Presentation Sequence:

1. Thesis in Relation to the Design Project

2. Introduction to the Concept, Skyport

3. Global Scale (Quick Summary of P3)
a. Analysis and problems in current freight distribution modes
b. Proposal of *Skycraft Global Distribution Network*

4. Design Concept (Building Scale)
a. Research on automation in container ports, automated docking systems
b. Design concept of *Skyport*



#### Theme - Technological Prosthesis

Emerging technologies, namely robotics, communication technologies, biotechnology and nanotechnology have concentrated and channelled their powers upon the human body in order to augment its capacity for better speed and precision in terms of production. These technologies have provided us with an increasing level of comfort, speed of activities, safety and well-being. However they have in turn made the body's rhythms and activities clockwork and layed it down on a barren plane, illuminated by an all seeing and searing gaze. The labile, becoming body dries and withers away under the intense gaze of forces.

Emergent technologies will further augment and expand the inward and outward scale of the fabrication and colonization of the human body by technology. My essay accepts the power of spatio-temporal technologies in the past but also expands, recognizes a similar trajectory in emergent technologies. Therefore this essay is a counter force proposing to divert and redirect the relentless stream of technological innovations towards an unpredictable, open future of becoming.

With every tool man is perfecting his own organs, whether motor or sensory, or is removing the limits to their functioning....Man has, as it were, become a kind of prosthetic God. When he puts on all his auxiliary organs, he is truly magnificent, but these organs have not grown on to him, and they still give him trouble at times.....Future ages will bring with them new and probably unimaginable great advances in this field of civilization and will increase man's likeness to God still more.

Sigmund Freud

## AVATAR

An architectural construct becomes a pure interface, an augmentation of bodily senses, a void without a function other than to reveal the unseen, the outside. A body integrated into our flesh and mind intensifying our senses in subtlety, sensitivity and articulateness. An extensive spiderweb to catch the intensive fly to recover what is lost. An Avatar to ride towards an unpredictable, unforeseen future...

"We are passing through a stage in a long process towards interpenetration, simultaneity, and fusion, on which humanity has been engaged for thousands of years."

Umberto Boccioni

# **SKYPORT** Robotic - Aerial Container Port

by Ahmet Korfali



## **GLOBAL SCALE**

## **Skycraft Distribution System**

is a fully automated, aerial, freight distribution network based on robotic and airship technologies.

## BUILDING SCALE (Design Project)

## Skyport

Skyport is one of the distribution nodes in the global network serving as an aerial port for the import and export activities of containerized freight.

## Analysis of Current Freight Distribution Modes

## **Current Freight Modes**



......

**Cruise Ferry** 



**Container Ship** 





Lorry



Tractor Trailer



Truck



Ocean Liner

**Truck Chassis** 



Bulk Ship





Percentage of Greengas Emissions per Sector



## Problems in Current Freight Transportation Modes





FREIGHT TRANSPORT GROWTH IN EU





## Proposal of Aerial Distribution Network Skycraft

Manned Cloud by French designer Jean-Marie Massaud

## **ADVENTAGES OF HYBRID AIRSHIPS**

LARGE PAYLOAD 500 tons (22 tons in cargo planes)

LONG RANGE - HIGH ENDURANCE 22,000 km - 7 days

LOW MAINTENANCE - OPERATING COSTS

**HIGH FUEL EFFICIENCY** 

**LOW INFRASTRUCTURAL REQUIREMENT** No Airport requirement - Simplicity and efficiency of ground maintenance

**ENVIRONMENTAL BENEFITS** Low noise, no hazardous fuel emmision

CAPABILITY TO FLY AT LOW SPEEDS AND LOW ALTITUDES NOVEL WAY TO TRAVEL

CURRENT POTENTIALS AND APPLICATIONS LOGISTICS - CARGO TRANSPORT - WARFARE SUPPORT ENVIRONMENTAL PROTECTION EXPLORATION OF REMOTE AND INACCESSIBLE AREAS SURVEILLANCE & INTERDICTION TOURISM, ADVERTISING (HOTEL) HUMANITARIAN AID - EMERGENCY HOUSING - RESCUE -SUPPORT

















## Comparison of Current Freight Modes with Skycrafts





## Comparison of Freight Modes with Skycraft Network



What Does Skycraft Network Replace in the Logistic Chain???





