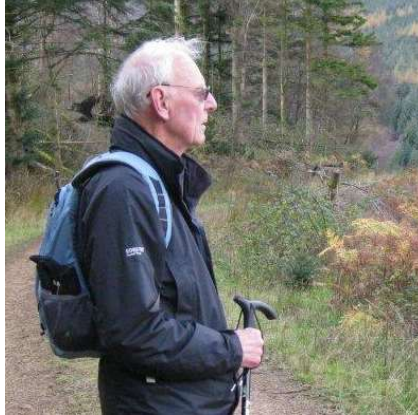


Careers in Aviation



Aircraft Designer

Ian Adams



The role of an aircraft designer is not as easy as some to describe. For example, a pilot flies the aircraft, an air traffic controller ensures that aircraft do not collide and a maintenance engineer fixes them when they break. The job of an aircraft designer (or, indeed any designer) is much more complex and, some would argue, more interesting and exotic. So, what is design?

What is Design?

- Describe
- Plan
- Create
- Invent
- Aim
- Intent
- Target
- Intrigue
- Plot
- Scheme

‘The Big Compromise!’

Before getting into the detail of the aircraft design role, it would be useful to think about what design is.

My Thesaurus identified several words that could be used in place of ‘design’ (synonyms) such as:

(Click) Describe, *(Click)* Plan, *(Click)* Create, *(Click)* Invent

These words suggest inventing or creating things, and are certainly descriptive of the aircraft designer’s role. Other synonyms are:

(Click) Aim, *(Click)* Intent, *(Click)* Target

These words suggest much bigger, strategic or ‘business’ thinking, and they are descriptive of the aircraft designer’s role as well.

Still more synonyms are:

(Click) Intrigue, *(Click)* Plot, *(Click)* Scheme

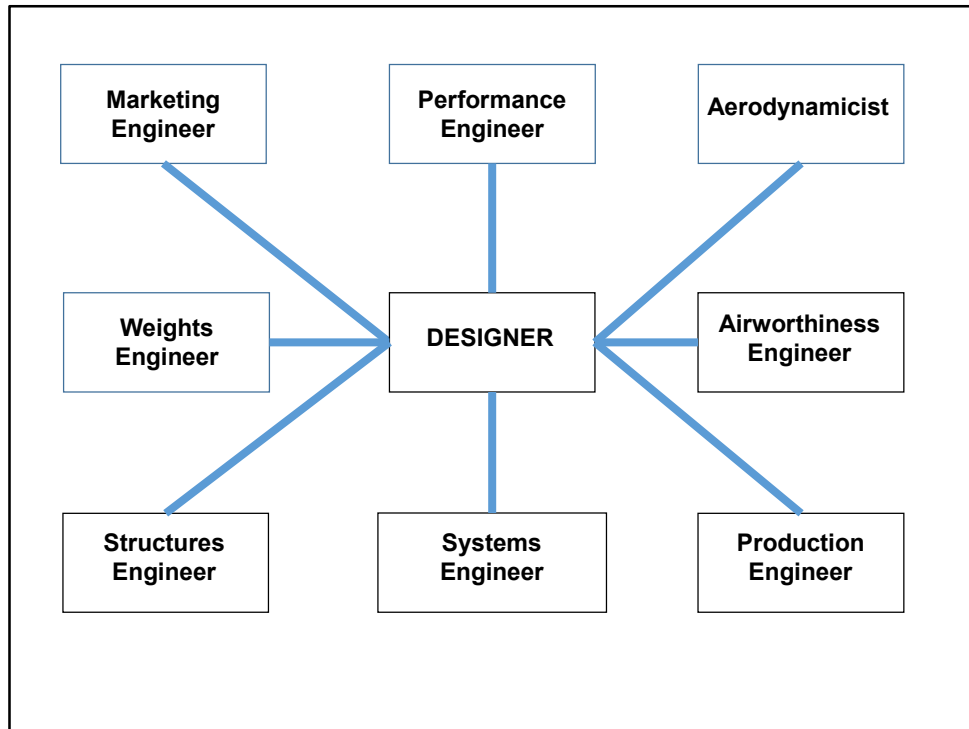
These words are less positive and imply craftiness and being clever, and they are applicable to some of the aircraft designer’s work as well.

Can you think of any other words that might be applicable?

My favourite description of the aircraft designer’s role is *(Click)*

‘The Big Compromise’

Let me describe what I mean...



