

Presented by

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**A new generation,
A new experience**

A380 Technical Route Proving
November 2006



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全新一代，崭新体验

A380技术航线验证
2006年11月



A380 Technical Route Proving

(3 times) Around the World in 18 days



Good morning, ladies and gentlemen and my personal welcome to this short briefing on the A380 Technical Route Proving test flight programme that will bring the aircraft here to China.

The flight test programme for the A380 has been one of the most successful in the history of Airbus. From the early test flights, where the target was to assess the general handling of the aircraft, we have continued with individual tests covering airfield performance, operational capabilities, examining fuel flows, climb rates, airfield noise, etc. At the same time we have also been looking at all the systems on the aircraft, covering not just normal operations but also checking the continued safe operation of the aircraft with various failure modes.

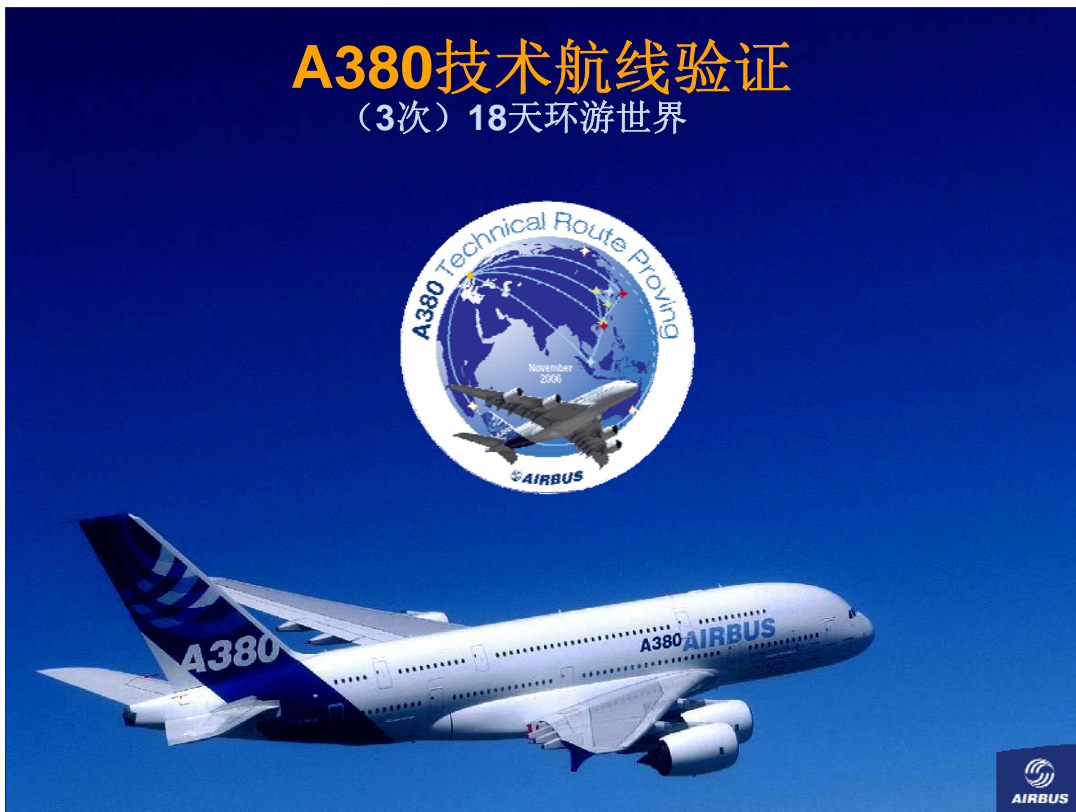
Throughout all of these trials, that have taken the aircraft from the cold of Northern Canada to the desert heat of the Persian Gulf, the aircraft has met and in many cases surpassed all its design targets.

Now we are almost at the last step in the journey that leads to certification of the aircraft by the regulatory authorities in Europe and the USA. Having brought the aircraft through all the required test scenarios, plus those we have placed on ourselves to assess the maturity of the programme, we reach the last stage where the authorities will review the operation of the aircraft in its normal operating environment.

But what, in detail is a 'Technical Route Proving programme'?

A380技术航线验证

(3次) 18天环游世界



女士们,先生们,早上好!欢迎大家参加A380航线验证的简介会。A380将会来到中国进行技术航线验证测试飞行。

A380的飞行测试项目是空客历史上最为成功的项目之一。从早期的以评估飞机总体勤务情况为目的的测试飞行开始,我们分别进行了各种飞行测试,包括机场性能,运行能力,燃油流量检查,爬升率,机场噪音等。同时我们一直关注飞机的所有系统,不仅测试正常运行的情况,同时也测试在各种故障模式下飞机的持续安全运行。在这些测试中,飞机飞越寒冷的加拿大北部到炎热的波斯湾沙漠腹地,飞机达到甚至在许多方面超出了设计目标。

走过了漫长的旅程,现在我们只剩下在欧洲和美国当局进行取证这最后一步。在通过了所有要求的飞行测试,和我们为了验证飞机成熟性另外增加的测试项目后,我们现在已经到了最后阶段,即当局评估飞机在正常运行环境下的运行。

但是,具体来说,什么是“技术航线验证项目”呢?

What is Technical Route Proving?



- **There is a certification requirement to accumulate 300 flight hours of representative operational flying.**
- **150 flight hours performed on MSN 2 have already been credited towards this requirement.**
- **The remaining 150 FH will be achieved by carrying out a dedicated Route Proving Campaign on the same aircraft during which:**
 - ▶ **The aircraft will be operated on a continuous schedule, as though it were in service.**
 - ▶ **The flights will include a range of representative ambient operating conditions and airfields.**
 - ▶ **The aircraft will be operated, under Airbus responsibility, by Airbus and Airworthiness Authorities (EASA and FAA) flight crews.**



Technical route proving flights are part of a process that examines the operating functionality and reliability of the complete aircraft. Around half of this process has already been completed, either in the normal test process or during the 'Early Long Flight' programme undertaken in September this year involving full passenger loads over a variety of flight lengths.

For this last stage we will be operating the aircraft on a series of routes with an operating pattern similar to that which will face the aircraft once it enters service.

As you can see, this is a joint undertaking between Airbus and the European and US authorities. Successful completion of these flights will lead to the issuing of the Certification of Airworthiness for a Transport Aircraft by EASA, jointly with the FAA. This then provides the basis for individual certification by the local authorities of each of our customer airlines. The initial certification basis is for the version of the aircraft powered by Rolls-Royce Trent 900 engines. A similar process is already underway for the Engine Alliance GP 7000 powered version of the aircraft and that will be finalised next year.

什么是技术航线验证？



- 认证要求在具有代表性的运行状态下累计飞行**300小时**
- **MSN 2**已完成的**150小时**已被计入累计的飞行小时
- 剩余的**150个**飞行小时将由同一架飞机的特定航线验证活动来完成，在这期间：
 - ▶ 飞机将连续飞行，模拟在役运营状态
 - ▶ 飞行将包括各种具有代表性的周边运行条件和各类机场
 - ▶ 此活动属空客的责任，飞行任务将由空客和适航当局（**EASA**和**FAA**）的飞行机组来完成



技术航线验证飞行是检测整架飞机运行功能和可靠性过程的一部分。整个过程已经完成了大约一半，包括正常的测试程序和今年9月份满载旅客时在不同的飞行长度情况下进行的“早期远程飞行”项目。

在这最后的阶段，飞机将在一系列的航线上模拟正常投入运营后的运营模式运行。

正如各位所看到的一样，这是空客和欧洲以及美国的适航当局联合进行的项目。在成功的完成这些飞行之后，**EASA**将与**FAA**联合颁发运输飞机适航证。这为我们的航空公司客户在本国的当局认证奠定了基础。初始认证的是发动机为罗罗遄达**900**的飞机。装备联合发动机公司**GP7000**发动机的飞机也正在进行相似的过程，明年将会完成。

The Technical Route Proving network



November 13-16: TLS – SIN – ICN – SIN – TLS

November 17-20: TLS – HKG – NRT- TLS

November 21-24: TLS – CAN – PEK – PVG – TLS

November 25-30: TLS – JNB – SYD – YVR - TLS



The network chosen for these initial tests takes the aircraft to several of the airports that will regularly see the aircraft in its early years of operation. Apart from the headquarter cities of some of our existing customers, in Singapore, Seoul, Guangzhou, and Sydney, the flights will also visit major traffic centres in Hong Kong, Tokyo, Beijing, Shanghai, Johannesburg and Vancouver.

The total distance covered during the four operations will be over 125,000 km, or more than three flights around the equator.

During the flying programme we will also be undertaking some additional testing of the aircraft and systems. Apart from monitoring aircraft and cabin systems on the transit flights, we will, for example, be taking the opportunity in Johannesburg to carry out autoland assessments at the relatively high elevation there. The fourth flight also sees the aircraft testing the navigation system in a polar environment by transiting over both the South and North Poles on its round the world journey.

As the aircraft is still in its test configuration, it will not be undertaking any passenger demonstration flying. A separate commercial route proving exercise will take place next year, with the fully certificated aircraft.

技术航线验证的网络



11月13-16日: 图卢兹 – 新加坡 – 首尔仁川 – 新加坡 – 图卢兹

11月17-20日: 图卢兹 – 香港 – 东京成田 – 图卢兹

11月21-24日: 图卢兹 – 广州白云 – 北京 – 上海浦东 – 图卢兹

11月25-30日: 图卢兹 – 南非约翰内斯堡 – 悉尼 – 加拿大温哥华 – 图卢兹



这些初始测试所选择的网络包括A380在运营之初会经常到访的机场。除了一些现有客户的总部所在地城市之外，例如新加坡，首尔，广州和悉尼，飞机还将出现在一些主要的交通运输中心如香港，东京，北京，上海，约翰内斯堡和温哥华。

四次运行的总距离为**125,000**公里，等于绕赤道三周。

在飞行项目中，我们还安排了一些飞机和飞行系统的额外测试项目。除了在转场飞行中监视飞机和客舱系统之外，我们还会进行其它测试，如：在约翰内斯堡进行高海拔自动着陆评估。第四次飞行还通过北极和南极的转场环球飞行进行极地环境下飞机导航系统的测试。

飞机仍为测试构型，不会进行任何的载客演示飞行。明年飞机完全取证后，将会单独进行商业航线验证测试。

The test aircraft A380-800 MSN 002



The aircraft being used for these tests is MSN 002. As mentioned earlier, this aircraft was used for the 'Early Long Flight' passenger assessment tests. As such it does not have a fully representative airline style cabin.

Instead there are mixtures of First, Business, Premium Economy and standard economy seating spread across the two decks. Galley equipment also sees different manufacturer's equipment in different locations.

Apart from this variety of equipment, the aircraft also has installed large quantities of test equipment such as temperature sensors all of which provided valuable information during the ELF flights.

But, we don't always need volunteers to get this information. Our test team have their own 'passengers' – heat generating dummies that can be used to replicate typical on-board conditions. These tend to be quieter than most and very rarely complain about the standard of service. Which is just as well as the 'Cabin Crew', or flight test engineers, very rarely get to leave their workstation.

测试的飞机 A380-800 MSN 002



进行这些测试的飞机是MSN002。正如之前提到过，这架飞机曾经进行搭载旅客的“早期远程飞行”测试。因此，这架飞机并没有装备典型航空公司风格的客舱。

头等舱，公务舱，高收益经济舱和标准经济舱座位在飞机的上舱和主舱中是混合布置的。在飞机不同的地方可以看到由不同的供应商提供的厨房设备。

除了各种设备之外，飞机也安装了大量的测试设备，如温度传感器等，所有这些设备在早期远程飞行中都提供了有价值的信息。

但是，要获取这些信息并不一定需要使用志愿者进行测试。我们的测试团队有他们自己的“乘客”——生成热量的假人，他们可以用于复制典型的机上条件。他们更加安静，而且很少抱怨服务的标准。他们就象乘务员或者是飞行测试工程师一样，极少离开工作岗位。

An outstanding aircraft



5 flight test aircraft, 2357 hours, 1683 take-offs

As at 3rd November 2006

Weight status – As defined in 2003

Airfield performance – Better than predicted

Range & fuel burn – All commitments met

Aircraft Handling – “ Superb”

Environmental performance – Better than predicted

Cabin comfort – Unprecedented

Certification scheduled for mid-December, 2006



So as we approach certification, having completed around 2500 hours of testing at the end of this TRP programme, what is the status of the aircraft?

In terms of empty weight the status is as defined in 2003, with early aircraft being less than 2% above specification values. We have seen nothing in any of the testing that has required major change to the aircraft and the optional design weights we offered to customers of early delivery aircraft will enable them to operate the aircraft as they intended. For later aircraft a programmed set of further weight reductions will see the aircraft get even closer to the specification standard. The current status of the initial production A380F, at around aircraft MSN 53, for example, is already less than 1% away from the nominal specification weight of the freighter, with ongoing detail design work likely to further improve this excellent position, which is already better than normal industry standards.

Regarding airfield performance, results of the flight test programme are demonstrating that the aircraft performs better than predicted for both take-off and landing. In fact the A380 will approach at the same speed as our A321, around 138 kts., at its maximum landing weight. This gives an actual landing distance of 1200m that will increase to around 2000m with the factoring required for operational use.

For en-route performance, the airframe and engine combination is again fully in line with the commitments we have made to our customers. At this stage there is obviously more data on the Rolls-Royce powered variant than that of the Engine Alliance, which first flew in August this year. However both engines are offering the level of fuel economy we had anticipated with specific fuel consumption levels at entry into service matching specification values.

In terms of environmental performance and the cabin qualities, the results of these trials have been so dramatic that they deserve to be looked at more closely, which we shall do shortly.

一个杰出的机型



5架用于飞行测试的飞机，2357小时，1683次起飞

截至2006年11月3日

重量状态 – 与2003年定义的相同

机场性能 – 优于之前的预期

航程及油耗 – 实现了所有承诺的指标

飞机勤务 – “极佳”

环境性能 – 优于之前的预期

客舱舒适性 – 前所未有的

预计于2006年12月中旬获得认证



在技术航线验证项目（TRP）之前，为了取证，我们已经完成了约2500小时的测试，那么飞机的情况如何呢？

2003年确定了飞机的空重，早期的飞机超出规格重量不到2%。经过了所有这些测试，我们没有看到对飞机做出大副调整的必要性。对于早期交付的客户，我们提供的可选飞机设计重量也能够使客户按照他们的期望来运行飞机。对于之后交付的飞机，会有一系列的项目来减轻飞机的重量，以接近规格中的标准。例如A380货机型的初始生产阶段是在MSN53左右，与标称重量之间的差异已经小于1%，现在我们已经做得比正常的工业标准好，随着详细设计工作的进展，还可以比现在做得更好。

从机场性能来看，机场性能测试结果显示起飞和着陆性能比预期更好。实际上，A380将以和A321相同的速度近进，在最大着陆重量之下速度约为138节。实际着陆距离为1200米，在实际运行要求的情况下，可增加到2000米。

从航线性能来看，机体和发动机的结合再一次实现了我们对于客户的承诺。在这个阶段，以罗罗为动力的机型数据比联合发动机为动力的数据要多，后者今年8月刚实现了首飞。但是两种发动机都能提供我们预计的燃油经济性水平，即特定燃油消耗量在投入运营的时候都能够满足规格的要求。

在环境性能和客舱质量方面，试验结果数据非常多，我们需要时间尽快来进行分析。

A380 A new generation



The successful completion of the certification programme and the excellent results achieved so far point to the inherent superiority of the A380. A combination of high quality aerodynamic design, advanced structures and systems collectively create the world's most efficient and economic airliner, the first of a new generation and designed to meet a 21st century operating environment.

