

Hurricanes and Cyclones—Nargis and Katrina:

Other deadly disasters to consider are the hurricanes and cyclones that ravage our world. Every decade, possibly a hundred thousand die from the deadly powers of the cyclone. Wind may be damaging, but many deaths are from the unfortunate who were flooded by the uprising of the tide—the flash flood. From this, however, we arrive to the strong point, the lifesaving advantage of the amphibious tiltrotor craft; the amphibious tiltrotor can land on the water, serving as both a craft of air and water. While a helicopter has to use a rope, which cannot hold much and can only be so strong, amphibious tiltrotors can land directly on the water, allowing immediate transport from the water into the craft. Pods in a water-buoyant shape could even be used as rescue boats, saving survivors trapped in the floods. This increase in efficiency can make missions quicker and therefore allow more lives to be saved even in the areas previously thought by most to be unreachable by aircraft.

For example, there is the more recent tragedy of Cyclone Nargis, which struck on April 27, 2008. 77,738 fatalities were confirmed, with 55,917 missing (Center of Excellence, "Cyclone Nargis Update"), making this a considerably large disaster. In total, over 2.3 million people were affected—however, of this number, only 1.3 million were reached, only a little over 56.5% of the total affected (Center of Excellence, "Cyclone Nargis Update"). A more efficient amphibious tiltrotor may have been able to reach these people. Some demands, also, need to be met. Among the 750,000 refugees, about 380 MT (metric tons) a day was demanded by the WFP (Center of Excellence, "Cyclone Nargis Update"); this would only take 28 trips with a amphibious tiltrotor, easily spread among about seven or eight craft. Over the next month and a half of the disaster (April 27 to June 12), the US, NGO, and UN sent 151 airlifts. This number alone with an amphibious tiltrotor could transport 2054 metric tons a day. 151 airlifts, however, is fairly slow in comparison to what a working, active loading station of amphibious tiltrotors could be capable of doing; one amphibious tiltrotor alone could easily carry 120-160 airlifts in 40 days. Even after help was sent, 52,000 victims may have had to face starvation by the November growing season (rice paddies) (Center of Excellence, "Cyclone Nargis Update"). Rice paddies are vital to rural Southeast Asia, and flooding can turn what is normally marshland to lifeless water. FAO planned to bring 6000 water buffalo and 120000 farm animals to the area, a hard task, especially considering its combination with food needs (Center of Excellence, "Cyclone Nargis Update"). Supplies for the loading stations would not be too hard to obtain, either. 2000 tons of supplies were put in MAPT hubs, little of which is actually used (Center of Excellence, "Cyclone Nargis Update"). With increased efficiency of the amphibious tiltrotor, problems—and therefore fatalities—may never have occurred from the cyclone.

Hurricane Katrina, a local disaster, may have easily been saved by amphibious tiltrotors. First of all, out of the 1836 total death toll, 1577 were concentrated just in the state of Louisiana ("11 Facts about Hurricane Katrina"). This is

almost 86% of the total death toll in a state 380 miles long at the longest and 130 miles wide at the widest, with an entire 1,100 confirmed dead in New Orleans alone ("11 Facts about Hurricane Katrina"). Out of the rest of the death toll, 238 deaths were in the neighboring state of Mississippi; only 21 deaths resulted elsewhere ("11 Facts about Hurricane Katrina"). As for lack of supplies, Katrina was known for its slow response. 69,706 trailers were requested from FEMA for the New Orleans metro area: only 31,517 trailers were actually sent to the area, 45.21% of the total requested (Espinoza, Cholene, "Hurricane Katrina Facts and Hurricane Katrina Information"). With an amphibious tiltrotor, a higher number could easily have been transported. 90,000 square miles were affected, equal to 78,209 square nautical miles ("11 Facts about Hurricane Katrina"). An amphibious tiltrotor, even if it came back to refuel, could scour the entire area in 39 days, little over a month. FEMA has not completed their supplies even today, four years after the hurricane. Help arrived a whole four days after the hurricane; an amphibious tiltrotor could reach the area in an hour. Especially important about Hurricane Katrina was that it flooded much of New Orleans. 80% of the city was underwater after the hurricane, up to twenty feet deep in some areas ("11 Facts about Hurricane Katrina"). People were even trapped in the flood, unable to get out. For an amphibious tiltrotor craft that can land on water, floods would be little of a problem (Ifill, Gwen, "Identifying Katrina's Victims"). Hurricane Katrina itself caused $75 billion in damage; the total economic impact, however, was calculated and predicted to be over $150 billion, double the original economic damage (Espinoza, Cholene, "Hurricane Katrina Facts and Hurricane Katrina Information"). With the added efficiency of an amphibious tiltrotor craft, such drastic economic measures and cost may not happen in the future.