- **3rd Level Terminals:** metropolitan areas without adequate ports
- **4th Level Terminals:** cities on major air freight traffic routes
- 5th Level Terminals: on disaster zones

## **TYPES OF AERIAL STATIONS**

### **SKYCRAFT FLEET**

Primary Terminals Number: 20 Location: existing major ports and metropolitan areas Capacity: 1000 containers Volume: 10 milyon m3 Length: 400 meters

**3rd Level Terminals** Number: 19 Location: existing major ports Capacity: 750 containers Volume: 8.5 milyon m3 Length: 320 meters Secondary Terminals Number: 18 Location: metropolitan areas without adequate ports Capacity: 800 containers Volume: 9 milyon m3 Length: 350 meters

#### SKYCRAFT 1

Number: 56 Route: international Freight Capacity: 240 containers Volume: .5 milyon m3 Length: 120 meters



SKYCRAFT 2

Number: 56 Route: Domestic Freight to distribution centers Capacity: 150 containers Volume: .4 milyon m3 Length: 90 meters



#### SKYCRAFT 3

Number: 56 Route: Harvesters from other modes of freight. Capacity: 80 containers Volume: .3 milyon m3 Length: 60 meters

**4th Level Terminals** Number: 56 Location: Cities on major air traffic routes. Capacity: 600 containers Volume: 8 milyon m3 Length: 280 meters

**5th Level Terminals** Number: 12 Location: Disaster Zones Capacity: 500 containers Volume: 7 milyon m3 Length: 250 meters Research for the Design, *Skyport* Automated, Robotic Ports and Warehouses Automated Docking Systems The Evolution of Airships



## Research on Automated, Robotic Ports and Warehouses

## Automation in Air Cargo Terminals - Spaces

## AIRSIDE HANDLING Identification - Sorting - Checking

## **AUTOMATED WAREHOUSE**

Storage - Retreival - Conveyer Systems

## LANDSIDE HANDLING Delivery



## Air Cargo Terminals - Flow of Goods



## Identification (sorting) - storage - delivery

#### AS/RS (Automated Storage and **Retrieval System**)

Automatic storage and retrieval for import This system links the AS/RS to the ULD hancargo. AS/RS maximizes floor space, improves throughput and adds routing flexibility line. 18 trolleys move the boxbins back and by providing out-of-the-way storage space.

#### **AEM** (Automated Electrified Monorail)

dling system using an overhead transport forth between the break down workstations, the AS/RS and the truck docks.

#### **TV (Transfer Vehicle) ETV** (Elevating Transfer Vehicle)

cargo containers smoothly and quickly.

The three-story ETV stores and retrieves air TV provides the direct high speed conveyer/ transport connection from the landside to the ETV on the airside.





## WATERSIDE HANDLING Gottwald AGVs

are unmanned, software-guided container transporters forming an efficient link between the quay crane and the stackyard.

## CONTAINER YARD ASC Automated Stacking Cranes

Antwerp G

are automated storage and retreival systems on the quay side. For landside storage and removal in conjunction with a railway link or road trucks.

Antwern Gatewa

## LANDSIDE HANDLING

Thanks to the innovative camera system, the container can be accurately deposited semi-automatically on the road truck.







Dry Cargo Storage Reefer Container Storage (temp. sensitive) Empty Container Storage Administration Building Maintenance Shop Container Repair - Cleaning Facility

## Automated - Robotic Car Parking Systems

#### Advantages:

-flexible and efficient use of space -minimum foot-print -very fast access time -no ramps and driving lanes -no costly illumination -environment-friendly in terms of its compact construction, and in addition it reduce emissions

-offers security against theft and vandalism

-saves the need for costly building engineering compared with conventional garage buildings







≡500 0015

3005





## Automated - Robotic Car Parking Systems

## Volkswagen Autostadt (Autocity)

The car towers work like giant vending machines: As a new car arrives from the factory, it's transported by robot to an empty storage slot in one of the towers; when a customer shows up to collect the car, the same robotic picking system fetches the vehicle, brings it down to ground level, and transfers it to the KundenCenter in the next building.







## Research on Docking Systems

## Airship Mooring Masts



Mooring masts were equiped with lifts and other machinery necessary to bring f**uel, crew, passengers and cargo** to the airship moored at the top of the tower.