Here is a typical aircraft project team. Around the edges are a bevy of highly qualified and experienced Specialist Engineers, all determined to do their jobs and make sure that, from their point of view, the aircraft does as intended. *(Click)*

The Marketing Engineer wants an aircraft that will beat the competition. *(Click)*

The Performance Engineer wants an aircraft that will fly high and fast. *(Click)*

The Aerodynamicist wants a slippery aircraft that cuts easily through the air. *(Click)*

The Structures Engineer wants the strongest possible aircraft. *(Click)*

The Systems Engineer wants to fill the aircraft with gadgets. *(Click)*

The Production Engineer wants an aircraft that can be built in his factory. *(Click)*

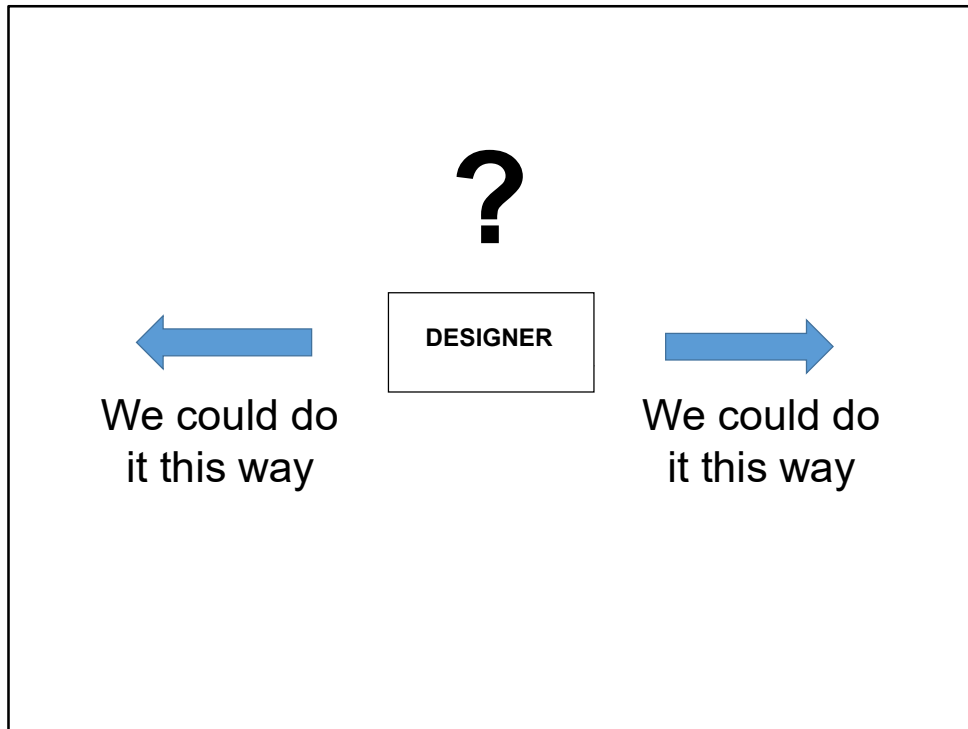
The Weights Engineer wants an aircraft that is as light as a feather. *(Click)*

The Airworthiness Engineer wants an aircraft that meets all the rules (and he is the only one who gets his way – otherwise the aircraft will not be allowed to fly!) *(Click)*

The Designer sits at the centre of this web and needs to deal with information coming from all these specialists. As you can probably tell, these engineers want different and often conflicting things. The Designer must understand all of this and must resolve any conflicts and achieve a practical design solution through, change and adaptation of the requirements of the Specialists.

This involves a great deal of technical understanding plus good inter-personnel skills to cajole and persuade the team and ensure a successful delivery.

Hence 'The Big Compromise'.



So how does the Designer set about achieving 'The Big Compromise'?

The next diagram shows how the designer tackles the problem of defining the aircraft.

(Click)

The question mark shows that a problem has arisen. This might be a conflict between the requirements of two Specialists, or possibly an unforeseen snag that prevents the achievement of a successful aircraft. The designer will have to be able to think "laterally" to imagine as many ways as possible of achieving the design.

