CLIMATE-RELATED HUMANITARIAN RELIEF: A MISSION FOR CARGO AIRSHIPS

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Every year the world witnesses climate-related and geophysical disasters that claim many lives and cause immense human suffering. A consistent feature of such catastrophic disasters is the serious difficulty and delay in delivering relief equipment and supplies in a timely fashion. Often roads and railway lines are knocked out of commission, and harbours can also be shutdown for indefinite periods. This may leave only air services which depend on the state of the airport.

Natural disasters create the demand for large quantities of necessities to be transported into damaged and unprepared sites at short notice. Time is essential, but the volume to be transported is also important.

Critical medical supplies can be delivered by helicopters, and maybe in small airplanes, but these transport are too expensive to deliver the volume of food and potable water necessary to sustain thousands of people. Cargo airplanes are frequently employed to bring in foreign assistance, but the delivery to a large airport still leaves the "last mile" problem. The potential for cargo airships to overcome this logistical barrier better than any other known aircraft provides the impetus for this paper.

This paper examines the logistics of cargo airships in the performance of humanitarian relief operations. The next section considers the scale of the overall problem. Some data are provided on a number of disasters and their impacts in terms of the number of people affected are examined. The discussion concludes with some observations on the development of the cargo airship technology for humanitarian relief missions and offers suggestions for raising the investment capital needed.

Climate-related Disasters

According to Oxfam the vast majority of people affected by natural disasters suffer from climate-related disasters. Between 1980 and 2007, 98% of people affected by natural disasters suffered from climate-related ones, as opposed to, geophysical. Oxfam forecasts that by 2015 an average over 375 million people per year are likely to be affected by climate-related disasters. This is over 50% more than have been affected in an average year during the last decade (Ganeshan and Diamond, 2009).

The Centre for Research on the Epidemiology of Disasters (CRED) maintains a publicly accessible database on emergency events. The Emergency Events Database (EM-DAT) is a comprehensive database carrying data for various types of natural disasters by both country and date (year & month) going back to 1900. However, it is generally accepted that EM-DAT data are more reliable from the beginnings of the 1980s onwards.

CRED tables offer detailed statistics that include the number of natural events per year by main type for the period 1980 to 2007. Over the decade 1998 to 2007 a total of 448 natural hazards, categorised into five main groups (biological, climatological, geophysical, hydrological and meteorological), affected a nearly 248 million people. 98% of these people were affected by 342 climate related hazards.

Many people are unwilling to connect the scale of climate-related disasters to rising levels of Greenhouse Gases (GHGs) in the atmosphere. They may be right, but even if the impact of climate change is relatively mild, the magnitude and frequency of these crises demands more attention to the logistics of dealing with emergencies.

Humanitarian Relief Supply Chains

Climate-related disasters disrupt established supply chains and thereby create the demand for transportation of large quantities of goods into unprepared sites, at short notice. Humanitarian logistics involves quickly accommodating victims' needs by providing and positioning assistance, services and materials. These supplies must be transported together with appropriate support equipment and personnel.

Like any supply chain, climate disaster relief logistics involves delivering the right supplies to the right people, at the right place, at the right time, and in the right quantities. Unlike commercial logistics however, none of the coordination has been established between transport and storage services providers. Response delays can be ameliorated by maintaining full logistics readiness during non-disaster periods. Although readiness is an essential requirement of relief activities, no two events are ever likely to be the same, while the costs of standby preparedness further limits response capabilities.

Considerable academic effort is being applied to the study of disaster relief issues and associated logistics and supply chain management. For example, Zobel (2011) views that in the commercial world a supply chain is the series of processes for getting goods to customers, from order placement to delivery. In disaster relief efforts, Zobel observes that supply chain management requires procurement of goods, followed by transportation to those who need them.

