TTU Presents

INNOVATION
PERFORMANCE COMPETITIVENESS

The OECD defines innovation as the implementation of a new or significantly improved product (good or service) or process (production), a new organisational method in business practices, workplace organisation or external relations, or a new marketing method. A key factor in competitiveness on a highly competitive aeronautics market, innovation is always, internally, a complex process of confrontation and negotiation that involves numerous technical players.
If Airbus Group is today a leader on the various civilian aeronautics,

AIRBUS GROUP

defence and space markets, it is because the group has always pursued an ambitious strategy of breakthrough innovation.

Paul Emerenko, Airbus Group's new Chief Technology Officer (CTO), explains his vision of technological breakthroughs as follows: "Thanks to innovation, we want to turn Airbus Group, and aeronautics itself, upside down. Rather than simply being affected by the major technological revolutions that are coming, we want to detect them, generate them and guide them. We want to create breakthroughs. What is a breakthrough? It is to meet expectations that are today considered impossible, to completely change the structure of a product to make it less expensive, or to innovate in the ways in which we design and manufacture products."

In order to deliver competitive and effective solutions to its civilian and military customers while increasing its performance in terms of growth and profitability, Airbus Group strengthens its internal culture of innovation each and every day.

In a dual group like Airbus, convergence between civilian and military technologies is at play when it comes to innovation, in a process of cross-fertilisation that is more balanced than in the past. Indeed, defence remains a terrific driver of technological innovation, continually stimulated by the diversification of threats. While innovation in defence is, by nature, contractual and led more by government customers, the latter are also often those who undertake the risks tied to innovation, before exploitation by the civilian market helps lower the costs of development. A purely civilian aeronautics industry does therefore not exist: the aeronautics "ecosystem" is always a dual one and innovation is never a one-way street.

Innovation in products:
AIRBUS GROUP between incremental and breakthrough innovation

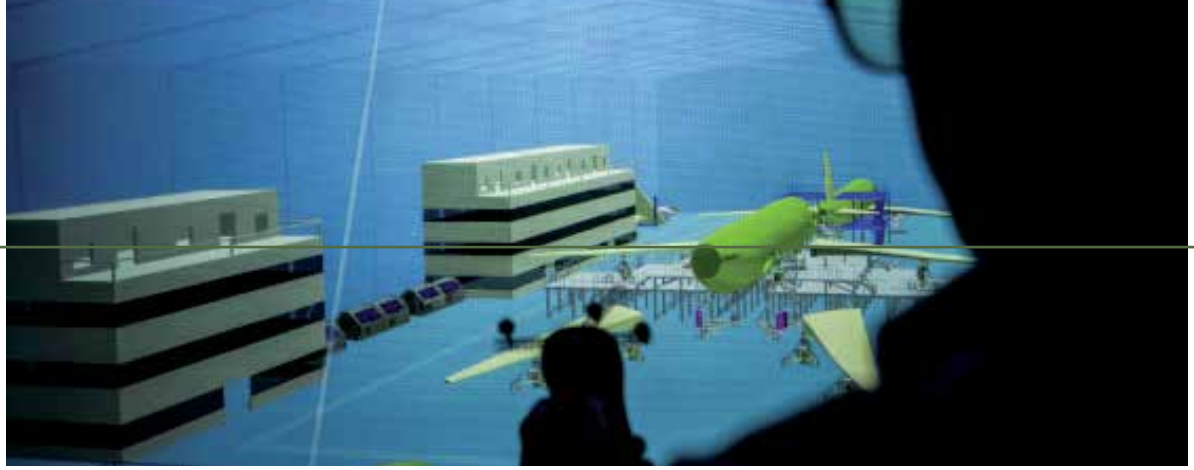
When it comes to products as well as industrial processes, Airbus Group is working on the entire spectrum of innovation. Nothing can be overlooked, whether radical or incremental innovation. Incremental innovation, which consists of adding new features to an existing product, generally does not fundamentally change the dynamics of an industry and disrupts neither conditions of use nor the state of the art, while offering a significant improvement.

It offers the advantage of making it possible to rapidly meet the requirements of the market but involves close management of the product platform over time, the timeframe for development of an aircraft being a long one, five to eight years on average. Yet, for Airbus, incremental innovation of a product or process often involves the use of breakthrough technologies.

