THE FUTURE OF VERY LARGE SUBSONIC TRANSPORTS

R. Steven Justice,
Anthony P. Hays, & Ed L. Parrott

Advanced Design
Lockheed Martin Aeronautical Systems
The Vision

Bel Geddes Air Liner Number 4 (1929)
VLST - Past & Present

Dornier Do X (1929)

Saunders-Roe S.R. 45 Princess (1952)

Boeing 747 (1969)
Today's Situation

- Slot Limits At Existing Airports
- Traffic Growth Outpacing New Airport Development
- Bigger Aircraft Required To Increase System Capacity & Productivity
- Heavy Airlift Military Aircraft To Be Replaced In Early 21st Century
Airport Congestion
Kennedy International Airport
International Passengers Vs Aircraft Movements

Millions of Pax
Thousands of A/C


SCH INT PAX
SCH INT A/C

Lockheed Martin
How Did We Get Here?

- No Significant Increases In Aircraft Capacity Since Early 1970's

Aircraft Size Growth Since 1940

- Year
- Passengers (Standard)
- 0 50 100 150 200 250 300 350 400 450 500
VLST Missions

- Passenger Transport
  - 600 to 800 Passengers Over Global Distances

- Commercial Freighter
  - 6.5% Annual Cargo Growth
  - Increased Use Of ISO & Intermodal Containers

- Military Airlift
  - Payload Of C-5 Over Global Distances
Key Design Challenges

- Size Issues & Constraints
  - Clearances At Gates, Taxiways, & Runways
  - Ground Loading & Floatation
- Increased Aircraft Separation Requirements
  - Increased Power In Wing Vortex
  - Increased Separation Will Reduce Aircraft Throughput At Airport
Key Design Challenges

- Taxiway Clearance

PANY&NJ Aviation Department

Lockheed Martin
Key Design Challenges

- Loading & Servicing
  - Compatibility With Current Gates
  - Servicing Vehicle Congestion
  - Longer Time Required For Loading & Servicing
Key Design Challenges

- Ground Support

“Airport Support”, December 1994
Key Design Challenges

- Gate Compatibility
Key Design Challenges

- Emergency Systems
  - Emergency Exit/Slide Height
  - Passenger Escape From Emergency Site
  - Emergency Systems Must Handle Up To 1,600 Victim Event (2 Aircraft)
Key Design Challenges

- Aircraft Noise Requirements
- Fabrication Of Large Composite Structures
- Control Of A Large Flexible Structure
Enabling Technologies

- Fly-By-Light/Power-By-Wire
- Active Control Systems
- Simple, Effective High Lift Systems
- Laminar Flow (Hybrid & Natural)
- Flight Deck Systems
- Modular Design
Options For VLST

- **Boeing 747-400F**
  - Wingspan: 231 ft
  - Length: 231 ft
  - Maximum Payload: 270,000 lb

- **Lockheed Very Large Airplane**
  - Wingspan: 243 ft
  - Length: 243 ft
  - Maximum Payload: 300,000 lb

- **McDonnell Douglas Blended Wing-Body**
  - Wingspan: 235 ft
  - Length: 235 ft
  - Maximum Payload: 300,000 lb

- **Lockheed Spanloader**
  - Wingspan: 231 ft
  - Length: 231 ft
  - Maximum Payload: 270,000 lb

- **Airbus Super Transporter A300-600ST**
  - Wingspan: 147 ft
  - Length: 147 ft
  - Maximum Payload: 100,000 lb

- **Molniya 1000 Hermes**
  - Wingspan: 230 ft
  - Length: 230 ft
  - Maximum Payload: 922,000 lb

*Lockheed Martin*
Options For VLST

- Sea Based Vehicles
  - Conventional Seaplane
  - Wing In Ground-Effect (WIG)
- No Runway Construction
- Use Existing Cargo Port/Terminals
- Increased Emergency/Alternate Landing Sites
Options For VLST

- Lockheed/Dornier Sea-Based VLST
  - 3,500 Nm Range With 882k lb Payload
  - 2.2M lb MTOW
Options For VLST

- Lockheed Martin Sea-Based WIG
Who Will Build The VLST?

- McDonnell Douglas
- Boeing
- AIRBUS
- Lockheed Martin
LMAS VLST

- 1.4 Million Pound Takeoff Weight
- 282 ft Wing Span (211 ft Folded)
- 262 ft Length
- 4 GE90, RR Trent, Or PW4000 Class Engines
- 3,200 Nm Range With Over 400k lb Payload

Lockheed Martin
Comparison To C-5

LMAS VLST

Lockheed Martin
LMAS VLST

- Passenger Layout (950 Passengers)
LMAS VLST

- Cargo Layout (16 ISO 40 ft Containers)
LMAS VLST

- Low Wing Concept
LMAS VLST

- Blended Wing/Body Concept
Routes That Could Use A VLST Today

London - Tokyo
London - Hong Kong
London - Singapore
New York - London
New York - Paris
New York - Frankfurt
Tokyo - San Francisco
Tokyo - Los Angeles
Tokyo - Honolulu
Hong Kong - San Francisco
## VLST Market

*(By 2010)*

- Big Enough For More Than One Aircraft?

<table>
<thead>
<tr>
<th>Region</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia/Pacific</td>
<td>160-200</td>
</tr>
<tr>
<td>USA</td>
<td>70-100</td>
</tr>
<tr>
<td>Europe</td>
<td>50-70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>280-370</strong></td>
</tr>
</tbody>
</table>

(British Airways Forecast)

---

*Lockheed Martin*
How Much Money?

- $8-15 Billion Development Cost
  - More Than One Company Can Handle
- $200-300 Million Unit Cost
  - Larger Than Annual Profits For Many Airlines
  - Unlikely To Be Internally Financed By Airline & Leasing Companies
  - Resulting High Capital Cost For Operator
Summary

- VLST Is Technically Possible Now
- Airline Interest Has Decreased Recently Due To Financial Difficulties
- Major Aircraft Manufacturers Are Poised To Act Once Economics Improve
VLST - Argosies Of The Sky!

"For I dipt into the future, far as the human eye could see,
Saw the Vision of the world, and the wonder that would be;
Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales."

Lord Tennyson