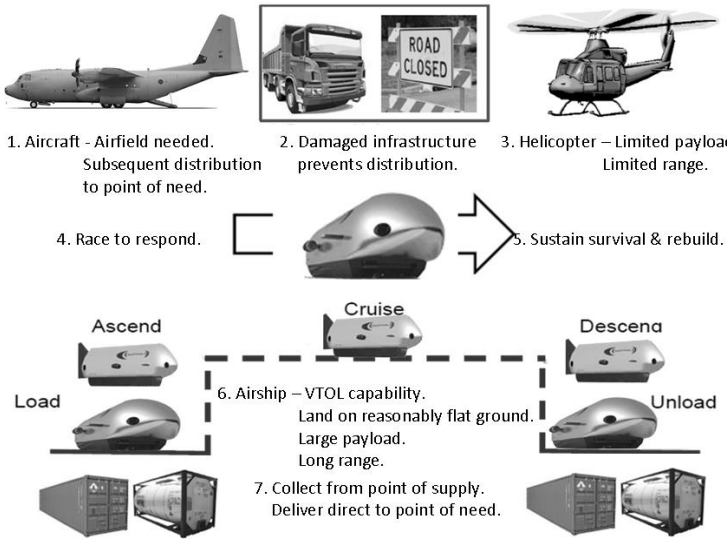
He also emphasises that humanitarian supply chain management is fraught with uncertainty and time and resource constraints: "We often don't know when a disaster will occur, the extent of the damage, what resources — roads, hospitals, equipment, and personnel — are

immediately available following the event, or how long it will take for resources to arrive" (Zobel. 2011).

Disaster relief supply chains operate within perhaps the most challenging logistics environment. They must be able to respond rapidly, serve multiple destinations simultaneously, coordinate global and local supplies, and more often than not, deal with inefficient means of communication and transportation, or in worst case, an almost total lack of civil means of communication and transportation (Kovács, 2009).

The airship is offered as a means to overcome damaged infrastructure problems. As illustrated in Figure 1, an airship can accommodate the "last mile", while other modes are limited by infrastructure gaps or payload capacity.

Figure 1 - The Challenge of the "Last Mile"

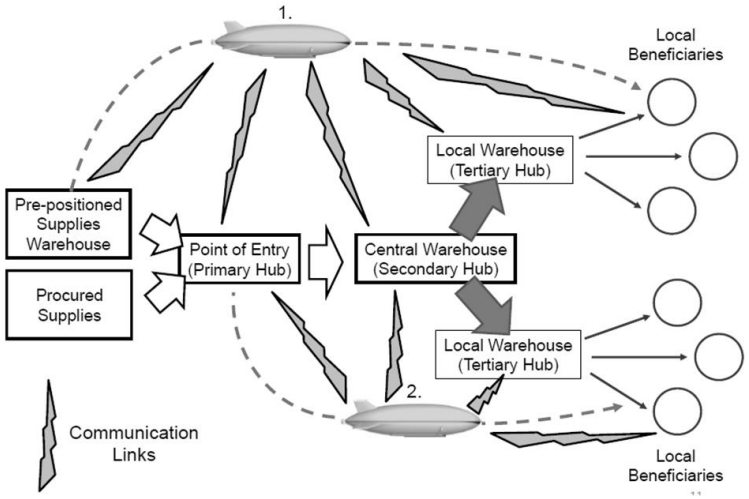


In cases of natural disasters, the most challenging logistics is the final leg of the delivery in which surface transport infrastructure is

disrupted. An airship would be able to fill this role better than any other known device. An airship's ability to vertically take off and land would allow it to reach remote areas not accessible by conventional aircraft. An airship, far cheaper to operate than a conventional aircraft, can transport aid directly from the point of supply to the point of need, with minimal support infrastructure.

The strength of cargo airships is to provide sustained logistics response to aid survival and reconstruction. Figure 2 illustrates two airship supply chains for distributing humanitarian relief supplies.

Figure 2 – Humanitarian Relief Supply Chains



In the first supply chain (1), cargo airships deliver supplies directly from a prepositioned warehouse to local beneficiaries. This is the race to respond mission. While an airship has long endurance and could reach distant markets, a reasonable cruise speed, based on the experience of the giant Zeppelins is about 80 miles per hour.

In the second supply chain (2) prepositioned supplies, together with additional procured supplies, are transported to and unloaded at a

primary hub. Subsequently, an airship moves supplies from the primary point of entry to a central warehouse (secondary hub), for distribution to warehouses in the locality of a disaster area, or directly to local beneficiaries.

