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## Model Curricula: International Space University

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## **Space Education: The International Space University Model**

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### **ABSTRACT**

How to educate Space professionals able to meet the needs of the Space community and the challenges of a changing Space sector in a changing world? The International Space University (ISU) was created in 1987 to educate Space leaders using a unique approach. ISU programs are based on a "3-I" International, Interdisciplinary and Intercultural) model which was built from discussions and meetings within the world Space community to meet its evolving needs.

The International Space University is well-positioned to carry out international, interdisciplinary and intercultural space education and research at the graduate level. ISU is a non-profit educational institution presently registered in Alsace (France). ISU is also registered as a 501 C3 non-profit educational organization in the USA. ISU serves as a worldwide collaborative network of broadly educated and visionary Space professionals and as a neutral international forum for the exchange of knowledge and ideas about challenges related to Space and its applications. ISU is also a network of institutions with a central Campus located in the Urban Community of Strasbourg (France), a North American Office located in Washington DC (USA) and 21 Affiliated campuses around the world.

ISU is supported in France by the National Government and by local authorities. It is also supported by such international Space agencies as NASDA, NASA, ESA, CNES, CSA, by the United Nations, by industries related to Space, by affiliated universities and by individuals.

ISU offers an 11 month Master of Space Studies (MSS) degree program delivered at its campus in France, a 2 month Summer Session Program (SSP) provided in host institutions around the world, an annual ISU Symposium, Professional Development Programs lasting 2 to 10 days and Forums and Workshops. Research Activities tied to a joint Ph.D. program are being developed.

## **INTRODUCTION**

Human resources are the key to Space development. Education of professionals is therefore a necessity for Space Development. As Space programs worldwide become increasingly international and commercial in nature, the education of the Space sector workforce needs to be constantly reviewed and adapted to keep pace. This raises the following fundamental question: How to educate professionals able to meet the needs of the Space community in a changing world? To give an appropriate answer to this question, the International Space University was created in 1987 to inspire, educate and train the professionals required to lead the way.

To keep up with the rapid changes in Space, ISU queried the Space sector on its evolving needs for education. A survey on Space Training and Education was distributed at the end of 1996 to human resource, personnel and training departments within 158 organizations in Space-related agencies or industries in 17 countries worldwide. ISU received 25 (16%) responses, of which 14 (48%) were from Government organizations, and 11 (52%) were from Industry. Geographically, 7 (32%) were from Europe, 17 (64%) from North America, and 1 (4%) from Japan.

An international workshop was held in Strasbourg December 8-9, 1996 on "Strategies for Training Space Professionals." During this workshop, 40 participants from 9 countries answered the following questions: Given the trend in the environment, what are the three biggest training and development needs and challenges? What are the most viable options in training and development to meet these requirements? Participants representing industry, government and academia were approximately equal in number, about one-third each, and represented small, medium and large organizations. Thus, their responses were significant.

Dr. Roland Doré, former President of ISU convened eleven focus group meetings and 14 other meetings from November 1996 to May 1997 in 11 countries: USA, Canada, France (Paris and Toulouse), Germany (Munich), Italy (Rome), Finland (Helsinki), Sweden (Stockholm), Norway (Oslo) and Spain (Madrid). In these meetings, participants from industry, ISU alumni and faculty members shared views on such questions as: How will the Space sector change in the coming decade relative to missions and programs, financing and participation? How will the preparation of tomorrow's leaders need to change to meet the coming needs?

A Space Education Questionnaire seeking input on how to proceed in improving higher education programs, professional development and training in the field of Space was circulated in January 1997 to international Space

agencies, Space industries, foundations and academic institutions. One third of the surveyed institutions answered. To digest the information gathered, ISU and the Space Agency Forum organized a workshop on Space Education at ISU in May 1997. It was followed the same year by an IAF/ISU workshop on education held during the IAF Congress at Turin in 1997. The year after, in cooperation with the Space and Education Committee of IAF and the SAF, ISU organized a world workshop on education during the International Astronautical Congress at Melbourne in September 1998. In this workshop some 60 participants discussed what skill-sets and capabilities are now required in the Space sector? How are educational institutions responding to these needs? What is the best balance between initial basic education and career-long educational renewal?

The needs that emerged from these inquiries reinforced the vision of ISU and helped it adjust its mission, its pedagogy and the goals and contents of its programs. These changes are discussed below.