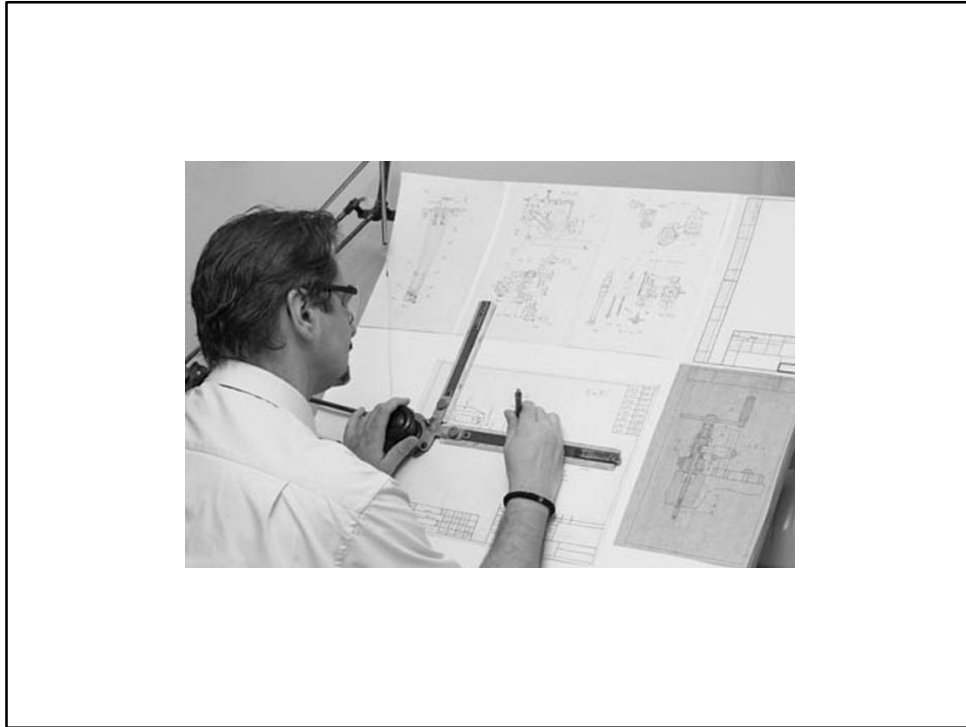
(Click)(Click)

These different ways of achieving the desired end result are known as 'Options'. Each will have advantages and disadvantages and these will need to be assessed to identify the one eventually implemented.

Although the designer will rely on past experience, each new aircraft will raise a new challenge on how to best use the latest technology.

It is usually not good enough to repeat what was done before since the designers in competitor companies will be trying to produce an aircraft that out performs and out sells your aircraft.

So how is the 'best option' identified?





Designers talk to engineers through the medium of drawings. Many drawings may have to be produced to get the ideas across. These initial drawings are usually called design schemes and these schemes allow the engineers to assess the proposed design and approve, or otherwise, of the concept.

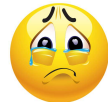
This was how drawings were produced when I started in the design department.



Nowadays, just like everything else, technology has intruded and you are more likely to produce drawings using a Computer Aided Design (CAD) package. It is a bit confusing that CAD has “Design” in its title because it does not design anything, the designer still uses his own brain to do that. However there are many advantages in producing the drawings using a computer because the same digital data that was used to draw the design can also be “looked” at by other computers. For instance, the weights engineer can use his computer to find out the weight of all the items on the drawing, the electrical production departments can assemble bundles of wires that will fit the aircraft, the aerodynamicist can use his computer to find out the air pressures on the outer surface of the aircraft and the production engineer can also use the digital data to drive machine tools that will cut the parts to shape. All this without ever seeing the aircraft.


**Design Scheme No 1 -
Weights Engineer doesn't like - too heavy** 

**Design Scheme No 2 -
Production Engineer doesn't like - too expensive** 

**Design Scheme No 3 -
Systems Engineer doesn't like - not enough space** 

and so on, and so on, until ---

**Design Scheme No ? -
All the engineers are happy that this compromise is the best that can be achieved.**

'The Big Compromise' 

The design schemes may fail or partly fail for various reasons. Here is a typical sequence.

(Click)

(Click)

(Click)

(Click)

Until finally...*(Click)*

(Click)....and we're done!

Commercial Requirements

**If the aircraft is to be a success
and make a profit for the company
it must meet the requirements
of the prospective customers.**

Although the foregoing are described from the point of view of the aircraft designer, the processes are similar for any multi-disciplined project design task.

Also, like any other commercial product, there are requirements which come from the customer and which have to be met for example – how many passengers it must carry and how far and at what cost.

