THE INTERNATIONAL SPACE UNIVERSITY,

Flying through our first 30 YEARS

Over the last 30 years the space world has changed considerably, evolving from a Space Race environment into a commercial and global space economy. More than 30 years ago a number of young visionaries realized that this process would take place and they realized as well that it would therefore require a different generation of space professionals, based upon what came to be known as ISU's 3 "i" principles: "interdisciplinary, intercultural, international".

30 years have passed now, and remarkable achievements have been made. ISU is now installed on its Central Campus and has conducted, in addition to its vested Masters in Space Studies (MSS) program, a series of very well-known annual summer sessions, in the Northern as well as in the Southern Hemisphere. Also research activities, enhanced by the second MSS research year, are regularly and actively taking place.

Fig.1: ISU Central Campus in Strasbourg

ISU has after 30 years educated 4200 alumni which are working all over the world. It represents the strongest network of space professionals worldwide at different levels in the space sector.

Therefore, it might be worthwhile to recall again the remarkable achievements over the past three decades, starting with its history.

1. A brief recapitulation of 30 years of ISU history

In 1985, three young space enthusiasts created a foundation called the Space Generation, dedicated to helping foster a sense of identity for those people born since the start of the Space Era [HAWLEY, 1986]. The founders were Peter Diamandis, a medical doctor with a master degree in aerospace engineering; Todd Hawley, a graduate from the famous Space Policy Institute at George Washington University, and Bob Richards, an engineer and physicist, and former assistant of the well-known astrophysicist Carl Sagan.

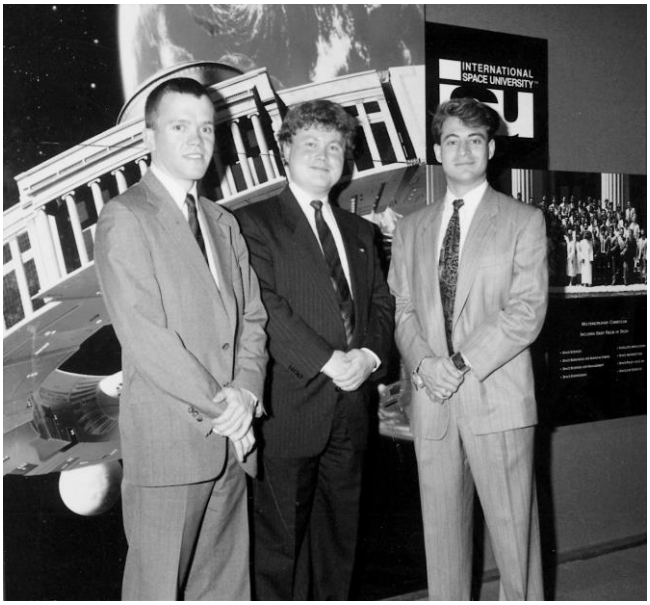

Fig.2: The three founders of ISU

They generated a series of novel ideas from which a 'Space University' was one of the best received ones. It received the support of a number of important personalities in the space field such as Prof. U.R. Rao, President of the Indian Space Research Organization, Dr. Harrison Schmitt, an Apollo 17 astronaut and former senator, Dr. Gerard K. O'Neill from the Space Studies Institute, space pioneer Prof. H. Oberth and Sir Arthur C. Clarke, the visionary writer, along with many others.

This initiative was further developed and presented to a broader audience [DIAMANDIS, SUNSHINE, 1986] and led to a 3-day event at MIT (April 10-12, 1987) with the formal creation of the International Space University. The date was chosen to commemorate the first human spaceflight of Yuri Gagarin (12 April 1961) and one of the strong ISU supporters, Arthur C. Clarke, worded its creation as follows:

> *The first universities helped to bring mankind out of the Dark Ages and into the Renaissance. They demonstrated a potential to unshackle the minds and spirits of the people of their time. In our day, there are few institutions which satisfy any higher individual aspirations or greater interests of humanity. The International Space University may well become an essential cornerstone in leading humanity ahead in space and on Earth in the century to come.*

This new concept raised a lot of public interest in articles in inter alia The New York Times, The Australian, and even Pravda.

The first Summer Session Program (SSP) was developed based upon this success and with the help of major space agencies took place at MIT in the period 20 June 1988 – 20 August 1988. The artwork for the first brochure was done by well-known space artist Pat Rawlings.

