The Erasmus Virtual Campus

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The Erasmus Virtual Campus was inaugurated in September 2000 to bring together scientists and engineers interested in using the International Space Station and other facilities for their research. It also provides the foundation for creating Virtual Institutes in selected scientific disciplines. The current capabilities of the Campus are highlighted, along with plans for the future.

What is the Erasmus Virtual Campus?
The purpose of the Erasmus Virtual Campus, based at ESA's ISS Erasmus User Information Centre in Noordwijk, The Netherlands, is to bring people together, increase their collective knowledge and facilitate cooperation between them. The target audience for the Campus is European scientists and engineers who are interested, or already involved, in using the International Space Station (ISS) or other space and ground facilities to which the ESA Directorate of Manned Spaceflight and Microgravity (D/MSM) can provide access.

The Virtual Campus also provides the foundation for the creation and operation of Virtual Institutes in selected scientific areas.

Who can use the Campus?
The Virtual Campus is open to anybody interested, or already involved, in using the research facilities developed and operated under the responsibility of D/MSM or for which this directorate coordinates and facilitates the access of European users. These facilities cover the European elements of the ISS, as well as other orbital and ground-based research facilities such as the US Space Shuttle, Russian Foton capsules, European Maser and Maxus sounding rockets, parabolic flight campaigns with the Airbus A300 aircraft, drop towers and selected ground facilities for research in life sciences and physical sciences.

Figure 1. The Erasmus building houses the ISS User Information Centre

The Erasmus Virtual Campus is thus open to a large potential user community:

– scientists who are interested in using any of the above facilities for their research;
– project engineers and managers involved in the development, building or operation of these facilities;
– scientists and engineers in the European User Support and Operations Centres (USOCs) who deal with the utilisation of these facilities;
– politicians who decide on research activities and who want to obtain information on the objectives and results of the work performed in these facilities;
– students in search of reference material for their university studies or of information and guidance in their personal career choices;
– public and private educational institutions and exposition centres that focus on the popularisation of science and technology activities in space;
– laypersons and media representatives with an interest in research and high-technology subjects.

Who is the primary target group of the Campus?
The primary target group of the Virtual Campus consists of the scientists, engineers and research coordinators who are involved in the various research or development projects of ESA's Microgravity Application Programme (MAP) or Technology Application Programme (TAP), or who are members of one of the 'Topical Teams'. The Campus wants to encourage and facilitate the setting up of MAP and TAP project teams and Topical Teams and support the communication and cooperation among their members.

What are the MAPs, TAPs and Topical Teams?
MAP aims at involving industry in applied research aboard the ISS, by identifying those areas where the utilisation of space could be an important element in the research and development of an industrial programme. Groups of scientists are encouraged to team up with industry. The MAP initiative was started by ESA in 1999 with an Announcement of Opportunity for proposals in which researchers and research teams, with partners from industry, suggested ideas and new approaches to include the microgravity research in their overall product-oriented and market-driven applied-research activities.

The 125 MAP proposals resulted in 44 concrete research projects. For the first 2 years, the financing is focused mainly on ground-based research. During this period, industrial questions that can be answered by future microgravity experiments are being identified. Thereafter, precursor experiments are planned in selected research areas using early opportunities on the ISS, Space Shuttle/Spacehab flights and sounding-rocket missions.

A similar programme, directed at applied research activities in technology, is being set up by ESA as the Technology Application Programme (TAP).

The MAP and TAP initiatives are supplemented by broadening the approach through the establishment of Topical Teams. In these Teams, new space-environment applications are discussed in a series of workshops with industrial participation. Covering the different disciplines of material science, fluid sciences and biotechnology, these workshops have proved to be an important step in identifying applied-research problems that could be solved by using microgravity as a key tool.

Why do these teams need a Virtual Campus?
The MAP and TAP projects and the Topical Teams unite people from different scientific disciplines and professional corporations on a common research objective. The teams are international and the members often do not know each other well at first. Becoming familiar with each other's discipline, sharing existing knowledge, working with the same reference documentation and jointly working out plans and proposals is a constant preoccupation of these teams. The Erasmus Virtual Campus makes this task easier.

It is expected that the Campus, thanks to its particular information and communication tools, can cater for a more interactive type of information exchange and a higher degree of

group interaction among the team members than was possible in the past with the classical one-to-one information and communication tools.

What are the principal functions of the Virtual Campus?
Firstly, the Campus is an information portal. It facilitates access to information that exists somewhere, but is difficult to find.