## Space Shuttle Mooring Systems

Docking with international space station



## 110 m.

**Orbital Maneuvering System** to thrust the Space Shuttle from one orbit to another.



## 50 m.

Reaction Control System is used to change speed, orbit, and attitude.



## **9** m.

**Reaction Control System** fine-tune the alignment of the Space Shuttle with the docking target.



## 0 m.

**Reaction Control System** makes contact with the docking ring. Once a series of hooks is engaged, the Space Shuttle is then successfully docked.



AFT Reaction — Control System



Forward Reaction Control System







## Container Ship Mooring Systems



Quay cranes are used to load and unload containers. Emma Maersk can use 11 cranes at the same time.



11 Cranes can load or unload the Ship at the same Time.



The first Trip was with 13 Crew The cost was \$145,000,000 US

## Automated Mooring Systems

Automated Mooring Systems imroves efficiency and productivity greatly and enhances the speed of the overall logistic chain.

NO ROPES..... NO PEOPLE.....NO ACCIDENTS



By using vacuum and hydraulic based technology instead of ropes the whole operation of mooring a ship is reduced to within 12 seconds.



**INFRASTRUCTURE** Improved pier utilization Absorption of vessel motion

SAFETY Reduced risk of mooring accidents Real-time monitoring of mooring status





#### **EFFICIENCY** Improved turn-around time Improved continuity of work processes Improved cargo transfer rates

#### ENVIRONMENT

Reduced emissions due to faster mooring process Less pier and breakwater structures required





QUICK RELEASE HOOKS The units are designed to withstand static and dynamic forces exerted by the vessel, often from wind or current load



**REMOTE RELEASE SYSTEMS** Purpose is to release the mooring lines, which may be under tension, in a safe and controlled manner.



ENVIRONMENTAL AND OCEAN MONITORING Environmental and oceanographic sensors provide data during docking and mooring.



DOCKING AID SYSTEM A tool used assist in manoeuvring the vessel during the last 300 m of approach. The docking system measures vessel distance, angle and speed of approach using lasers.



CENTRAL MONITORING SYSTEM The data from load cells, docking lasers and environmental sensors is relayed to a central PC system usually located in the Jetty Control Room.



MOORING LINE LOAD MONITORING Once the mooring ropes secured, line tensions and their distribution must be monitored effectively. -wind and current, speed and direction of waves -surge effects from passing vessels -tidal changes -vessel draft changes due to loading or discharge of product
The Evolution of Airship Technology

## Balloon (first manned flight - 1783)

## Type: Balloon

A RATAILLE DE FLEUR

**Description:** Balloons are simple 'bags' holding gas or hot air, without a frame-work.

A balloon is a type of aircraft that remains aloft due to its buoyancy. A balloon travels by moving with the wind. It is distinct from an airship, which is a buoyant aircraft that can be propelled through the air in a controlled manner.







Blimps (non-rigid airship - early 20th century)

Type: Airship

**Description:** Use a shaped bag without a framework or supporting structure.

Non-rigid airships, also known as Blimps, are the most common form nowadays. They are basically large gas balloons. Their shape is maintained by their internal gas pressure. The only solid parts are the passenger gondola slung beneath the ship, and the tail fins. All the airships currently flying for publicity use are of that type.









## Semi-Rigid Airship (early 20th century)

Type: Airship

**Description:** *airships with a partial framework.* 

Semi-rigid airships are airships with a partial framework. These often consist of a rigid, occasionally flexible, keel frame along the long axis under the aerodynamic hull envelope. The partial framework can also be inside the hull.





## **Rigid Airship**

(Zeppelin early 20th century - Hindenburg explosion in 1937)

Type: Airship

## **Description:** *complete internal structural framework*

A rigid airship was a type of airship in which the envelope retained its shape by the use of an internal structural framework rather than by being forced into shape by the pressure of the lifting gas within the envelope as used in blimps and semi-rigid airships.