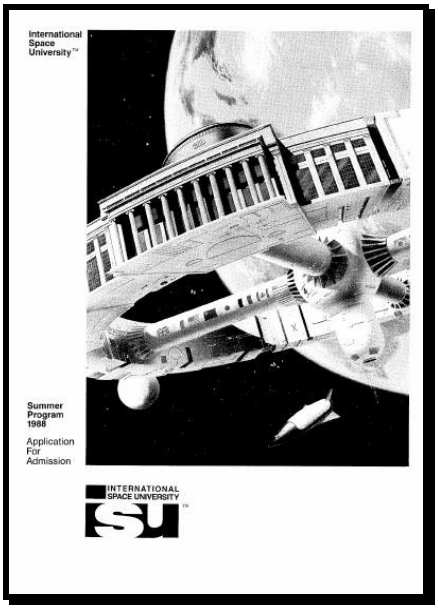

Fig.3: Brochure of the first summer session (1988)

The resulting 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)*. The International Space University (ISU), as a dynamic institution of higher education, is therefore dedicated to the creation, expansion, exchange and dissemination of knowledge and ideas related to space and space activities.

It has been established as a 501(c)(3) non-profit educational organization in the USA, chartered in the State of Massachusetts. Following an international competition for the establishment of its Central Campus, ISU moved in 1994 to the Urban Community of Strasbourg, France. It is presently a non-profit educational institution registered in Alsace (France), while still registered in the USA as a 501(c)(3) non-profit educational organization. The members of ISU, called the "Governing Members", are international organizations, industries, space agencies, academic institutions and individual members.

ISU Headquarters is located at the Central Campus in Illkirch-Graffenstaden in the Urban Community of Strasbourg in brand new facilities, especially built by the French Government, the Region Alsace, the Department of Bas-Rhin and the Urban Community of Strasbourg. It is located in a complex, which also houses parts of University Louis Pasteur, University Robert Schuman, and high tech Industries

Over the evolution, however, ISU's mission and vision have remained unchanged:

The "*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*).

A more detailed historical overview was published (PEETERS, W.) whereas a recent book describes well the ISU background story, leading into the subsequent achievements of Peter Diamandis, notably the well-known X-Prize. (GUTHRIE, J.)

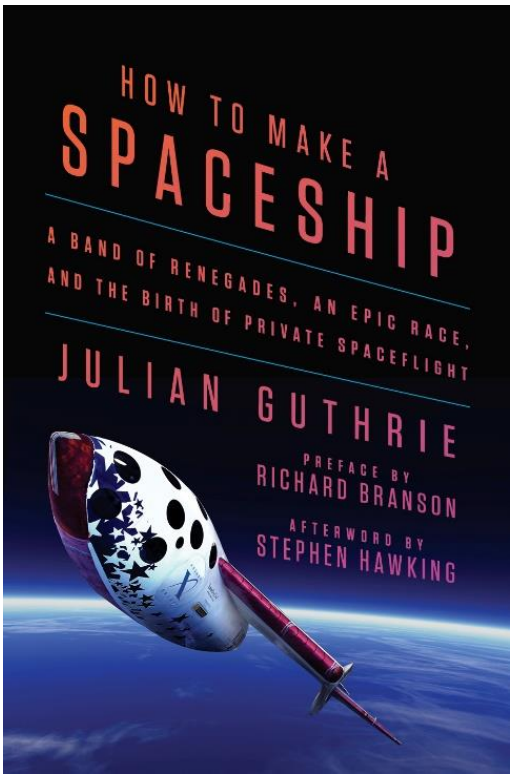

Fig.4: Recent book covering the ISU success story (2016)

After selection of Strasbourg as the location of the central campus, ISU was permanently housed in its present location in 2002.

Furthermore, after detailed examination of the programs offered, official accreditation from the French Government was obtained in 2004 (decree MENS0400386A of 27 February 2004).

In line with its increasing international recognition, since 1998 the International Space University has permanent observer status with the Committee for Peaceful Uses of Outer Space (COPUOS) of the United Nations Office for Outer Space Affairs.

Also, ISU is a member of the International Astronautical Federation (IAF). It has been invited to contribute to several other international activities. Moreover, it also houses the European Association of Space Explorers (ASE) headquarters and maintains a WIA (Women In Aerospace) chapter status.