A380 全新的一代



成功的完成取证项目和到目前为止取得的良好成绩充分证明了A380本身的卓越品质。A380具有出色的气动设计，先进的结构和系统，这些都造就了史上最高效和经济的飞机，也是满足21世纪运营环境的新一代飞机。

The most efficient large aircraft



Aerodynamics / Propulsion

- Optimised aerodynamics using the latest digital tools
- New materials and manufacturing for drag reduction
- Dual source new generation engines for lower fuel burn



Materials

- 25% advanced materials content
- Providing a 15 tonne saving over conventional materials
- Lighter weight for lower fuel burn

Systems

- Fully integrated, new generation systems
- Higher operational reliability, lower maintenance costs
- Supported by the most extensive maturity programme ever

Highly mature, state-of-the-art technology



Much of the technical excellence that continues to be demonstrated during the test programme comes from the use of advanced technologies in terms of aerodynamics, structural materials and aircraft systems.

In many areas the A380 has proven technologies that will become the standard for the next generation of airliners. As one example, the aircraft benefits from a higher proportion of carbon-fibre composite than any previous Airbus aircraft, around 22% compared with 12% for an A340-600 or 9% on a 777. For the first time, this technology has been applied to major components such as the centre-wing box, the heart of the aircraft structure.

The information and data management requirements for an aircraft as large as the A380 also have placed demands on system design. These have been met in two ways. The aircraft's avionics system uses 22 computers of 7 different varieties that share all the functions traditionally handled by individual 'black boxes'. Data exchange in the system utilises a high capacity and high speed ethernet datalink with data exchange at a rate of 10 million bits per second, 100 times the capacity of a traditional avionics system.

Outside this secure avionics world, information is managed by a further network of computer servers that provide operating data to flight and cabin crew, maintenance staff as well as providing passenger communication facilities.

Behind all of this technology is the most comprehensive product maturity programme with numerous test benches, rigs and simulators, culminating in the assessment of the whole plane package with our five flight test aircraft.

最高效的大型飞机



气动性 / 推力

- 使用最新的数字工具实现了气动性的最优
- 可减小阻力的新材料和制造工艺
- 两种低油耗的新一代发动机可供选择



材料

- 25%的先进材料
- 与传统材料相比，减重15吨
- 重量更轻，油耗更低

系统

- 完全整合的新一代系统
- 运行可靠性更高，维修成本更低
- 对系统成熟性的范围和程度要求最高的项目

运用了高度成熟的先进技术



随着飞行测试的进行，在飞机的气动性，结构材料和飞机系统方面所使用的先进技术其卓越性会不断的展示出来。

在很多方面，A380经验证的技术都将成为下一代飞机的标准。例如与以前的飞机相比，飞机采用了更多的碳纤维复合材料。A380复合材料的使用比例为22%，A340-600的比例为12%，777的比例为9%。这些复合材料技术也首次应用于主要的部件，比如中央翼盒和飞机结构的“心脏”。

对于象A380这样的大飞机，信息和数据管理对系统设计提出了要求。这些要求在两个方面得以满足。飞机的航电系统使用了7种类型的22台电脑来承担所有的功能，而这些功能以前是由各个“黑盒子”来执行。系统数据交换应用了大容量高速以太网数据链，数据交换速度为1千万比特每秒，是传统航电系统速度的100倍。

除了安全的航电系统，信息还通过计算机服务器网络来管理，可以向飞行及客舱机组，维修人员提供运行数据，或向旅客信息设备提供数据。

在所有这些技术的背后是最全面的产品成熟项目。整个项目通过无数测试台，测试装备和模拟设备，其成熟度在对五架飞行测试飞机的飞机包进行评估后达到了顶峰。

A clean sheet design – for unmatched efficiency



Fully designed using

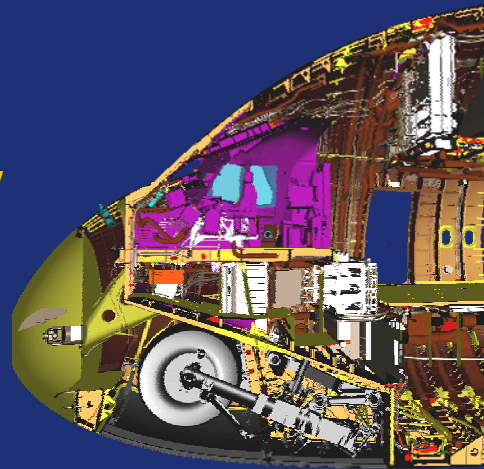
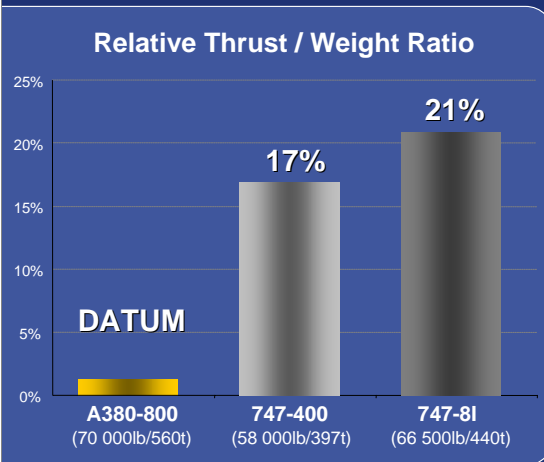
Computational Fluid Dynamics

Design and production using full

Digital Mock-Up

Incorporating

The latest technology



The A380 simply flies better

Another of the inherent benefits of the all new A380 is just that – it is a new design. As a result we have been able to use the most comprehensive design tools to achieve excellent aerodynamic performance. As one indication, the high standard of airfield performance proven in the A380 test programme is achieved with a significantly lower thrust to weight ratio than either the 747-400 or the proposed 747-8, which requires a 21% higher engine thrust to weight ratio, and over 16% more when comparing the two freighter variants, despite its advertised 'New Wing'. The conservatively rated engines on the A380 will give benefits for years to come by minimising engine maintenance costs.

Other tools have include a full digital mock-up of the aircraft and its systems, enabling the efficient location of components to ease maintenance access, while maximising the available cabin volume for passengers and crew.

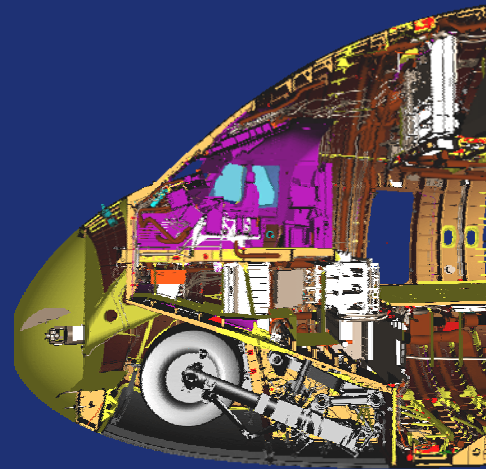
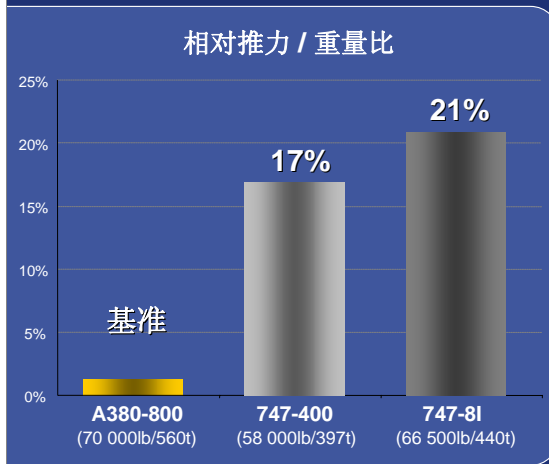
从零开始的设计 – 旨在实现无与伦比的效率



设计过程全部使用
计算流体动力学

设计和生产使用了完全的
数字模拟

融合了
最新的技术



A380的飞行性能无疑更佳

全新A380的另一个与生俱来的益处是她的全新设计。正因如此，我们能够使用最全面的设计工具来达到最优异的气动性能。比如，A380测试项目已经证明了飞机具有高标准的机场性能，推力与重量比比747-400或即将面世的747-800更低，后者要求的发动机推力与重量比比A380高出21%，两种货机型相比，比A380高出16%，虽然747宣称她具有“新型机翼”。较低的额定功率将使A380飞机在未来多年内发动机的维修成本降至最低。

其它的工具包括全数字飞机和系统模拟，可以使部件布局更合理、更高效，从而很容易的进行维修，同时可以使可用的乘客和机组客舱容积最大化。

Superior performance



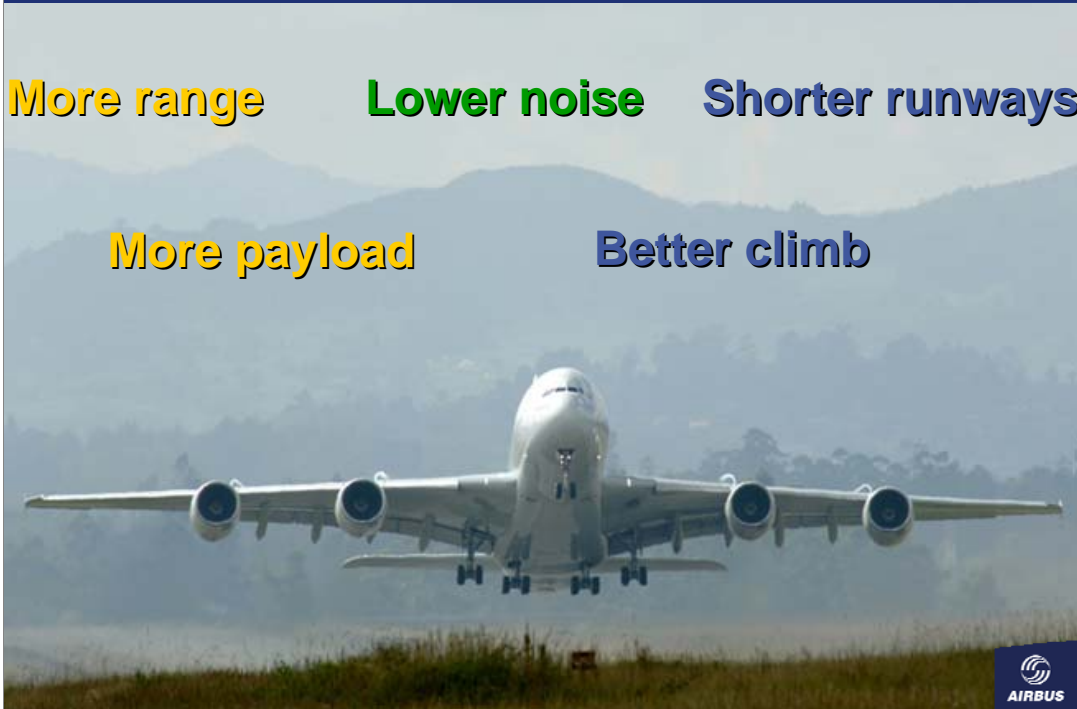
More range

Lower noise

Shorter runways

More payload

Better climb



The result of the careful matching of aerodynamics and power requirements is that the A380 is destined not only to be the market leader on the world's major trunk routes, but that it will also offer unbeatable performance levels. The ability to carry 555 passengers, 8000nm from a 10,000 ft runway at sea level on a 30 deg. C day is unmatched. In fact the A380, although 1/3 larger than the 747-400, takes off and lands in a shorter distance – this remains true when compared to both passenger and freighter versions of the proposed 747-8.

After take-off, the performance benefits continue, with the aircraft outclimbing the lumbering 747 and reaching an initial cruising altitude of 35000 ft in less than half an hour, 4000 feet higher than its predecessor and avoiding requirements for changes in flight level early in the flight, an advantage for air traffic controllers in increasingly busy airspace.

During the cruise, the high levels of A380 operating ability continue, with passengers benefiting from the aircraft's M0.85 cruise speed and excellent stability.

At the end of the flight, similar exceptional performance allows approach speeds similar to an Airbus single aisle family member.

Quite simply, the A380 Just Flies Better!