Airworthiness Requirements

These are the rules that all aircraft must meet.

**If they do not, they will not get a certificate
of airworthiness and therefore
can not be sold to a customer.**

For all civil aircraft, there are other sets of regulatory requirements which the design must meet by law.

The award of a Certificate of Airworthiness is a significant milestone on the road to achieving a successful design, but the work of the designer is far from over and extends through further flight testing, entry into service and indeed, during the whole service life of the aircraft.

So how did I become an aircraft designer?



When I was a teenager at school I was on a course that did not include technical subjects and, as it turned out, that was my real interest. I had always been intrigued by how things worked and thought that I might be good at designing houses.

My life took an unexpected turn when, as a fifteen year old in 1953, my father took me on a visit to the new apprentice school at Scottish Aviation Ltd at Prestwick Airport. The apprentices were working on a small model speedboat, powered by a petrol engine and owned by Group Capt. McIntyre, the Managing Director of the company. This fired my imagination and I applied there and then to become an apprentice. It was to be about another fifty years before I saw that speedboat again.

I was lucky enough to gain a place in the apprentice school and had an interesting and varied apprenticeship.

I became involved in designing and building a display for the company's stand at the 1954 Farnborough Air Show. This work let me see that designing things could be fun. I went to the Farnborough Show to look after the display and saw all the new aircraft that were at the show.



I then spent a year in the Test House learning about materials and processes used in the aviation industry but then moved to the Trial Installation Hangar and played a small part in helping to build the prototype Twin Pioneer. I then spent some time as part of the ground crew during the early flight testing phase of the aircraft. I learned a lot about aircraft during this period. I was picked for a draughtsman training course and a few months later was transferred to the Production Drawing Office where I spent some time drawing parts for the Twin Pioneer. During this time I had to catch up with the subjects that I should have covered at school and I enrolled for further education at night classes. Not the easiest way to do this.

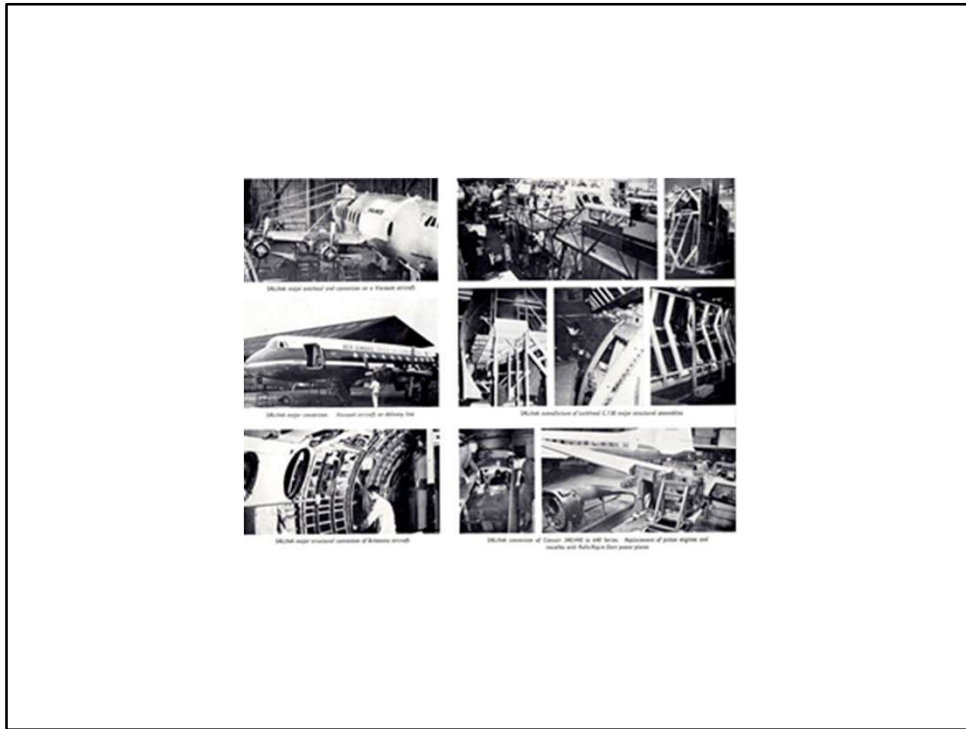


RAF Seletar, Singapore

When I was 21 and at the end of my apprenticeship I was sent off to do my National Service and, as I had a background in aviation, I ended up in the Royal Air Force working on communications equipment in the Far East.