The milestones of ISU's – short but successful – history are recapitulated in table 1.

Date	Milestone
1987	ISU Founding Conference and Incorporation in USA
1988	First Summer Session at MIT in Cambridge, Massachusetts
1993	Strasbourg Selected as Location for ISU Central Campus
1994	ISU Relocates to Strasbourg and Incorporates in Alsace
1995	First Master in Space Studies (MSS) Program based in Strasbourg
2002	Official Opening of ISU Central Campus Building
2003	First Executive Space Course (ESC) held in Strasbourg
2004	Official Accreditation by the French Ministry of Education
2011	First Southern Hemisphere Space Studies Program (SH-SSP)
2015	First MSS 2nd research year offered
2016	Lease Agreement in Strasbourg extended for 15 years
2017	Initiation of US Heinlein partner Institute
2017	First ISU experiments on board of ISS

Table 1: ISU major milestones

The present general structure of the Masters program, the SSP and the interaction between both streams is given in Figure 5, whereby SSP and SH-SSP alumni obtaining good results can get a waiver for the first MSS module (hence the question mark).

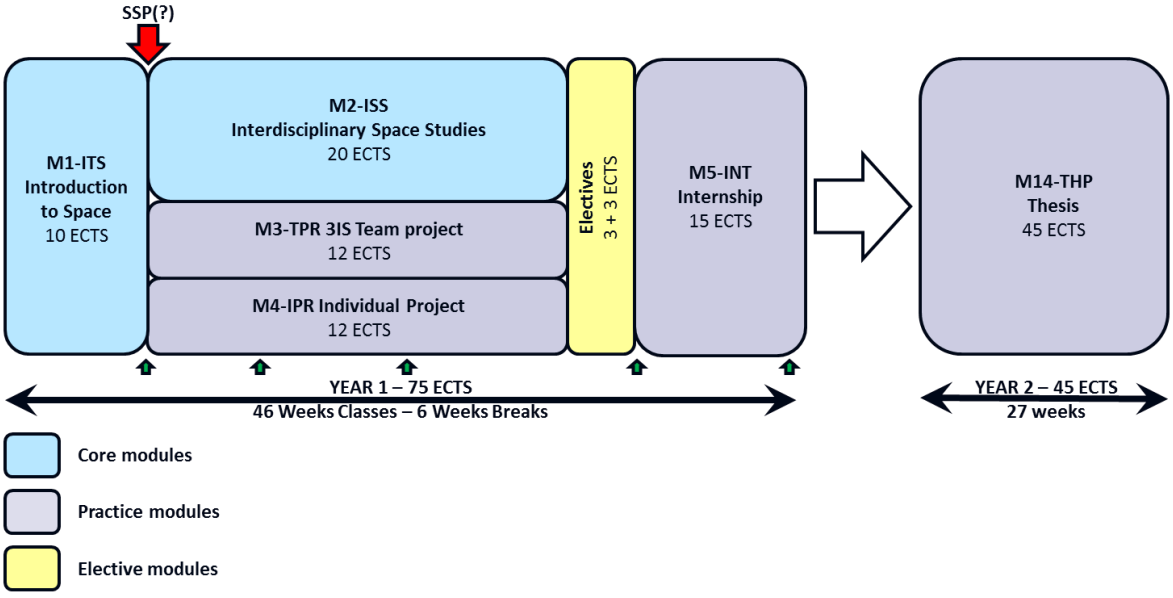

Fig.5: Structure of the Master programs and interrelation with SSP and SH-SSP

The main education and professional development needs resulting from the evolution in the space sector, as identified by ISU after the series of inquiries, are presented in Table 2.

	Providers	Users
All	Inter-disciplinary, Intercultural and International approach of knowledge International & intercultural opening, (SB: “opening”? UNCLEAR) Teamwork within international, intercultural and interdisciplinary teams	
Engineers & Scientists	• New skills to achieve more effective and innovative products more efficiently • Understand users needs	• New skills to - evaluate potential of space - use and sell space “products” • Understand technical constraints
Business Management	•Respond to user needs •Technology management	• Become “intelligent” customer
	• Able to develop business and marketing within complex and evolving political, cultural, administrative and commercial structures	
Policy & Decision Making	• Appreciation of global perspectives and of the challenges of Space • Understand other cultures, other national methods & practices, diverse contracting approaches, policies and practices regarding risk, liability, and quality control.	