卓越的性能



航程更长

噪音更低

跑道更短

业载更多

爬升能力更强

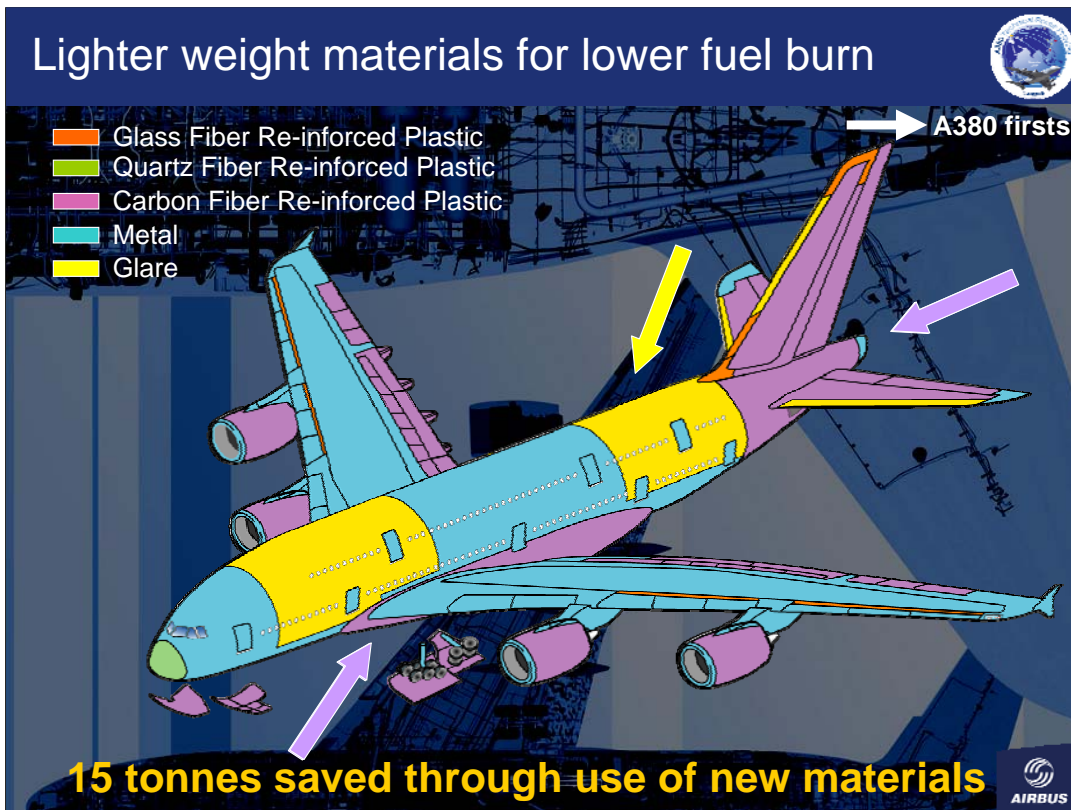


得益于气动性和动力需求的精心匹配，A380飞机注定是世界主要干线市场的领跑者，而且其性能水平也是无可匹敌的。A380飞机能够在搭载555名乘客飞行8,000nm航程条件下，在海平面30摄氏度时从10,000英尺长的跑道上起飞，这种能力是无与伦比的。事实上，A380虽然比747-400大1/3，但是起飞和着陆距离却更短—如果与即将面世的747-8的客机型和货机型相比的话，这个优势也同样成立。

起飞之后，A380性能的优势依然存在，与747略显笨重的爬升能力相比A380更胜一筹，A380能够在半个小时以内达到初始巡航高度即35000英尺，比上一代大型飞机高4000英尺，并避免了在飞行早期阶段更改飞行高度，这对于在日益繁忙的空域中的空管又是一个优势。

在巡航的过程中，A380仍保持了高水平的运行能力，在巡航速度为0.85马赫数时乘客能够感受到A380卓越的稳定性。

在飞行结束的时候，相似的杰出性能可以使飞机的近进速度与空客单通道系列飞机相似。一言以蔽之，A380的飞行性能更佳。



In addition to aerodynamic excellence, the A380 also makes use of advanced structural design. The choice of the materials and manufacturing techniques used quite specifically targets the overall economics of the aircraft as a priority. This has required the selection of the optimum material for each part of the structure, with particular attention being paid to appropriate material properties, availability of supply and, most importantly, weight. As a result metals are only used for around 70% of the weight of an A380. These are mainly advanced aluminium alloys of copper, zinc or lithium, with some steel and titanium.

The remainder consists mainly of a mix of different composite materials, plus the necessary surface treatments and the final paint scheme. The composites are a mix of Glass, Quartz & Carbon Fibre Re-inforced Plastic with major applications in the centre wing box and tail fuselage assemblies, both primarily CFRP.

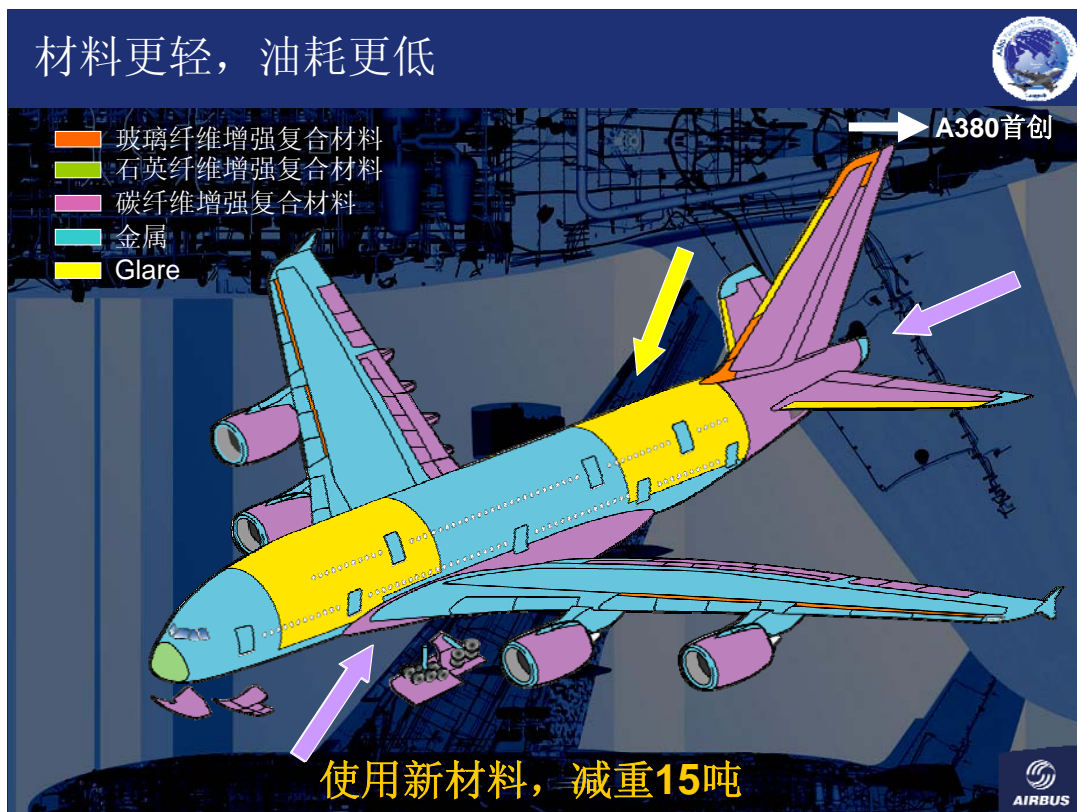
Another advanced material is Glare, a fibre / metal laminate used as primary structure for the first time on the A380 with applications as fuselage skins and in leading edge of both the vertical and horizontal stabilisers.

This efficient mix of material offers a 15 tonne relative improvement in payload over a similar-sized aircraft using previous technologies, a weight saving that directly benefits fuel consumption.

Structural manufacture of the aircraft also uses new methodologies such as the use of laser technology to provide continuous welding of skins to stringers in the lower fuselage area, reducing stress points and eliminating areas traditionally prone to corrosion.

A380 structure – designed for long life and low weight.

材料更轻，油耗更低



除了卓越的气动性之外，A380同时也使用了先进的结构设计。在选择所使用的材料和制造技术方面，飞机的整体经济性被视为是一个重要目标。这就要求飞机结构的每部分都要选择最佳的材料，同时考虑到材料的特性是否合适，及其材料的供应，以及最重要一点——材料的重量。因此，金属材料仅占了A380重量的70%。这些金属材料主要是高级铜铝、锌铝或锂铝合金，还有部分钢和钛合金。

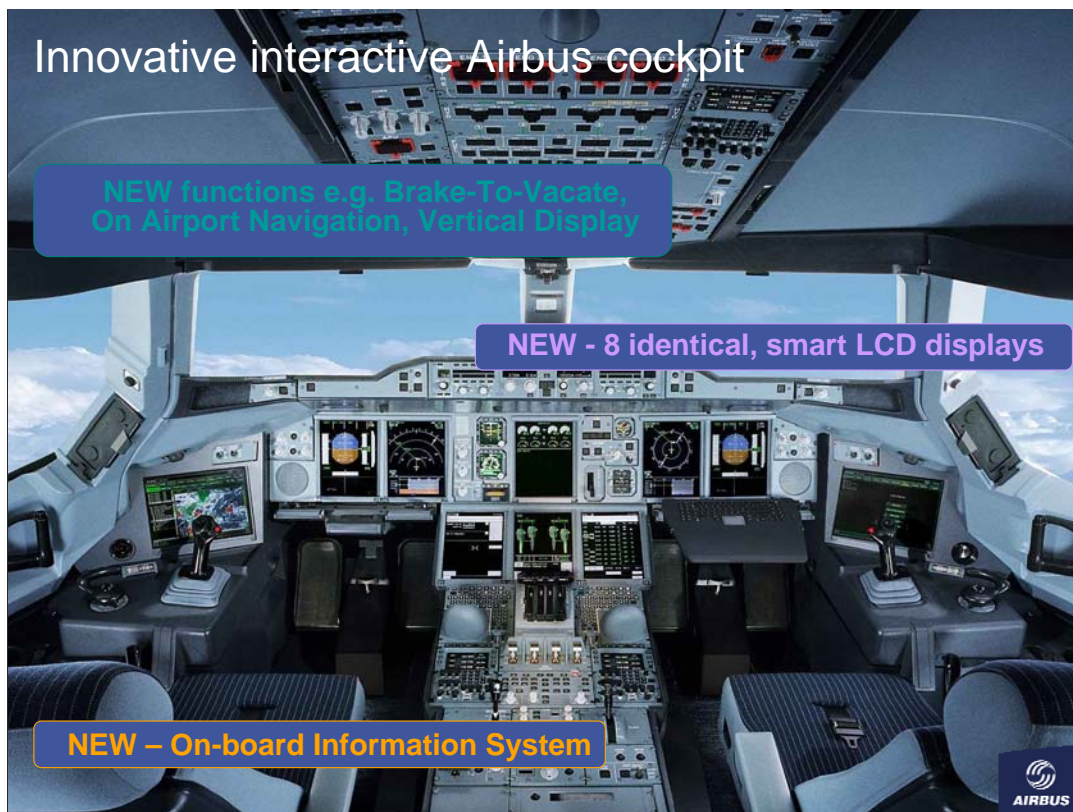
其余的部分由不同的复合材料组合而成，然后进行必要的表面处理和最后的喷漆。复合材料有玻璃纤维、石英纤维和碳纤维增强塑料，这些材料主要应用于中央翼盒和机身尾部，主要是碳纤维增强增强塑料。

另外一种高级材料是Glare，一种纤维/金属层压材料，首次在A380上应用于主要结构，即机身蒙皮，垂直和水平安定面前缘。

这种材料的高效组合使A380比使用上一代技术的尺寸相似的飞机多了15吨的业载，飞机重量的降低直接带来燃油消耗方面的好处。

飞机的结构制造过程中也使用新的方法，例如使用激光技术来提供蒙皮和机身下部的桁条之间的连续焊接，减少应力点和消除传统方法下易腐蚀的区域。

A380结构一旨在延长寿命和降低重量



Within the aircraft some of the most visible of the systems developments on the A380 occur in the flight deck. This retains the classic Airbus layout and so ensures that the A380 meets the requirements for cross-crew qualification and mixed fleet flying. However, advantage has been taken of technological change to enhance the working environment for the crew.

For example the A380 is equipped with 8 identical smart Liquid Crystal Displays, covering all primary operational, systems management and communications requirements. These 'smart' displays generate images using raw data rather than from a symbol generator. This enables rapid reconfiguration in the event of screen failure, and, as they are all identical, spares costs can be reduced. Being interactive, dynamic management of the flight plan or check lists can be done using the keyboard and cursor control unit in the centre pedestal.

The larger size of the screens also enables new display features such as vertical flight profile views as well as the traditional horizontal view. Integration of video displays from the external cameras and active mapping of the aircraft's position at an airport are some of the additional facilities available. The On-board Airport Navigation System can be seen as the equivalent to a car navigation systems, providing the crew with guidance between runway and ramp. However the A380 goes further by offering a Brake-To-Vacate function that enables the crew to pre-select their runway turn-off point, giving benefits to airport ground controllers, passengers, who will surely not miss the sudden heavy braking that sometimes occurs, and to the airlines that will see improved brake life from the a properly managed braking system.

This is just one area where focused attention is leading to reduced maintenance costs. In particular, Airbus has developed the On-board Maintenance System (OMS) that provides maintenance documentation in an electronic format (e.g. Master Equipment List, Trouble Shooting Manual) greatly facilitating trouble-shooting for the maintenance staff during a turn-around and preserving scheduled departure times.

The logbook in which the crew members record any encountered failures is also in electronic format and uses standardised terminology entered via the keypad installed in the pull-out tray avoiding inconsistencies or an incomplete failure message report.

The OMS is also part of the comprehensive On-board Information System which provides the crew with all the operational data traditionally carried in a pilot's flight bag. Again access is via the table key pad, with information displayed on the two large screens on either side of the main panel.

The end result is a system that offers real flight management capabilities to the crew as well as comprehensive data for analysis by the maintenance team - a combination designed to maximise the effectiveness of the aircraft.



A380上最明显的系统改进之一是在驾驶舱内。由于保留了传统的空客布局，因此保证A380符合交叉机组驾驶资格和混合机队飞行的要求。但是，A380应用了技术的进步来加强机组人员的工作环境。

例如，A380装有8个相同的智能液晶显示器，覆盖所有主要的运行管理、系统管理和通信要求。这种智能显示使用原始数据而非符号生成器来生成影像。这使得在屏幕故障时能够快速重构，而且因为这些显示器都是相同的，备件的成本也得以降低。由于互动性很好，飞行计划或检查清单的动态管理可以通过使用中央操纵台键盘和指针控制组件来完成。

更大尺寸的屏幕允许发展新的显示功能，例如能够同时显示纵向飞行剖面图和传统的横向飞行剖面图。来自外部摄像机的视频显示和飞机在机场位置的主动绘图的一体化就是其中额外增加的功能。机载机场导航系统和汽车的导航系统一样，为机组人员提供跑道和机坪之间的引导。不仅如此A380还提供了自动刹车脱离跑道功能，能够使机组预选跑道退出点。这给机场地面控制人员和乘客带来好处，突然的重刹车是谁都不想见到的。同时这也给航空公司带来好处，因为恰当的管理刹车系统可以延长刹车寿命。

这仅仅是减少维修成本的其中一个重点领域。特别值得一提的是，空客已经开发出机载维修系统（OMS），能够提供电子格式的维修文件（例如主设备清单、排故手册）大大方便了维修人员在过站时间的排故，从而保证了预定的离港时间。

机组人员用于记录故障的日志也是电子格式的，并使用标准化术语，这些术语通过拉出式托盘上的键盘输入，以避免术语的不一致或不完整的故障信息报告。

机载维修系统（OMS）也是综合机载信息系统的一部分，机载信息系统能够为机组人员提供所有运行数据，这些数据以前装载在飞行员的飞行箱里。通过拉出式托盘上的键盘可以进入这个系统，信息会显示在主面板两边的两个大屏幕上。

最后的结果是这个系统既能够使机组人员真正实现飞行管理，又能为维修人员提供综合数据以进行分析——一个旨在使飞机有效性最大化的组合。

A380: what airline pilots have to say



"Compared to the A320, you do not feel the difference in flight. Although much bigger than the A320, the A380 is easy to taxi."