Water-Related Disasters: 2004 Indian Ocean Tsunami, Vargas, and Southern Leyte Mudslides:

There are some major disasters completely caused by flooding or other vast movements of water. Most of the time they do not cause as high of a death toll as earthquakes. One example, though, of how a wave can damage the world, how one disaster could change a million lives, is still today in our memory: the 2004 Indian Ocean tsunami. Over 283,000 people, almost 300,000, died from the disaster, and over 1.5 million were left homeless ("11 Facts about the Indian Ocean Tsunami"). Caused by a 9.3 earthquake, 150,000 immediately died or went missing (National Geographic, "The Deadliest Tsunami in History?"). As time passed, however, that number doubled, and over 150,000 more people perished from disease and other causes that could easily have been prevented by rescue and supplies. It took the *Abraham Lincoln* Strike Group five days to finally arrive on the scene for relief efforts, as opposed to the loading station and amphibious tiltrotor's hour-long response ("U.S. Navy Relief Efforts after the Indian Ocean Tsunami"). The 19 Seahawks also sent only carried 3,043 passengers and 5.92 million pounds of cargo in 1,747 missions over 1000 hours ("U.S. Navy Relief Efforts after the Indian Ocean Tsunami"). Of these 1,747 missions, each assumed completed by a single helicopter, about 500 were carrying people and 1200 carried supplies. Because amphibious tiltrotors can travel over twice as fast and carry well over ten or twenty times as much, however, 18 million pounds of supplies and 15,000 people could have been transported, saving about 4.9 times (492.93%) more people within just that time period. Always remember, too, that an amphibious tiltrotors could be set up and transported directly to the site within the first day, for warnings had already been sent out; an extra 75,000 people could have been saved. Three days after the *Abraham Lincoln* was sent, aircraft carriers with 24 more Seahawks were sent ("U.S. Navy Relief Efforts after the Indian Ocean Tsunami"); would greater numbers be necessary, however, if the craft itself was improved to be faster, stronger, and overall more efficient?

Out on the coast of Venezuela, ten years ago, the worst mudslides in history slid down to attack Los Corales and other helpless cities. Several people were already evacuated (190,000), but it was too late for the residents who remained ("Venezuela mudslides of 1999"). 60 miles of Venezuelan coastline was completely covered and wiped out, killing an estimated ten to thirty thousand people ("Venezuela mudslides of 1999"). A helicopter would be useless in the wet mud, but would the amphibious tiltrotor? With a direct access onto the mud, troops may be able to lend their hand to the survivors, reaching their own hands from under the mud, a final wave to call anyone who could help.

Trouble also flowed out in the region of Southern Leyte, in the Philippine Islands. Of the original count of 973 missing and 139 presumed dead, a total of 1,112 people, only 40 bodies were found ("Philippines: Leyte Landslide Update"). In another poll, 200 were presumed dead and over 1,500 missing ("2006 Southern Leyte Mudslide"). Why was there such uncertainty, such lack of ability to rescue the victims and refugees? As a report stated, rescue efforts were "hampered by rain, chest-deep mud … washed out bridges, and lack of heavy equipment." Rain would do little to an amphibious tiltrotor, and chest-deep mud is not hard to navigate when portable boats and floatable aircraft are nearby. Two aircraft carriers, the *USS Essex* and the *USS Harpers Ferry*, were used, each filled with aircraft ("2006 Southern Leyte Mudslide"). Aircraft carriers carry tons of heavy equipment, yet there was a lack of heavy equipment at the site. This may have been because of trouble in transporting the heavy equipment to the sites of