### **THE INTERNATIONAL SPACE UNIVERSITY (ISU)**

The International Space University is an international institution of higher learning, dedicated to the development of outer space for peaceful purposes through international and multidisciplinary education and research programs *ISU Bylaws, Art 2.1*. As a dynamic institution of higher education, ISU is therefore dedicated to the creation, expansion, exchange and dissemination of knowledge and ideas related to Space and Space activities.

The International Space University was created in 1987 at an international workshop held in April 1987 at MIT. Its three founders, Peter Diamandis, Todd Hawley and Robert Richard, used the workshop to define the concepts of ISU, elaborate its programs and foresee its evolution. ISU was registered as a 501 C 3 non-profit educational organization in the State of Massachusetts in the USA. Following an international competition for the establishment of its Central Campus, ISU moved in 1994 to the Urban Community of Strasbourg, France as a non-profit educational institution registered in Alsace (France). The members of ISU, called the "Governing Members," are international organizations, industries, Space agencies, academic institutions and individual members.

ISU Headquarters are located at Illkirch Graffenstaden in the Urban Community of Strasbourg in new facilities built by the French Government, the Region Alsace, the Department of Bas-Rhin and the Urban Community of Strasbourg. The ISU campus is part of a complex gathering parts of

University Louis Pasteur, University Robert Schuman and several high tech industries.

## **MISSION AND VISION**

"International Space University is founded on the vision of a peaceful, prosperous and boundless future through the study, exploration and development of Space for the benefit of all humanity. ISU is an institution dedicated to international cooperation, collaboration and open, scholarly pursuits related to outer space exploration and development. It is a place where students and faculty from all backgrounds are welcomed; where diversity of culture, philosophy, lifestyle, training and opinion are honored and nurtured" (*ISU Credo §2 and 3, Peter Diamandis, Todd B. Hawley, Robert D. Richards, ISU Founders.*)

The vision of ISU is to be the preeminent institution for interdisciplinary, international and intercultural space education and research for developing and inspiring future Space leaders and professionals. Its goal is to contribute to the creation, expansion, exchange and dissemination of knowledge and ideas by delivering innovative programs, both on and off the Earth. ISU will constitute a worldwide community serving as a collaborative network of broadly educated and visionary space professionals. It will enable, with its community, the exploration, development and peaceful use of space for the improvement of life on Earth and the advancement of humanity into space.

The mission of ISU is therefore to develop the future leaders of the world space community by providing interdisciplinary educational programs to students and space professionals in an international and intercultural environment. ISU will also serve as a neutral international forum for the exchange of knowledge and ideas about challenging issues related to space and applications. It's mission is to deliver programs that impart critical knowledge and skills essential to future space initiatives in the public and private sectors.

## **THE PROGRAMS OF ISU**

ISU offers interdisciplinary graduate programs in Space Studies. It's Masters programs prepare professionals to meet the present and future challenges of international space cooperation, as well as the challenges implied by the restructuring of the Space sector.

ISU programs are dedicated to the career development of graduate students and professionals from all nations seeking advancement in Space-related fields. The space sector needs each year in the world about 20,000 professionals and ISU objectives are to educate those who will be their leaders. ISU offers three kinds of programs:

Annual programs: 1) Two graduate programs: an eleven-month Master of Space Studies (MSS) and a two-month Summer Session Program (SSP);

2) Two annual conferences, one organized under the responsibility of the Alumni (The ISU Annual Symposium) and the Alumni Conference.

Short programs: One day to 2 weeks programs delivered on demand and/or to respond to a specific need, including Professional Development Programs, Workshops, Short courses, and Forums.

Research and Ph.D. Programs: These programs include Academic Research, Contractual Research and a Joint Ph.D. Program under development.

Participation in ISU programs is open to individuals and institutions of all nationalities. ISU welcomes open and free discussions and follows a Code of Conduct and Ethics.

ISU publishes several kinds of documents. Student projects and research papers are published. A text book KEYS TO SPACE was published by McGraw-Hill in 1999. The proceedings of the ISU Annual Symposium, SPACE STUDIES, is published by Kluwers Academic Publishers. All these documents are available and can be obtained from the Librarian of International Space University; some of them are available on electronic format.

## **INTERNATIONAL RESPONSIBILITIES**

International Space University is a forum where space activities can be discussed internationally, unconstrained by national or political conditions and unencumbered by any particular bias.