"The aircraft is very stable but also very responsive; more like flying an A320 than an A340."

"Please do not change the handling qualities of this a/c!"

"I have been flying all the fly-by-wire types of Airbus. It's the same situation here with the A380: it's very easy to fly these aircraft because handling characteristics are extremely similar and **it's a real family.**"

"The aircraft is much more responsive than anticipated, it does not feel like a big aircraft. **Cockpit innovation and new technologies are combined well with Airbus cockpit philosophy.** Coming from the A330, you feel at home and the transition is very easy."

"The aircraft, for its size, is **extremely manoeuvrable**: very responsive, easy to fly, very stable. Actually, I would like to take this plane home and start flying with it immediately."

"The cockpit and flying characteristics are similar, so it is easy for somebody who has flown an Airbus before to fly this airplane. I thought that because the A380 is bigger there would be a lot more lag in the controls, but to my pleasant surprise it is **very lively and very stable - it's a lovely plane.**"



Lufthansa



virgin atlantic

KOREAN AIR



THAI



One of the most pleasing elements of the whole test programme, has been the handling qualities of the aircraft. The early good reports from our test crews have been backed up, initially by pilots from the certification authorities and more recently by line pilots from all of our customers, that have been given opportunity to fly the aircraft. We have even let certain members of the aviation press loose on the aircraft and you can read their glowing reports in some of the major trade journals.

A380: 飞行员们如是说



“和A320相比，感觉不到飞行方面的不同。虽然比A320大得多，但滑行非常灵活。”

“我驾驶过所有的空客电传操纵的机型。A380的情形也是相同的：驾驶这些飞机都非常简单，因为操作特性都是极其类似的，这才是真正的飞机系列。”



“飞机十分平稳，但反应也非常灵敏；和A340相比，更像在驾驶A320。”

“飞机的反应比预期的好很多，感觉并不像是一架大型飞机。驾驶舱的创新和新技术与空客的驾驶舱理念完美结合。我由A330转型而来，没有任何陌生感，过渡转型也非常简单。”

“对于这样体积的飞机来说，它的机动性极其灵活：反应灵敏，驾驶便捷，且十分平稳。事实上，我真想把这架飞机带回家，立刻开始驾驶的体验。”

“请千万不要改变这架飞机的操作质量！”

“驾驶舱和飞行特性都是相似的，所以对于以前驾驶过空客飞机的飞行员来说操作十分简单。我本以为由于A380体积庞大，控制上必定有很多滞后，但是让我十分吃惊也十分高兴的是它非常的灵活和稳定——A380真是个可爱的飞机。”



Lufthansa



virgin atlantic



KOREAN AIR

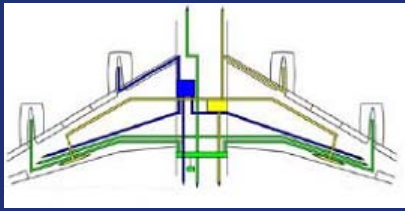


THAI



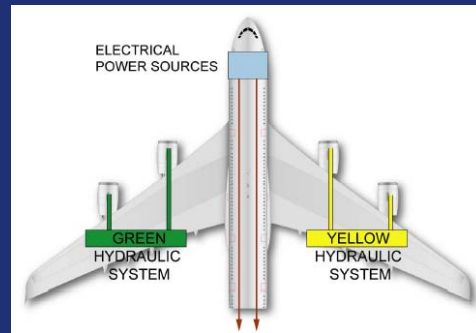
整个测试项目中最令人高兴的一点是飞机的操纵特性。早期的报告结果非常好，得到了我们的测试机组及当局飞行员的肯定，也得到了所有有机会驾驶A380的客户公司的航线飞行员的肯定。我们甚至让一些航空媒体的工作人员在飞机上随便走动，大家可以在一些主要的行业杂志上读到他们写的生动报道。

Designed for operational reliability



On current large commercial aircraft

- ✓ 3 hydraulic systems (3000 psi)
- ✓ I.e. only one power source for flight controls



7 electrical generators

On the A380, dual power sources, i.e.

- ✓ 2 hydraulic systems (5000 psi) + 2 electrical systems
- ✓ 1.2 tonnes weight saving
- ✓ Improved dispatch capability
- ✓ Improved integrity

Lighter, simpler, more reliable – effective technology

One major technology change hidden within the A380 is a new flight control architecture philosophy which combines hydraulic and electrical power sources to give exceedingly high levels of system protection.

Typical current long range aircraft utilise triple hydraulic circuits to give a mix of primary and secondary control. This implies that there is only one source of power for the actuators, the hydraulic system.

On the A380, there are 2 hydraulic circuits plus 2 electrical circuits giving dual power source protection. The results, firstly a valuable weight saving: 1.2 tonnes compared with a triple hydraulic circuits design. And secondly, increased reliability as no operational interruption will occur in the unlikely event of a double hydraulic circuit failure, the aircraft being flown, as it has been during the test programme, purely on the electrical circuits.

These operate in addition to the conventional hydraulically powered servo controls in two forms:

Electro-Hydraulic Actuators, or EHA, that work with electric power, and

Electrical Back-up Hydraulic Actuators, or EBHA, that can work with either hydraulic or electrical power.

Other advantages of this increased level of electrical control include:

better segregation, higher redundancy and reliability benefits.

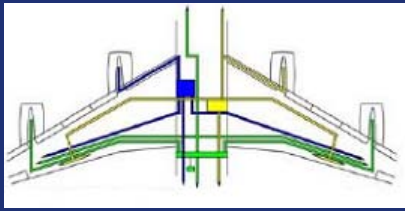
Aircraft dispatch with one engine-driven pump damaged out of 8 (without a maintenance action).

Continuing low visibility approaches down to CAT 3B with One Engine Inoperative.

Elsewhere on the aircraft there are further examples of the increasing use of electrical power. For example the thrust reversers, located on the inboard pair of engines only (for benefits in weight, maintenance and drag), are electrically actuated, as are the back-up brake controls through a local electro-hydraulic generating system, separate from the main hydraulic system.

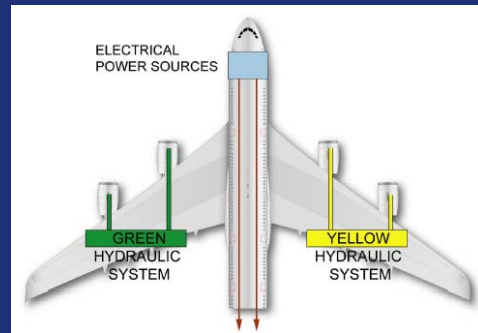
All of these technologies have been extensively tested and maturity proven on a variety of test benches and rigs, with frequent input from airline representatives during the customer focus group process. Integration of all the developments into a full scale systems mock-up linked to a simulator (the so-called Aircraft 0) enable comprehensive assessments to be made prior to installation on the aircraft.

设计旨在保障运行可靠性



现有的大型商用飞机

- ✓ 3套液压系统 (3000 psi)
- ✓ 例如, 只有一套飞行控制的动力源



7个发电机

A380则具有两套动力源, 如:

- ✓ 2套液压系统 (5000 psi) + 2套电力系统
- ✓ 减重1.2吨
- ✓ 提高了放行可靠性
- ✓ 提升了完整性

更轻巧、更简易、更可靠 – 实用有效的技术

A380上一个外面看不见的主要技术改变就是新的飞行控制架构理念, 该理念结合了液压源和电源两种动力源以提供极强的系统保障。

现在的远程飞机使用三重液压回路提供主要和二级控制, 这表明作动筒只有一个动力源, 即液压系统。

A380有2套液压回路加上2套电路, 提供双重动力保护。由此带来的好处首先是飞机的重量减轻: 比采用三重液压回路设计的飞机减少1.2吨。其次, 提高可靠性, 因为即使是发生极为罕见的双液压回路失效的情况下, 飞机的飞行也可以只靠电路来完成, 就象在测试飞行中一样, 而不会出现运行中断。

除了传统的液压驱动伺服控制, 还有以下两种操纵形式:

电-液压作动筒, 或简称EHA, 由电驱动, 以及

电备用液压作动筒, 或简称EBHA, 可由液压动力或电驱动。

这个加强的电控制带来的其它好处包括:

更好的隔离, 更多的冗余和可靠性方面的好处

在8个发动机驱动泵中的一个受损的情况下(没有采取维修行动), 仍然可以放行飞机。

在一发失效的情况下, 飞机仍然可以实现3B类的低能见度进近。

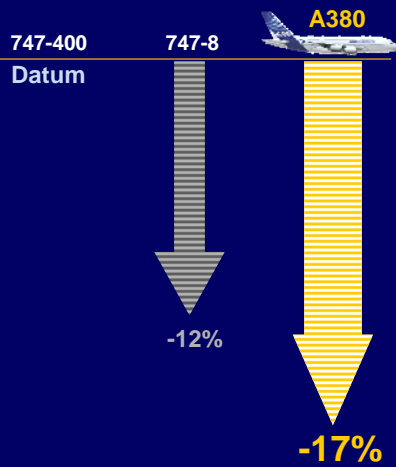
飞机的其它部件也表明了电驱动的使用得到提高。例如反推只位于内侧发动机上(出于飞机重量、维修和阻力方面的考虑), 使用电驱动, 备用刹车控制也通过一个就近的电-液压力系统来使用电力驱动, 与主液压系统分离开来。

所有这些技术已经得到全面测试, 并在一系列的试验台、架中证实了其成熟性, 在这个过程中, 各航空公司代表在客户小组座谈会中也提出了许多建议。将这些新技术做成一个全尺寸的实体模型, 并与模拟机(也就是所谓的0号飞机)相连, 以便在飞机上安装这些系统之前进行全面的评估。

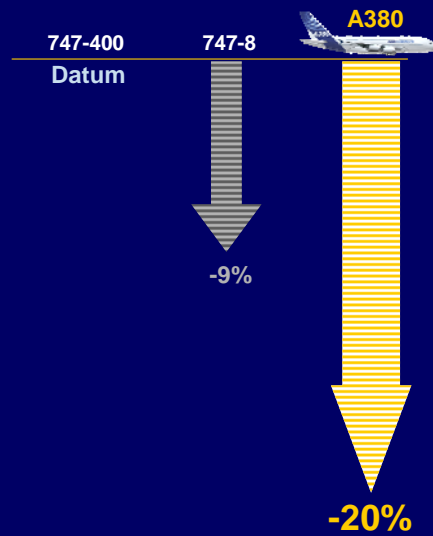
A380 - the most advanced technology...



Fuel Burn per Seat



Operating Cost per Seat



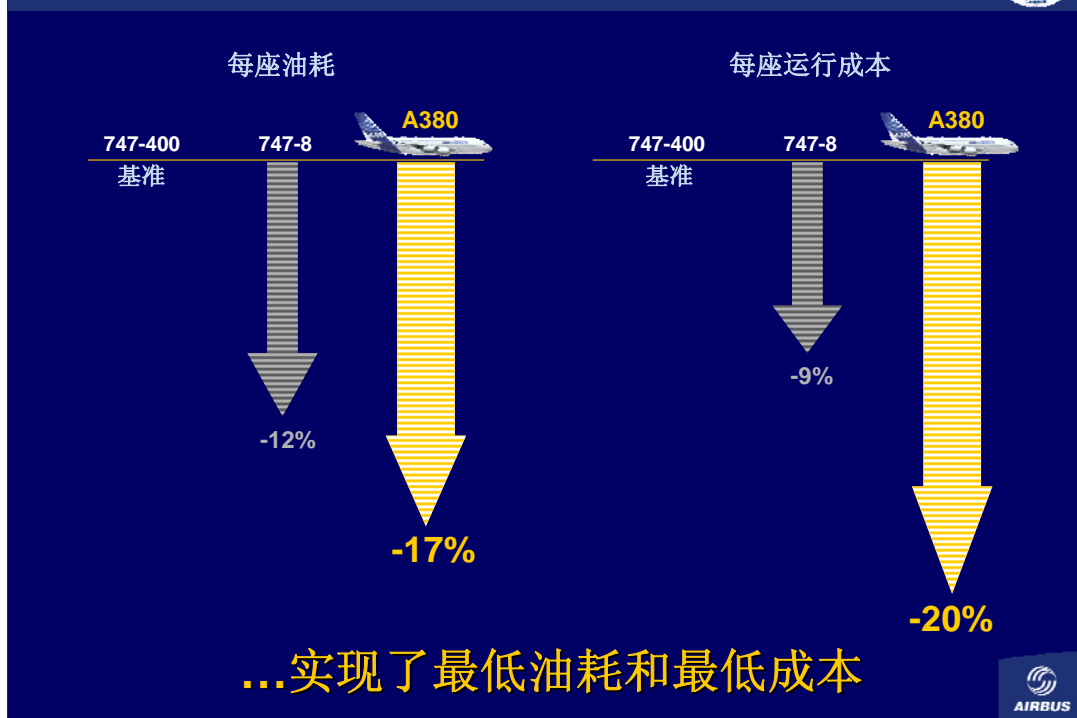
...for the lowest fuel burn and costs



The result of this careful attention to detail throughout the design of the aircraft can be seen in its economic efficiency. The excellent aerodynamics and low specific fuel consumption of the Rolls-Royce and Engine Alliance engines combine to give significant reductions in fuel burn when compared with either the current 747-400 or its warmed-over derivative. Combining this fuel efficiency with other cost parameters such as maintenance, crew costs, landing, handling and navigation fees show that the A380 will offer unmatched economic opportunities for its operators, a 20% unit cost improvement over today's 747 and 10% lower costs than the any potential 747-8. Similar improvements are available to major air freight operators with 25% lower unit costs than the most recent version of the 747-400, the ERF, and 10% lower than the 747-8F.

The A380 is a real game-changer, setting an economic standard for the future.

A380 – 最先进的技术...



A380的设计非常注重细节，其益处体现在A380的经济效益方面。与现在的747-400或其多有耳闻的衍生机型相比，卓越的气动性和罗罗和联合发动机公司的发动机所能提供的低燃油消耗率能够大大减少油耗。燃油高效性加上其它的成本元素，例如维修、机组成本、着陆、地面勤务和导航费，都表明A380将能为运营商提供无与伦比的商机，比现在的747的单位成本低20%，比即将面试的747-8低10%。在货机方面也有相似的改进。主要的航空货运运营商也将得到比最新版本的747-400 ERF低25%，比747-8F低10%的单位成本。

A380是一架真正具有划时代意义的飞机，为航空业的未来设定了经济性标准。

A380

A new experience



So having produced an aircraft that flies well, is structurally efficient and offers excellent economics, where do the benefits lie for the end-users – the passengers?

Quite simply the A380 offers a magical flying experience; new standards of comfort, new standards of cabin ambience, new standards of in-flight entertainment and, for the wider community, new standards of environmental acceptability.

