THE PAST PRESENT AND FUTURE WITH AIRCRAFT AND THEIR ENGINES

A PERSONAL VIEW

BY Dr Ken Ramsden

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CONTENTS

HISTORY OF FLIGHT
EARLY COMMERCIAL AVIATION COMPETITION
CURRENT TECHNOLOGY OF CIVIL AIRCRAFT
THE NEAR FUTURE WITH CIVIL AIRCRAFT
THE LONG TERM FUTURE FOR CIVIL AIRCRAFT??
HISTORICAL DEVELOPMENT OF AIRCRAFT ENGINES
CURRENT AIRCRAFT ENGINES
FUTURE ENGINE DEVELOPMENT
MODERN MILITARY AIRCRAFT AND ENGINES
HISTORY OF FLIGHT

1903 Wright Brothers – First Powered Flight - Kittyhawk
OR SANTOS DUMONT

1947 Chuck Yeager
Sound Barrier X-1

1961 Yurij Gagarin – Space Flight
HISTORY OF FLIGHT

THE THIRTIES AND FORTIES

BATTLE OF BRITAIN FLIGHT

SUPERMARINE SPITFIRE

AVRO LANCASTER

HAWKER HURRICANE
HISTORY OF FLIGHT

THE FIFTIES AND SIXTIES

THE AVIATION MONOPOLY RACE

BLIGHTED BY POLITICS

TSR2
Mach 0.9 at sea level
Mach 2.2 at 60000 ft

COMMERCIALLY UNSUCCESSFUL ??

CONCORDE – MACH 2 AT 60000 FT
_FF IN MARCH 69, LAUNCHED IN 1976_

“OLYMPIC ENGINES”
HISTORY OF FLIGHT

TSR2 AND (FLYING) VULCAN

AT DUXFORD

TSR 2 - XR222
EARLY COMMERCIAL AVIATION COMPETITION
EARLY COMMERCIAL AVIATION COMPETITION

TECHNICALLY UNSUCCESSFUL ??

SQUARE WINDOWS
WITH HIGH CORNER STRESS

Ken’s theory

LOW FREQUENCY PISTON ENGINES
VERSUS

HIGH FREQUENCY GT’S ??

COMET - Mach 0.85 AT 36000 FT
FF JULY 49
LAUNCHED JAN 52
DeH GHOST ENGINES
WITHDRAWN EARLY 80’s
EARLY COMMERCIAL AVIATION COMPETITION

COMMERCIALY SUCCESSFUL

BOEING 707

FF JULY 54
LAUNCHED OCT 58
ENGINES JT3D OR CFM56

BOEING 737

FF APRIL 67
LAUNCHED FEB 68
ENGINES JT8D OR CFM56
CURRENT TECHNOLOGY OF CIVIL AIRCRAFT
CURRENT TECHNOLOGY OF CIVIL AIRCRAFT

PROPOSED BOEING STRETCHED 747 ON HOLD

BOEING DO NOT EXPECT MARKET TO DEMAND A LARGER AIRCRAFT IN THE NEAR FUTURE

WINGLETS INCREASE LIFT

DESIGNED AT CRANFIELD
CURRENT TECHNOLOGY OF CIVIL AIRCRAFT

AIRBUS VIEW

MARKET WILL GROW BY 2.5 + TIMES IN NEXT 20 YEARS

EXISTING SLOTS SATURATED SO MORE FLIGHTS VERY DIFFICULT AND EXPENSIVE REQUIRING MORE RUNWAYS ETC

THEREFORE AIRCRAFT SIZE MUST GROW

AIRBUS A380

FF APRIL 2005

SERVICE ENTRY 2007 – SINGAPORE A/L

2008 WITH FEDERAL EXPRESS
THE NEAR FUTURE WITH CIVIL AIRCRAFT
THE NEAR FUTURE WITH CIVIL AIRCRAFT

BOEING SONIC CRUISER

CLAIMS FOR 15 – 20% FASTER WOULD SAVE 1 HOUR ON (SAY) NEW YORK TO LOS ANGELES FLIGHT

NOW SHELVED THROUGH LACK OF PURCHASER SUPPORT

BOEING SONIC CRUISER

MACH 0.95 – 0.98
AT 40,000 FT
THE NEAR FUTURE WITH CIVIL AIRCRAFT

THE BOEING 787 DREAMLINER
(REPLACES THE SONIC CRUISER)

Entry into service in late 2010

- 200 to 300 passengers
- Range = 16,000 km
- Cruise Speed: Mach 0.85

FUSELAGE LARGELY NON-METALLIC

It is claimed it:

- Will be “super-efficient with new passenger-pleasing features”
- Will bring large transport economics to the middle of the market
- Will use 20 percent less fuel than any other airplane of its size
THE NEAR FUTURE WITH CIVIL AIRCRAFT

