Exploiting the Space Station

Space is a major commercial opportunity of the 21st century and as the Space Station heads towards completion the new challenge for Europe is to successfully exploit it.

ESA has launched a new initiative aimed at promoting specific commercial opportunities to companies interested in research, development and technology.

It also paves the way for innovative Space Station based activities in entertainment, advertising and sponsorship for businesses that would not normally think about space.

Students at schools, colleges and universities across Europe will also benefit from many exciting educational opportunities, including student participation in observations and experiments.

At the same time ESA is streamlining its management commitments for the day to day running and operations of the Station by passing much of the executional level responsibility to an industry consortium.

Euro astronauts play a key role

ESA astronauts – already experienced in Space Shuttle flights and long-duration missions on the former Mir space station – are supporting Space Station assembly flights and will be regular members of the permanent six or seven-member international crews when Columbus becomes operational.

During 2001, Umberto Guidoni, from Italy, and Claudie André-Deshays, from France, will be the first European astronauts to visit the Space Station.

Guidoni is a mission specialist on the ninth Space Shuttle assembly flight in the spring 2001 and André-Deshays an onboard engineer on a Soyuz 'taxi' flight scheduled for the autumn 2001.

When the Space Station becomes fully operational, one or two European astronauts from the ESA team will live and work in orbit each year for missions of typically 90 days.

Space Station crews, carried into orbit by the Space Shuttle or Russian Soyuz spacecraft, will spend most of their time working on experiments, usually in teams of two.

Many experiments are fully automatic but astronauts will still be required for making adjustments and reacting to unforeseen problems.

As well as working on experiments and interacting with scientists on Earth, their responsibilities will extend to Space Station and equipment maintenance, and operational duties.

Typical work days will average between eight and 10 hours and crew members will have some freedom to organise their leisure time activities.

ESA trains its own astronauts at a specialist centre in Germany and will also instruct those from other countries in the operation of European elements, such as Columbus.

Astronaut Umberto Guidoni

The ESA European astronaut team (front row from left): Léopold Eyharts (France), Gerhard Thiele (Germany), Claudie André-Deshays (France), Umberto Guidoni (Italy) and Reinhold Ewald (Germany). Second row (from left): Pedro Duque (Spain), Claude Nicollier (Switzerland), Michel Tognini (France), Christer Fuglesang (Sweden), Jean-François Clervoy (France) and Roberto Vittori (Italy). Third row (from left): André Kuipers (Netherlands), Hans Schlegel (Germany), Frank De Winne (Belgium), Thomas Reiter (Germany) and Paolo Nespoli (Italy).

Crew Return Vehicle

ESA is working with NASA on the development of a Crew Return Vehicle (CRV), four of which will be built to serve as the Space Station's 'lifeboats'. The ESA team has also been joined by Austria.

Among the items being developed in Europe are high technology body flaps and the nose cap and rudders – all of which will experience extremely high temperatures during re-entry.

ESA is also completing work on the design of parafoil guidance, navigation and control software algorithms for the X-38 prototype. The first flight of a CRV to the Space Station is scheduled for December 2005.

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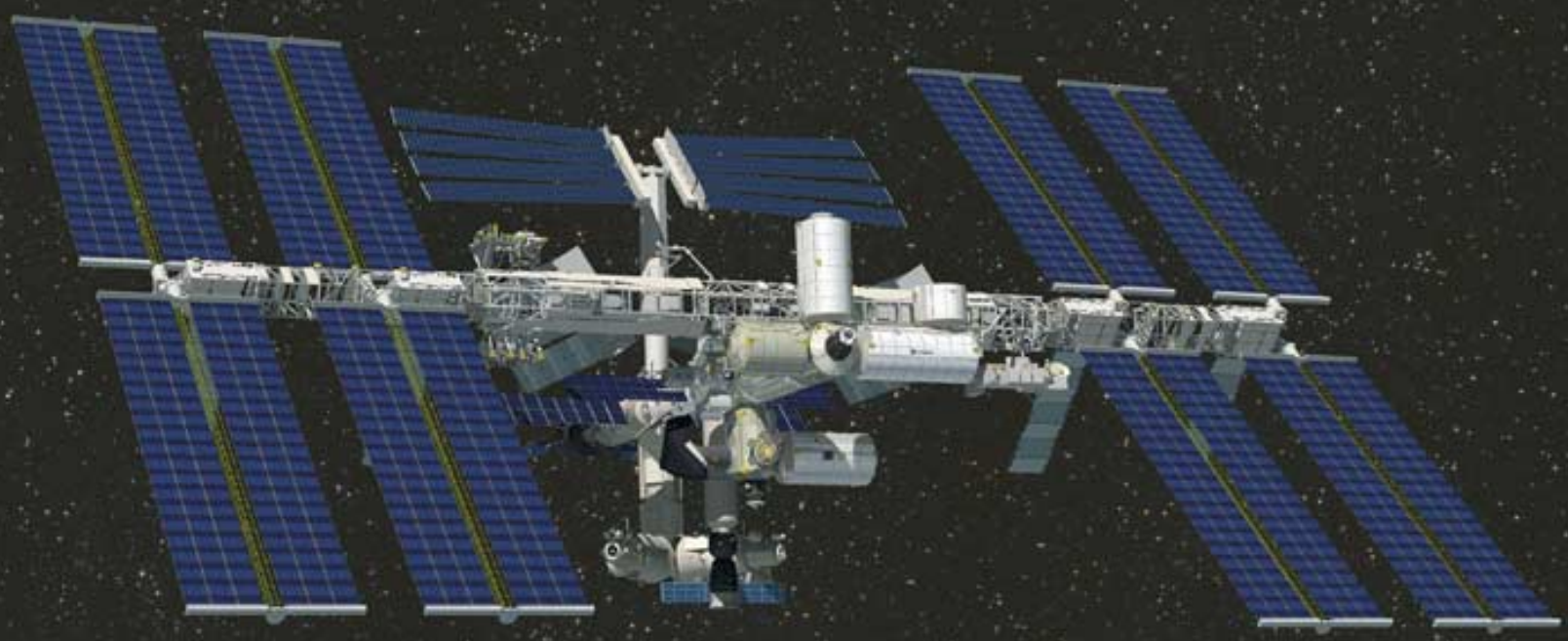