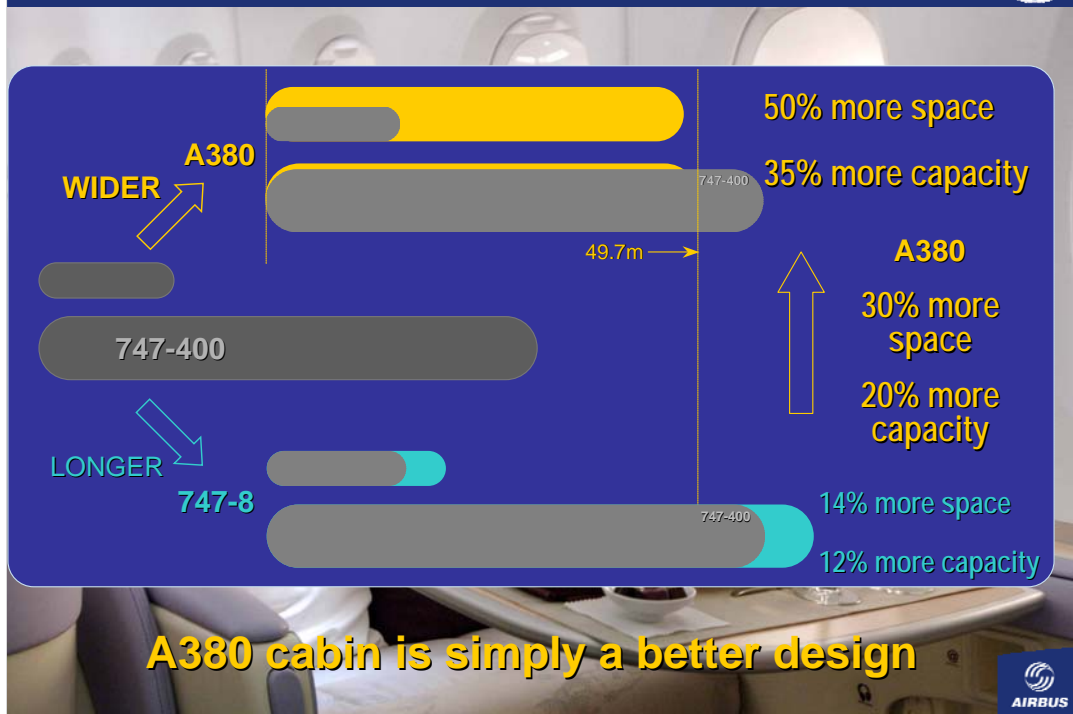
A380 崭新的体验



一架性能优越，拥有`高效的结构和卓越的经济性的飞机会给最终用户—乘客带来什么样的好处呢？

一言以蔽之，A380能够给乘客带来奇妙的飞行体验：新的舒适度标准，新的客舱环境标准，新的空中娱乐标准，更广泛地讲，A380建立了新的环保标准。

A380 - More space, better arranged



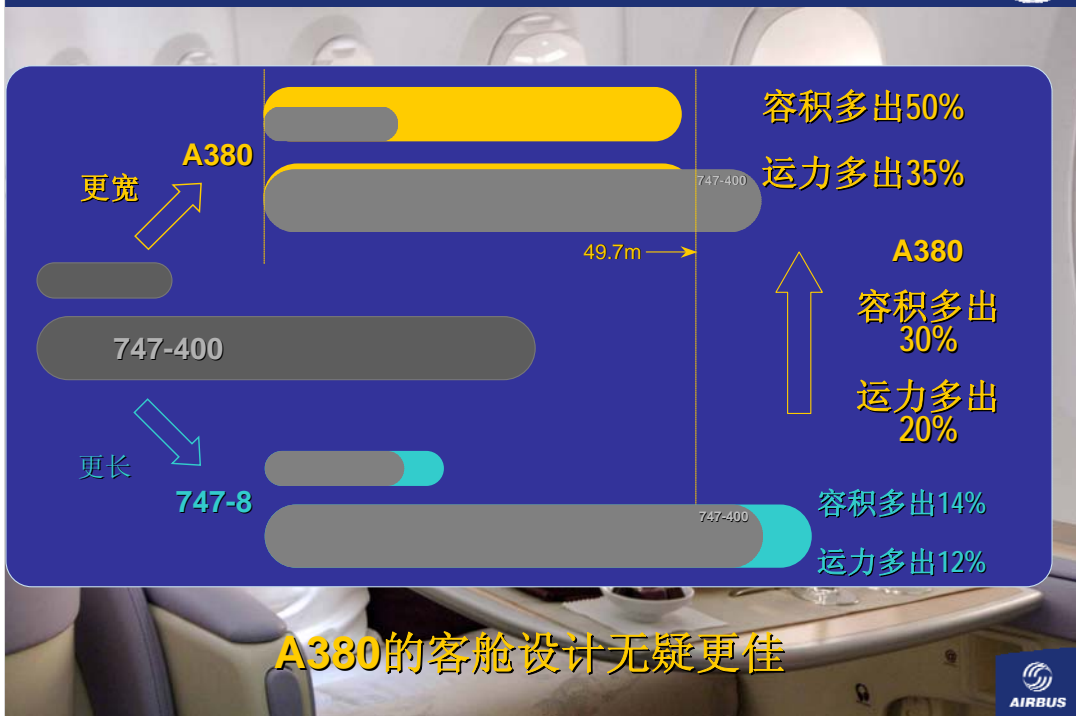
The A380's two, full length, truly wide-body decks provide more capacity, and at the same time, a more comfortable travel experience.

In order to increase capacity on the 747-8, Boeing has chosen to stretch the fuselage by 6m, thus lengthening the cabin and adding more seat rows that actually spoil the flying experience. Instead, by adding a 2nd, twin-aisle upper deck, the A380 increases passenger capacity, while both decks remain shorter than those of other long-haul wide-body aircraft operating today.

The A380's cabin floor area is increased by 50%, compared to today's 747, while offering a more than the 35% capacity increase. This translates into wider seats, particularly in Economy class, and larger cross-aisle and end-zone areas, both of which provide a better experience for passengers and crew.

With its superior cabin architecture (including wider aisles and wider stairs), the A380 achieves a similar boarding time to today's 747 despite boarding more passengers. The longer cabin of the 747-8, with its architecture virtually unchanged from the 1960s, will offer an inefficient boarding time and bring a poor passenger experience.

A380 – 空间更大，配置更佳



A380的两个真正全尺寸、宽体的双层舱能够提供更高的运力，同时，提供更为舒适的飞行体验。为了提高747-8的运力，波音选择将机身加长6米，以加长客舱和增加座椅排数，事实上这会降低飞行舒适度。相反，通过增加一个双通道上舱，A380增加了客运力，同时两舱的长度都比现在在役的其它远程宽体飞机短。

与现在的747相比，A380的客舱面积增加了50%，而且运力也提高超过35%。这就意味着座椅更宽，特别是经济舱位的座位，横通道和尾部区域也更宽，能够给乘客和机组人员提供更好的飞行体验。

由于有高级的客舱结构（包括更宽的通道和楼梯），虽然登机乘客更多，A380的登机时间和今天的747不相上下。747-8客舱更长，但是其结构自60年代以来几乎没有改进，造成登机效率低，从而降低乘客舒适度。

A380 – A new way to fly



The A380 will become the flagship for the airlines that operate it. This is not just because it will be their largest aircraft, but because it has the most spacious, comfortable, and versatile passenger cabin ever seen.

The A380 gives airlines the best possible means to configure the aircraft to match their own markets. And airlines will leverage the A380's potential for innovation and offer new services, building passenger loyalty.

The A380 cabin cross section has been defined taking into account peoples travel expectations in the 21st century – that is comfort and economy, not one or the other. Today's trend-setting airlines have started to offer new generation full flat seats in their Business class that allow passengers to sleep in a comfortable, horizontal position. As comfort standards of business class are rising, there is a clear need for first class cabins to be updated to keep a clear step between both cabin classes. This ultimate move will respond to first class passengers' expectations, by installing mini-suites that dramatically enhance personal space and privacy. The A380 is particularly suited for these new trends as it has the space to accommodate such products while providing a capacity increase (rather than capacity drop).

With the A380, all classes of service will benefit from the greater space, with economy class passengers enjoying wider seats on both upper and main decks.

A380 – 崭新的飞行体验



A380将会成为运营航空公司的旗舰飞机。不仅是因为A380是航空公司最大的飞机，它也是航空公司迄今最宽敞、舒适和多功能的客舱。

A380为航空公司提供最好构型方式，使飞机满足市场的需要。A380的无穷潜力将为航空公司提供创新和服务的平台，建立旅客对公司的忠诚度。

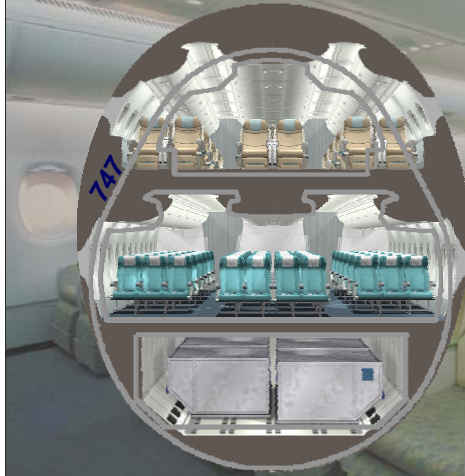
A380客舱横截面在设计定义时便充分考虑到21世纪旅客对航空旅行的期望——即舒适性和经济性，二者兼有。今天能够引领潮流的航空公司开始为公务舱乘客提供新一代全躺平式座椅，使乘客在舒适平坦的环境中入睡。随着公务舱舒适度的提升，头等舱迫切需要革新，以使客舱之间保有等级差别。A380最终踏出了一步，完全满足了头等舱乘客的期望，机上小型套间为乘客提供更多私人空间和隐私权。A380完全顺应时代潮流，可以容纳这些产品（而不是减少总座位数）。

A380宽敞的空间使各级舱位受益，上舱和主舱经济舱的乘客都能享受到更宽敞的座位。

A380 - Cabin superiority



Two separate, full length widebody cabins
21st century comfort standards for all



PLUS

- The best IFE
- Lowest noise
- Layout flexibility
- The best lighting
- Best air distribution
- Larger stowage bins
- The best crew rest facilities



By comparison, the cross section of the 747 was defined in the 1960s, with economy seating as a throwback to the 707! Peoples expectations of flying have changed completely since that time.

In this illustration for example, we show the A380 Premium Economy cabin with a comfortable 38 inch pitch, 8 abreast configuration. A very good standard, except that this is what Boeing offer as a Business Class seat in their allegedly 467 seat 747-8 – a concept a million miles away from today's reality, but the only way they can attempt to even approach the A380's unit costs.

The A380 cabin cross section has been defined to reflect passenger expectations of what travel should mean in the 21st century. Wider on the main deck than the 747 by 20 inches, the A380 will offer more comfort to all classes – in economy class the A380 main deck is 10 abreast, the same as the 747 but the extra cabin width allows wider seats, by more than an inch (2.5 cm)

The A380 cabin is not only superior due to its outstanding comfort and spaciousness but it also offers many extra amenities:

Lower noise – The A380 will have the lowest cabin noise levels of any long-haul aircraft; far lower than the 747 or 777.

The best IFE – The first aircraft to have 3rd generation IFE distribution, enabled by fibre optics. New IFE products developed specifically for A380 will be market leading.

Layout flexibility – enables a variety of efficient cabin configurations to best match airline desires on the seat products they can offer – quite the opposite of the inflexible 747.

Superior Lighting – the latest LED lighting technology; 6 primary light sources across the cabin, unlike all other aircraft which have only four.

The best air distribution – 4 outlets rather than 2 (same as A340-600) eliminating drafts.

Larger stowage bins – 15% more volume per Y class pax than 747, designed for today's shaped baggage.

Best Crew Rest facilities – choice of two locations, standing height, changing area, IFE/CIDS, optional humidification.

And all now proven in practice...

A380 – 优越的客舱



两个独立、全长的宽体客舱
21世纪的客舱舒适性新标准



还具有

- 最佳的IFE系统
- 最低的噪音
- 布局灵活性
- 最佳的照明系统
- 最佳的空气分配
- 更宽敞的行李舱
- 最佳的机组休息设施



作为比较，747的横截面确定于20世纪60年代，其经济舱座位反而倒退回了707的水平。从那时开始，人们对空中旅行的期望就已彻底改变。

在这个例子中，我们推出的A380高收益经济舱是非常舒适的38英寸排距、8座并排的构型。这是一个非常好的标准，同时也是波音467座级的747-8宣称的公务舱配置—当然波音的这种宣称和现在的标准相距十万八千里，但这是波音试图接近A380单位成本的唯一方法。

A380客舱横截面的设计真实反映了乘客对21世纪航空旅行的期望。A380的主舱比747宽21英寸，各级舱位都更加舒适—A380主舱的经济舱是10座并排配置，虽然数量与747相同，但更宽的客舱允许每个座位比747的额外宽1英寸（2.5厘米）。

A380客舱之所以不同凡响，不仅是因为它更舒适更宽敞，还因为它具有其他优点：

噪音更低—A380将会是所有远程飞机中噪音最低的飞机，比波音747和777低的多。

最好的IFE（机载娱乐设施）—A380是第一种配置由光纤实现的第三代机载娱乐设施的机型。专门为A380研发的IFE将成为市场的领军产品。

灵活的布局—多种高效的客舱布局可以最好地满足航空公司对不同座位产品的需要—与缺乏灵活性的747正好相反。

先进的照明—使用最先进的LED照明技术；客舱有6处主灯光源，而其他飞机只有4处。

最佳的空气分配—4个空气出口(与340-600一样)，而不是两个，以消除扰流。

行李箱更大—A380经济舱每名乘客储物箱容量比747多15%，专门根据当今各种行李的形状设计。

最好的机组休息设施—两个地点可供选择，站立高度、更衣室、IFE/CIDS、湿度可自选。

以上所有项目现已经实践的验证。

A380 - Early Long Flights (ELF) 4 – 8 September 2006



First A380 passenger flights

Voluntary exercise to ensure maturity

Excellent feedback from passengers & crew

Faster boarding than today's large aircraft



...as on Monday 4th September 2006, when the first A380 passenger flight took off in a series of four ELF tests (Early Long Flights). Though not part of the technical certification programme, the ELF process has been used on earlier Airbus programmes and allows an early assessment of the cabin environment and systems in flight and ahead of final certification. This helps to ensure airlines will benefit from a fully mature aircraft on delivery.

Operating with a full complement of passengers and crew, the first ELF started with a 7 hours flight, followed on Tuesday 5th September by a 10 hours flight. Over Wednesday and Thursday night a 12 hour flight was performed to assess the different lighting and air-conditioning requirements of night time operations. The final sector was of 15 hours duration.