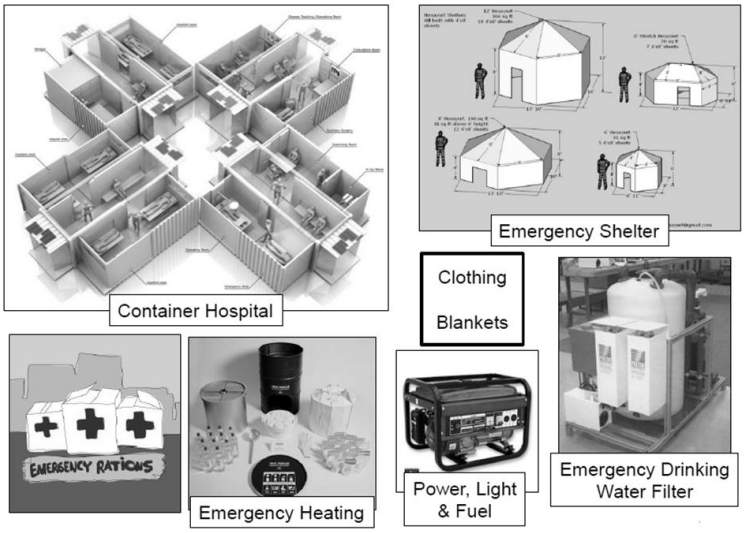
Implicit in this illustration of the supply chain is the transhipment from other transport modes (e.g. shipping, airlift and road) that could feed the hubs. Communication links between the airship and supply chain management hubs are also illustrated. Often in climate-related disasters, communications systems are also interrupted (e.g. downed cell phone towers). Airships are capable of carrying large antennae.

The need for transport can be accompanied with the need for storage. In some cases, like medicines, the problem is deterioration if exposed to rain, but it can also be security because the population is desperate and opportunists abound.

An airship could deliver supplies, stored in ISO containers, direct to a point of need. Shipping in containers permits rapid unloading. Although the deadweight of the containers would reduce the payload, once emptied, the containers could be used to provide accommodation, office or medical facilities. Figure 3 gives an idea of supplies and equipment needed in a disaster situation.

The goods illustrated in Figure 3 would be the materials that could be prepositioned at emergency locations and stored ready for rapid deployment. Once these critical materials are delivered, the airships could ferry food and water from the delivery hubs.

Figure 3 – Deliver Supplies Direct to the Point of Need



The idea of using an airship to deliver relief has an historical precedent. In November 1917 a military conflict demonstrated the first effective use of an airship for emergency re-supply purposes. A German military airship made a journey of nearly 4,200 miles (6,800 km) from Bulgaria to East Africa and back in an attempt to fly food, medicine and equipment to relieve a German army garrison. While the Zeppelin flight was recalled before the equipment was delivered, this flight demonstrated the capability of delivering relief (Meighsorner-Schardt, 1992).

The Zeppelin flight happened over 90 years ago with the technology available then. Think of what could be achieved now. No heavy lift airships currently exist, but the technology, knowledge and ability to build such craft are readily available. The economic drive to create cargo airships is emerging.

The Case for Cargo Airships

Both airplane and airship technology received a boost during the First World War. The German military built over 100 Zeppelins for reconnaissance and to bomb England. International interest in airships remained strong in the inter-war period and it was uncertain whether fixed-wing aircraft or airships would become the dominant form of trans-oceanic transport. The tables were tipped against airships in the Second World War by the massive investment in fighter airplanes, bombers and fixed-wing transports. During the six year period of conflict, the five largest combatants built over 750,000 airplanes and the technology advanced to high altitude bombers and jet engines[i]. Moreover, huge investments were made in airports, hangars and ground support (Prentice, Ashcroft and Hochstetler, 2009) .

During the Second World War, the US Navy blimp program did advance lighter-than-air technology but airships were confronted with competition from war-surplus aircraft using demobilized air crews. Customers demanded speed over economy of transport, fuel was inexpensive and no one cared about GHG emissions. Moreover airships had unresolved weather and ground handling issues. The airship industry was small, fragmented and with insufficient impetus to generate the necessary research and development funding to compete with fixed-wing aircraft. The introduction of passenger jet airplanes in the 1950s sealed the fate of the passenger airships.