disaster. It is also just as likely that a craft like a amphibious tiltrotor, with about a 15-ton cargo capacity and a 400-knot cruising speed, would have much less trouble reaching the same disaster site with enough heavy equipment to do their job without affected by weather and unsuitable conditions of rescue, for there are people there dealing with unsuitable conditions of survival.

Water Siphoning and Its Effect on and Importance in the Black Saturday Bushfires:

There is also another major advantage of the amphibious tiltrotor: its ability to draw and drain water. Only certain helicopters (and only heavy, slower fixed-wing airplanes; the Mars Bomber's maximum speed is 221 mph, or 192 knots ("Martin Mars Water Bombers") can siphon water into the craft, and none of them are also commonly used for rescue. A amphibious tiltrotor also can store literally tons of water, if a suitable pod was designed, more than enough water to stifle any beginnings of a fire while rescuing those trapped by the fires. There is also enough speed in the amphibious tiltrotor to unload each round of water in a very short period of time; at 400 knots, the amphibious tiltrotor can unload its entire cargo and return in under an hour. Helicopters designed for firefighting and other uses of sprayed water may not also be military-grade in speed and efficiency as well as cargo load. The common water-siphoning helicopter, the Erickson S-64 Air-Crane (or Sky Crane), travels at about 115 knots and can only go for about 217 nautical miles before reloading (*Erickson Aircraft: Precision in Rotorcraft*). The amphibious tiltrotor has a cruising speed of 400 knots, is almost 3.48 as fast, and the 800 nautical mile range is 3.68 times as long. While the Air-Crane travels 200 nautical miles in over 104 minutes, nearly running out of gas (only 7.94% is left), the amphibious tiltrotor can breeze through in 30 minutes with ¾ (75%) of a tank left. Though the Air Crane has a slightly larger payload (42,000 pounds) (*Erickson Aircraft: Precision in Rotorcraft*), there is little comparison with the amphibious tiltrotors, which has the advantage of speed and distance for firefighting, allowing it to more quickly quench the flames.

As global warming and drought continue, fires have continued to worsen over the years. Last year, in Australia, the worst fire in history ignited on February 7, later referred to as the Black Saturday bushfires. The fire soon spread, killing 108 people by the next day (Callinan). Over 100 more people, however, were to lose their lives from the fire. Over 1800 homes were destroyed, causing about $2 billion Australian dollars' ($1.4 billion US) worth of damage and killing over 210 people (Callinan). There were only 33 flames recorded, but it took over 4,000 firefighters to quench the flames (Callinan). If only a few hundred had manned tiltrotors, the hundred people that were not reached in time could have been saved, cutting down the overall death rate by 47%. Almost half the Australians who perished from the fire or from lack of help could have been saved.

The Black Saturday fires may not be the end. Global warming may cause an increase in droughts by up to 20%, says the IPCC ("Rainfall Distribution"). Because of this, bushfires will happen more often while spreading out over greater distances, resulting in deadlier fires. It may be too late to stop global warming, but we can try to save ourselves by preparing for the worst. By sending amphibious tiltrotors to areas more susceptible to bush fires, we may at least be able to prevent upcoming fires from becoming deadly. If enough amphibious tiltrotors were used, fires can more easily be regressed, and what may in the future kill 200 people could be tamed so only 50 casualties may be lost, and if a fire like this happens every five years, 300 people could be saved per decade, amounting to 900 people in the next 30 years.