Secondly, the Campus is itself an information content provider. It is a warehouse for validated and up-to-date reference information. It packs this information into appropriate boxes, writes the description of content on top and stores the boxes in a structured way on shelves where they can easily be found.

Thirdly, the Campus is a broker. It contributes to making the ideas and projects of people known to other people and helps them to connect with each other.

Fourthly, the Campus is a cooperation facilitator. It provides information and communication tools that allow research teams to work on a common research project even though they are geographically separated.

Fifthly, the Campus is a time-saver and trouble-shooter. The ISS User Information Centre selects or develops for the Virtual Campus information and communication tools that are compatible and complementary. It ensures coherence and standardisation in the use of tools throughout the whole Virtual Campus community and helps participants to set up these tools and become familiar with their operation. It runs the Internet servers and the communication hubs through which the members of the Virtual Campus can share information and communicate.

What does the Virtual Campus look like?
The Virtual Campus is structured very much like a campus in the physical world. It is a city with places and buildings connected by streets. While some buildings may be open to all visitors, others have a restricted access for members only. There is a Forum for discussion and for meeting new people, an Amphitheatre for lectures and presentations and a Coliseum for events. There is a Library and an Archive. The Virtual Campus can also host Virtual Institutes. These Virtual Institutes will be operated in a shop-within-a-shop mode. They would be the masters of their own business, but they could make use of a common information and communication infrastructure and of certain services provided by the Virtual Campus.