All four flights went extremely smoothly, the aircraft operating as expected. Full catering and passenger service was provided, despite the developmental nature of the galley systems. Functioning of the Thales in-flight entertainment system was also tested; similar tests of the alternative Panasonic system will take place on MSN 007 in early 2007.

Timings of ground operations were made and the results were better than predicted. Despite using stairs, the superior cabin architecture of the A380 resulted in boarding and deboarding times being 35% faster than those measured on the 747-400s.

Comprehensive measurements of noise and temperature in the cabin were also made along with detailed questionnaires to assess the passenger's initial perceptions of the aircraft.

A380 – 早期的远程飞行 (ELF)

2006年9月4-8日



A380首次载客飞行

为了确保成熟性的主动测试

乘客和机组的反馈极佳

与现有大型飞机相比，登机时间更短



2006年9月4日星期一，四次ELF（早期远程飞行）测试中的第一个客机测试航班起飞。尽管ELF并不是技术取证项目的一部分，但ELF一直应用于空中客车之前的项目中，在最终认证前评估飞行客舱环境和系统。ELF能够帮助交付给航空公司一架完全成熟的飞机。

在满载乘客和机组情况下，第一次ELF测试历时7小时。随后于9月5日星期二进行了第二次ELF，历时10小时。在星期三和星期四之间的晚上又进行了12小时的ELF测试，评估了夜航对空调和照明系统的不同要求。最后一次ELF测试为15小时的续航。

四次飞行进展非常顺利，飞机按预想的运行。尽管餐车系统仍然处于研发阶段，但航行中依然为乘客提供全套配餐和服务。航行中还测试了泰蕾兹公司提供的飞行娱乐系统的功能。2007年早期，备用的松下娱乐系统也将在MSN007号飞机上接受类似的测试。

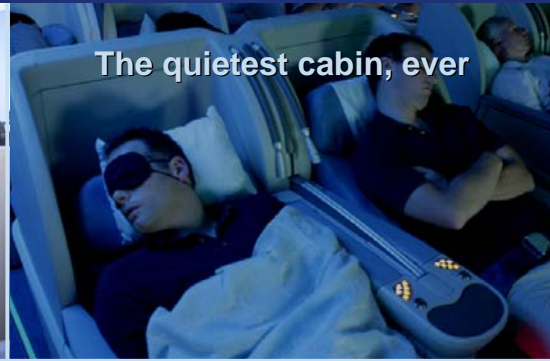
地面运营的时间计时也已进行，结果比预料的还好。尽管使用了楼梯，但A380的出色的客舱结构使得登机和离机时间比747-400快35%。

对客舱噪音和温度的全面测评也已结合详细的调查问卷进行，以评估乘客对飞机的初步感觉。

ELF feedback: A380 - the best cabin in the sky



Spaciousness for all



The quietest cabin, ever



Make magic out of light



Leading edge design



These questionnaires targeted impressions on cabin systems, including air conditioning, lighting, acoustics, IFE, toilets, etc. Comments were globally extremely positive.

The large majority of passengers, irrespective of their seat location (upper deck or main deck) and across all cabin class's, rated the cabin as:

very spacious (passengers discovered the unprecedented cabin spaciousness that allows Economy class passengers to benefit from at least 1" wider seats)

very quiet (noticeably quieter than any aircraft cabin, no matter where passengers were seated)

very good lighting (variety of lighting scenarios contributed to the overall comfort of the cabin)

very good cabin design (the forward stairs are an excellent illustration of the great A380 cabin design. For almost all passengers, width, step angle, ease of using the stairs, etc were convincing)

Without a shadow of doubt, the A380 is the best cabin in the sky.

ELF的反馈：A380-具有所有机型中最好的客舱



为所有乘客提供宽敞的空间



空前安静的客舱



梦幻般的照明效果



超前的设计



问卷调查主要关注乘客对客舱系统的印象，其中包括空调、照明、音响、IFE、盥洗室等等。全球的评论都是非常积极的。

无论乘客坐在哪个座位，哪个舱位，大部分乘客都对客舱做出如下评价：

非常宽敞（乘客们发现客舱史无前例的宽敞，至少宽了1英寸的经济舱座位使经济舱乘客受益匪浅。

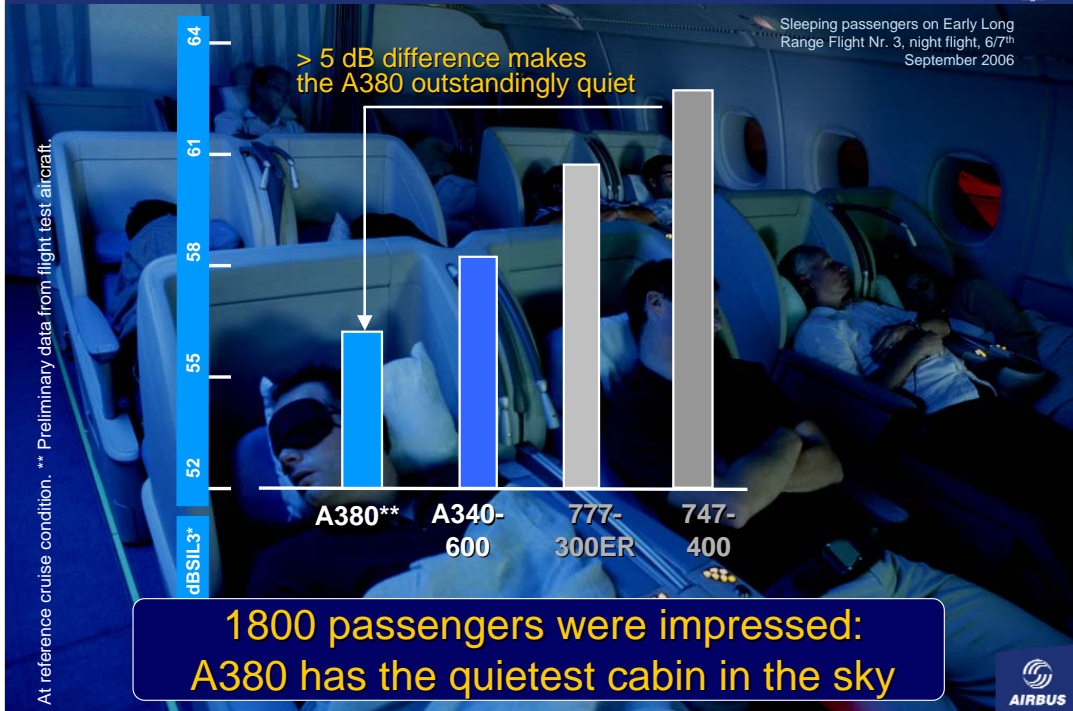
非常安静（无论乘客坐在哪里，A380客舱明显比其他飞机更安静）

卓越的照明（各种照明情景在整个客舱营造了舒适感）

卓越的客舱设计（前梯是A380客舱设计卓越的最好证明。大部分乘客都肯定了A380楼梯的宽度、楼梯角度和使用便捷性。）

毫无疑问，A380拥有全天下最好的客舱。

A380 – the quietest airliner ever



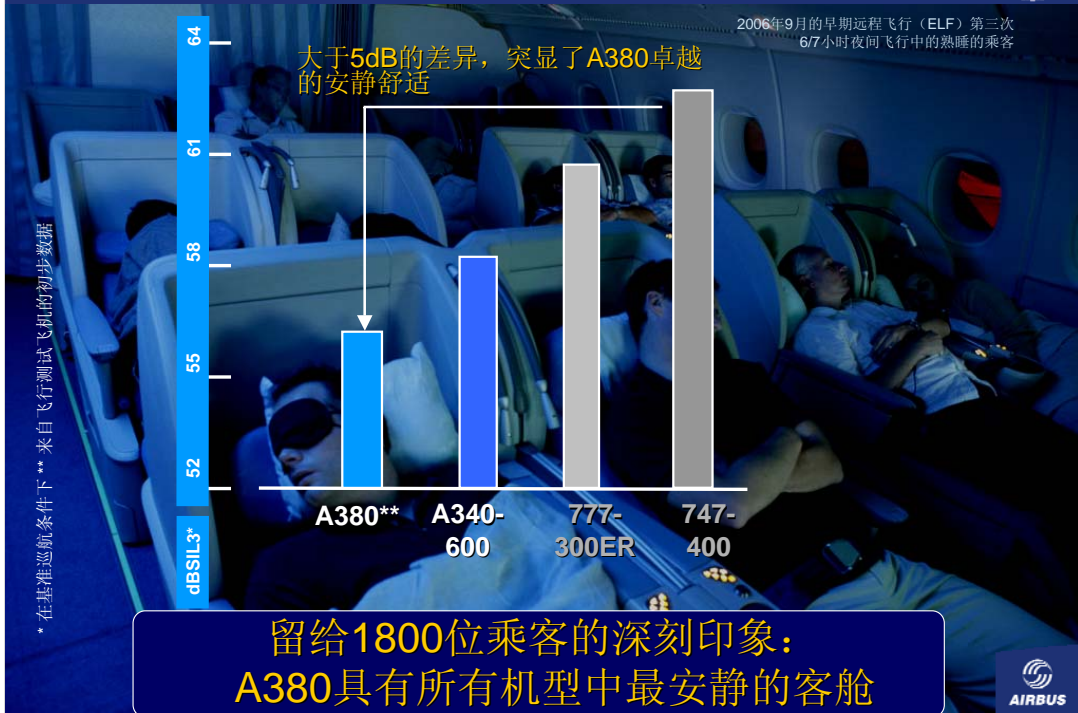
Perhaps the most impressive result from the trials was that they also demonstrated that the A380 also has the quietest cabin in the sky.

Average (UD and MD for A380 and 747-400) dBSIL3 values for the A380, A340-600, 777-300ER and 747-400 are shown here. dBSIL3 reflects speech intelligibility and high levels contribute to the feeling of fatigue during long range flights. So the lower the value for dBSIL3 in the cabin of a given aircraft, the more comfortable the flying experience for the passengers. In absolute noise terms, as measured in EPNdB, the same relationship still applies. Passengers who took part in the ELF consistently highlighted the quietness of the A380 cabin, both at take-off and during cruise where the aircraft was operating at typical cruise speeds of up to M0.86.

Although the instrumented data had already demonstrated low noise levels in an empty cabin, the fact that passengers are really able to hear and appreciate the difference of a quieter cabin is an impressive testament to the cabin standard.

A similar level of silence can be found in the cockpit where A380 pilots will experience the quietest working environment of any airliner, 3-4dB lower than any Boeing flight deck.

A380 – 空前安静的飞机



这些测试中得出了一项也许是最令人印象深刻的结果：即A380拥有世界所有机型中最安静的客舱。

图中显示的是A380、A340-600、777-300ER和747-400 (A380和747-400的上舱和主舱) 的平均dBSIL3值。dBSIL3值反映了乘客在远程飞行的话语理解难度和疲劳程度。所以某架给定飞机客舱的dBSIL3值越低，乘客在飞行中感觉越舒适。如果用噪音绝对度量单位EPNdB来衡量，也是同样的道理。所有参加早期远程飞行的乘客都指出，在马赫数高达0.86的情况下，起飞和巡航阶段的A380客舱都非常安静。

尽管测试所得的数据已经证明空客客舱时的噪音处于低水平，但乘客能如此清楚感觉到A380安静的客舱与其它客舱的区别，足以证明A380客舱标准确实令人印象深刻。

同样安静的噪音水平也在A380驾驶舱中得以实现。A380飞行员将会在所有飞机中最安静的环境中工作，其噪音比所有波音驾驶舱低3-4dB。



Another major success has been the airfield acceptability during the test programme. Following the first flight on April 24th 2005, the scope of testing has demanded that the aircraft operates away from its home base at Toulouse. Early flights to Paris for the Le Bourget airshow and to Istres near Marseille for performance testing were followed by initial airport compatibility checks at Frankfurt, Singapore, Sydney, Kuala Lumpur and Dubai. During these tests all the appropriate types of standard ramp equipment were checked against the aircraft, together with the only pieces of new recommended GSE, an upper deck catering vehicle and tow tractor. Operational checks of direct upper deck access (DUDA) boarding bridges also took place at those airports planning on offering such a facility to their customers. For the A380, such a facility only enhances the passenger experience, there being minimal effect on turn-around times.

Specific performance and system trials have taken the aircraft to Medellin and Addis Ababa for high altitude tests, Shannon in Ireland for cross-wind performance demonstrations, Iqaluit in Northern Canada for cold weather tests and Al Ain in the United Arab Emirates for the balancing hot weather trials.

It is apparent that many of these points are not the major international airports that will see the aircraft on a regular basis when it enters regular scheduled service. Instead they demonstrate the aircrafts ability to operate to virtually any airport that currently sees A340-600, 777-300 or 747 service.



测试项目同时也在机场兼容性方面取得巨大成功。继2005年4月24日A380首航之后，测试的范围要求飞机在远离图卢兹的本场运行。A380先后飞到巴黎参加巴黎布尔歇航展，并在马赛的特斯特进行性能测试，随后到达法兰克福、新加坡、悉尼、吉隆坡和迪拜进行首批机场兼容性测试。在这些测试中，所有合适的标准机坪设施都受到检验，唯一的新推荐的GSE即上舱配餐车和拖车也参与了测试。那些计划为客户提供上舱登机设施的机场在运营中测试了上舱登机廊桥（DUDA）。对于A380来说，这样的设施只会增加乘客的旅行体验，而对飞机的过站时间影响甚微。

特殊性能和系统的测试也已展开，在麦得林和亚的斯亚贝巴进行了高原测试，爱尔兰香农进行侧风性能演示，加拿大北部的伊魁特进行寒冷气候测试，同时也在阿联酋艾因进行了相应的炎热气候测试。

显而易见，以上提到的测试地点并不是A380正式投入定期运营时会飞抵的主要国际大机场。但是这更加证明A380有能力在几乎所有A340-600、777-300或747目前飞达的机场运行。

A380 - Already welcome around the world

- 28 airports of all sizes already visited in an unprecedented testing campaign
- 8 more airports to be added to A380 list during technical route proving

Already 36 airports visited, and more will be before EIS

Boeing say less than 30 airports can accommodate the A380!

With 28 airports already visited to date during the course of its flight test programme, the A380 is already a seasoned world traveler. The technical route proving (TRP) exercise will see the aircraft visit 8 more airports across 4 continents, continuing an unprecedented airport validation campaign.

While the TRP is one of the final steps in the certification programme, designed to demonstrate that the aircraft can operate routes that are representative of airline service, operational testing on the ground will be similar to what has already performed during previous A380 airport compatibility checks. These involved using the airport navigation aids, maneuvering on the ground and servicing using new and existing equipment.