Since 1998, ISU has held permanent observer status with the Committee for Peaceful Uses of Outer Space (COPUOS) of the United Nations

Office for Outer Space Affairs. (The Scientific and Technical subcommittee of COPUOS is presently chaired by Dr. Karl Doetsch, President of ISU). ISU was granted full membership in the Space Agency Forum (SAF) in 1995 at the 3rd meeting of the Forum, held in Oslo. At the 1996 meeting of SAF, on the occasion of the International Astronautical Congress in Beijing, ISU was asked to be the focal point of SAF for matters relating to space and education, and reports by ISU have been included in each subsequent meeting.

ISU is a member of the International Astronautical Federation. It has been invited to contribute to several other international activities, including Asia-Pacific Regional Space Agency Forum (APRSAF), IAF Specialists' Symposium - "Bringing Space into Education," World Space Workshop on Education, and the National Science Week Steering Committee.

## **ISU NETWORK**

To fulfill its international commitments, ISU is an international "Network University" consisting of networked institutions, networked professionals and an electronic network called ISUNet.

The Institutional network includes: the Central Campus located at Illkirch, a city of the Strasbourg Urban Community in France, where the ISU Headquarters are located; ISU North American Office, located at Washington DC in the USA; 21 Affiliate Campuses in different countries across the five continents; 15 Summer Session Host Institutions; 50 Master of Space Studies Placement Host Institutions and National Liaisons and Foundations spread throughout the world.

The Professional Network includes about 2,500 space professionals; ISU Faculty and Lecturers from around the world; Sponsors and Partners (university and research institutes, industries, Space agencies); 1,461 ISU alumni, grouped within 5 Alumni Associations; Governing Members and members of the various ISU governing boards and councils.

ISUNet is an electronic network linking institutional and professional members at: <http://www.isunet.edu>

ISU'S "3-I":

International Space University is a unique institution in the Interdisciplinary, International, Intercultural education it provides.

ISU is interdisciplinary by the curriculum of its programs, by the expertise and experiences of its faculty and by the background of the students enrolling. The programs of ISU address Space and Space related activities from both technical and non-technical points of view, including sciences, engineering and techniques, policy and laws, business and management, social sciences and humanities, including ethics. At each level of discussion, an overall perspective of space and space-related activities is introduced to show the interactions between the disciplines leading to an understanding of Space as a complex system.

ISU is also unique in its international character. It is international in its implementation with a Central Campus and a Network of Affiliate Campuses, with its international distribution of SSP host sites and MSS Placement Host sites. Its Teaching and Research Body is composed of persons coming from universities and research institutes, industries, Space agencies, governmental and international organizations spread out all around the world. Its programs have integrated the different national and cultural approaches and are delivered by members of its international Teaching and Research Body. Its governing members, board and council members, staff are composed of people coming from around the world.

The students constituting its classes each year comprise between 20 and 30 nationalities. (There are no "foreign students" at ISU, as students of ISU have now come from 82 countries.) ISU provides its students with a unique international and intercultural experience, giving them the opportunity to meet key members of the space community coming from all the parts of the world.

ISU is also Intercultural in character. ISU is open to the cultures of its students and organizes "intercultural activities" programs. Consideration is given to the different cultural approaches to problems and their solution. Students are trained in the principles of teamwork as they are formed into international, intercultural and interdisciplinary teams. This is made possible thanks to the diverse cultures of the student body and the faculty.

## **AFFILIATE CAMPUSES**

ISU Affiliates are institutions or consortia of institutions that include industries, universities and research laboratories. They are located in 14

different countries spread across the four continents and currently include 21 members. A complete listing can be found at <http://www.isunet.edu>.

The role of the Affiliate Campuses is to provide an international network of academic specialists in the various domains involved with Space. The Affiliates provided faculty and experts to ISU Programs. They host placement students from the Master's of Space Science program for their 12-week thesis project and play an active role in facilitating placements within industry and space agencies. Several Affiliate Campuses have hosted summer programs (SSP).

Affiliate Conferences are held each year. Past conferences have taken advantage of the opportunities to meet with MSS students when held in Strasbourg to promote wider understanding of Affiliates resources and to encourage placements. Similarly, these meetings provide opportunities to hear guest lecturers and have experts lead workshops with students. An ISU Affiliate Research Advisory Committee was established in 1999 to implement research among the ISU network and to use this leverage to address student recruitment, Affiliate-to-Affiliate student exchanges, and placements.