## AEROSCRAFT - ML866 (2010)

### Type: Hybrid Airship

**Description:** The Aeroscraft ML866 is a buoyancy assisted air vehicle with a rigid structure and gas cells.

Lift: Helium - buoyancy (70 percent), aerodynamics, turbofan jet engines for vertical takeoff

Energy: Hydrogen Fuel Cells

## **Function:**

-luxury private yacht,
-sightseeing and long-distance cruise
-to reach isolated communities, such as remote islands in the Atlantic and

Pacific oceans

-transport military vehicles or supplies to difficult terrain

## **SPECIFICATIONS**

Volume: 19,000 meters cube Dimensions: 64 x 36 x 17 meters Range: 9,656 km Max. Endurance: 90 hours Cruising Speed: 222 km/h Altitude Range: 0 to 3600 m Payload: 400 tons or 250 passengers Helium Volume: Cabin Area: 500 square meters





## Strato Cruiser (Design Phase)

by art director Tino Schaedler and Michael J Brown

## Type: Hybrid Airship

**Function:** The luxury helium-filled airship contains a gourmet restaurant, a spa, a swimming pool, a resident DJ and so on.

## Key-features: Structure:

With its carbon fiber skin, sectional helium chamber design and photovoltaic cells, the Stratocruiser's construction brings new levels of safety, speed and ecology to travel. Its "doughnut hole" atrium reinvents the zeppelin concept with a sky lounge on top, the earthward viewing restaurant on the underside and a recreational climbing wall in between. Private suites are sheltered away from public spaces on the ship's belly, while an advanced propulsion system more than doubles

the cruising speed of conventional blimps.



1.Rigid Airship Frame with Helium Chambers

- 2.Photovoltaic Cell Network
- 3.Retractable Polycarbonate Roof
- 4.Terraced Deck with Lap pool
- 5.SkyView Lounge
- 6.Main Atrium with Climbing Wall
- 7.EarthView Restaurant & Bar

8.Spa Treatment & Library9. Private Suites10.Kitchen & Staff Rooms11.Captain's Bridge12.Gantryway13.Propulsion14.Bungee Jumping Platform



## Manned Cloud (Design Phase)

by by Jean-Marie Massaud

Type: Hybrid Airship

**Description:** Flying Hotel

Function: Emergency - housing

## Key-features - Program:

Two two-deck cabin will contain amenities including a restaurant, a library, a fitness suite and a spa. There will also be a sun deck on top of the double helium-filled envelopes.

## **SPECIFICATIONS**

Volume: 520,000 meters cube Dimensions: 210 x 82 x 52 meters 40 passengers - 15 crew Range: 5000 km / 72 h Cruising Speed: 170 km/h Altitude Range: 0 to 3600 m Payload: 400 tons or 250 passengers Helium Volume: Cabin Area: 1100 m2 First deck (500 m2) : Restaurant, lounge, library, fitness Second deck (600 m2) : 20 rooms, terraces, spa, bar









## Air\_ray (Research Phase) by by FESTO

## **Type:** Hybrid Airship

A remote-controlled hybrid construction with flappingwing mechanism.

Tail ionic jet propulsion engine



Air\_ray is a remote-controlled hybrid construction comprising a helium-filled ballonett and a flapping-wing drive mechanism. The propulsion is effected by a flapping-wing mechanism. The wing module, which can be moved up and down by a servo drive unit, has a structure like that of the tail fins of many fish.

http://www.festo.com





Tail fin of b-IONIC Airfish









## **IONIC Airfish** (*Research Phase*) by by FESTO

### Type: Ionic Airship

The flow-optimised pneumatic structure is derived from the penguin.



The new bionic plasma undulating drive in the stubby wings is a simplified copy of the mechanical beating wing drive of birds, without the moving parts. The classical principle of the ion beam drive, that functions using air-ionising high DC voltage fields, is at work in the tail. The accelerated air ions thus produce an ion wind with a speed of up to 10 m/s.