The success of the visits to both large and very small airports to date, are a testament to the extensive input that airports have had into the design of the A380. The aim from the start of the programme was to ensure compatibility with existing infrastructure and equipment in order to minimise changes on the ground. The end result is an aircraft, which although physically larger, can be operated much like any other wide-body type.

In many important respects, the A380 has exceeded its design goals – it actually takes off and lands in much less distance, climbs quicker, has better manoeuvrability, uses 90% existing ground equipment and generates much less noise and emissions than its nearest competitors.

With more airport visits planned in 2007, it is likely that most of 60 nominated A380 destinations around the world will have the unique opportunity to accommodate the aircraft before its entry into service. Airbus teams are also extensively documenting the airport visits in order to share the data so that all future destinations will be fully prepared for their first commercial services.

A380 – 已受到全世界的欢迎



- 在一场前所未有的测试活动过程中，A380已到访了28个各种规模的机场
 - 在技术航线验证过程中，A380又将到访8个机场
- 已到访了**36**个机场；在投入运营之前，这一数字还将增加
- 波音却称，只有不到**30**个机场可以容纳A380！



迄今为止A380在飞行测试项目中已经飞抵过28家机场，现在的A380的国际飞行经验已经非常丰富。随后的技术航线验证（TRP）中，A380将到访4个大陆，飞抵另外8家机场，继续推动这场史无前例的机场验证活动。


技术航线验证是整个认证项目的最后一个阶段，目的是证明A380能够在对航空公司有代表性的航线上运行。此后的地面运行测试会与之前的A380机场兼容性检测类似，涉及到导航辅助、地面机动操作和新的以及现有的勤务设备的使用。


迄今为止，A380成功到访各大小机场取得证明，在A380的设计阶段机场也提供了很多信息。A380项目在一开始就立志保证飞机与机场现有基础设施和设备的兼容，将地面的改动最小化。最终达到的结果是，造一架虽然体积庞大，却可以像其他任何宽体飞机一样运行的飞机。

在很多重要方面，A380已经超出其设计标准—它的起飞和着陆距离更短，爬升更快，机动性更好，可以使用90%的现有地面设备，与最接近的竞争机型相比噪音和排放都要低的多。

2007年A380将会飞抵更多机场，世界上指定的60个A380的目的地中的大多数可以有唯一的机会，在飞机投入运营前接纳飞机。空中客车团队也将全面记录测试机场的数据，以便与机场共享，使将来的目的地机场能够在A380投入商业运营之前作好充分的准备。

Consultation from an early stage...







Over 60 Airports

Regulatory Authorities


20+ Airlines


ICAO

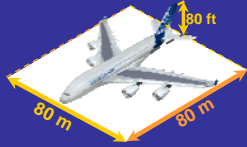

Airports Council International

Ground Handlers

GSE manufacturers


IATA

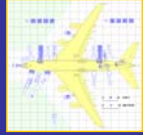
...has resulted in:



Airport optimised family design

"80m box" compliant


Similar to existing large aircraft



All ground equipment available

Similar equipment count to 747

Only 2 new vehicles needed




A friendly neighbour

Half the noise

Less movements

The A380 has proven that it can operate into any airport that can accommodate today's large aircraft



This is a direct result of a commitment by Airbus to work with the aviation community in develop cost effective methods for incorporating new large aircraft into their operations. With its larger capacity it offers the most efficient use of terminal stands and runway slots thereby mitigating the requirement for complex and costly infrastructure development. The A380 may be the biggest passenger aircraft ever built, but it has been, unlike the initial introduction of the 747, designed in collaboration with the airport authorities, such that it would fit into the existing infrastructure as much as possible. The A380 is airport friendly, and has already demonstrated being so, thanks to four unique attributes for an aircraft of this size:

1. Maneuverability:

The A380 has a maneuverability comparable to existing widebodies, even better than the 777-300ER. This is possible thanks to:

Cockpit positioning: pilots have a great angle of vision

Landing gear track and gear base which enable steep and accurate turns on narrow taxiways

Help for pilots: cameras are positioned on top of the tail and on the belly of the aircraft, giving the pilot a panoramic vision while maneuvering

2. Unmatched take off and landing performance:

We have seen that the A380 will set new standards in airfield performance. Compared with the 747, the A380 needs less than 3000m to take off at maximum weight and around 2000m in landing distance, where the 747-400 requires 400m more runway. Any runway seeing a 747 today has more than enough length to accommodate the A380 in the future.

3. Short turn around time, easy ground handling:

The A380 has been designed together with the airports and the airlines. As a consequence, the A380 can achieve a 90 minute turn around time. Despite the A380's greater capacity, the two deck architecture enables passengers to board and disembark the aircraft more quickly than will be the case with the 747-8, with its extended fuselage. With the same door sill and ground connection point heights to existing wide-body aircraft, 90% of the equipment required to service the A380 is standard. The two A380 specific units, an upper deck catering vehicle and tow tractor are available from on the market today, and already extensively tested on the A380. Furthermore they can also be used on existing aircraft types.

4. Excellent pavement loading:

The A380 is the biggest passenger aircraft ever built and as such is the heaviest aircraft. But by spreading the loads over a 22 wheel landing gear, the A380 is less restricted than other existing aircraft like the 777-300ER and the new, heavier 747-8.

经过早期的意见征询...



空客曾承诺要与航空业共同努力，为新型大型飞机投入运营找到最经济有效的方法，我们已看到了结果。因其运力更大，它可最有效的利用停机位和跑道空间，由此也便降低了对复杂且高昂的基础设施建设的要求。

A380是迄今为止最大的民航客机，但在设计阶段便已与机场当局合作，以使其最大限度的适应于现有的基础设施，而这一点是747在最初推向市场的时候没有做到的。尽管A380的体积很大，其机场兼容性却很好，多次的测试也已证明了这一点，这都得益于以下四个特点：

1. 机动性：

A380的机动性与现有的宽体飞机不相上下，甚至比777-300ER更好。这要归功于：

驾驶舱位置：飞行员的视角良好；

起落架轮距和轴距设计可以实现在狭窄滑行道上的大角度精确转弯；

协助飞行员：飞机的尾翼顶端和腹部装有摄像机，可以使飞行员在滑行过程中全方位观测外界的情况。

2. 无与伦比的起飞和着陆性能：

我们都知道，A380将成为机场性能新标准的制定者。在最大重量的状态下，A380的起飞滑跑距离不超过3000米，着陆距离大约为2000米，而747-400的滑跑距离则要多出400米。任何可以起降747的所有跑道未来都将可以起降A380。

3. 过站时间较短，地面服务简便

A380的设计工作是众多机场及航空公司一起合作完成的。因此，A380可以实现90分钟的过站时间。尽管A380的运力更大，但其两层客舱的结构使得上下客时间比机身加长的747-8要短。A380的门槛和地面连接点的高度与现有的宽体飞机相同，因此A380客机90%的地面设备都是标准的。A380客机的专用设备只有上舱配餐车和拖车，目前这两种设备均可以买到，且均已经过了A380的全面测试。此外，这些设备也可用于现有的机型。

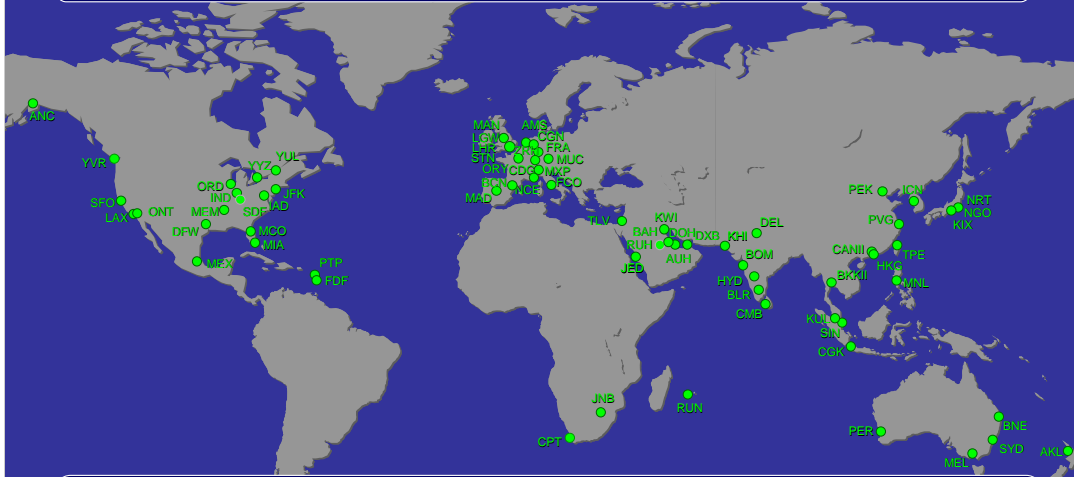
4. 极佳的道面负荷

A380是体积最大的客机，也是重量最大的。但是，由于有22个起落架机轮分摊负荷，A380比777-300ER及更新更重的747-8对道面的要求要低。

Airports getting ready for the next generation



By 2011, 71 airports will be ready for New Large Aircraft



All airports that see the majority of 747 operations today are preparing for larger aircraft (A380 / 747-8), more will follow

Subject to change, based on current A380 customer and airport statements - Status as at October 2006



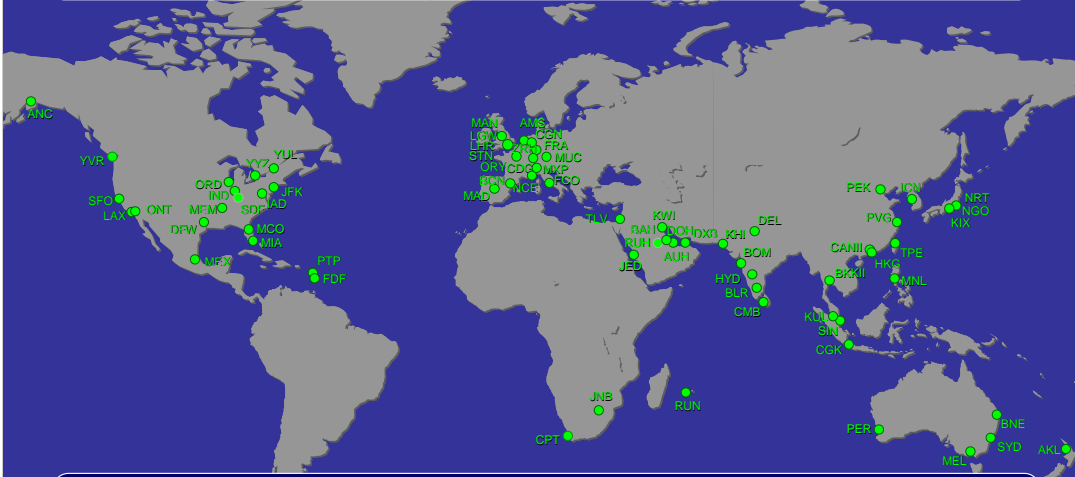
As the A380 fleet in-service fleet grows in size so will the list of destinations served. By 2012, more than 70 airports will be ready for A380 operation. Those marked here have either been designated as an A380 destination by customers or have decided to modify their facilities to accommodate the A380 and other New Large Aircraft, such as the 747-8, whose 68.5m wingspan and 76.4m fuselage length firmly place it in the very same airport planning category, the so-called Code F classification (ICAO) / Group VI (FAA).

Many airports see the benefit of being designated as future A380 destinations as it means increased income from landing charges combined with additional incremental revenue from the greater passenger flow, all for a minimal investment level. New York's JFK airport, for example, has an A380 compatibility budget that is only 1% of its overall development plan.

机场已做好了迎接新一代的准备



2011年，将有71个机场为新一代大型飞机的运行做好了准备



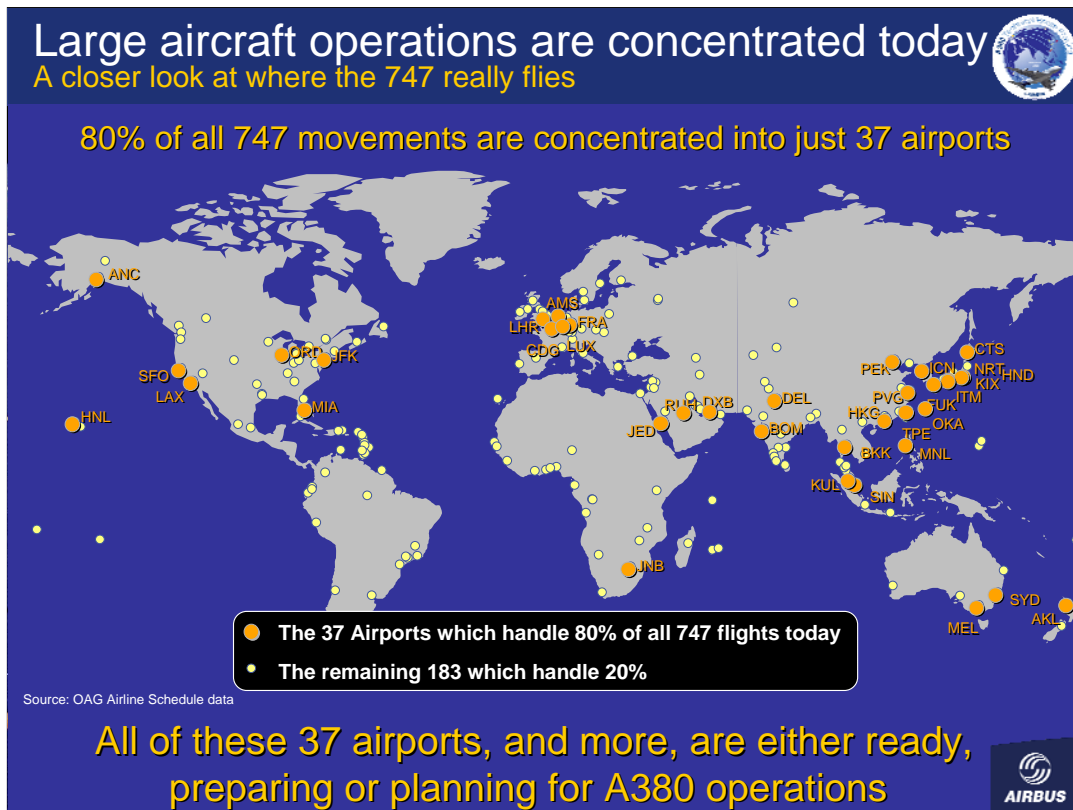
目前正在运行747的所有主要机场都在为大型飞机（A380 / 747-8）做准备，将来还会有更多的机场做出应对

或有变化；根据现有A380客户和机场情况汇报 - 截至2006年10月的状态



随着A380机队规模的增长，飞抵的机场也会越来越多。到2012年，将会有超过70家机场准备迎接A380的到来。这里标出的机场或者是由客户指定为A380目的地的机场，或者是决定修改现有设施来迎接A380或其它新大型飞机，例如747-8，其68.5米的翼展和76.4米的机身长度已经无疑被列入相同的机场类别行列，即F类（ICAO）/第五组（FAA）。

许多机场都意识到了作为A380指定目的地机场的好处，因为这意味着以最少的投资可以获得更多的起降收费，以及因客流量增长所带来收入的增加。例如纽约肯尼迪机场，为A380客机的改造费用预算只占其总体规划发展预算的1%。



Boeing are claiming the 747 flies into 220 airports world-wide – this is true but the important thing to note is the degree of concentration of these operations. 80% of all 747 movements are concentrated into just 37 of those 220 airports.