Examples of successful incremental innovation:
• the improvement of Airbus's bestsellers (A320 and A330) with "neo" versions, to extend their success;
• the launch of the A350 XWB, the first airliner built with carbon-fibre-reinforced plastics; and the use of new high-performance composite alloys. Airbus Group is also innovating in more radical ways, with products that involve breakthrough innovations that are shaking up the business model and the industrial structure.
This is notably the case with the digital revolution and the **OneWeb** project to build a constellation of 900 low-cost microsatellites to meet Internet requirements.

Digitisation

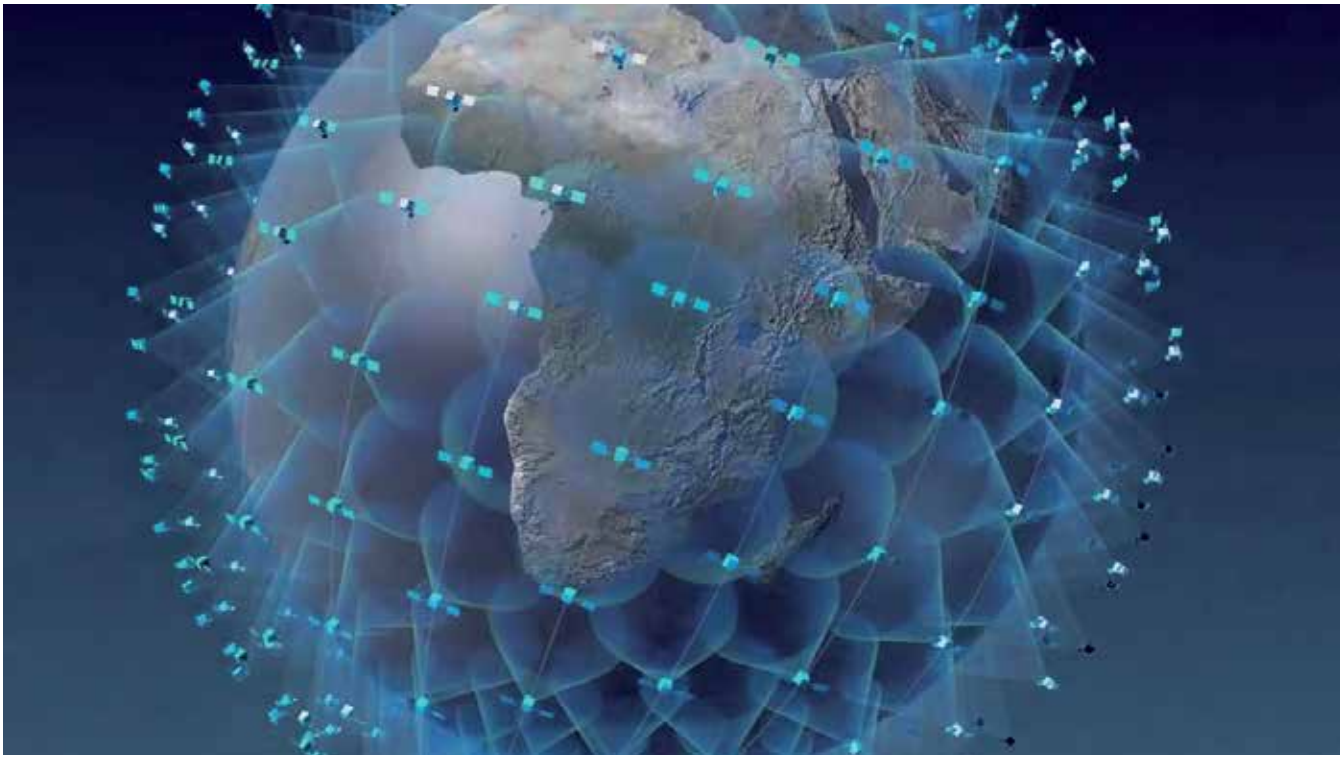
Launched at the initiative of Tom Enders at the end of 2014, the group's new digital strategy aims to prepare Airbus to meet the challenges arising from new forms of industrial organisation, which are notably seen in Silicon Valley. According to Marc Fontaine, the group's Digital Transformation Officer: "The integration of digital technologies in the production of our aircraft is a giant step forward. This means less paper, greater automation and clearer communication for faster resolution of problems. Its goal is simple: to make Airbus the world's leading aircraft manufacturer by making the most of digital technologies." In future, having the industrial platforms will not be sufficient without intelligent control of data that is indispensable to guaranteeing the best quality at the lowest cost and for creating new services. Making the best use of the rich resource that is data will be crucial: aeronautical manufacturers deal with a considerable volume of information in research, technology, production, purchasing, marketing, etc., as well as during flight. Airbus Group will have to be capable of connecting the data and making use of it to become more efficient in creating the aircraft of tomorrow and offering new services. By digitising all processes (construction, model, inspection, etc.), the exploitation of Big Data makes it possible,



