

# ORBIT

“That’s one small



step for man,



one giant



leap for



mankind.”



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## Spacehab: the Italian bridge towards ISS by Umberto Cavallaro

Built mainly in Turin, Italy, by Aeritalia (now Thales Alenia Space) – which designed and produced its global structure and thermal system, allowing astronauts to work in orbit “in shirt sleeves” – SPACEHAB for many aspects represented, for the Italian industrial experience, the bridge between Spacelab and the MLPM Modules (Leonardo, Raffaello and Donatello) built for the ISS.



Cover commemorating SPACEHAB's first flight on STS-57. Post-marked in Turin, where the pressurized module was built

The idea for what would become SPACEHAB, Inc. originated in 1981 while Aeritalia – still involved in the intense campaign of Spacelab acceptance test – was investigating new applications exploiting the experience gained with Spacelab. *“In our preliminary studies”* – recalls Ernesto Vallerani, author of *L'Italia e lo Spazio* – *“we had involved Tom Taylor, a young American consultant just returned from Alaska where he had designed human settlements in severe environment and extreme isolation. He also was passionately interested in space.*

*“Among other ideas, we had worked in a pressurized environment with flat bulkheads instead of truncated cones, which drastically reduced the overall size of the payload and its occupation of space in the cargo bay – the cost of transport aboard of the shuttle is in fact based on the meters of occupation of the hold. Such a solution caused substantial problems since, to cope with the pressure while minimizing the weight, the shape of a container should approximate a sphere as closely as possible. Certainly flat walls should be avoided since they require instead to be substantially reinforced to resist pressure”.*

Several options were investigated, including a cylindrical telescopic module which, once in space, could be unthreaded axially up to its complete extension. This innovative solution was then patented.

*“All those investigations”* – recalls Vallerani – *“were run in a very confidential way both to avoid on one hand to whet the appetite of our industrial Spacelab Partners and to entice them to enter the arena, and – on the other side – to avoid irritating our own technicians who didn't appreciate such an appointment to an outsider perceived, moreover, as a visionary”.*

*“Returned to the States, Taylor ran into Bob Citron, another old acquaintance of our, who attended the same international*

*astronautic conferences”.*

The late Bob Citron, a former scientist with the Smithsonian Institution, at that time president of Space Development Co. in Seattle, contacted Aeritalia to try out its interest in the design of a module to be used to bring tourists into space, via a Shuttle. Round-trip airfare would be in the order of magnitude of \$ 1 million each.

Within a few days he received back a preliminary evaluation of the technical aspects of the deal, identifying a few problems to be further deeply investigated: bringing into space twenty tourists required in fact a module equipped with a proper number of portholes, of sleeping accommodations, of toilets, of systems for food preparation and distribution. The document also contained a cost estimate for developing such a module (in the order of magnitude of \$ 200 millions).

At the end, the global cost, including the modification of the Orbiter, turned out to be prohibitive and NASA put aside this proposal, but voiced interest in a similar module for manned experiments. Bob Citron set up in Seattle Spacehab Inc. – whose name was created as a contraction of “Space Habitat” – offered Tom Taylor the position of Technical Director, and started to raise private funds to set up what had to become the first privately funded space commercial company. He was supported by the great enthusiasm for the long awaited explosion of space activities to come with the new shuttle era.

Even Aeritalia, consulted by Bob Citron, decided to invest in the deal, and prepared the working plan. *“Thanks to our experience, gained with Spacelab, Aeritalia could develop on its own the entire programme”* – recalls Vallerani – *“but it was clear that, in order to raise credibility within NASA, the industrial team needed a strong American Company able to powerfully lead the programme and to authoritatively interface NASA”.*

Complex negotiations were opened with American industrial giants like Martin Marietta and Rockwell. *“Once the initial scepticisms were defeated, we had to avoid the situation where potential partners could take hold*

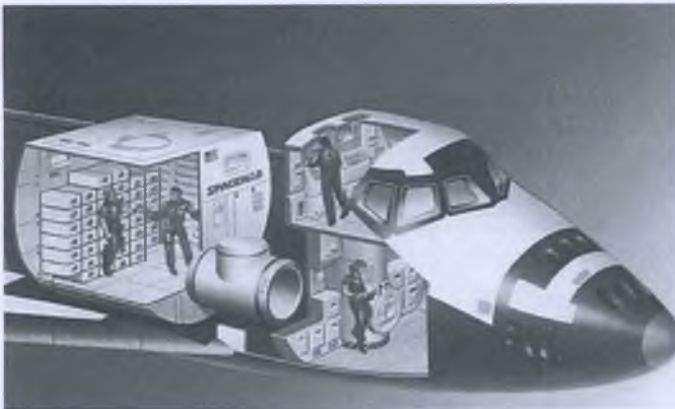


**SPACEHAB**  
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of the programme and neglect Spacehab Inc. and, mainly, Aeritalia, perceived as an awkward overseas player, which could alter balanced industrial positions”.