I was based at RAF Seletar in Singapore, but I also got the chance to visit many places in the Far East including Hong Kong and RAF Gan in the Maldives.

Thankfully, National Service is no longer with us, but it is a shame that the opportunities that it provided to travel to and work in exotic locations have also been lost.



When I returned to Scottish Aviation two years later I found that almost all of the draughtsmen had been made redundant when the company nearly collapsed in 1959. However this proved to be an interesting time working in what was now a small department which was busy producing drawings to modify many different types of customer's aircraft. This type of work was good training for us young design people and the experience of having to produce a design from scratch in a very short time gave a good grounding for future work.

Around that time we took on some contract design work for Handley Page Ltd to support the manufacture of the wings for their Jetstream aircraft at Prestwick and, although I did not know it then, this was the start of a thirty-five year relationship with the various versions of the Jetstream aircraft.



The Bulldog Series 120 in service with the Royal Air Force as the Bulldog T Mk 1.

Not long after this the Handley Page company collapsed but, luckily for us, so did the Beagle Aircraft Co and we ended up as the design authority for their Bulldog training aircraft. This now gave our small design office an aircraft of our own to work on. Here is the Bulldog in service with our own Royal Air Force, but it also served with the air forces of Sweden, Malaysia, Kenya and many other countries. I became involved with various modifications to the Bulldog to meet the customers requirements and the most important of these was the design and testing of the canopy jettison system that would allow the crew to escape from the aircraft by parachute in an emergency.



This was our design department in the 1970's. We were drawing with pencils and pens on paper, linen and plastic sheets supported mainly on flat drawing boards.



The Bulldog Series 200. This air-to-air photo of the prototype shows what it actually looked like although somewhat disguised by the Scottish Aviation air-race colour scheme.

Having gained experience in working with the aircraft we went on to develop an improved version, the Bulldog 200, with retractable landing gear.



Jetstream T Mk1 multi-engine trainer for the Royal Air Force

Meantime the company had bought the design rights to the Jetstream aircraft and we started to modify the aircraft for use by the Royal Air Force and eventually the Royal Navy. Also, during this time, I began to take more of a leading role in the department and became responsible for the management of some of the designers.

A large change to the fortunes of the company happened when we became part of British Aerospace and that allowed us to go ahead with a project to update the original Jetstream to be a more capable aircraft to suit what was seen to be the big market in the USA. This was the start of a difficult but exciting time.