Tab. 2: Skill analysis resulting from inquiries

2. 30 years of Achievements

Being designed to meet the needs of the Space Community, the programs enhance the future career development of graduate students and professionals from all nations and with all backgrounds seeking advancement in space-related fields and a widening of their perception of the sector. In order to do so, it is necessary to continuously adapt both initial and continuing education to the rapid evolution of techniques and the utilization of space. That implies a need to update not only the curriculum of the programs but also to seek frequent feedback from users.

An important contribution to ISU’s global perspective are the summer session programs (SSP and SH-SSP), which have taken place all over the world, as is pictured in Figure 6.

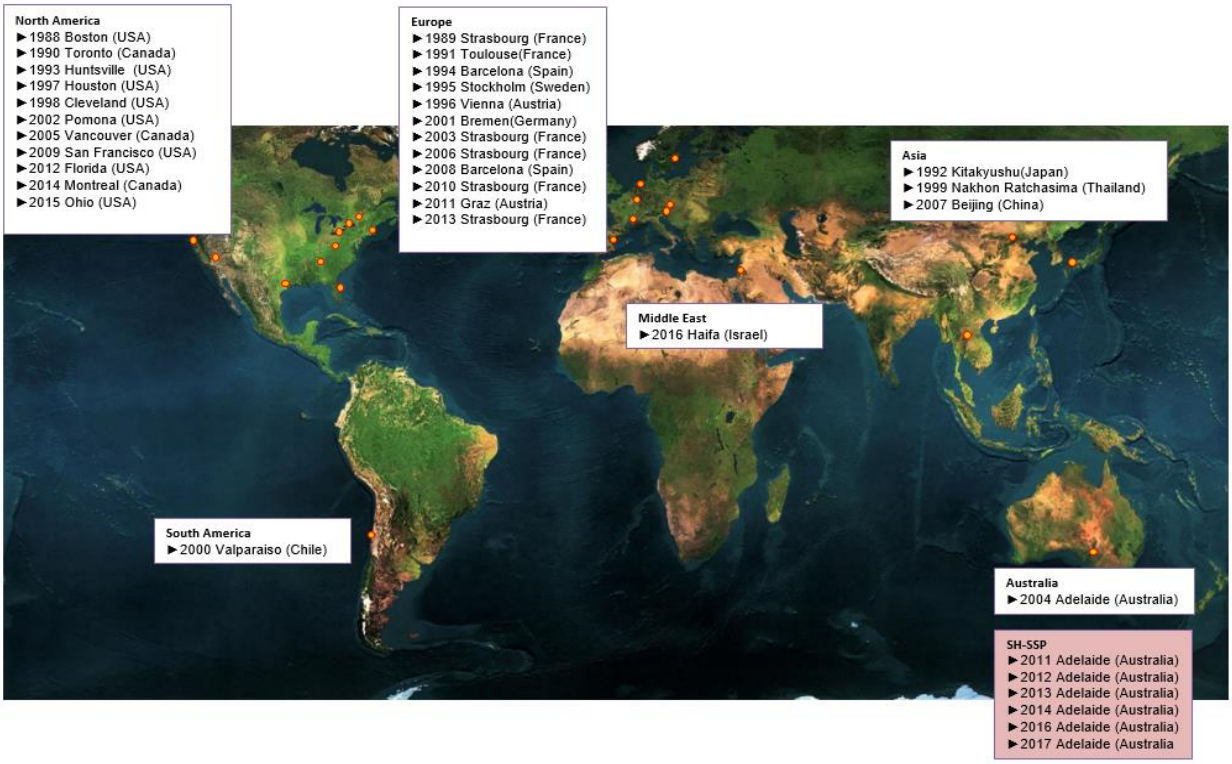

Fig. 6: ISU SSP and SH-SSP locations

This geographical distribution of SSP locations is a deliberate choice for a number of reasons. The visionary character of ISU wants to bring space closer to the overall worldwide community for which the emphasis is different. Emerging development countries' interests lay primarily in space applications. The first need is related to communications. The risk of broadening the gap between developed and developing countries due to a lack of access to (broadband) communications is recognized and called the 'digital divide'.

