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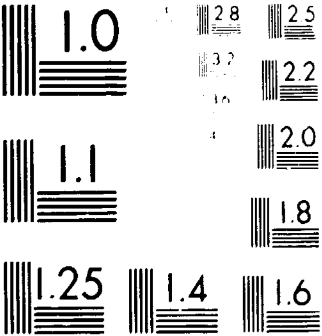

MICROCOPY RESOLUTION TEST CHART

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GENERAL APPLICATIONS AND LIMITATIONS OF LTAs *

by

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** UNIDO Consultant.

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1. There are a number of specific applications for which the airship is uniquely qualified as an economical mode of transport.

2. In Figure I, the different uses have been outlined. Airships have evidently a clear-cut miliatary use, in addition to their civilian application, and in some fields the issue remains as a "combined effort".

3. The civilian operation can be executed over land or sea and each case has its own characteristics.

4. The over-the-sea operations are easier, in general. There are no obstacles to obstruct the view, and the weather plays fewer tricks. There is less thermic movement as the "underneath" remains constant. This is quite different to flying over land, as many a pilot can recount! Visibility over the sea may also be further than overland, which in a sense is only a relative concept, considering modern instrumentation.

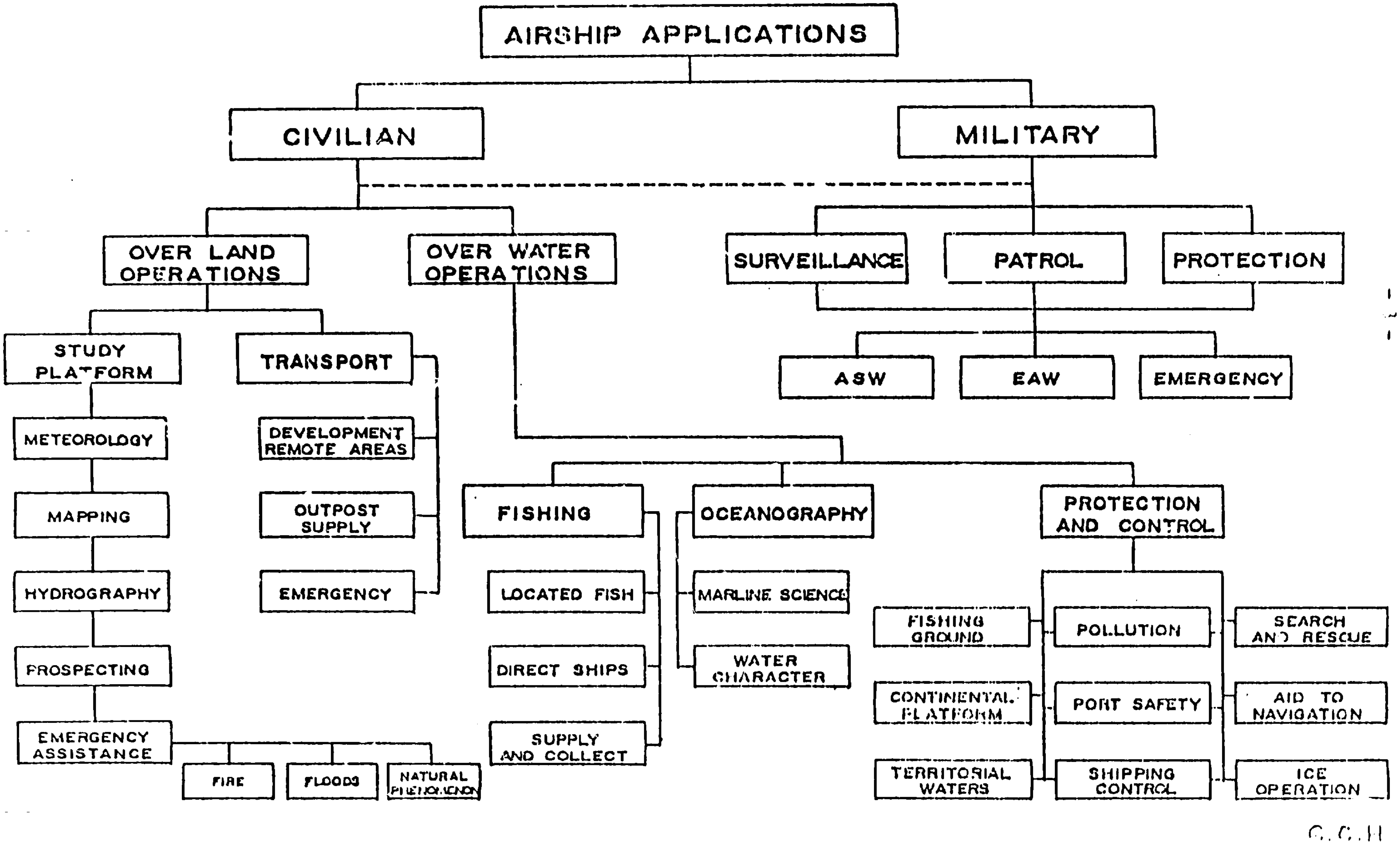
5. The airships' immediate applications are related to oceanography, study of the oceans, measurement of characteristics, temperature, salinity, biology, etc. It can be done from above, or by seeding buoys which later on can be collected or by towing some device.