THE BOEING 787 DREAMLINER

SEVERAL VARIANTS

<table>
<thead>
<tr>
<th>AIRCRAFT ORDERS</th>
<th>448</th>
<th>(2008)</th>
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<tbody>
<tr>
<td>AIR NEW ZEALAND</td>
<td>8</td>
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<tr>
<td>AL NIPPON</td>
<td>50</td>
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<tr>
<td>AIR CANADA</td>
<td>14 + 46 OPTIONS</td>
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<tr>
<td>QUANTAS</td>
<td>45 + 60 OPTIONS</td>
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<tr>
<td>OTHERS</td>
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ENGINES

| GENERAL ELECTRIC GENX (GE 90 DERIVATIVE) |
| ROLLS-ROYCE TRENT 1000 |

COMPOSITE FAN

CABIN FEATURES

| DYNAMIC LIGHTING |
| LARGER WINDOWS |
| TRANSPARENCY VARIABLE WINDOWS |
THE NEAR FUTURE WITH CIVIL AIRCRAFT

THE BOEING 787 DREAMLINER

CREATURE COMFORTS
THE LONG TERM FUTURE FOR CIVIL AIRCRAFT
THE LONG TERM FUTURE FOR CIVIL AIRCRAFT

STAGED FLIGHTS

BLENDED WING BODY AIRCRAFT

DISTRIBUTED PROPULSION

UNMANNED AIR VEHICLES – UAV’S
STAGED FLIGHTS

(GLOBAL WARMING MEASURES)

WHY NOT

FLY TO SINGAPORE ETC WITH A STOP-OFF EN-ROUTE ??
THE LONG TERM FUTURE FOR CIVIL AIRCRAFT
A RESEARCH AIRCRAFT
BLENDED WING BODY – BWB
ULTRA LOW DRAG AIRCRAFT
with boundary layer control
THE LONG TERM FUTURE FOR CIVIL AIRCRAFT

DISTRIBUTED PROPULSION
THE LONG TERM FUTURE FOR CIVIL AIRCRAFT??

UAV’s FOR COMMERCIAL TRAVEL ???

Global Hawk - RR AE 3007
HISTORICAL DEVELOPMENT OF AIRCRAFT ENGINES
HISTORICAL DEVELOPMENT OF AIRCRAFT ENGINES

SFC
SFC t/ jet

BYPASS RATIO

RB162
VIPER
OLYMPUS
CONWAY
J79
AVON
F404 (0.35-0.4)
EJ200 (0.35-0.4)
F100 (0.6)
SPEY (0.6-1.0)
PEGASUS (1.2)
RB199 (1.1)
TAY (3.0)
PW 4000
CF6
RB211
TRENT
GE90
CFM56
CURRENT AIRCRAFT ENGINES
CURRENT AIRCRAFT ENGINES

PAST TO PRESENT WITH ROLLS-ROYCE ENGINES
CURRENT AIRCRAFT ENGINES

LARGE TURBOFAN ENGINES
Trent – Comparison to GE90

Long flexible HP shaft = poor tip clearances
FUTURE ENGINE DEVELOPMENT
FUTURE ENGINE DEVELOPMENT

ALTITUDE (Km)

FLIGHT MACH NUMBER

1 2 3 4 5 6

TURBOPROP
TURBOFAN (HIGH BPR)
TURBOFAN (LOW BPR)
TURBOJET (SST)
SCRAMJET
RAMJET
ROCKET

PROPFAN

ORBIT ! *

ALTITUDE AND NOISE LIMITED

THEN MASS RAPID TRANSFER ??

ALTITUDE AND NOISE LIMITED
FUTURE ENGINE DEVELOPMENT

ZIMBRICK VIEW

BYPASS RATIO WILL NOT EXCEED 20 ???
FUTURE ENGINE DEVELOPMENT

VARIABLE CYCLE ENGINES

TIP TURBINE DRIVEN TURBOFANS

SUPERSONIC THROUGHFLOW FANS

INTELLIGENT COMPRESSORS

CERAMICS
OSPREY
Old Generation Versus New Generation

- Comparison between **Pegasus (RR)** and **F135-PW-600(P&W RR)**

Vs

Harrier II

F-35
MODERN MILITARY AIRCRAFT AND ENGINES

The Joint Strike Fighter Aircraft - JSF
MODERN MILITARY AIRCRAFT AND ENGINES

Joint Strike Fighter

Three Variants:

X-35A  Conventional Takeoff and Landing (CTOL)
X-35B  Short Takeoff and Vertical Landing (STOVL)
X-35C  Carrier Variant (CV)
MODERN MILITARY AIRCRAFT AND ENGINES

Requirements for JSF

- **USN 480**
  - Multi-role, stealthy strike fighter to complement the F/A-18E/F

- **USAF 1763**
  - Multi-role (primary air-to-ground) fighter to replace the F-16 and A-10 and to complement the F-22

- **USMC 609**
  - Multi-role, short takeoff, vertical landing strike fighter to replace the AV-8B and F/A-18C/D

- **UK (RN and RAF) 150**
  - Supersonic STOVL replacement for the Sea Harrier and GR-7
END OF PRESENTATION