After many hesitations that could have easily wrecked the initiative, an agreement was reached with McDonnell Douglas which had previously participated in the Spacelab programme. In parallel Bob Citron, with great ability, was collecting the requirements of the experimenters, requesting a more rapid and less expensive access to Shuttle, and was offering SPACEHAB as the extension of the pressurised cabin, able to redouble its volume. SPACEHAB filled only one quarter of the hold and allowed housing for other payloads, the “primary” payloads which largely justified, and paid the mission costs. The decisive turning point came in December 1985, when NASA agreed to sign a memorandum of understanding, after dealing with the limitation of its Spacelab agreement with the European Space Agency which prevented NASA from producing and using competitive systems.

At that time NASA was still in shock from the *Challenger* tragedy and anxiety for safety of future missions hit the ceiling. New projects were not only closely scrutinized by technical commissions, but were also submitted for the evaluation of the astronauts who expressed the desire to have a permanent visibility over the cargo bay also with the SPACEHAB aboard, in order to maintain control over the main payloads stowed behind the cylinder. This led to the idea of truncating the cylinder and flattening the top - hence the typical but unusual “D-shape” section of the SPACEHAB which raised many serious structural problems in addition to the poser of the flat bulkheads.



“Engineers in Turin, after some complaint, had to face a new challenge and started to re-design and re-calculate the cylinder with a flat top,” – recalls Dino Brondolo, who was SPACEHAB Programme Manager – “It really took some cheek to implement a structure with flat heads and flat top, flouting all the known rules of effectiveness! At the end we implemented a solution which still is on the cutting edge”.

Meanwhile Bob Citron had reinforced the team with many NASA experts, including Chester Lee (former Programme Manager during the development of Saturn and then



responsible for NASA strategic planning as Assistant Associate Administrator) and the former NASA Administrator James Beggs.

In 1990 it was finally possible to sign a contract with Alenia Spazio (formerly Aeritalia) and to fix the first flight for 1993. This required that both the implementation of the first two flight units and the acceptance tests had to be completed by the end of 1991. “As usual, after a long gestation period, which had lasted approximately ten years, we had only 18 months left to implement the project”. recalls Vallerani.

Dino Brondolo was appointed Programme Manager and had to face the challenge of keeping the project within its time and cost limits. The value of the contract (\$ 38M) did not leave much room for manoeuvre. The first Flight Unit was officially delivered on January 13, 1992, during a ceremony held in Turin.

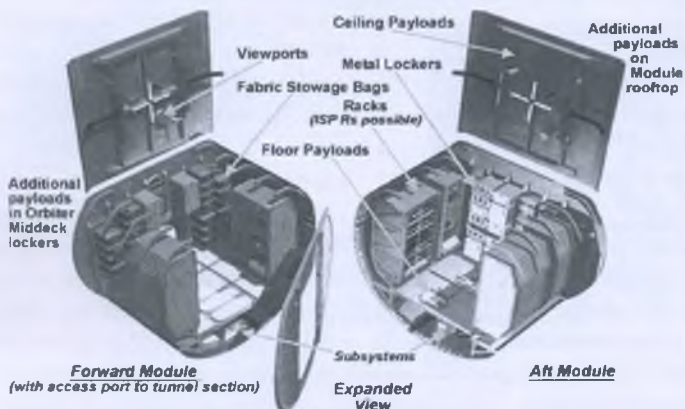
The new experience of working in a commercial programme turned out to be very interesting. For the first time the



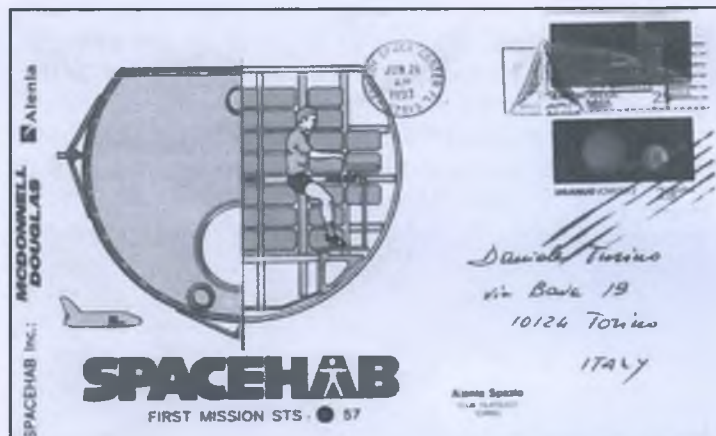
customer was not a structured government entity, with complex procedures, often slowing down the operation. The decision-making process was greatly simplified, thanks to the high level of independence of the programme management.

Four flight units were built altogether, and – after 1996 – they were often used in the “double module” configuration, obtained by putting together two flight units, joined through an intermediate frame adapter.