### **ISU IN SHORT:**

ISU records show that more than 1700 ISU Alumni live and work in 82 countries, representing about 1% of the space professionals in the world. Each year, about 150 graduate-level students from 25-30 countries with many different academic backgrounds are enrolled in MSS and SSP programs. Some 170 faculty and guest lecturers from Space producer and user countries are chosen from an active resource base of 700 to teach in ISU programs.

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## **THE INTERNATIONAL SPACE UNIVERSITY**

### **Master of Space Studies**

The MSS is a graduate-level program degree designed for individuals seeking professional development or further academic study. This advanced professional degree course entails 11 months of highly intensive graduate study, including a three-month professional placement and several trips and visits of professional interest. The MSS program starts in the first week of September and ends in the last week of July.

The main elements of the MSS program are: a balanced series of lectures covering all major disciplines related to space, with workshops and roundtables; a series of lectures on contemporary space-related issues and events which as a whole provide an interdisciplinary and intercultural education; team design project(s) involving most, if not all, of those disciplines; individual projects performed during a placement period; professional visits and participation to the ISU Annual Symposium; skill training, and social events to understand cultural differences.

This broad program is complemented by more detailed study in the area of the individual student's main interest achieved through advanced lectures, specialized seminars, individual projects and through a student placement period for practical training at a chosen ISU partner.

The course is divided into 5 modules, which can be taken over a period of up to 3 years. In such cases, a student must successfully complete all the modules within a period of three calendar years from the date of first admission to the MSS program in order to receive the Master of Space Studies degree. Students having successfully completed a Summer Session within the two years preceding acceptance into the MSS program can join it in Module 2.

The curriculum is structured around six main themes: Introduction to Space and Space Activities, Access to Space, Space Mission Architecture, Design and Operations, Space Policies and Activities in the world, Space Sciences (on Space, in Space and from Space), Applications and Utilization of Space. Each of these themes is approached in an interdisciplinary manner, considering aspects of Science and Engineering, Business and Management, Policy and Law and also the Humanities.

The curriculum is designed to build progressively upon the knowledge assimilated during each module, simultaneously broadening cross-disciplinary scope and acquiring more specific knowledge in each field. The program is delivered in such a way as to make sure students understand the relationships and interaction between the various components and disciplines related to space activities at each phase of a space program or space mission.

The program also provides for the acquisition of necessary skills such as efficient team-working, international project management, presentation

and computer skills, and information retrieval. It assures experience of different cultures and problem solving thanks to 3-I teams and cultural nights.

The MSS has been evaluated by several universities and in particular by the Scientific Council of the University Louis Pasteur, Strasbourg, France in 1996. It concluded that MSS graduates had the same level of education as the French "Diplome d'Etudes Approfondies" and therefore the right to be enrolled as Ph.D. students at this university, after agreement with a thesis supervisor.

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## **THE INTERNATIONAL SPACE UNIVERSITY**

### **Summer Session Program**

The Summer Session Program (SSP) is an intensive 2-month academic experience at the post-graduate level. Its focus is the teaching of the international, interdisciplinary and intercultural aspects of the exploration and development of Space for peaceful purposes. The interdisciplinary curriculum provides an overview of international Space activities and opens to the students new perspectives on the world's Space activities.

All the major Space-related disciplines are studied through interaction with an international faculty, eminent in their respective fields. In combination with the team work of a Design Project, these studies broaden participants' knowledge beyond that of their original specialization and gives them a greatly improved awareness and understanding of Space activities.

Presently, the SSP curriculum consists of a Core Lecture Series giving all students a common fundamental knowledge of Space, Space programs and Space-related activities; Theme Days presenting key issues of Space with an interdisciplinary approach; a Distinguished Lecture Series, giving the point of view or presenting the experience of persons who have made outstanding contributions to Space and/or space-related activities; Faculty/Student Workshops, giving students the opportunity to discuss with faculty problems of their interest or to have practical applications of the knowledge given in the lectures; Individual Assignments performed under the supervision of the faculty in the frame of a department; a Design Project performed within an international team of students and giving each of them the opportunity to learn and practice team-working and project management in the design of a project, and experience problem solving in different cultures.

In 2000, the SSP was evaluated by Cleveland State University (CSU), Cleveland, Ohio, resulting in CSU's listing of SSP in the CSU Graduate School Schedule and awarding 8 semester graduate credits in Space Studies to SSP Graduates.