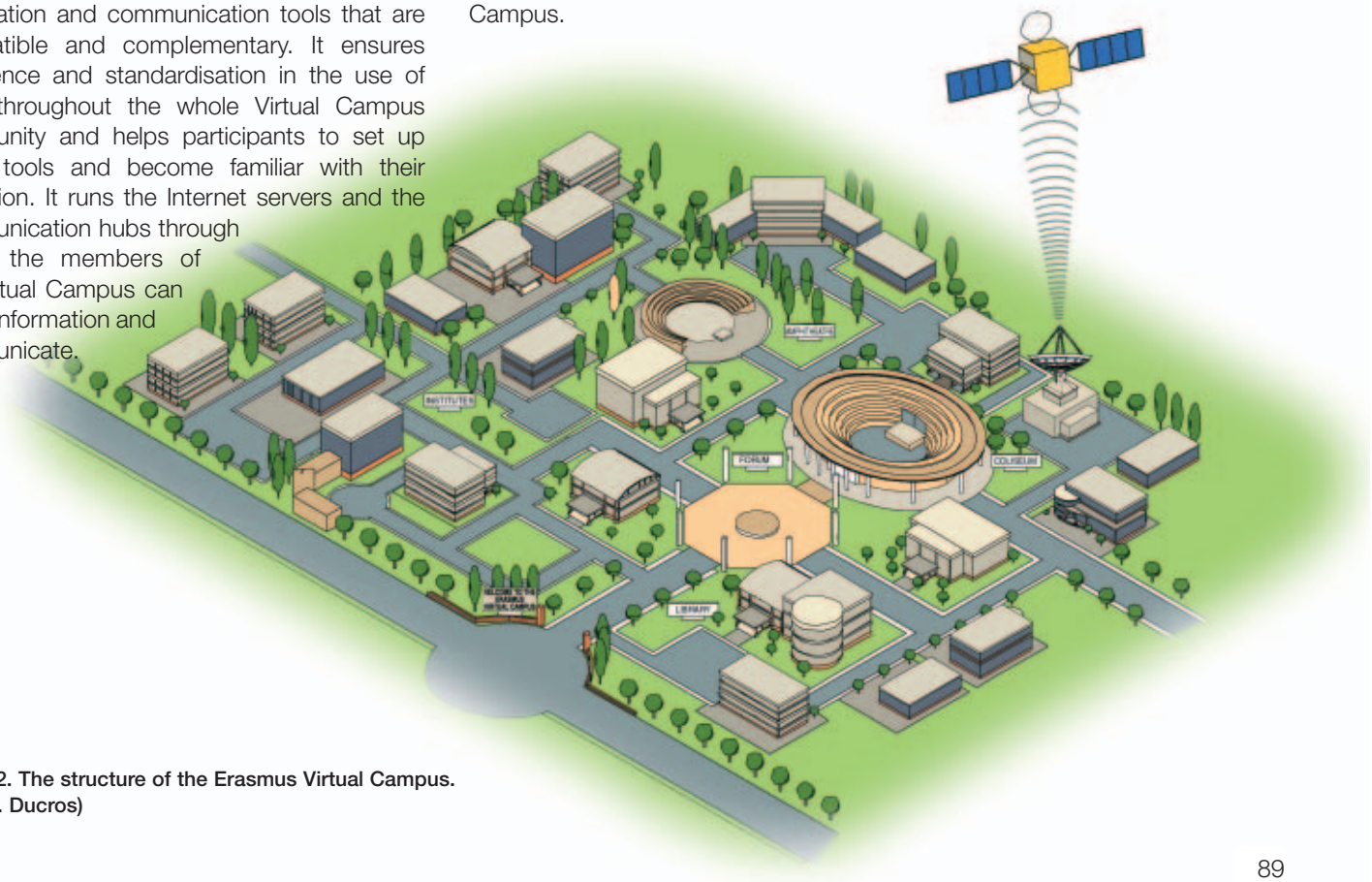

Figure 2. The structure of the Erasmus Virtual Campus. (ESA/D. Ducros)

What are the products and services of the Virtual Campus?

Internet site

The core product of the Virtual Campus in its triple function as an information portal, an information content provider and an information broker is the Internet site at *www.spaceflight.esa.int/users*. This site is structured into the following main areas: Facilities, Disciplines, Mission and Campaigns, Coordination of Research, Information, Advice and Support, and Databases.

Facilities contains information on the various facilities for research and applications that are covered by the Erasmus Virtual Campus. The Internet site catalogues all these facilities, presenting their purpose, technical and operational characteristics, responsibilities and access rules. Page structure and content are such that the advantages as well as the limitations of the facilities can easily be identified and the facilities compared with each other.

Disciplines shows the relevance of the available facilities for the various disciplines and points to the scientific or technical results that have already been obtained or are envisaged to be obtained with these facilities.

Mission and Campaigns identifies past and future activities that use these facilities, presents the scientific content of these missions and campaigns, and points to the scientists and engineers involved in these activities.

Coordination of Research is both a noticeboard for the announcement of research opportunities and a meeting place for people who are involved in research on the ISS and other facilities.

Information, Advice and Support is where the Campus visitor can find contact points and counterparts who can answer specific questions and give advice and support in the preparation and execution of research projects.

Databases gives an overview of and provides access to databases such as the Erasmus Experiment Archive, Internet-based documentation depositories and the Photo and Video Archive.

This Internet site is not meant to be a simple online equivalent of public-relations-oriented information brochures, but a resource of validated up-to-date reference information for scientists and engineers. It is therefore based on two essential concepts: the avoidance of information duplication; and data and information ownership.

Avoiding duplication is the prerequisite for efficient configuration control of the reference information contained in the many pages of an Internet site that is expected to cover about 1000 individual pages once it is completed. Any fact or figure that is expected to evolve over time is presented on a minimum number of different pages. The ideal is a single reference page to which other pages then refer. Structuring the Internet site accordingly is therefore a major effort.

The other concept, which ensures that the information on the site is up-to-date, unambiguous and contradiction-free, is the ownership of data and information. For each page, the owner or owners of the reference information contained are clearly identified and agreed upon. The content of each page is then either submitted for the endorsement of the information owner or, if appropriate, the full responsibility for maintaining the page is handed over to the information owner. In order to make this concept feasible, the site *www.spaceflight.esa.int/users* is based on a rather complex Oracle database linked to a Cold Fusion server.

Document Server

In its role as a cooperation facilitator, the Campus allows its members to store documents of common interest and share them among team members. As a first step, the documents are uploaded upon request by the various research teams participating in the Campus by the collaborators of the ISS User Information Centre. As a second step, an interactive document server is envisaged to allow easy upload and maintenance of the stored documents by the individual research teams themselves.

Photo and Video Archive

A function similar to the interactive document server, but for the shared storage and access of photo and video files, is already operational as the Photo and Video Archive. This archive is also based on the information ownership concept and the individual owners of the files in the archive can decide themselves whether they want to restrict access to a particular user community or share them with the public.

At present, the interested viewer must first download the video files in the archive before they can be seen. The technical capability to

receive the video files via streaming video is under preparation. This will make the Photo and Video Archive particularly attractive for use in tele-education activities on the Campus. Computer-based familiarisation and training sessions can then be accessed easily as video-on-demand streaming video files.

Remote working sessions
In its role as a cooperation facilitator, the Virtual Campus is setting up a tool that allows geographically separated research teams to work in real-time and interactively in Word, Powerpoint and Excel, and to speak to each other through the Internet. It is true that there is already an abundance of similar tools – some of them are even offered for free download from the Internet. However, while most of these tools work well between two computer enthusiasts connected through their individual modems, they often fail, or even create serious software operations conflicts, when they have to be compatible with existing office software tools and the firewall protection techniques that are typically used in the computer networks of research institutes, space agencies and industrial companies. The ISS User Information Centre is therefore setting up a dedicated server and procuring the necessary numbers of licences for a tele-conferencing and tele-education tool that will work with the software and firewall environment of the Campus participants. It will also familiarise the participants with the use of this tool and provide support during its operation.

