

## Italy and the Shuttle 1 - Spacelab

The launch of the last Space Shuttle, the 37th and last launch to the International Space Station (ISS), has been important also for Italy: not only because the mission's primary cargo was the Multi-Purpose Logistics Module (MPLM) *Raffaello* but also because it marks 30 years of fruitful Italian cooperation with NASA.

In the last issue of AD\*ASTRA, after briefly commenting the event, we had promised to come back to this subject.

We want now to go through this thirty-years successful experience which greatly contributed to the growth of the European Space and paved the way for Italy actively and effectively entering the fascinating human space flight adventure.



*«Italian Industry has been at home with the Space Shuttle since the very beginning of its history – recalled Luigi Quaglino, the Vice-President of Thales Alenia Space, when introducing the “STS-135 Launch” event held on July 8<sup>th</sup> in Turin (Italy), at the TAS-I plant – Since then as many as 62 Shuttle missions, out of 135, have delivered the space systems and flight units born in Italy. Thanks to this technological cooperation, we established strong connections with NASA and gained their confidence, to the point of becoming in many cases favourite partner and the first non-American supplier ».*



Luigi Quaglino introduces in Turin the Event for the Launch of STS-135

The story had begun some time before, when in the Autumn of 1969, just after the historic Apollo 11's moonlanding, NASA started work on a recoverable space transport system, and opened it up to the cooperation of allied western Countries (in parallel, the other “soul” of the post-Apollo NASA addressed its choice towards the implementation of orbiting space station).

The U.S. DoD (Department of Defense) had a direct interest in the NASA project, and put pressure on the development of the reusable space vehicle, since it was engaged, at that time, in the development of large-scale military systems, and needed reusable systems capable of putting heavy payloads into Earth orbit. Which, by the way, would drastically penalise scientific activities, since the 'habitable' space would be limited to the cockpit. Needless to say that at the end, due the military support, was this project “all systems go”.

According to **Ernesto Vallerani**: *«After the conquest of the Moon, followed too early by the lost interest in continued human exploration, The USA administration decided to abandon the adventure of the space exploration and to focus on “useful” space applications. At that time Europe was quite technologically backward and this pause was heaven-sent and allowed old country to gain time, to develop its own capabilities and to actively enter the space business ».*



Prof. Ernesto Vallerani

The openness to the cooperation of the allied countries was potentially at 360°. It was however necessary to identify an area of cooperation as far as possible “self-standing” -- thus fully integrated in the complex project – where to concentrate the interest of the European partners (mainly British, French, German and Italian) which were initially dissipating their energies in limited technological areas, pursuing small technological niches, of specific interest for their national industries.

Some European countries had already gained the leadership in such areas like rockets and satellites. The size of the Italian Space Industry didn't encourage competition, nor Italy was in position of striving for leading or prominent roles..

When, in 1973, NASA and newborn ESA signed the agreement which engaged Europe to build a reusable space laboratory **Spacelab** was regarded in Italy as “the big opportunity” and the Italian Ministry for Scientific Research adhered to the project, by contributing 18% of the initial investment, the second partner after Germany offering 54%.



The Spacelab concept, the most elaborate payload system ever carried, represented the implementation of a study started shortly before by the NASA Marshall Space Flight Center. Aiming at turning the shuttle into a short-term space station, it was an innovative concept which at the end came to reconcile the two souls of NASA: those who, under the pressure of DoD, were sponsoring an economical and reusable space transport system and who were in favour of the space station, pressed by the academic world.

*«Few programmes – recalls Vallerani, who was the Italian “father” of Spacelab – have so deeply affected the development of European aerospace companies as Spacelab did, both because of the extent of the enterprise and its duration. The programme marked the entry of the “aerospace” Europe into the circle of the nations involved in developing inhabited systems to be used in the great enterprises of the future and opened the door to international cooperation in the ISS»*

The **Spacelab** adventure in Italy had begun with the participation of the UTSS, the Technical Office for Special Studies within the Direction of FIAT Aviation.

Vallerani, who had participated in the researches on thermal flows that assault the surface of a body at supersonic speed, recalls: *«Relying on the name of FIAT, although that represented at that time only an extremely modest reality, we undertook a very ambitious programme of studies and activities, buoyed up by a tremendous enthusiasm and galvanized by the idea of working alongside such renowned companies»*



*particularly when reentering the atmosphere, were among the most serious and most discussed at that moment, I felt it proper to express my interest in that area and I ventured into a discussion on the transition of the boundary layer from laminar to turbulent, just to show that also we knew something on the subject».*

In the meeting where the NASA consultants, at the beginning of 1970, presented the areas of potential international participation, aerothermodynamics was at the top of the long list.

Vallerani who, in the meeting was the last European guest to speak, refers: *«Knowing that the thermodynamic problems of Shuttle,*



When the project started, two European consortia were created in competition, each of them headed by a German company. Aeritalia, which represented Italy in the MESH Consortium and couldn't take pride in their concrete aerospace experience, was initially assigned a quite minor role: designing the structure of the pallet: the unpressurized portion, not the habitable section of Spacelab.