The Space Station takes shape in orbit as successive missions install more components.

February 2001

February 2001

International Space Station takes Europe to new heights

The European Space Agency (ESA) is one of the major partners in the International Space Station which will provide a permanent human presence in space over the next 10 to15 years. Far above the constraints of the atmosphere and free from the disrupting effects of gravity, it will be a unique tool for new scientific research, technological development and the commercialisation of space.

Space Station assembly started in November 1998 and when completed around 2005 the huge complex will be the largest structure ever built in space, some 100 metres in length and sprawling across an area the size of a modern football field.

The first inhabitants arrived in November 2000 and remained onboard until March 2001. Crews will normally be rotated every 90 days and European astronauts, regular visitors during the construction phase, will serve as crew members when the Station is fully operational.

An International Space Station was first discussed in 1984 when Europe, Japan and Canada joined the United States to develop the project. In 1993 Russia became the fifth partner, making this the world's biggest ever cooperative programme in science or technology.

ESA represents the 10 participating European countries of Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Sweden, Spain and Switzerland.

As the Station takes shape in orbit, European scientists and engineers are eagerly awaiting the opportunity to carry out long-term research in medicine and the development of materials and manufacturing processes not possible on Earth.

ESA's main contributions are Columbus, a multi-purpose science and technology laboratory, and the Automated Transfer Vehicle(ATV). The latter will be launched by Ariane 5 and used to ferry supplies to the Space Station.

Whilst docked for several months at a time, the ATV's engines will also be used to periodically raise the entire Space Station's orbit, compensating for the effects of atmospheric drag.

The first European hardware, launched on-board the Russian Zvezda Service Module in July 2000, is a computer system that is acting as the 'brain' of the Russian part of the Space Station and provides altitude control for the overall complex.

In total, ESA developed hardware will be launched on 20 of the 50 assembly missions and will be used in the American, Japanese and Russian laboratories as well as on Columbus.

September 2000

May 2000

May 2000

INFO

Partners
US, Russia, Europe, Canada, Japan

Laboratories
six

Permanent crew
six/seven

Orbit
90 mins to circle Earth

Inclination
51.6° to the Equator

Altitude
400 km (average) above Earth

Dimensions
108 m long x 80 m wide

Mass (weight)
455 865 kg

Living volume
1200 m^3

The International Space Station pictured during a fly-around by the Space Shuttle Atlantis after completing an assembly mission in February 2001

Web site:
www.esa.int

Europe's role in the Inte

Ferry for basic supplies

ESA's unmanned Automated Transfer Vehicle (ATV) will carry a cargo comprising four tonnes of propellant and five tonnes of payload, food and other supplies on each of its missions to the Space Station.

The European ATV en route to the Space Station

The versatile craft is an essential European contribution to the regular operations of the Space Station and ESA is procuring nine ATVs from EADS-LV (France) and Astrium GmbH (Germany).

After the first flight, scheduled for 2004, an ATV will be launched by Ariane 5 about every 12 months. Once in orbit a European command centre will monitor and control the ATV's automatic Space Station approach and docking manoeuvres.

Each ATV will remain docked for several months and during this time its engines can be fired to raise the Space Station's altitude, compensating for a gradual lowering of the orbit caused by the Earth's atmosphere.

At the end of its useful life the ATV will be loaded with waste material, undocked and sent on a self-destructing return flight steep into the Earth's atmosphere.

Data Management System

ESA's Data Management System (DMS-R) is the 'brain' of the Russian-built Zvezda module, which was launched in July 2000. DMS-R performs overall control of the Russian elements, as well as guidance and navigation for the Space Station.