6. The advantage of an airship is that it produces neither downwash nor interference when towing acoustical instruments.

7. The airship can locate fish and submarines by measuring the surface temperature of the water by means of radiation or by towing acoustical arrays.

8. Since the airship is a stable airborne platform, it can perform a number of control and survey activities, as well as assisting in airlifting people from a ship or providing them with special equipment in case of emergency.

FIGURE I


AIRSHIP APPLICATIONS
CIVILIAN
MILITARY
OVER LAND OPERATIONS
OVER WATER OPERATIONS
SURVEILLANCE
PATROL
PROTECTION
ASW
EAW
EMERGENCY
STUDY PLATFORM
TRANSPORT
METEOROLOGY
MAPPING
HYDROGRAPHY
PROSPECTING
EMERGENCY ASSISTANCE
FIRE
FLOODS
NATURAL PHENOMENON
DEVELOPMENT REMOTE AREAS
OUTPOST SUPPLY
EMERGENCY
FISHING
LOCATED FISH
DIRECT SHIPS
SUPPLY AND COLLECT
OCEANOGRAPHY
MARLINE SCIENCE
WATER CHARACTER
PROTECTION AND CONTROL
FISHING GROUND
CONTINENTAL PLATFORM
TERRITORIAL WATERS
POLLUTION
PORT SAFETY
SHIPPING CONTROL
SEARCH AND RESCUE
AID TO NAVIGATION
ICE OPERATION
G.C.H

9. The use of airships for overland operations involves surveys, patrol, prospecting, mapping, aerophotography and related activities, which may also include seismic studies and specific earth sciences as well as, of course, transport.

10. The use of airships for transportation in underdeveloped areas requires some efforts to simplify the landing and cargo interchange operations. It must be borne in mind that an airship flies at a certain "weight equilibrium", and when cargo is removed, ballast must be added to some degree, and vice-versa when cargo is loaded. Figure I provides a list which by no means exhausts the dirigible's applications.

11. The military uses refer to surveillance, patrol and protection. The platform at 1,800 metres has a direct visibility of approximately 250 miles. This gives several minutes advance notice of any flying object, even of the fastest missiles. Thus, it is an early aerial warning system (EAW).

12. During the Second World War, the airship was used not as an attack vessel, but only for defense. However, there was one exception. A dirigible, against orders, attacked a submarine in the Caribbean. The submarine was captured, and the dirigible came down without any loss of life. Today, that part probably can change somewhat with the new generation of air-to-surface missiles. Thus, the airship is an anti-submarine warfare (ASW) tool.

13. It is important to always bear in mind that an airship is recommended only for specific uses under well defined conditions and to satisfy particular requirements. Like all other methods of transportation, it is not a universal mode that can economically transport everything under any condition. It is meant to complement other modes.

14. It may be asked why is it that we are only now hearing again of this technology after such a long period of silence since the last civilian use of airships which ended in 1937 with the Hindenburg tragedy.

15. The appeal of airships evidently decreased in the years following the Hindenburg tragedy. Nations could do without them until the mid-sixties, except for their military applications such as surveys, patrols and anti-submarine warfare (ASW) and as an early aerial warning system (EAW). There

was simply a "lack of need". This was due, in part, to the development of aircraft for World War II when the emphasis was on speed and manoeuvrability and fuel was readily available. The objective then was to reach a destination as quickly as possible. Fuel costs were only a small expense component. This aspect changed greatly in the early 70's when fuel first became scarce and then expensive.

16. After the end of World War II world population began expanding. The spectre of overpopulating the urban regions demanded the development of remote areas for settlement and agriculture. To reach these distant areas with conventional modes of transportation required the costly and time-consuming construction of roads, railroads or airports with a secondary feeder road system. The construction costs of these routes are high when considering the low traffic flow. However, a worse problem than the high construction costs is the high cost of maintenance to keep the roads operative for more or less extended periods during the year. These costs often become prohibitive for a developing nation's budget.