Experience with existing, ISDN-based video-conferencing tools has shown that they are not yet widely accepted as a replacement for face-to-face meetings. They are difficult to set up, have limited field of view and offer insufficient resolution and interactivity for dealing with documents, images and drawings. The tele-conferencing and tele-education tool selected for the Virtual Campus will avoid these problems, and its combination with other communication tools, such as satellite communication, 3D television and the Interconnected Ground System (IGS) network that links the USOCs with ESA, can increase the attraction of this form of remote cooperation to potential users.

Chat and discussion forums
In addition to the interactive working sessions in closed-circuit mode, the Virtual Campus will organise chat sessions and discussion forums with a broader audience and the general public. These tools will be part of the *www.spaceflight.esa.int/users* Internet server.

Figure 3. Working in the Multimedia Library

Video production and broadcast facilities
The ISS User Information Centre is equipped with a TV studio and the resources for producing video films (including 3D). It also has its own satellite television uplink and downlink facility and access to a Ku-band transponder on a Eutelsat satellite, so video productions and live events can be broadcast from Noordwijk to the whole of Europe for the Erasmus Virtual Campus.

The ISS User Information Centre had already contracted and supervised the production of a number of video recordings with leading scientists and engineers to illustrate the Station's utilisation in the various user

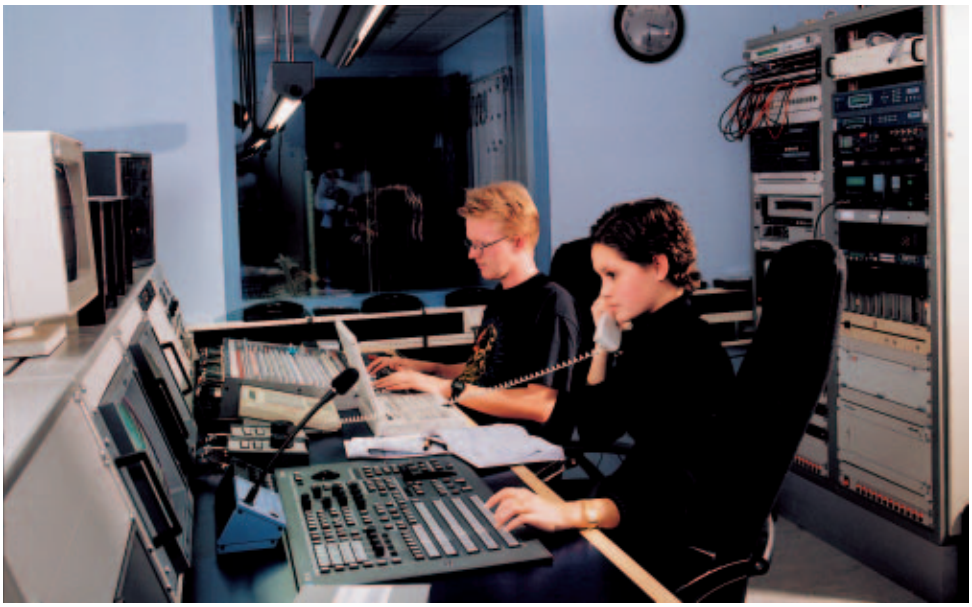

Figure 4. The control room for the TV and video facilities

disciplines at the ISS Forum 2001 in Berlin in June 2001. There is much raw material that was not used at the Forum, and it will become the initial stock for the production of lectures and educational films in the framework of the Erasmus Virtual Campus for broadcast via TV satellite and as streaming video-on-demand.

Presentations, lectures and live events

The television studio of the ISS User Information Centre in Noordwijk is complemented by an auditorium for 120 spectators. Together with the existing satellite broadcast facility and the planned Internet streaming video broadcast facility, the auditorium can be used for regular presentations and lectures on selected topics of interest to the Virtual Campus and which can be broadcast live to Europe via satellite and Internet.

Figure 5. Live TV coverage of the Campus inauguration

The same tools and resources also ensure a wider distribution for launch and ISS in-flight events, in particular for events with a scientific or educational connotation.