European Robotic Arm

ESA is building the European Robotic Arm (ERA) which will be used for on-orbit assembly of the Russian Science Power Platform and for external servicing of the Russian elements. Operated from either inside or outside the Space Station, the 11.3 m long arm will be able to manoeuvre equipment weighing up to 8000 kg. Amongst its first tasks will be installation of solar arrays for the Science and Power Platform.

Crew Return Vehicle

ESA is working with NASA on the development of a Crew Return Vehicle (CRV), four of which will be built to serve as the Space Station's 'lifeboats'.

Europe's Ariane-5 will launch unmanned supply craft to the Space Station.

Columbus science labora

The Columbus laboratory will give Europe the opportunity to work at the cutting edge of scientific and technological research.

Every year it will allow a large number of experiments to be conducted in materials science, medicine, biology and technology – many eventually leading to benefits in commercial processes that will enhance everyday life on Earth.

Columbus will be attached to the Space Station around the end of 2004. Its development owes much to the success and experience of Europe's Spacelab, a re-usable laboratory that first flew on the Space Shuttle in 1983 and continued through 21 other missions.

Spacelab, the first joint European effort in manned space exploration, heralded a new approach to the use of space, allowing scientists to work in a typical laboratory environment while orbiting the Earth in conditions of weightlessness.

Experiments on Spacelab missions were limited to a maximum of two weeks, but this new multi-purpose research facility will provide an on-going opportunity stretching over at least a decade.

Columbus is cylindrical in shape – some 6.7 m long and 4.5 m in diameter – with a versatile interior containing rows of payload and system racks on each of four 'walls'.

Each of the payload racks – which can be exchanged or modified in orbit – can accommodate up to 700 kg of scientific equipment and hardware.

Columbus will accommodate several specialised facilities:

- Materials Science Laboratory, for research in metal and alloy solidification, crystal growth (semi-conductors) and measurement of thermo-physical properties of materials.
- Biolab, for experiments on micro-organisms, cell and tissue cultures, small plants and small animals.
- Fluid Science Laboratory, allowing the study of dynamic phenomena in fluids, such as instabilities induced by surface tension gradients and temperature changes.
- Physiology modules, a laboratory for the study of human physiology with particular emphasis on bone demineralisation, heat and lung functions.
- European Drawer Rack for the accommodation of up to eight smaller, easily exchangeable experiment modules.
- External structure to carry out technology and exobiology experiments, observation of the Earth and the stars.

Columbus is being built with the involvement of many European industrial contractors and will be operated from Europe, allowing payloads to be controlled independently.

ernational Space Station

A new era of research and development in space

Astronauts on the International Space Station will perform work that covers everything from fundamental scientific research to advanced technology and commercial product development.

Many activities will be concerned with the effects of gravity on biological, physical and chemical processes – and the implications for life on Earth.

The orbiting laboratory will serve as a test bed for future technologies and may ultimately help improve manufacturing processes for conventional factories.

It will also provide astronauts and scientists studying our home planet with a flexible platform to perform measurements that would be impossible from the ground.

Although the motivation for many studies often begins with purely scientific interest, it has already been shown that the answers to scientific questioning can quickly be taken up and successfully applied to practical problems.

Applied research in space may lead to innovative or more environment friendly production techniques in steel and chemical factories as well as electrical power plants. The absence of convection – the currents that cause warm air or fluid to rise and cool air or fluid to sink – in space will allow materials and combustion processes to be studied more accurately in orbit than on Earth.

The effective absence of gravity on the Space Station will lead to insights into human health, disease prevention and treatment. This will include the functioning of the heart, lungs and kidneys, and will allow studies into cardiovascular disease, bone calcium loss (osteoporosis), muscle atrophy and hormonal disorders.

Several of the medical issues addressed in space are related to the effects of ageing and immobility of patients. As European governments face up to the reality of ageing populations, such research may be crucial in helping to limit public health care spending in the future.

Equipment developed for keeping fit in space and for remotely monitoring astronauts is also being increasingly adapted for use in hospitals and medical centres.

US laboratory

A number of European experiments, including a microgravity glovebox and refigerator/freezer will be installed in the US laboratory.

Nodes 2 and 3

These European built elements are cylindrical in shape and measure 7.19 m in length by 4.48 m in diameter. Each contains a two bay section, accommodating eight equipment racks, plus a section with four radial ports. The Nodes, scheduled for launch in October 2003 and July 2005, will provide important on-orbit resources for operating other Space Station elements. Node 3 will provide water processing and oxygen generation for the US segment.

Cupola

The European-built Cupola is a pressurised observation and control zone for the crew to perform remote robot arm operations. It has six trapezoidal side windows and a circular top window, each protected by external shutters, manually operated from the inside. As well as assisting in the assembly of Space Station hardware, the 'shirtsleeve' observation post will offer priceless psychological benefits to the crew during extended stays in space. Its launch is planned for 2005.

tory

Inside a mock-up of Columbus

esa