through the regrouping of a large volume of heterogeneous data, to extract information that enables, for example, the processing of all quality data to detect production defects and best manage the availability of machines. Real-time processing makes it possible to reduce the number of investigations and inspections and thus increase profitability. Pilot programmes are already in place in several factories in the area of quality control (analysis of materials or processes that go off course). The creation of a "data lake," a database of all aircraft in service that, made available to the entire company, free of silos, enables improvements in design, production and marketing of aircraft as connected products, with obvious advantages for customers. The digitisation of factories will also involve the widespread use of augmented reality, on laptop computers or tablets: MiRA (Mixed Reality Application), a geo-localised digital terrain mock-up system, enables users to superimpose the 3-D virtual mock-up on the real environment and thus save time and gain in precision when it comes to interventions on the assembly line. MiRA is now used on the production lines of the A380 and the A350 XWB for the inspection of secondary structural brackets that notably support hydraulic circuits. The system reduces the likelihood of later discovering damaged, missing or poorly positioned brackets. The use of MiRA has made it possible to reduce the inspection time for the A380's 50,000 brackets from three weeks to three days! In the area of support, other processes will be made possible through the use of Big Data, such as the remote detection and diagnosis of breakdowns. Outfitted with a smart jacket that uses connected devices, a local Airbus representative will, for example, be able to gather all of an aircraft's data and, from a distance, consult with a group expert to obtain technical assistance in the event of a problem. This is a very economical solution that obviates the need for travel and which is particularly suitable for small helicopter fleets, for example. Digitisation is a true revolution for a large company like Airbus, for which digital technology is not the core business. It involves a change in thinking for a company whose DNA is first and foremost that of engineers. It will also involve the arrival of co-workers with varied backgrounds who are familiar with new information technologies.

Breakthrough innovation
at Airbus Defence & Space: **One Web**

As part of a joint-venture with the U.S. Internet service provider **OneWeb,** Airbus Defence and Space is to build a constellation of 900 satellites to provide extensive and affordable access to Internet. The project represents the new nature of the civilian satellite market, i.e., the quest for lower technological intensity, lower production costs and the emergence of the concept of a constellation of satellites. This comes as new players are appearing on the market, such as Silicon Valley entrepreneurs. For Airbus, **OneWeb** represents a challenge: that of rapidly building a myriad of low-cost microsatellites weighing 150kg each. The challenge is both technological and industrial. Airbus DS must learn to step up the rate of satellite production in order to deliver as many satellites on schedule, while respecting constraints in terms of cost and quality. Airbus aircraft teams were called upon to design a two-satellites-per-day production line, as with civilian aircraft. The design is required to adhere closely to technical specifications (no overreach in terms of capabilities), with an absolute requirement to remain within budget, a fundamental aspect of the project's business model. This involves the use of new technologies that go beyond the traditional players in the space field. This apprenticeship will have concrete repercussions on the competitiveness of Airbus's entire satellite offering. With such a large-scale project, the advantage for Airbus DS in being part of a large group with a varied portfolio of activities, is to have benefited from Airbus's expertise in terms of manufacturing and management of high production rates.



Incremental innovation at Airbus: **the NEO line**

An example of successful incremental innovation, the A320neo features the latest technologies, such as new-generation engines and sharklet wingtip devices, which together enable a 15% reduction in fuel consumption. In 2020, innovations in the cabin and new enhancements in engine performance will make it possible to achieve a reduction of 20%. In addition to these benefits in terms of operating costs, the A320neo's impact on the environment will be lower, with a 50% reduction of its carbon footprint compared with previous-generation aircraft. It is a real commercial success: as of the end of 2015, Airbus Group had secured 4,500 firm orders for the latest addition to the A320 line.