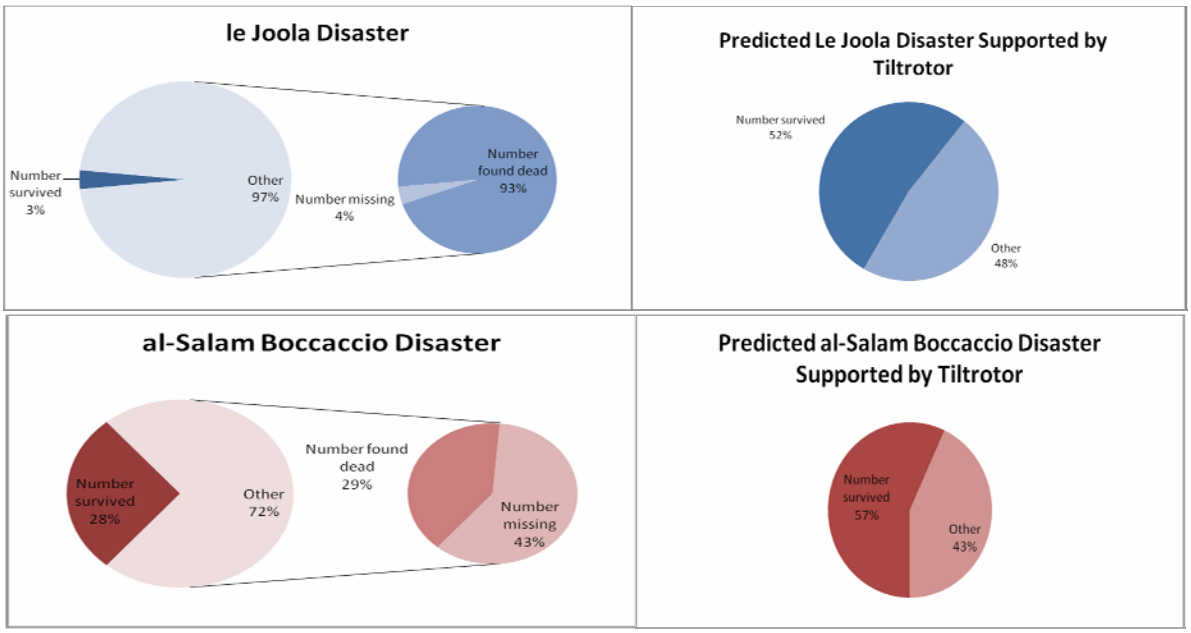
The Amphibious Tiltrotor When Dealing with Shipwrecks—le Joola and the al-Salam Boccaccio:

Not all disasters have to be natural. Not all disasters even have to occur in a country, or a city, or even on land. Two shipwrecks, both occurring in the past ten years, have each individually killed over a thousand lives. For disasters like these, far away from typical disaster regions, amphibious tiltrotors could also use ships for fuel and emergency supplies. If a disaster strikes far away from the loading station, or a danger zone for disaster is far away from land, amphibious tiltrotors could transport a boat's emergency supply to a disaster site within range. Fuel could also be loaded into the boats to help the amphibious tiltrotor in case the disaster site or the ship is far away. Spare amphibious tiltrotors could even be placed on these boats like normal aircraft in case the carrier/cargo boat is entirely unreachable by amphibious tiltrotors at loading stations. Though the process may not be as fast as a near-site loading station, it would still be much faster than if a helicopter were to undergo the same mission or a ship (which travel, on average, over ten times as slow) were to by itself rescue all of the victims of the said disaster.

The first of the shipwrecks was the Le Joola disaster of 2002, the worst recorded shipwreck. At least 2000 people were on a ship off the coast of Gambia; only 62 survivors were found in the water (Sheriff Bojang Jnr). A prime example of bad timing, it was not until several hours had passed until official rescue teams finally arrived. Local