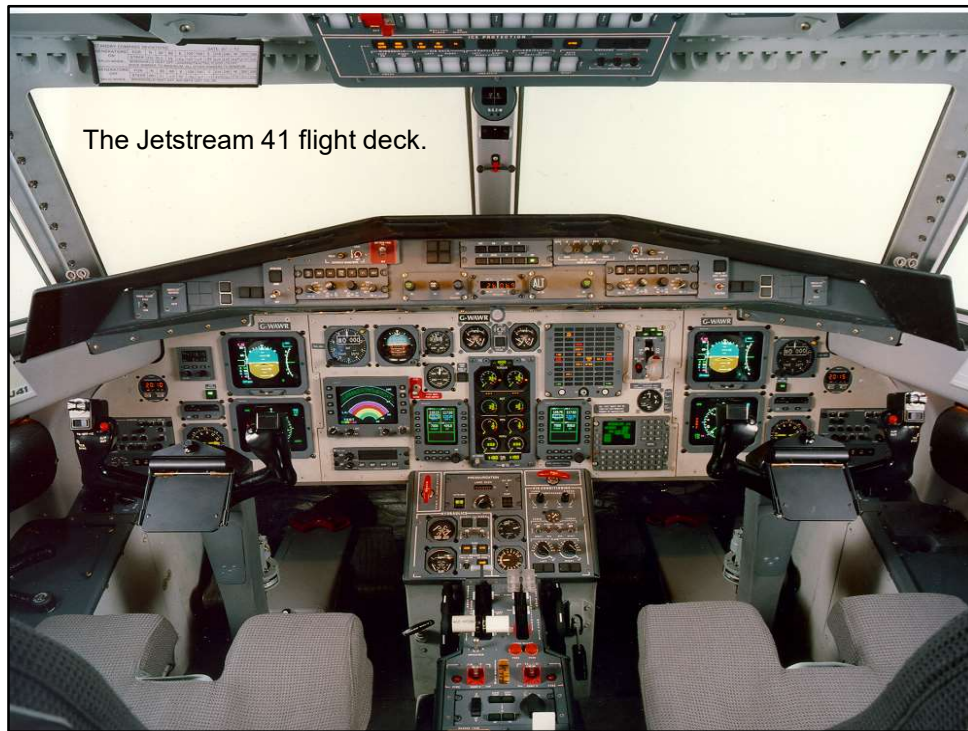


The redesign of the aircraft, now known as the Jetstream 31, was started but the most difficult task was to build the small department into a much bigger one capable of taking on the work. I was now in the middle of the challenging task of not only controlling the aircraft design and all the design processes and procedures but also hiring and training the staff that were needed. This much expanded department of mainly young designers rose to the challenge and the company eventually sold nearly 400 of the Jetstream 31s, most of them to American based airlines. I was proud of what we had achieved and many of the young designers went on to take responsible positions in the department or take good jobs elsewhere in the aviation industry.



One of the first Series 4100 aircraft to go into service seen in an Ayrshire valley.

The company now was given the go ahead to develop the aircraft further to increase the passenger carrying capacity. This aircraft, the Jetstream 41, could not be developed from the Jetstream 31 but had to be an entirely new aircraft to meet the latest airworthiness requirements. At this point in my career I relinquished my management post and returned to pure designing.



I was tasked with looking at the design of the forward fuselage including the structure, control systems and flight deck layout. After some time producing design schemes we started into the full production design and I was asked to lead a small design group to tackle the whole of the forward fuselage. A sustained 18 months of effort produced the final design and it was a great day when the prototype aircraft took to the air for the first time. When the continued development of the aircraft, to meet the airworthiness and customers requirements, was drawing to a close I got the chance to work on the design of new projects.



Not only did I work on the design of much larger aircraft, the Jetstream 51 and 71, which were sadly never built, but also on other British Aerospace aircraft such as the Nimrod and the Eurofighter.



My final project with the company was to design the latching and locking mechanism of a large freight door which was used to convert many of the original ATP aircraft into freighters capable of carrying up to 8 tons of cargo.

I retired from the company after 45 years of work in the design department and having had the opportunity of seeing it from almost every angle.

So how do you become a designer?

How to become a Designer

Study the STEM subjects at school.

Science
Technology
Engineering
Maths

and English

Firstly, study the appropriate subjects at school – STEM plus English at least .

Many schools these days include the opportunity to study Product Design. A design element is also included in Tech and Art...

....and a foreign language would be helpful too in the modern world.

University of Strathclyde

Search

STUDY WITH US · WORK WITH US · WHY STRATHCLYDE? ·

Home > Courses > Undergraduate > Product Design Engineering BEng

BEng
Product Design Engineering

Key facts

- **UCAS code** I771
- **Accreditations** Institution of Engineering and Technology, Institution of Mechanical Engineers & Institution of Engineering Designers
- **Second-year entry** available for suitably-qualified students
- **Study abroad** options include Europe, Australia & Singapore

Study

- Undergraduate Degrees
 - Architecture (BArch)
 - Architecture (BArch)
 - Communication Design
 - Engineering with Architecture
 - Fashion Design
 - Fine Art Photography
 - Interior Design
 - Interior Design
 - Painting & Printmaking
 - Product Design
 - Product Design Engineering**
 - Science & Environmental Art
 - Specialising in Jewellery
 - Textile Design

