AEROSPACE MANUFACTURING
DESIGN/PRODUCTION/SUPPLY CHAIN MANAGEMENT
JANUARY 2016
www.aero-mag.com

AIRCRAFT PROGRAMMES

BOEING 787: RE-INVENTING THE DRAWING BOARD Page 17

THE EUROPEAN MAGAZINE FOR A GLOBAL INDUSTRY

RE-INVENTING THE DRAWING BOARD

Dassault Systèmes explains how the use of its PLM software in the Boeing 787 programme led to a transformation of how commercial aircraft are produced. **Ed Hill** reports.

When Boeing decided it was going to develop the 787 it was not only revolutionising the design, materials and systems of a commercial passenger aircraft, it was also transforming the manufacturing, supply chain and support.

To implement and integrate all these new elements would also require a revolution in the software that supported the programme.

Dassault Systèmes was already well-known for its development of computer-aided design (CAD) products such as CATIA for designing new aircraft. By the early 2000s this had evolved to include programs such as DELMIA to support manufacturing, ENOVIA to support internal and external collaboration and SIMULIA for analysis and simulation. These new programs and others were packaged under the banner of its 3D product lifecycle management (PLM) solutions.

Boeing took these elements and developed them further with Dassault Systèmes to create an all-encompassing software programme that would support the entire 787 project.

Mich Tellier, aerospace and defence vice-president at Dassault Systèmes begins: "In reality what we created was what we call today model based systems engineering (MBSE). That means integrating many of the system engineering processes, such as design and structural development all the way into full digital manufacturing, logistics, fabrication and shopfloor tracking and even into the development of the maintenance and support packages for the aircraft.

"Another element was to augment that with what we call 'Relational Design' which means the design and engineering is morphable. If you change a requirement it will propagate change into the design, production and support definitions of the process, to some extent, automatically."

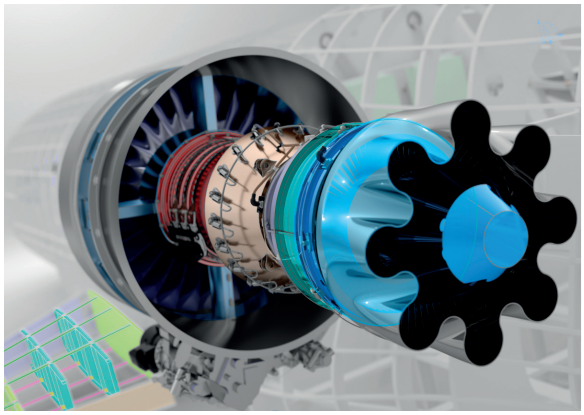
ABOVE: A new approach to design

BELOW: Mich Tellier, vice-president, aerospace and defence industry, Dassault Systèmes

Grand designs

Boeing had ambitious aims for the 787 programme. Not only was it introducing widespread use of composite materials for major structural elements of the aircraft such as the fuselage, it was also replacing high pressure pneumatic power flight systems with electrically driven pump and compressor systems and introducing a central computing control system instead of numerous individual subsystems with their own CPUs. The new software development platform developed with Dassault Systèmes was itself a major step change.

Much of the manufacturing technology for dealing with composite manufacturing had yet to be developed.



ABOVE: Detailed aero-engine design using CATIA

"The introduction of composites was one of the biggest challenges. On the design side we already had a lot of good capability for work with composites, but on the manufacturing side a tremendous amount of work had to be done. Boeing was inventing new ways to fabricate composites in terms of multi-head tape laying robotics. Some of these machines didn't even exist before the programme so a lot of R&D had to be done to develop the solutions that we needed to support these new processes."

Another major change for the production of the 787 was the role of the supply chain. Instead of building the plane from the ground up, Boeing assigned its global subcontractors to do more fabrication themselves and deliver completed subassemblies to Boeing for final assembly at its facility in Everett, Washington.

This meant many of Boeing's global prime, tier 1 and 2 partners in the US, Japan, South Korea and Europe would need to have access to the Dassault Systèmes' software development platform.

"Making the PLM platform globally available introduced a great deal of complexity. We had hundreds of partners and locations that were all patched into the same design environment and they had to be able to work together effectively. Our system also had to be extremely robust from a security perspective. We had multi-tiers, multi-locations, multi-nationalities, and contractual and work management hierarchies that had to be adhered to.

"We had to put in a platform that not only met all those criteria, but also include, installation, training and certification, security audit and network performance audit functions."

By developing the Relational Design elements of the 3D platform, where the impact of a component design or material change is replicated and then passed to all participants involved in the programme, the nature of the work of systems engineers has also changed.

"You still want engineers insuring that the implementation is done properly, but it means the workload is different. The balance changes from design engineering work to much more verification and validation."

The impact of Relational Design has also meant that when Boeing wanted to develop derivatives such as the 787-9 and recently completed 787-10, which stretches the original -8 design from 186ft (57m) to 224ft (68m). It has been able to do so relatively easily.