fishermen even led their own rescue missions to help the victims in the prolonged absence of help. Assuming thirty minutes were taken every two hours for refueling, an amphibious tiltrotor could travel 1,840 miles in five hours, enough distance to cover about half the entire American continent or a full mission to the Gambia from the eastern Mediterranean. A trip from a carrier in the Cape Verde is within the allowed 400 nautical mile range of the ship, therefore, when a carrier is notified there, the amphibious tiltrotor could reach the area in little over an hour (including preparations). In case the distance stretches the limits of the amphibious tiltrotor, the carrier could continue cruising while the amphibious tiltrotor is rescuing, shortening the return distance by at least 50 nautical miles (assuming 1 hour 45 minutes cruising at 39 knots) and allowing the amphibious tiltrotor to not entirely run out of fuel. Even with an extra hour for the news to reach the Cape Verde, the arrival time of two hours, with up to 200 people saved immediately (assuming 4 spare amphibious tiltrotors arrived there), and another 200 within the next two hours and the two hours afterward (1 hour 10 minutes to return and refuel, 50 to arrive), 600 people would already have been saved by the time the original rescue teams arrived.

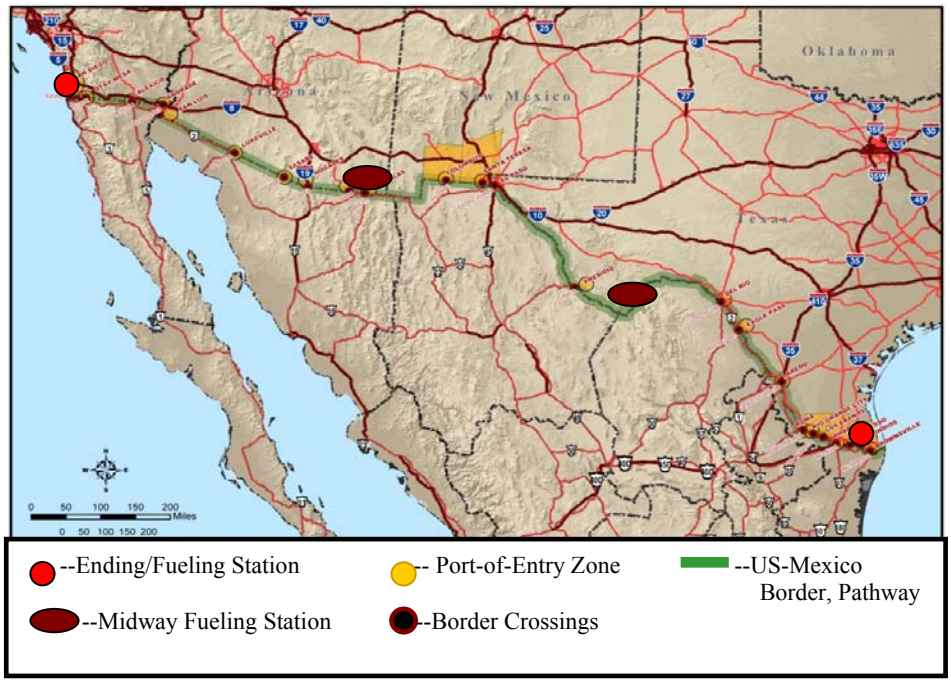
A more recent shipwreck was one on February 3, 2006 in the Red Sea, 50 miles off the coast of Egypt, by a ship known as the Al Salam Boccaccio ("Egyptian Ferry Sinks in Red Sea"). Out of 1406 people, only 100 to 120 people were found alive and only 14 dead bodies were originally found, leaving 1292 people out in the sea ("Egyptian Ferry Sinks in Red Sea;" Salah-Ahmed). The ships and aircraft did not arrive until well after 8 am, an hour after ships left the shore. It was only after days did rescuers save 268-308 more people (total of 388-400 saved) and 395 bodies (total of 409 bodies) (Salah-Ahmed; Kelly). An amphibious tiltrotor could reach the place in less than seven minutes. With the amphibious tiltrotor's ability to land on water, the amphibious tiltrotor could transform into a sort of air-traveling rescue boat, able to collect rescue victims directly onto the craft. With fifteen prepared amphibious tiltrotors on a carrier 400 nautical miles away in the Mediterranean, there may have immediately been about a 60% recovery, for the lives saved could be saved in an hour, half the time carriers took to travel to the shipwreck site. If there were only eight amphibious tiltrotors on a carrier within 100 nautical miles of the shipwreck site, there would still be about three hours after the shipwreck until the rescue was completed (the carriers must be able to respond and travel within the amphibious tiltrotor's range of the shipwreck site), but as the amphibious tiltrotor can land on water, the amphibious tiltrotors could act as rescue boats, directly helping those who needed assistance; possibly half the total missing and dead would occur (as help arrived in half the time), resulting in ~900 lives saved or around 512 more people compared to the actual number of lives saved. There would certainly be more than 388 people, 27.6% of the total shipwrecked, recovered from this disaster.