**SPACEHAB RESEARCH DOUBLE MODULE RDM**



Above: Dino Brondolo commemorates the SPACEHAB adventure during the “historical reenactment” held at the Thales Alenia Space premises in Turin (Italy) on July 8th, 2011 for the launch of the last Shuttle mission, STS-135.  
Below : cover commemorating the maiden flight of the first SPACEHAB during the STS-57 mission in June 1993.



The maiden flight of SPACEHAB took place in summer 1993 with mission STS-57: see cover above right. Eighteen Space Shuttle missions were completed in total as shown in the table on the next page. With the first missions being mainly devoted to scientific experiments the Research Single Module was used.

After 1996, SPACEHAB demonstrated its operational flexibility and space capabilities in providing logistics support and ferrying cargoes during the seven missions to Mir followed by eight resupply missions to the ISS. Interestingly the emblem of STS-84, 6th Shuttle/MIR docking mission in 1997, as shown right, reproduces the typical “D-shaped” profile of SPACEHAB which in that mission carried to Mir 3.5 tons of experiments, station hardware, food and clothing.



Crew signed cover commemorating the STS-84 mission. The mission emblem references SPACEHAB’s profile.



In 1998 SPACEHAB was used again as the Research Single Module, during the STS-95 mission, which marked the return to space of the Mercury pioneer Senator John Glenn, who at age 77, became the oldest person, to date, to go into space. Main goals of this mission were investigating life-sciences experiments, using the SPACEHAB to perform these experiments on Senator Glenn. NASA has defined 52 changes that occur in the human body during extended space flight. Some of these changes are remarkably similar to what happens in the process of ageing here on earth.

In the eight resupply missions to the International Space Station, carrying every time tons of cargo, SPACEHAB substantially contributed to its construction. The SPACEHAB Double Research Module was carried on its inaugural and only flight, aboard STS-107 and destroyed during its tragic re-entry

SPACEHAB was used for the last time in August 2007, aboard Mission STS-118.

#### Mission Launch Date Configuration

STS-57 Jun 21, 1993 RSM  
 STS-60 Feb 3, 1994 RSM  
 STS-63 Feb 3, 1995 RSM  
 STS-76 Mar 22, 1996 RSM  
 STS-77 May 19, 1996 LSM  
 STS-79 Sep 16, 1996 LDM  
 STS-81 Jan 12, 1997 LDM  
 STS-84 May 15, 1997 LDM  
 STS-86 Sep 25, 1997 LDM  
 STS-89 Jan 22, 1998 LDM  
 STS-91 Jun 2, 1998 LSM  
 STS-95 Oct 29, 1998 RSM  
 STS-96 May 27, 1999 LDM  
 STS-101 May 19, 2000 LDM  
 STS-106 Sep 8, 2000 LDM  
 STS-107 Jan 16, 2003 RDM  
 STS-116 Dec 9, 2006 LSM  
 STS-118 Aug 8, 2007 LSM

LSM *Logistics Single Module*  
 RSM *Research Single Module*  
 LDM *Logistics Double Module*  
 RDM *Research Double Module*

#### Bibliography

- Ernesto Vallerani**, *L'Italia e lo Spazio*, McGraw Hill, Milano 1995.  
**Dino Brondolo**, *Spacehab - A commercial approach to space*, Space Congress, 28th, Cocoa Beach, FL, Apr. 23-26, 1991  
**Marc M. Cohen**, *Space Habitat Design Integration Issues*, 28th International Conference on Environmental Systems Danvers, Massachusetts July 13-16, 1998, SAE Technical Paper Series, Warrendale, PA, USA

## ASSS Canadian Member Delivers Lecture to British Interplanetary Society at October Symposium:

Flying over from Canada to give his talk after a magnificent culinary spread organized again by Suszann, Mary and Ben, last up was noted space historian Dr Chris Gainor with a fascinating insight to the story of Canadians in Apollo. A group employed by NASA after a collapse in Avro Canada when the CF-105 Arrow, a supersonic interceptor, was cancelled in 1959. Chris showed that Canada's involvement began before any serious British participation in Apollo began and helped forge from the outset the basis upon which all US manned space missions were organized and managed.

The day attracted almost 40 attendees and was brought to a close following a vibrant exchange of comment and questions, answered in turn and collectively by all the speakers. Thanks go to Suszann, Mary and Ben for adding yet another day of background support with hospitality and humour.

*The BIS was honoured to have Chris Gainor over from Canada deliver a fascinating talk about the professional and social activities of Canadians in the US space programme.* Jerry Stone



## Edinburgh Member Addresses Glasgow P.S. on "Space"

**Bob Catto**, President of Edinburgh Philatelic Society, who welcomed your editor to give a display in September, himself gave a presentation to members of Glasgow P.S. on 5th November with our Chairman Emeritus **Margaret Morris** in the audience. Margaret commented very favourably on Bob's 180 or so sheets. His speciality is Skylab having worked on the project in the States in the 1970's and that will be his Presidential swansong display topic in the Spring of 2013 and hopefully an *Orbit* article thereafter.