Plasma ray propulsion engine



Tail fin of b-IONIC Airfish







Skyport Design Parameters

## **Design Parameters**

### The Evolution of Airship & Design Stages of Skyport



## **Design Parameters**



inefficient distribution system





## Design Parameters Container Types & Distribution of Payload

## Container Specifications and Distribution of Payload

Shipping Container	Specifications	
	2.5 x 2.5 x 12 meters Volume: 68 m3 Max. Gross Weight: 20 tons Empty Weight: 2 tons	asa an
	Fitted inside TEU	
	Compatibility with existing logistic modes	
Air Freight ULD		empty container
	1.5 x 1.5 x 3 meters Volume: 15 m3 Max. Gross Weight: 3 tons Empty Weight: 169 kg	heavy container (refrigerated)
		Containers will be able to interlock to each other becoming a single container increasing the system's speed and efficiency.
Skyport Container	3 x 3 x 3 maters	
sso or	Volume: 27 m3 Max. Gross Weight: 6 tons Empty Weight: 100 kg	
bon	Different translucent containers will differ in color accoding to their cargo and weight.	

During storage containers will seperate and move through the system individually via conveyer rails.

## Container Specifications and Distribution of Payload

Placing heavier containers close and around the central axis,lighter ones on the periphery and empty ones on the edges, reduces moment forces exerted on the structure due to shifting payloads and helps to maintain overall balance of the skyport.

heavy payload

light payload



Heavy Container Weight: 3<x<6 tons Around central axis



Light Container Weight: 0<x<3 tons Close to central axis empty containers



Empty Container Weight: 100 kg On the periphery

Volume of Helium: 20 milyon cubic m. <u>Skyport Payload Capacity: 3000 containers</u> Container ship Payload Capacity: 9000 containers





## Design Parameters Stability & Balance

during crusing and loading and unloading of cargo

## Systems used for Weight balance and stability of Conventional Carriers

## Ballast Tanks

Seperate ballast tanks are used to stabilize a ship by filling or emptying the tanks with water.







## Ant-Heeling System

Quick

Response

Designed for quick acting in response to fast and heavy cargo loading processes.





## Weight balance and stability of skyport during

## Ascend - decend and weight differenciation



Weight balance and stability of skyport during loading - unloading

Anti - Heeling System (Redistribution of Weight)

Designed for balancing vessels for fast - heavy cargo loading and loading processes.

Stability is maintained by pumping water around the vessel's ballast tanks.





# Design Parameters Aerodynamics & Orientation



## CONVENTIONAL AIR-FOIL SHAPES

 Low chamber - low drag - high speed suitable for race planes, fighters....

 Deep chamber - high lift - low speed - thick section suitable for transports, bombers...

• Deep chamber - high lift - low speed - thin section suitable for transports, bombers...

- Low lift high drag reflex trailing edge Good stability
- Symmetrical sections Good stability

 thicker for better structure and lower weight increased lift capacity and decreased drag

## AIR-FOIL SHAPED HELIUM ENVELOPE



- -minimizes wind loads
- -increases lift capacity
- -creates better stability

Wind shield

## LIFT FORCE IS CREATED

Wind cavity Seperating helium envelope and freight towers

## **ORIENTATION OF SKYPORT**





References on Construction Technology -Aircraft Carrier--Passenger Plane--Airship-

## Construction Phases of Skyport



Construction Phases of an Aircraft Carrier



4 Superlifts are adjusted on site and connected to the adjacent module.

The last superlift module is connected and inside installations are finished.

dock is flooded with water.

## Construction Phases of a Passenger Airplane



## Various components of the plane are constructed around factories in Europe.

1



3 A380 final assembly is taking place in Toulouse , France , with interior fitment in Hamburg, Germany .



Later major A380 assemblies are transported to Toulouse by ship, barge and road .





## Construction Phases of a Rigid Airship





Primary structure, aluminium girders are joined.



2 Assembled parts are shipped to the construction site.



5 Secondary structure, stringers are added, binding the ribs and completing the frame of the airship.



3 A temparory base id constructed to support the airship during construction.



Aluminium outer skin is connected to the structure.



Gas cells, fuel tanks, water ballast, pipes, wires and engines are installed.



8 The envelope is inflated with helium and support base is removed, leaving the airship floating.





Construction of aluminium rings

Laying down the base.



Completing the airframe.



Connecting the aluminium skin to the structure.



Installing the fuel and gas tanks....



Openning of hangar doors for initial flight.



Construction Phases of Skyport



3 Airframe of the superlift structure is completed by joining the aluminum ribs and connecting them with stringers, metal beams.



Primary composite rings are constructed at various construction yards spanning upto 400 meters in length.

Framework of superlift structures is composed of triangular lattice girders.