In 2015, Airbus Group invested nearly 3.5 billion euros in R&D, an increase of 158% compared with 2000. The group, which holds more than 37,000 patents, is France's 8th largest patent holder and registers more than 370 trademarks each year. The group established one of its Airbus Group Innovations centres in Suresnes, near Paris, and supports the French network of competitiveness clusters, such as Aerospace Valley, which links the Aquitaine and Midi-Pyrénées regions. The group's commitment to its suppliers, which are small- and medium-sized companies, is reflected in its adhesion to the "Pacte PME" (SME pact), designed to strengthen ties between small companies and large manufacturing groups.

Innovation at Airbus Helicopters

At Airbus Helicopters, the innovation portfolio involves requirements on both the short/medium term and the long term. The helicopter manufacturer benefits from the group's synergies in terms of innovation, whether advances in composite materials or the incremental deployment of new production tools (factory of the future).

An example of this type of synergy is the development of a hybrid system that enables the improvement of autorotation using an electrical system, or an obstacle avoidance system (rotor strike alerting system), tested on the H135.

Other innovations, specific to rotary wings, are the product of internal R&D, notably on new technologies in the field of helicopter blades.

On the short term, Airbus Helicopters is innovating by enhancing the current line in order to simultaneously improve three factors:

- **customer satisfaction** (for example, with noise reduction),
- **safety and quality of platforms,**
- **economic efficiency.**

With spillover effects, like with noise reduction, which, in satisfying the customer, improves commercial results.

Among long-term innovation programmes is the **Clean Sky 2 demonstrator,** a hybrid helicopter that features a novel architecture. It includes breakthrough innovations in terms of propulsion system, based on lateral rotors, fixed on the end of a wing, which makes it possible to increase speed by 50% and significantly enhance propulsion output in forward flight. In terms of costs, if these breakthrough technologies increase them by 20%, the gain in speed makes it possible to lower the final flight cost. **Clean Sky 2** is also innovative in terms of mechanisms of industrial collaboration. The programme, which is 50% funded by the European Union, involved the collaboration of several European research centres and allowed Airbus Helicopters to increase its chain of suppliers while identifying potential new technological markets.

H160 : A wealth of innovation

As the first civilian helicopter made entirely of composite materials, Airbus's **H160** is packed with innovations, integrating nearly 68 new technologies. First, in terms of significant reduction of noise produced by the aircraft, thanks to its Blue Edge blades and its new tail boom with canted Fenestron. Its turbine offers a significant reduction in fuel consumption, with an energy output that is 15 to 20% higher than that of the competition. Its composite structure, for which Airbus Helicopters benefited from the group's know-how, makes maintenance easier and lowers the cost of ownership.

Innovation in production: factory of the future

The challenge of composites

For Airbus Group, meeting the needs of the market requires being able to increase the production rate and enhance industrial efficiency. Innovation in engineering processes involves respecting the trio of time (speed up engineering cycles), quality (obtain the most complete definition of the product) and cost. In order to meet the growing need for lightweight parts, Airbus has chosen to improve performance in the manufacturing of high-performance composites, such as thermoplastics. For example, by giving priority to new materials that do not require cold storage and expensive autoclaves. But also by automating their production (installation of lightning protection or paint). The main challenge remains that of metal parts, where 3D printing could make it possible to build small complex parts, which currently take a long time to manufacture and involve significant waste (shavings).

The use of powders that enable production of these parts is very expensive and while it is justified for small series (such as in the space field), such use in aeronautical construction requires coming up with new processes. Airbus is therefore developing titanium wire-based metal parts to design more precise preliminary designs, with less waste, which will result in lower production costs.

The smart workshop

At Airbus, a gradual digitisation of the workshop is underway. This goes well beyond the disappearance of paper-based work orders: it is an opportunity to develop value-creating applications by making data that is useful at an opportune moment visible to operators, thanks to the use of Big Data. By placing them at the heart of the digital strategy, allowing them, for example, to understand the root causes of a production non-conformity and to decide on the corrective action required. A focal point of the digital projects underway is the pilot production digitisation system, notably the MES (Manufacturing Execution System), the cornerstone of smart production. The latter is the basis on which other digital models are built and provides interactive features throughout the entire production cycle. To optimise costs and production times, introduce more frequent tracking capabilities, highlight waste and improve the responsibility and responsiveness of operators. Deployment of the MES is first and foremost focused on the A350 XWB and the A320neo, which will benefit from more than 50 positions per programme between now and the end of its deployment in 2018.