Even if a fraction of the lost were saved by arriving more quickly, there would be a significant improvement in both disasters. Cutting the death toll of the Le Joola disaster only in half would have increased the number who survived from 3% to 52%, keeping almost 1000 people alive. If the people who were found dead at the Al-Salam Boccaccio disaster were found alive, the percent who survived would more than double.
Sources: Sheriff Bojang Jnr.; "Egyptian Ferry Sinks in Red Sea"

1.5 Civilian Uses of Amphibious Tiltrotors

Amphibious Tiltrotors as Border Patrol Craft:



This map represents possible arrangements of fueling stations for an amphibious tiltrotor border patrol.
Original map from "Under the Feet of Jesus"

Our borders are not protected nearly as well as they should. Millions of people are coming into this country unchecked and unknown, mostly from our southern border. Anyone could pass: drug smugglers, human traffickers, and even terrorists can cross a virtually open border. What if a fast patrol of aircraft checked the borders, reloading at each end? Amphibious tiltrotors are fast, and can cover almost half the US-Mexico border in two hours. Traveling the entire border (1952-2000 miles long, or 1696 -1738 nautical miles ("US-Mexico Border Fence / Great Wall of Mexico") at 400 knots could cover the US-Mexico in under four-and-a-half hours (254 minutes 24 seconds). If a fuel station was placed on each end, with two in the middle (shown above), and if loading stations patrolled their local area, then the amphibious tiltrotor will have enough fuel to search the border without problems. With the required stops (half-an-hour at each fueling station), the search time would still be 314 minutes, under 5.5 hours; the amphibious tiltrotor could easily search the entire border four times in one day. Fuel stations could patrol their local area. As shown in the above chart, several larger border-crossing regions could be patrolled by these amphibious tiltrotor stations. Not only will this help the security of our borders, this will indirectly be a major help in preventing drug trafficking, which enters the US through this very border. A metal-detector or forward-looking infrared (FLIR) device could be used to spot any trucks or people crossing the border. Since the amphibious tiltrotor can carry fifty people of 15 tons, any captured individuals and illegal immigrant trucks could be transported to a fueling station, where they could be officially deported. Because there are large numbers of people crammed into trucks, well over 50, they must be attached to an external clip on the aircraft; some of those still inside could be sent into the amphibious tiltrotor to allow more space. This new method, with different shifts of border patrollers, allows a better view of the entire border than patrolling in cars while being less tedious and inefficient as constructing a 2,000-mile long fence.

Mainstream Uses of Amphibious Tiltrotors:

Amphibious tiltrotors could even replace planes in places without a proper landing strip. In some areas, natural beauty is preserved at all costs. There is a limit to the size and color of our houses, and billboards are not even allowed. In other areas, a full landing strip may not be affordable since the area may be rural or part of a developing country. Because of the limit to manmade structures, the takeoff/landing strips are fairly short. An aircraft that could take off vertically, carry a considerable number of passengers, and travel at a speed that rivals most airline travel (even commercial aircraft only cruise at about 469 knots) would be useful as a replacement to the commercial jet. As smaller airports do not usually offer flights to distant places, only to larger airports within a couple hundred miles, the destinations are likely within range of the amphibious tiltrotor.