"This has significantly reduced the cost of producing the variants because they can morph the design to make the changes. It actually helped earlier on in the design phase when changes were made. Changes that could have ended up adding years to the project only added weeks. This demonstrated what a game changer this new software platform was for an aircraft programme."

A new experience

The work carried out on the 787 was a precursor to Dassault Systèmes launching what it now calls its 3DEXPERIENCE platform used for the development of new products in many sectors.

"Our strategy has always been to extend the integrated development platform both upstream and downstream and wider. The 787 programme was a huge catalyst in helping to realise that ambition and a lot of what we learnt was implemented into what is now the 3DEXPERIENCE Platform."

And 3DEXPERIENCE has itself led to another transformation into how aircraft are designed and built, particularly with the development of computer technology, such as the cloud, which enables even more distribution and sharing among stakeholders.

The constant demand from airlines and passengers to make flying a more agreeable experience is also having an increasing influence on how passenger aircraft are designed.

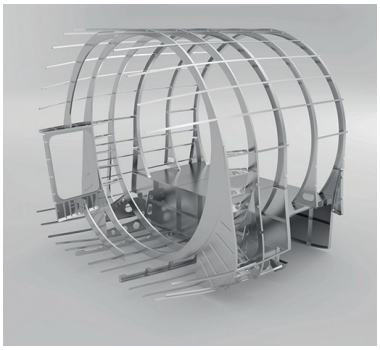
"The operator and end user experience is now one of the biggest drivers of aircraft design. Aircraft have ever more complicated systems, particularly with passengers demanding increasing interconnectivity with their personal devices such as phones and tablets.

"Every airline also wants their interior to look more bespoke. And of course manufacturers compete on their ability to be able to deliver that. Additionally, OEMs are focused on how they engineer for cost or what I would prefer to call produce-ability aside from just performance. Now (at least in commercial aviation) cost, rate and simplicity of production are huge design factors that need to be included right at the beginning of the design phase."

So what is the impact of the 787 programme on aircraft production and what does it mean for the future of designing aircraft?

"You couldn't have designed such a radical new airplane using the old traditional practices in the time that it was achieved," concludes Tellier. "It's a positive development particularly from the passenger's experience. There's a shift of focus from just making the plane fly, to making it a pleasure to fly in, and yet more affordable to operate at the same time."

www.3ds.com/aerospace

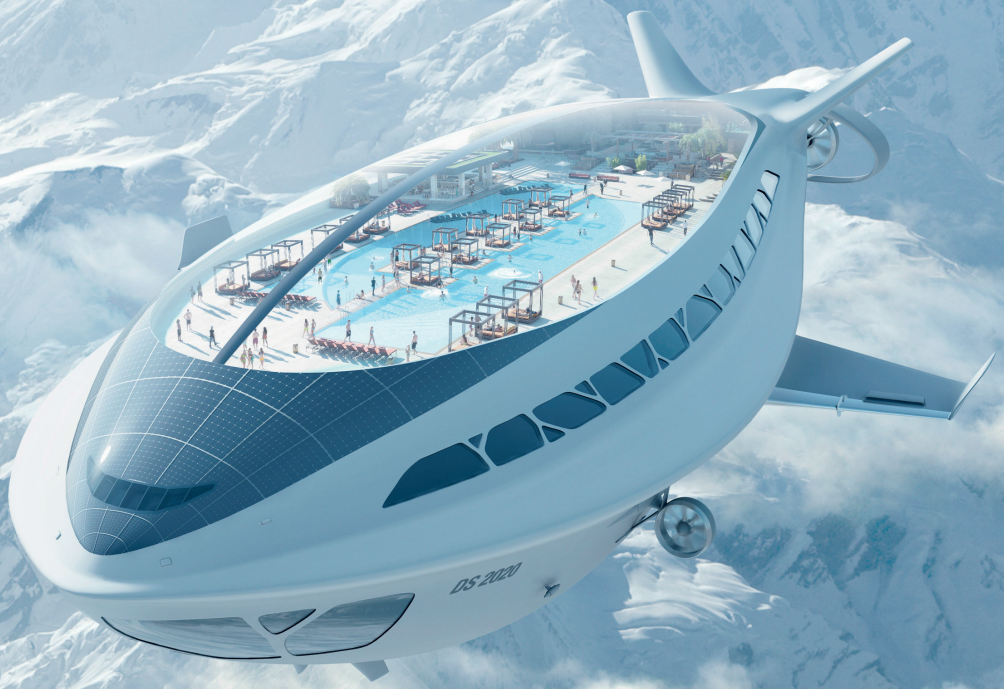


TOP RIGHT: In the frame: fuselage designs in CATIA

BOTTOM RIGHT: Future factory simulation

IF WE™ go on a cruise, does it have to be at sea level?

Flying cruise liners –
a dream our software could bring to life.



3DEXPERIENCE

It takes a special kind of compass to understand the present and navigate the future.

3DS.COM/AEROSPACE-DEFENSE

DASSAULT SYSTEMES | The **3D**EXPERIENCE Company