European viewing sites

The satellite uplink station of the ISS User Information Centre was designed mainly for distributing satellite feeds to other TV broadcasters. It is therefore equipped for using a Ku-band digital satellite transponder in the Single-Carrier-per-Channel (SCPC) mode. The ESA Television Service normally uses a leased transponder on a Eutelsat satellite at an orbital position of 10ºE. Although typical consumer-type equipment can receive this satellite, it is not expected that many potential viewers who the Erasmus Virtual Campus hopes to reach will have the necessary equipment installed and pointing at 10ºE. This TV satellite is not widely used by the public and the SCPC mode requires an antenna diameter of at least 1.2 m.

The Virtual Campus will therefore base its programme of lectures and event transmissions around a number of viewing sites in Europe that have the necessary satellite TV reception equipment and an appropriate auditorium to host interested viewers from their geographical area. The USOCs are expected to play a key role in this network of viewing sites. Apart from the satellite reception, these centres are also connected to the Erasmus User Information Centre through the ESA-internal IGS network, which offers additional possibilities for communication, including 2-way. Commercially funded user support centres like ALTEC in Turin, Italy, and BEOS in Bremen, Germany, are invited to become part of the network of viewing sites.

In a second step, it is envisaged to extend the network to interested research institutes and organisations, universities, other space agencies, industrial companies, and education and popular science centres.

What is the status of the Virtual Campus?

The Erasmus Virtual Campus was formally inaugurated on 8 September 2000, in the presence of the ESA Director General, A. Rodotà, and the Director of Manned Spaceflight and Microgravity, J. Feustel-Büechl, with a series of presentations and a roundtable discussion on the life sciences utilisation of the ISS. The event was transmitted live to Europe via satellite and as streaming Internet video.

Subsequently, the work focused on the development and refinement of the tools, in particular in the area of television and Internet. Working with the TMP company in Bayreuth (D), a new 3D television system was developed

and made operational. It was presented for the first time to the general public during the International Radio and Television Exhibition IFA 2001 in Berlin in August 2001 with a live 3D TV transmission from Noordwijk to Berlin.

In parallel, the Internet site at *www.spaceflight.esa.int/users* has been set up, together with the Photo and Video Archive. A substantial area of concern has been the insufficient bandwidth of ESA's access to the Internet backbone for streaming Internet video activities. This is critical for reaching a large audience of the Virtual Campus in a cost-efficient manner. With the expected increase in the course of 2002 from 4 Mbit/s to 34 Mbit/s, these problems should be resolved.

The success of the Internet video streaming of the whole ISS Forum 2001 conference in real-time and as video-on-demand – organised by the User Information Centre – not only increased our experience with the technique, but also demonstrated the high interest in this form of information distribution within the potential target audience of the Erasmus Virtual Campus.

With most of the tools now being developed or ready for operation, the next step is to bring life to the Erasmus Virtual Campus. It is planned to highlight the concept and resources of the Campus in a series of presentations to its primary target users, namely the members of the MAP and TAP project teams and the Topical Teams.

The emphasis over the coming months will be on the Internet, tele-conferencing, events, education and Virtual Institutes.

Teams will be offered the opportunity to present their activities on the Internet site at *www.spaceflight.esa.int/users* and to use it for exchanging project information, documents, and photo and video files.

The efficiency and acceptance of the tele-conferencing tools will be tested and evaluated during a number of joint ESA/NASA sessions on ISS payload safety, with engineers and scientists meeting in parallel in Houston and Noordwijk, and during the joint 8th European Symposium on Life Sciences Research in Space / 23rd Annual International Gravitational Physiology Meeting in Stockholm this June. Based on our experience with the particular advantages and limitations of the various tools during these sessions, a standardised tele-conferencing support concept will then be presented to the MAP/TAP project teams and the Topical Teams.

In the area of events, the emphasis is on establishing the initial viewing sites and initiating joint events with the USOCs. The technical and organisational measures will be implemented to use the ESA IGS network for these events.

For education, the approach is two-fold. Working with the scientists concerned, the video footage produced for the ISS Forum 2001 will be 'upgraded' into a collection of short educational video films explaining the background, objectives and benefits of research on the ISS and other research facilities, in selected disciplines. In parallel, scientists will be invited to elaborate a joint concept for a cycle of presentations and lectures given at regular intervals in the auditorium of the ISS User Information Centre beginning in 2002.

Figure 6. Hosting coverage of the Zvezda launch

For the Virtual Institutes, it is planned to present the principal possibilities and the available resources of the Virtual Campus to interested scientists, and to assess with them how they could benefit from the Virtual Campus for creating their own Virtual Institutes.

Contact point

Scientists and engineers from the potential user community of the Virtual Campus who would like to receive additional information or who would like to be among the foundation members of the Campus are invited to contact:

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