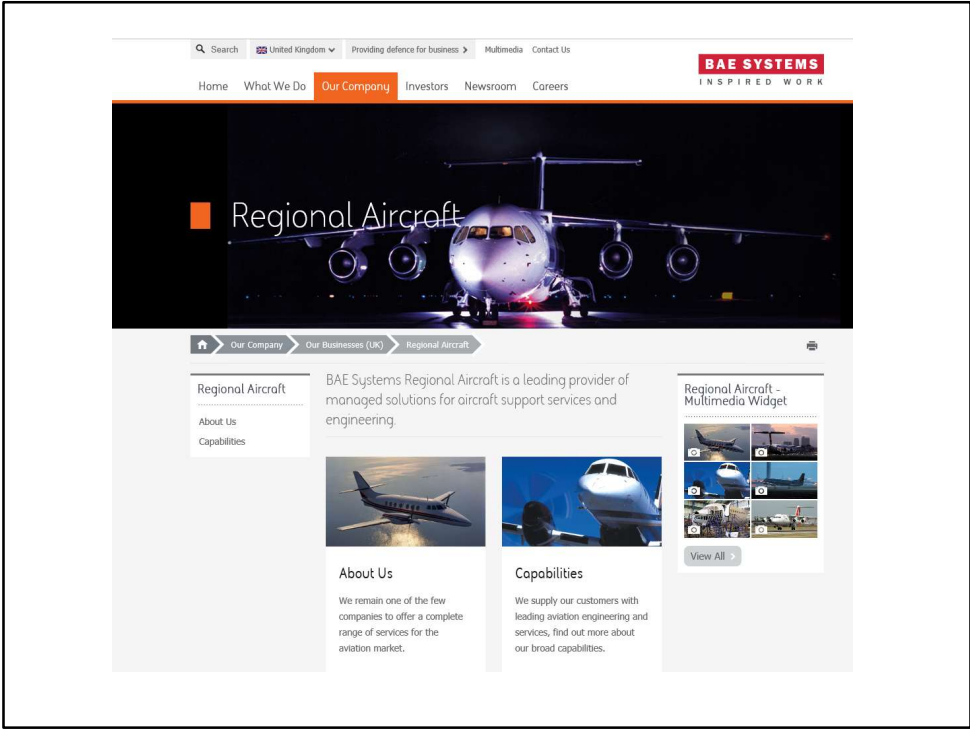
GS&A

Life Research Visit GSA About GSA Support GSA

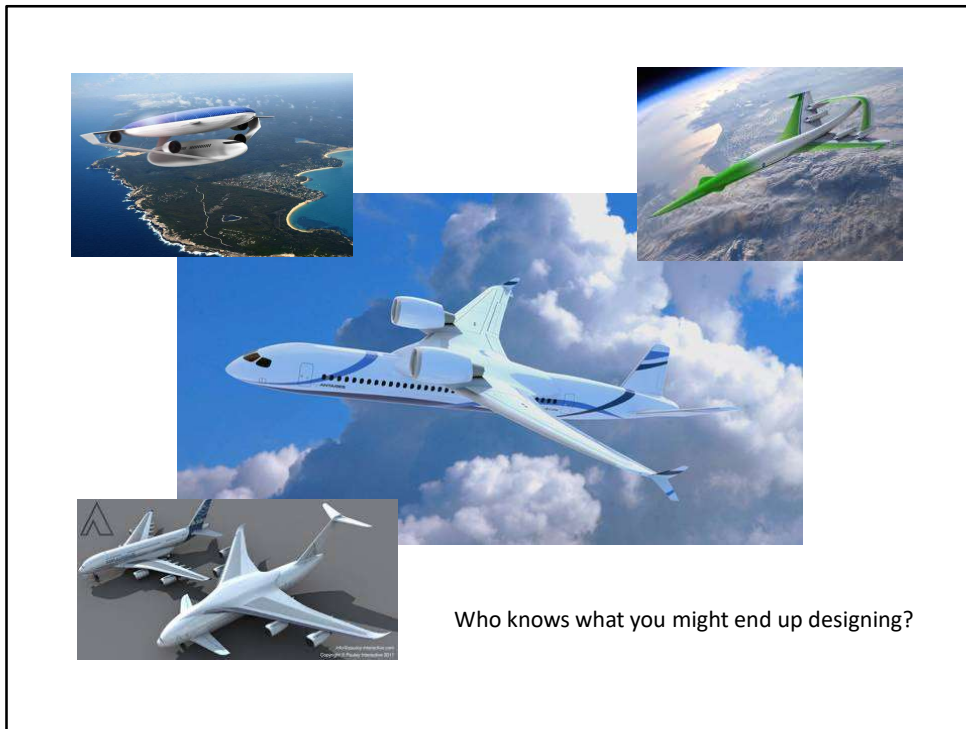
PRODUCT DESIGN ENGINEERING

Most employers require a higher level qualification

Most employers nowadays require a higher level qualification and there are many higher education opportunities in Scotland (and elsewhere) to study product design.



It has to be said that the aircraft design and manufacturing industry in the UK is not what it used to be, but one of the most capable aircraft design teams is still resident in Scotland at Prestwick.



There are now many designers looking at ways in which aviation can be made to be more sustainable. Questions need to be answered on how we make aviation more carbon neutral and more eco-friendly. This gives an exciting challenge for designers in the future.