17. Therefore, even if the necessary systems were built, most developing nations would not be able to provide for their maintenance and the system would soon become inoperative or inadequate. Both these problems could be solved with a non-conventional mode of transport which does not require costly or time-consuming construction nor extensive maintenance in order to be operative.

18. The airship is such a mode of transport.

19. The technology of airship construction has improved over the past years. There are now better and stronger materials for the envelope, simpler construction methods, better bonding and sealing methods. In addition, technology has provided the airship with lighter, more reliable and smaller engines with improved fuel/weight/power ratios.

20. Consequently, the modern airship is more cost-efficient and safer, thereby able to fulfill functions beyond the capabilities of previous years. Today, the airship is able to reach areas economically which otherwise would remain undeveloped. Thus it has the potential of becoming a developmental tool in the near future.

21. Up to now the positive aspects concerning the use of airships have been stressed. Of course there are also limitations. The question is that in reality there is quite a difference between what an airship should do, and how it actually operates in practice.

22. The different types of airship are basically rigid airships, semi-rigid, non-rigid and hybrid airships.

23. The manufacture of rigid and hybrid airships is totally different to building non-rigid dirigibles. The engineering and economic aspects have no similarities. Rigid airships and their variants are for the time being so expensive that they deserve little consideration for commercial purposes. Thus, it is more practical to consider what would be more predictable for the near future, i.e. the non-rigid airship, often called the "Blimp".

24. The limitations of these non-rigid dirigibles stems from the laws of physics, laws of economics, laws of nature, or a mixture of all three.

25. With today's technology, non-rigid airships can be built with a payload capacity of up to approximately 30 tons representing a volume of about 55 to 60,000 cubic metres, under normal conditions of 15°C. at sea level.

26. With the increase in temperature, humidity or altitude, the payload capacity diminishes. The reason is simple to understand when one considers that an airship floats due to the difference in density between the floating gas (helium) and the surrounding air. Consequently, when the air density diminishes, the floating capacity is reduced.

27. The size or volume of an airship is limited by the strength of the building materials. The transporting of heavier loads would require semi-rigid, rigid or hybrid airships. Here again the construction cost of these types would be great and economics determine the minimum size for the efficient operation of these heavy lifters. The "Helistat" which operates with four helicopters under the envelope is a typical example of a hybrid airship.

28. Wind is a limiting factor not so much in flying, but in landing. It is not safe to land an airship in winds of over 25 knots, although the U.S. Navy

has flown airships in the most adverse conditions when even airplanes could not operate without ever losing a unit. The limitation in landing, especially in gusty winds, is obvious if one does not wish to run the risk of hitting the landing mast. Side winds can also be a nuisance when performing maintenance operations or exchanging cargo. However, this problem has been solved more or less satisfactorily without the need of entering a hangar. Tail winds are naturally advantageous, but if the wind is 180^{o} against the intended flying direction and is more than the maximum speed of the dirigible, then the airship must disregard economics and operate as a sailing ship. Therefore, winds against the direction of flight present only an economic problem.

29. The economic ceiling for non-rigid airships is approximately 10,000 feet (3,000 metres). The reason is related to the dead weight of the ballonets which at that altitude are completely empty. Under normal conditions approximately 30 percent of the airship's volume is occupied by full ballonets. In other words, the airship's envelope is full of helium gas which has expanded to its full size while the inside pressure has remained constant. Any decrease in altitude requires further expansion of the helium as the outside pressure decreases. Thus, it has to be vented.

30. On landing the gas would have to be replenished and this is a costly venture. Therefore, it is more economical to stay under 3,000 metres. If flying at a higher altitude is necessary, then the airship must be redesigned with larger ballonets. This would mean a higher dead weight and would of course be more expensive.

31. Related to these aspects is the rate of climb. As mentioned before, when the airship increases altitude the helium expands and air is vented from the ballonets to make room for the expanding gas. There is a limit to the size of the valves which will, when fully opened, allow the flow of only a certain, well-determined amount of air per second if the pressure in the airship is to be kept constant. Thus, the rate of climb is limited by the design of the vent valves.