In medical rescues, however, there is never a landing strip, and the nearest adequate hospital may be well over a hundred miles away. These emergencies usually result in the airlifting by helicopter to the hospital. Even a helicopter, though, will take an hour or two to reach a hospital two hundred miles away, and in this time, a person's illness, injury, or other life-threatening malady may become fatal and incurable or unable to regress. Because a amphibious tiltrotor can travel 230 miles in about half an hour (30 minutes), or 115 miles in fifteen minutes, even places far away can be reached in as much time as a car traveling down an interstate to a hospital only about thirty or fifteen miles away, respectively. An amphibious tiltrotor is also a large craft, able to carry up to fifty people; stops could be made for several different people in need. Fueling stations could be placed in a small sector or in some way separate from the rest of the hospital (they probably should be hidden to protect the hospital's safety and environment) so the amphibious tiltrotor can travel near its maximum of 800 nautical miles (over 920 miles) and have time for all the stops. Because of this significant cut in time, rural areas can have better transportation, traveling people, including those in desperate need of medical assistance, faster.

1.6 Recommendations and Conclusions

Recommendations:

We as a country and we as the world should invest in the amphibious tiltrotor as well as loading stations for the sake of the developing countries devastated by constant disasters. In cases like the Indian Ocean tsunami, Cyclone Nargis, and the recent Haiti earthquake, thousands upon thousands have died, not because of disaster but because of the famine and disease that sweeps the victims like a slow and painful aftershock of an earthquake. Other countries around the world try to help, but rescue is only so fast and so effective. Why we need the amphibious tiltrotor and all its new innovations is to raise the limit on "fast" and "effective." Rescue itself is a matter of time, using time to stop time itself, the time where death spreads like a virus among the helpless, homeless, and starving. Nobody can stop a tsunami, push back a hurricane, or stifle an earthquake. What matters is the response, the ability to end a disaster as quickly and powerfully as it came. It would be beneficial to this response, to make it faster and more effective, to utilize the amphibious tiltrotor for its speed and capacity, saving time and lives at the same time. In this way, the plague of disaster could be regressed in days, disappearing seemingly in the blink of an eye.

Conclusion:

With the speed of tomorrow, the amphibious tiltrotor will rise into to the dawn of disaster, bringing the world one step forward in the name of search and rescue, of hope when the worst has happened. Larger, faster, and more powerful than the ordinary helicopter, this civil aircraft will become the racing giant of emergency relief efforts. Hundreds, sometimes thousands of lives could be saved with the utilization of amphibious tiltrotors and loading stations as disaster response becomes immediate and effective. As the amphibious tiltrotor will be an international aircraft, a world of possibilities could be opened by its invention. Water could be spread among nations facing severe drought to normalize the ecosystem and prevent fires if they occur. In places hit by a disaster when everyone least expects it, amphibious tiltrotors are more than capable of loading and takeoff from carriers and still provide an advantage over most helicopters and ships alone. The vertical takeoff ability allows the amphibious tiltrotor to take the place of planes in the absence of a landing strip, a source of commercial aircraft in rural areas. Because of the craft's speed, it can transport civilians in desperate need of medical help to hospitals over a hundred miles away. Perhaps the most important innovation—the greatest achievement of the amphibious tiltrotor—is that it will, like those flying shadows in the dawn, arrive not in the dark, but in the sunrise of hope and, in a distant but possible future, prosperity and happiness.

As the engines died in the light of sunset, the shadows that rode into the sunrise rested after a day of work. Over 2,400 lives had been saved that day, a remarkable achievement never accomplished by a rescue team before. It was here, today, that these shadows, the amphibious tiltrotors, came and underwent their first rescue mission. Their mission did not end today; when the sun rose the next day, they would rise to the sunrise again, saving those who thought they may never see the sun rise. The sun, for them, has risen. Dawn had arisen in the disaster sites, almost in perfect unison with the powerful aircraft roaring in the distance. When this day comes, in a day, in a month, in a year or in a decade, the sun will rise over the stricken, the flooded, and the victimized, casting a sort of brightness on them, a reassurance that the sun has risen on them once again. When this day comes, the sun will never have been brighter.

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