Over the past 50 years, many transport airship market studies have been conducted by reputable authorities (Goodyear, Boeing, Booz-Allen, MIT, etc.). They all found substantial markets for large transport airships. A variety of reasons explain why these investigations were not followed by funded development of transport airships, but most issues fall into just a few categories. First, the existing transport options were providing adequate service at affordable costs. Airships could provide enhanced services, but the advantages were not sufficiently greater than what was in use at the time. The other challenges were that fuel costs were much lower than now, environmental impacts were generally ignored, congestion was

not a concern and most transportation infrastructures (roads, rail, ports, and airports) were already in place.

Massive military funding for conventional aircraft accelerated their development to a very high level of technical maturity. It is precisely because of this funding disparity that airships now offer so much growth potential for "unexploited" technical capability.

A new generation of cargo airships could benefit from growing customer demand for new freight capacity and capabilities. The cost of conventional transportation is increasing because of fuel costs and anticipated future carbon taxes. Robust, lightweight materials, like carbon-fibre composites, vectoring engines, and computerized control make possible airships that are reliable and can operate without large ground crews. Advances in airship technology have also improved operational safety and buoyancy control sufficient to eliminate issues that have plagued airships of the past.

Cargo airships for humanitarian logistics need to be rugged and flexible. Vehicles must be able to operate at the extremes of temperature, and transfer cargo with little or no ground support. These are the same conditions that prevail in the northern sub-Arctic and Arctic zones of the planet.

Climate-change and a race for minerals and petroleum are driving the need for heavy lift airships in Alaska, Canada and Russia. All three jurisdictions seek to develop the natural resources of their northern territories, but transportation infrastructure is either unavailable or unattainable because of environmental and/or economic reasons.

Climate-change is opening up more of the Arctic Ocean to summer navigation, however warmer winters are having the opposite effect on land transport. Ice road access is available from six weeks to three months depending on location and winter conditions. This is about half of the period of operations 20 years ago.

The Alaskan, Canadian and Russian authorities need an alternative mode of transport, and cargo airships seem to provide an answer. This

requirement could stimulate development and building of heavy lift airships that could also be suitable for disaster and humanitarian relief.

Overall airships provide the following benefits and opportunities[ii]:

a. **Safe mode of air transport** – airships offer a very safe mode of air transport. They do not stall and have slow take-off and landing approach speeds with a capability of landing on any reasonably flat surface.

b. **Environmental benefit** – airships consume less fuel than a conventional aircraft, which results in lower emissions. Fuel burn is between 50 – 65% less than a conventional fixed wing aircraft when compared on a tonne per mile or km basis. Modern airships can also replace infrastructure, reducing the need for roads, railway lines, bridges and airport runways.

c. **Cargo flexibility** – airships offer considerable flexibility in the loads that they are designed to carry. Surveillance equipment, containers, cargo, people and associated combinations offer this flexibility which is reinforced by airships having a large payload volume (ISO containers), an on-board crane system and a large cargo hatch.

d. **Operational versatility** – airships offer greater versatility than conventional aircraft. They offer vertical take-off and landing (VTOL) capability anywhere that is reasonably flat, while carrying more weight and volume than a conventional aircraft. Once VTOL and cargo exchange is complete, the craft offers greater range because of its associated fuel savings than conventional and rotary wing aircraft.

   Airships could also provide a solution for land transport that is blocked infrastructure damage. For example, where bridges are destroyed, airships could ferry trucks across to roadways for delivery to local beneficiaries.

e. **A game changer in both surveillance and heavy lift** – airships open up new, economically viable opportunities in the field of logistics. Airships offer a capability that is currently lacking in humanitarian relief operations – the ability to collect supplies, equipment and personnel from the point of supply and deliver them directly to the point of need without having to stage through various levels of warehousing hubs. They could also offer platforms disaster for airborne surveillance as part of the humanitarian relief operations. Basically airships offer game changing opportunities in the field of humanitarian relief.

Without a means of effectively delivering humanitarian relief in future disasters many more people will suffer. The technology, knowledge and ability exist to build heavy lift airships. What is needed is the political will and economic drive to make this form of transportation available in emergency situations.

A Way Forward

Funding is the greatest barrier to developing, constructing and operating humanitarian relief airships. The costs associated with airships operated solely on a humanitarian relief basis are high to the point that commercial companies would not readily be prepared to accommodate them. Government and private sponsors will have to form partnerships to fund development, construction and operation of the airships (Christopher, 2008).