32. Finally, the weight of the airship should at all times be somewhere near the equilibrium point, or preferably higher. This requires the use of ballast when loading or unloading cargo. As ballast, water is the simplest and easiest

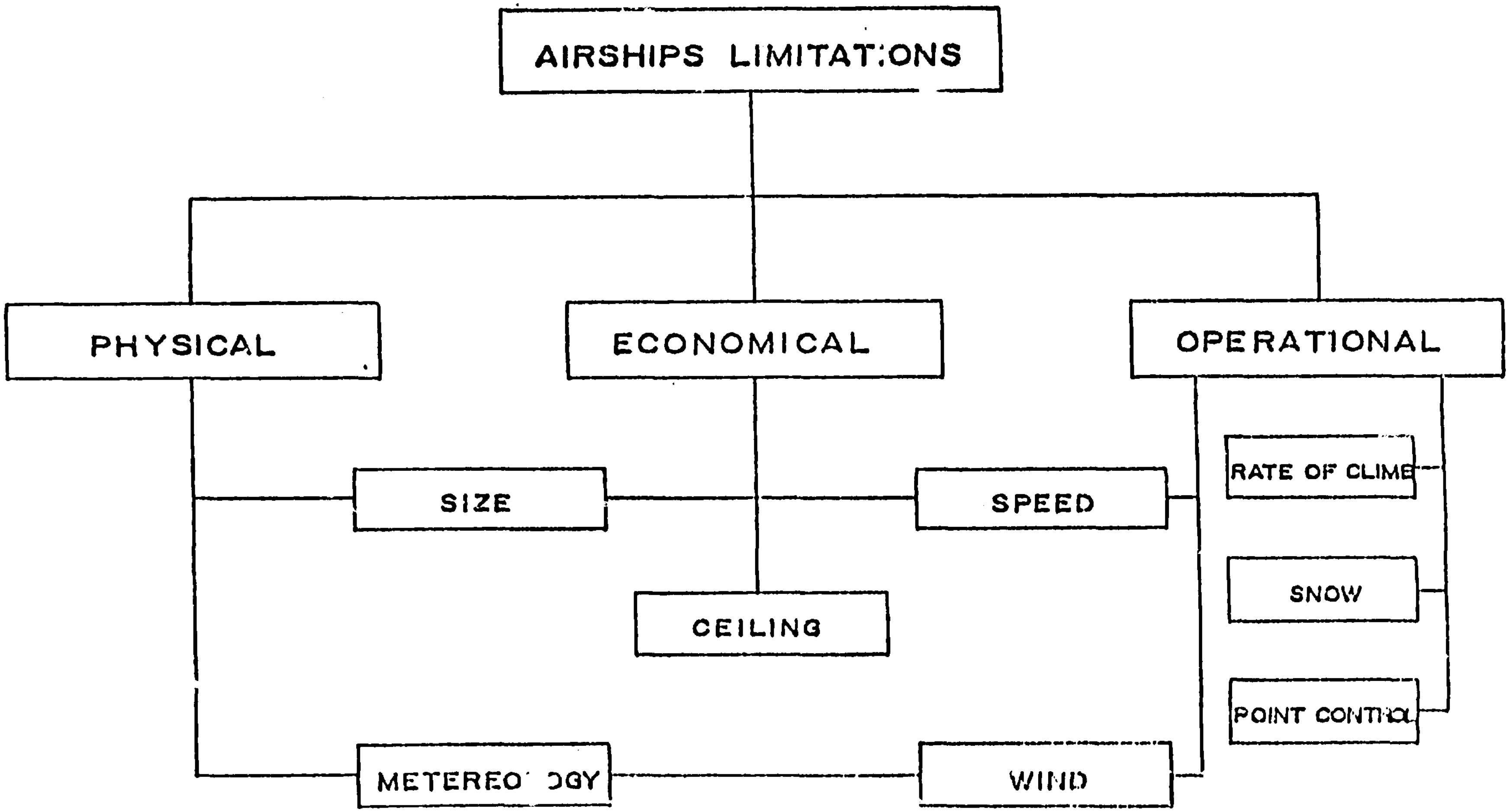
to handle and therefore it would be desirable if water were available at all landing sites. Alternatively, sand or any other heavy material which preferably requires a minimum number of handling personnel, could be used.

33. On Figure II the airship's principal limitations have been summarized. Evidently, the limitations of the airship relate to metereology, aerostatics and the ground handling of the airship.

34. In summary, it can be said that even though there are still limitations in the usage of airships, it presents a number of advantages even today - which justify their use for sea and overland operations. The airship can obviously improve fishing and ocean science studies, as well as promote the development of new territories that have until now remained inaccessible.

35. There is still room for improvements and further technical development. The current limitations will shortly be overcome as needs and requirements for the use of airships change, and technology improves the art of airship operations.

FIGURE 2



AIRSHIPS LIMITAT:ONS
PHYSICAL
ECONOMICAL
OPERATIONAL
SIZE
SPEED
RATE OF CLIMB
SNOW
CEILING
POINT CONTROL
METEREO' OGY
WIND

G.C.H