They are now also saying that all these 220 airports can accept the 747-8 without an issue – this is not the case, the 747-8 is in the same airport design category as the A380 (ICAO Code F) and therefore requires the same level of infrastructure.

Note that out of these 37 airports the only ones that are planning (ie have not been formally nominated as a destination by an airline but are looking at accommodating in the A380 in the long term) are the Japanese domestic airports (HND, CTS, ITM, FUK) as well as HNL and LUX. Clearly these are very likely candidates to be nominated by an airline customer in the future. Ostensibly then, those airports that see 80% of all 747 operations are (no surprise here!) either ready or getting ready for the A380.

Are we infrastructure limited? NO



波音声称747可以飞往全世界220个机场—当然这是事实，但是，重要的是我们应该考虑到这些运行的集中程度。所有747飞机的活动有80%都是集中在这220个机场中的37个机场。

波音同时声称这220个机场都能够毫无问题地接纳747-8—这种说法不正确，747-8和A380的机场设计类别是一样的（ICAO F类），因此其要求的基础设施和A380是一样的。

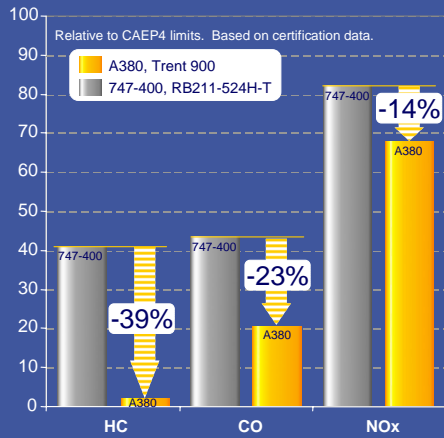
需要注意的是除了这37个机场之外，还有日本的国内机场（HND, CTS, ITM, FUK）、HNL和LUX是正在进行规划（即还未被航空公司正式指定为目的地，但是出于长期的发展考虑接纳A380）。显然，这些机场很可能在未来被某个航空公司客户指定为目的地。因此很显然，占747运营70%的机场或已经准备好或正在准备迎接A380。

我们会在基础设施方面受到限制吗？不

Less environmental impact

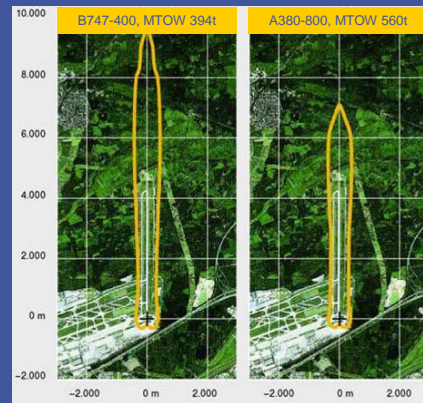


The lowest emissions



A380 emission levels well below international guidelines

The lowest noise



143 more passengers
35% less footprint area



Another important A380 benefit to the airport community is the aircraft's low environmental impact, for both emissions and noise.

Regarding emissions, the A380 benefits from the latest engine technology. The advance in technology translates into significant margins to the current ICAO regulations (CAEP 4) and can be demonstrated by comparing the A380 with the Trent 900, with the RB 211 powered 747-400. In fact both A380 powerplants already meet proposed standards for lower nitrous-oxide emissions. This places the A380 in an enviable position as environmental standards are tightened.

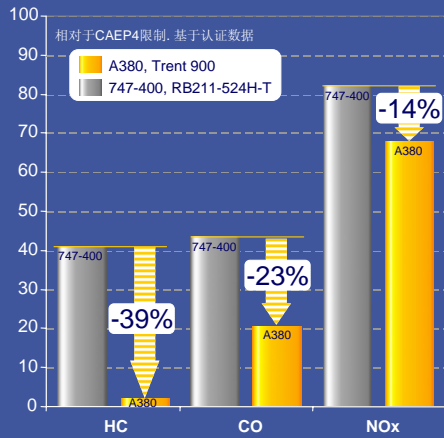
When it comes to noise levels the A380 is in class of its own, reducing comparable noise footprint areas by 35% when compared to a 747-400, with both aircraft operating at their maximum take-off weight. In other words the A380 carries more passengers, flies them further and dramatically reduces the noise impact on the community. In the dynamic and growing international air travel market the A380 and A380F offer a double benefit, increased capacity to slow the growth of movements, with major improvements in noise and emissions.

For sustainable growth the answer is A380.

环境影响更低

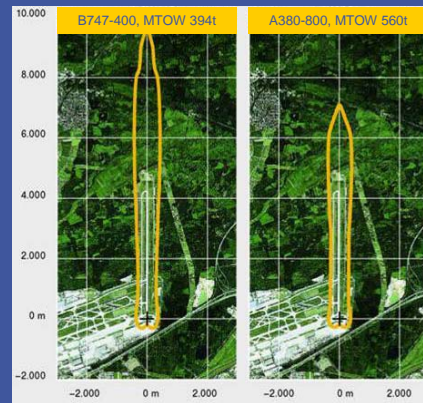


排放最低



A380的排放水平
远低于国际指导标准

噪音最低



可多搭载143位乘客
等值线区域缩小了35%



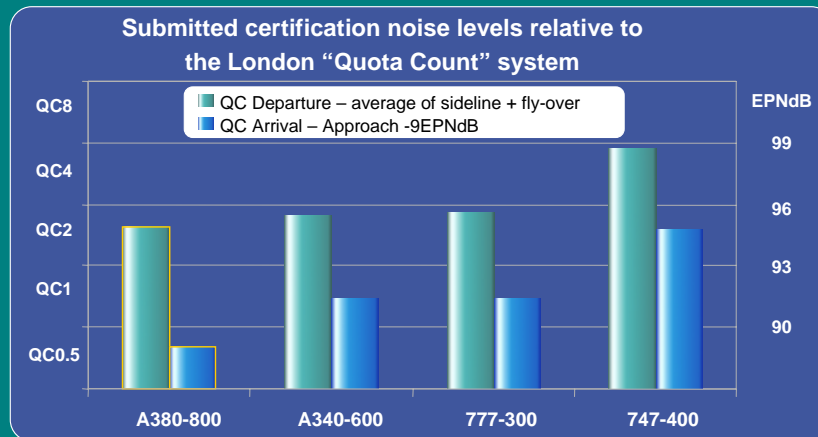
A380能够为机场带来的另外一个重要的好处是飞机在排放和噪音方面的环保性。

A380在排放方面得益于最新的发动机技术。技术的先进性可以使飞机的排放标准大大低于国际民航组织规章(CAEP4)的规定。以遛达900为动力的A380和以RB211为动力的747-400的比较结果证明了这一点。事实上,配置两种动力装置的A380都已经低于即将推出的氮氧化物标准。在环境标准日益严格的今天,A380无疑已处于令人羡慕的地位。

提到噪音水平,A380更是无人企及,如果A380和747-400都在最大起飞重量条件下,A380的噪音水平降低30%。也就是说,A380承载了更多的旅客,将他们带到更远的目的地,并且大大减少了噪音对于机场的影响。随着国际航空运输市场不断变化并且迅速增长,A380客机型和货机型带来双重益处,即一方面提高运力的降低飞机起降次数,另一方面大大改进了噪音和排放。

A380——可持续发展的动力。

A380 certificated noise lower than predicted



Noise levels submitted for certification better than commitments:

- London QC2 Departure with margin
- London QC0.5 Arrival (same category as 787 / A350XWB)
- -16 EPNdB margin to Chapter 4 / Stage 4

Noise guarantees met with significant margin



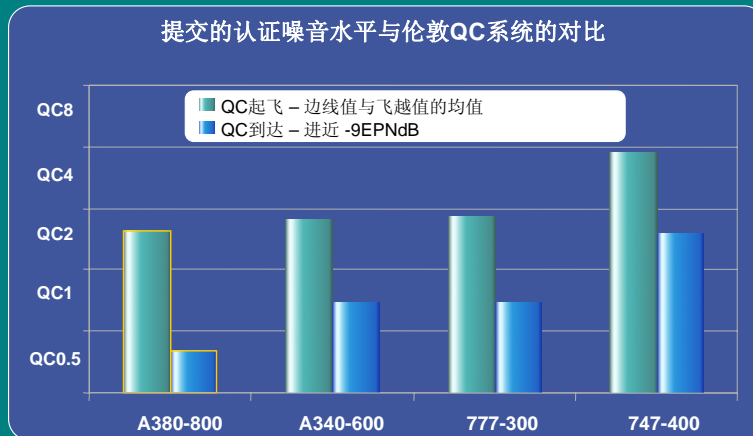
The levels of permitted aircraft noise nuisance have become more and more stringent over time. The latest standard, set by ICAO, called for a 10 dB reduction from the level under which all recent aircraft have been certificated. Preliminary flight test results submitted as part of the certification plan demonstrate that the A380 has exceeded our expectations with a margin of 16EPNdB to this new 'stage 4' limit. This gives a significant benefit to operators that will be far less constrained in their operations.

One of the most restrictive noise regimes in the world applies at the London airports of Heathrow, Gatwick and Stansted. Here night time operational quotas are allocated each summer and winter, limiting the number of aircraft movements permissible, with each aircraft type allocated a quota level depending on its noise characteristics. Today's 747-400 has a Quota Count of 4 at departure, twice that of the A380. In other words today's 747 operator could double the number of flights, without increasing their quota requirement by operating the A380. In practice, continuing reductions of the available budget are likely, in the future, to limit operations of the older, noisier aircraft.

On arrival, the A380 exhibits an even more stunning capability with a Quota Count of 0.5, a quarter of that of the 747-400.

Boeing's latest indications are that the 747-8 will not reach the same level, particularly at arrival where QC1 is merely mentioned as being a target. Even if this is achieved, the A380 will have double the frequency capability of its competitor. Perhaps the A380 re-orders by Qantas and Singapore Airlines are not so surprising given the importance of London operations by both of our customers. In fact the A380 is exhibiting today the same capability as that predicted for the 787 even though it is a bigger and heavier aircraft, with a much greater capacity.

A380的认证噪音水平远远好于预期



提交供认证的噪音水平比承诺的要好：

- 伦敦QC2起飞仍有裕度
- 伦敦QC0.5到达(与787/A350XWB位于同一级别)
- 较之第4章/第4阶段的标准仍有-16EPNdB的裕度

达到了承诺的噪音水平，且仍有大量裕度

目前对飞机噪音的限制越来越严格，根据ICAO最新颁布的标准，所有新近取证的飞机噪音水平必须降低10dB。作为适航取证计划的一部分，A380客机初始验证飞行的结果已经超出了我们的预期，比“4级噪音标准”还要低16EPNdB。用户因此在运营中受到的限制更少。

伦敦的希思罗机场、盖特威克机场和斯坦斯特德机场实行的是世界上最严格的噪音限制标准。这些机场每年夏季和冬季都要重新调整夜航航班的限额，控制飞机起降的架次。各种机型会根据它的噪音水平分到限额。747-400在离场时的QC为4，是A380的两倍。换言之，今天的747用户如果运营A380，就可以在不增加限额规定的情况下，使航班次数翻倍。在实际操作中，减少老旧且噪音大的飞机可以大幅降低运营成本。

A380的进场噪音之低令人惊讶，QC仅为0.5，是747-400的四分之一。

波音最近曾暗示，未来的747-8将无法达到这样的标准，尤其在进港时，QC1只是747-8的一个努力目标。即使747-8能够达到预想的目标，A380的班次密度仍然可以达到竞争对手的两倍。在这样的情况下，快达航空公司和新加坡航空公司最近增购A380也就不足为奇了。虽然A380客机目前的表现与未来的787相同，但事实上A380更大、更重、载客能力也更强。

An outstanding new generation aircraft...



Weight status – As defined in 2003

Airfield performance – Better than predicted

Range & fuel burn – All commitments met

Aircraft Handling – “ Superb”

Environmental performance – Better than predicted

Cabin comfort – unprecedented

...offering a truly new flying experience.



So just to wrap up, the A380 programme is more than meeting the challenging operational targets set for it by the airline community. A community that has worked with Airbus for the last 10 years to produce an aircraft that will set the standards for long haul travel for the next 20 years.

An aircraft that offers unmatched performance capabilities.

An aircraft that offers unprecedented standards of cabin comfort for its passengers.

An aircraft that truly deserves the description 'Outstanding'

一个杰出的新一代机型...



重量状态 – 与2003年定义的相同

机场性能 – 优于之前的预期

航程及油耗 – 实现了所有承诺的指标

飞机勤务 – “极佳”

环境性能 – 优于之前的预期

客舱舒适性 – 前所未有

...带来了真正崭新的飞行体验



总而言之，A380客机不仅仅是实现了航空业设定的充满挑战的运营目标。经过10年的合作，航空业和空中客车共同制造了A380客机——一架设定了未来20年远程飞行标准的客机。

一架性能无可匹敌的飞机。

一架为乘客提供前所未有的客舱舒适标准的飞机。

一架真正称得上是“杰出”的飞机。

A380 Values

- Technology leader
- Outstanding handling qualities – pilots love it
- Very quiet cabin – smooth ride
- Environmentally very friendly:
 - Externally very quiet (as, or better than, anticipated)
 - Very quiet cabin – smooth ride
 - Very quiet cockpit
- Low emissions and lowest fuel consumption per seat (17% less than 747-400)
- Lowest operating costs
- Welcome at airports

Meeting guaranteed performance



A380的价值

- 技术领先
- 杰出的操作性能 – 飞行员的钟爱
- 无比安静的客舱 – 安稳的乘机感受
- 十分注重环境影响：
 - 外部无比安静（相当于或优于预期）
 - 无比安静的客舱 – 安稳的乘机感受
 - 无比安静的驾驶舱
- 排放低，每座油耗最低（比747-400低了17%）
- 运行成本最低
- 受到机场的欢迎

实现了承诺的性能要求





Thank you



Q&A





谢谢



Q&A





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