Commercial companies seek to maximize profits and minimize risks when considering the procurement of an asset such as an airship. However, neither natural disasters, nor humanitarian response are driven by market forces. Another way of raising investment capital is needed. Funding could come from the following sources:

a. **Private enterprise funding** – providing disaster and humanitarian relief solely as a business venture is wrong, if not immoral. Disaster relief is heavily funded by charitable

contributions. Donors would be unhappy to see the money they provide used to generate profit, at the expense of supplies.

b. **Government funding** – governments purchase transport equipment to support defence, search and rescue, surveillance, etc. Military and civil emergency forces, such as police and fire brigades, are government funded by taxpayers. The same principle should apply to funding disaster relief airships that could be used domestically and overseas.

c. **Combined private enterprise and government** – the US government's Strategic Airlift Fleet is made up of dedicated military and commercial aircraft that are part of the Civil Reserve Air Fleet (CRAF) (CBO, 1997). The US government gives over US $ 1 billion annually to US airlines to be part of the CRAF. A similar arrangement could be offered to future heavy lift airship operators to be part of government led humanitarian relief logistics activities. In the case of Canada, commercial airships that serve northern resource operations could be temporarily redeployed for such emergencies.

   Governments also need to assist the development, design and manufacture of cargo airships. A contractual approach would accommodate those who oppose procuring airships solely for disaster and humanitarian relief purposes. Under a public investment structure, commercial operators could be required to make airships available immediately when required for disaster and humanitarian relief purposes.

d. **International Funding through United Nations** - a possible course of action is to request heads nations that lead the world's economy to provide the financial and technical resources needed to design, build and operate a fleet of airships for disaster and humanitarian relief. Such action could be directed specifically by individual nations or through the offices of the United Nations.

e. **Funding from Benefactors** - funding could possibly be sought from benefactors in the form of wealthy individuals, companies

or nations. One approach that has a long and successful history is to create a technology prize. "Prizes syndicate the risk of technology investment among many parties. Sponsors pay winners only when and if the goal is achieved. The prize is a performance-based investment, rather than a "best effort" capital commitment. Competitors invest their own resources in technological development, but the prize subsidizes their acquisition of intellectual property." (Prentice, Ashcroft and Hochstetler, 2009). A technology prize would not fund on-going airship service, but it would create the conditions under which a new cargo airship could be developed for humanitarian relief missions.

Conclusions

Climate-related disasters are claiming many lives and causing immense human suffering in disparate parts of the world. A consistent, common feature of these disasters is the serious difficulties and delays encountered in delivering the relief equipment and supplies.

Relief efforts require large quantities of goods to be transported into unprepared sites at short notice. A new generation of cargo airships would be able to fill this role better than any other known craft. In November 1917, Germany demonstrated the capability of using airships for relief purposes by flying food, medicine and equipment from Bulgaria to East Africa, a round trip of nearly 4,200 miles (6,800 km).

Arguments highlighting the high cost of providing, operating and maintaining airships dedicated to relief activities can be countered by considering the number of disasters that occur every year.

The technology, knowledge and ability exist to build heavy lift airships. What is also needed are the political will and economic drive. Support is growing in Alaska, Canada and Russia to develop airships as a transport means to remote areas for extracting oil, gas,

chemicals and minerals and for supporting isolated communities. This requirement should stimulate development and building of heavy lift airships that could also be suitable for disaster and humanitarian relief.

Governments throughout the world have yet to be persuaded to provide the incentives needed to build airships for disaster relief operations. A possible course of action is to request heads of state of nations to provide the financial and technical resources needed to design, build and operate a fleet of airships for disaster relief. Such action could be directed specifically against individual nations or through the offices of the United Nations.

A suggested funding arrangement involves making government subsidies to commercial operators of airships with a contractual obligation that the vehicles must be made available immediately they are required for disaster and humanitarian relief purposes.

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[i] Airplane production by the main combatants from 1939-1945 were: United States 297,199, Germany 119,871, UK 131,549, Russia 158,218, Japan 76,320
http://www.taphilo.com/history/WWII/Production-Figures-WWII.shtml

[ii] Discussions between Robert Knotts and Hardy Giesler (Hybrid Air Vehicles), May 2013.