The MES will be supplied by another module currently being developed, the eCMAP (electronic capture of manufacturing processes): the latter will enable precise measurement of the time required for execution of a task by providing a constant flow of productivity data. A new application called "digital companion," accessible via an electronic system in the workshop is part of a pilot project. It will record a value for "standard time," a key piece of information in the calculation of workload balancing. Deployment of this solution is underway in Spain, France and the United Kingdom. In Germany, it is part of a pilot project in Hamburg, and its deployment in all of the country's factories is set to begin this summer.

The same type of module is currently being adapted ahead of time, at the work order level (Shop Order Instructions, or SOI). An interactive SOI will provide operators with information about the best way to carry out their task. It will eliminate the distance between the operator and the writer of the documentation, by introducing a bi-directional flow that takes feedback and knowledge into account.

The production digitisation system goes even further when it comes to the smart workshop, with projects such as automatic dynamometric keys that are calibrated using information communicated electronically. All information regarding the availability of tools, as well as their condition and location, will be accessible in real time. A pilot project is already in place in Nantes with a team of first users working on the finishing touches to the central wing box of long-haul aircraft.

Example of breakthrough innovation: APWorks and 3D printing

A subsidiary of Airbus Group, APWorks, specialised in 3D printing (metallic ALM, or Additive Layer Manufacturing) of advanced materials, was recently i n the spotlight for building, with the SME Autodesk, the biggest cabin part ever created by 3D printing—a cabin partition separating the passenger cabin from the galley. The partition was designed in bionic form, by reproducing the organic cell structures and bone growth of living organisms. The result was a success, with a very solid, yet much lighter structure (45% reduction in weight) than traditional designs and therefore, in the end, reduced fuel consumption. If this innovative design were used throughout the cabins of the A320s on backorder, Airbus estimates it would reduce annual CO2 emissions by 465,000 tonnes. The new structure is made of Scalmalloy, an aluminium-magnesium-scandium alloy specially designed by APWorks for 3D printing and as sturdy as titanium. In parallel, APWorks is working on the development of a liquid-to-liquid heat exchanger created by 3D printing and which should offer unprecedented capabilities for the industry.

Cobots rather than all robots

The improvement of assembly processes must take into account the specific requirements of aeronautics in terms of parts quality. If automation is an industrial necessity, the widespread use of robots is not possible in factories, given the size of the aircraft being built. Airbus therefore favours the use of cobotics, i.e., the direct or remote-controlled interaction between a human operator and a robotic system. Alongside highly qualified companions, which will remain indispensable, a cobot (or collaborative robot) will directly assist the operator's work by increasing his capability to handle heavy loads or for simple and repetitive tasks. Pre-deployments are already underway, notably with the pre-drilling of supports or printing the positioning of supports. Airbus has chosen to develop, internally, the collaborative parts between humans and robots, crucial for the security of the process (detection of persons, avoidance, etc.).

Another area of innovation in production: the use this time of humanoid robots for work in confined spaces (cockpit or lower parts), enabling operators to avoid working in uncomfortable positions and thus contributing to greater work security by reducing musculoskeletal disorders (MSD).

Partnership with Japan for robots

In its quest for partners of excellence, Airbus Innovation teams have, for years, been scouting in Japan, a world leader when it comes to robotics. A first collaboration initiative was launched in 2014 with the **"COMANOID"** project, part of the key European programme Horizon 2020. Over a four-year period, teams from Airbus and their Japanese partners have developed a humanoid robot capable of entering an aircraft under construction to carry out simple tasks. A new stage was reached in February 2016 with the announcement of a joint R&D programme between the CNRS and the National Institute of Advanced Industrial Science and Technology (AIST), with which Airbus is associated, on a humanoid robot capable this time of carrying out complex tasks. This involves developing new algorithms enabling existing prototypes of humanoid robots to work in confined spaces on various tasks such as torquing, cleaning of metallic powders, integration of parts into the aircraft and inspection of its systems. The estimated time-frame for the arrival of these humanoid robots on aircraft and helicopter assembly lines is 10 to 15 years.

« Increasingly, it's all about learning
learning from others »