Afterwards Italy – which meanwhile had started to be better valued for its fast technical improvements and in those years was effectively supported at a political level – was even assigned the study of the system for onboard electrical power supply.



The subsequent consortia's reorganisation to adapt to the arrival of new partners, offered Italy – «a bit irritated by the German attempt to “dominate the whole project”» – the opportunity to gain a more prominent role. «Grown in FIAT, renowned engineering industry – adds Vallerani – it was for us obvious to point to the module pressurized structure, the main element, pivot of the whole subsystems»

Aeritalia was therefore assigned the implementation of the module structure and the thermodynamic control – two of the most demanding parts of the project – passing on the responsibility of the external pallet to the British partners.

So started the adventure that would lead Italy to achieve ambitious technological targets and to become worldwide leader in pressurized and habitable modules, helped by the initial agreement signed by ESA and NASA, by which NASA committed itself not to run in the States a parallel development of the same modules, and to purchase from Europe all the



A true adventure, if you think that the implementation of Spacelab run in parallel with the development of Shuttle and that every change – sometimes important changes – on the project of Shuttle had an impact on, the European activities with new requirements inducing slowdowns and delays in delivery.

Just to mention one, towards the end of the project, the refining of the Shuttle project led to the definition of some new values for the flying loads, which caused all the European consortium to

needed units.

Intensive interactions started on one hand with astronauts, who began in Germany the specific training for the use of the new environment and, on the other hand, with the “users” scientists who, in parallel, began to get acquainted with the innovative space laboratory in order to best exploit the new opportunity.



Finally on December, 4, 1980 ESA was able to deliver to NASA the *Engineering Model*. Thirty-two tons of hardware were embarked onboard a C5A Galaxy cargo and arrived the following day to Kennedy Space Center, followed by another load onboard a Lufthansa's Jumbo 747 with all the documentation.



But only after the delivery of the Ground Support Equipment (GSE) in July 1981, it was possible to start the functional tests at the KSC for the hardware integration, led by McDonnell Douglas. The tests showed that connecting points of the pallets had to be strengthened and that airlock had to be partially redesigned, with new delay and shifting in the delivery of the flight unit, postponed in December 1981.



The strategic importance of Spacelab, which was an integral part of Shuttle was one of the main aspects stressed during the official ceremony for the delivery of the Flight Unit in Bremen and was highlighted by the personal participation of the ESA General Director and of the NASA Deputy Administrator who – in turn – with their speeches emphasized the gravitas of the event.

Even more solemn and formal was the ceremony held at KSC on February 5, 1982, participated in person by the American vice-president George H. W. Bush, accompanied by the highest personalities of the US Administration, in the presence of the Top Management of ESA and three hundred European guests, representing the governments of the ESA Member states and the companies involved in the project.

As a matter of fact, the delivery of the European Laboratory to the United States, marked the beginning of space cooperation between the two sides of the Atlantic, which would grow later during the implementation of the International Space Station.

The first Spacelab was launched on board the Columbia Shuttle during the **STS-9** mission, on November 28, 1983. it was a complete success, followed by huge Italian delegation surprisingly joined, at the last minute, by the Minister of the Scientific Research Luigi Granelli, who, from that moment, became the most convinced supporter of the Italian Space Industry.



«The weather was bad – recalls Vallerani in his book – and it was bad also in Spain, which was the landing base for emergencies. There were all the board Member of the Space Consortium with their families. On the other side of the lake, we could see the silhouette of the Shuttle, on the launch pad, waiting for the ignition that would cause a tremendous roar.

We could see the flash of the ignition of the engines, then a white smoke. And the Shuttle slowly–very slowly – started to rise from the launch pad moving in all its stately power. The applause and the cheers of joy were drowned out by the deafening noise of the engines which we experienced as a wave of sound.

It's hard to explain to others the sensation you feel in those moments after ten years of work concerns and commitment in seeing come true a dream which has absorbed a great part of your professional life. You live in anxiety thinking at the possible problems your product may face in the mission which is just starting now».



In this plaque flown onboard Spacelab 1 by initiative of ESA the Italian flag is represented in central position among the Spacelab Partners.

He clearly remembers those moments: "For the first time an Italian team was successfully contributing to a European Pressurized Module that would be followed later one by other elements built for the International Space Station. After months of testing of the Spacelab water and Freon thermal control loops was really a great satisfaction to know that everything was working perfectly including all the components such as pump packages , heat exchangers, cold plates, valves, etc. in line with our best predictions. In particular the water



pump package, developed through the Microtecnica company in Turin, was as usual absolutely reliable, without leak and very much silent as was the case during the ground testing when we were obliged to go very close to it in order to hear any noise".



Italy gained from this experience considerable benefits in terms of knowledge of the space human spaceflight which led its space industries to the leadership of pressurized modules in Europe.

[To be continued in the next issue]

#### References

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