Materials: Duraluminum (light, strong alloy), carbon fibre-reinforced plastic, aluminium glass fibre reinforced laminate.







5 Superlifts are transported to main construction yards via freight ships.





## **Construction Phases of Skyport**





10 While the skyport is floating close to the ground, the gantry crane will be installed at the bottom of the vessel. It will begin lifting and securing the freight rings one by one until they are all joined to the main structure.
# Skyport - Construction Phases



















# Once Skyport is Constructed......and transported to the Port of Roterdam



Initial Phase Total Container Port Capacity: 15,000 TEU.





-Inceased Capacity -Better Efficiency, Speed of exchange -Lower Cost





Phase - 1 1 SkyPort Capacity: 1.200 TEU. Plugin to the existing port infrastructure as an expansion

-Inceased Capacity -Better Efficiency, Speed of exchange -Lower Cost





Phase - 3 15 SkyPort Capacity: 18,000 TEU. Totally replacing the container ports by Skyports and staging them near coasts.

-Using freed port ares for recreation. -No need for connection to land transportation infrastructure



# Section Through the Container Port



1 Large size Skycraft - between Skyports

2 Middle size Skycraft - to distribution centers

3 Small size Skycraft - to other ports, container ships

50 100 300m

0





# Skyport Design

Concept Drawings

3D Renders

Sections - Elevations

Facade Detail

**Renders in Context** 

# Skycraft Early Sketches









Sky-Craft, mble, ceived, holdohan, disked. For them the idea of being afters sourity, identity, fixity, all the Illusory comports of the controlled, the known in advance, the predicted, the designed.

apple show pake = dunishe is all !

But the domain of the dies is too. complex in its aurents and counter currents, too transitory in its invisible pluitity, too uncertain, in its potentials. Letters Woods

Aerici numads, habiting their supersists, in an intensive, deep and intensite symbolicsis

The cropts are like sup-boards pouring through the crean of spore in intensive currents (time?) resonate currents

They are territories, the spider webs, to add attact from notive, does the sensetions affects, in order per indeterminate, artside to perce though our etsh 2 aistence.





Storyboard for Skyport for Final Rendering







## Skyport Envelope



#### Skyport Envelope:

The envelope structure is composed of vertical ribs and horizontal beams strengthened by tension cables. The airframe is composite aluminum alloys. The large truss beams carriving the ring, also contains all the mechanical installations, emergency evacuation capsules and environmental sensors. Furthermore on the top surface of the envelope are heat and pressure sensors to detect fluctuations in the climate.



#### Skyport Envelope:

The upper envelope contains the lifting gas, helium as well as air ballonets. A social ring is attached to the envelope which houses the social spaces above and the office spaces for port authorities below. These spaces are entered through the side decks on the broad side of the ship and are pressurized and heated by a climate control system. The lower spaces are also naturally lighted by indirect sunlight bouncing from the clouds below. All the social spaces are linked by a express shuttle system at the periphary of the envelope.

The upper parts of the envelope is penetrated by social decks and observation platforms, ending with the skydeck at its apex. The vertical circulation spine which connects the freight towers with the envelope connects all the social spaces together.

## Skyport - Gondola







Skyport - Elevations





## Skyport Aerial and Exploded Perspective





#### Central Spine

Vertical distribution shaft connecting import and export aprons and moving goods and people among different floors. Import - Export Aprons The alignment of import and export aprons that are attached to the central spine. Automated Container Tower The layout of central spine, import - export interfaces and container rings together with the installation of windshield to the front of the structure.





#### Technologies incorporated:

Ship Docking systems



• remote release system



monitoring

 mooring line load docking aid system



 environmental monitoring sys.



 central monitoring interface



 quay gantry cranes

Airship Docking sys.





mast probe cables

 reaction control sys.

### Skyport Docking Systems



Skyport docking system serving three skycrafts simultaneously.



Section through Skyport Docking System

Flow of container freight through skyport interface

Skyport Docking Systems - EXPORT



Skyport export interface showing three skycrafts docking at the same time and exchanging cargo.



Gantry crane and mooring details of skycraft.



Container ring and open export apron in view.

#### Skyport Social Spaces - Unautomated



#### Skyport - Social Ring - Facade Detail









Skyport Aerial Cluster - Automated Container Port Altitude: 10,000 m.