The outreach effect is equally strong in emerging space countries. ISU's international focus and global reach has led to a gradual distribution of the present 4200 ISU alumni, covering a considerable part of the world's map as can be noted from Figure 7.

Fig. 7: International ISU alumni network (status 2016)

If we would express “density” in such a map, the picture would be very different. Present space-faring nations, in particular the USA, Europe, Canada and Japan represent the majority of participants to the ISU programs. This balance is gradually shifting with an increasing participation of participants from India and, in particular, from China.

Due to the limited number of unrestricted scholarships, there is still an under-representation of participants from Latin America, Southeast Asia and, in particular, Africa. There are topical exceptions, like the case of Nigeria where many of the middle management of the Nigerian Space Agency are ISU alumni, but these cases remain unfortunately exceptional. One of the remedial actions taken is to ask the successful alumni to pay back part of the loan received from ISU, in order to allow for new students from emerging countries to attend the ISU programs.

There is one other imbalance where ISU tries to take remedial action: in order to achieve better gender equality in the space sector. The aim of ISU is to have at least 30% female participants in its programs as well as in its teaching community. Also here, this target is gradually being achieved.

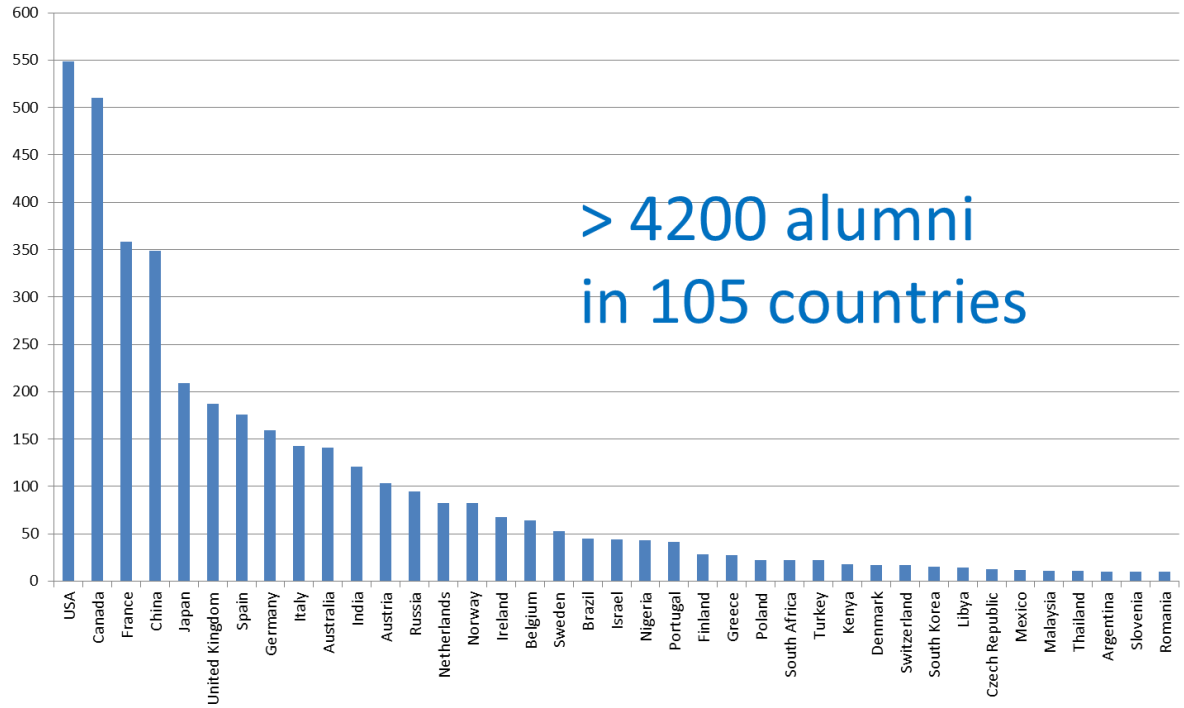

Fig. 8: Distribution of alumni per country of origin (20 largest alumni groups, status 2016)

3. ISU alumni in the space sector

A survey showed that about 75% of the ISU alumni are active in the space sector. Figure 9 pictures the distribution of alumni over the various space activities.

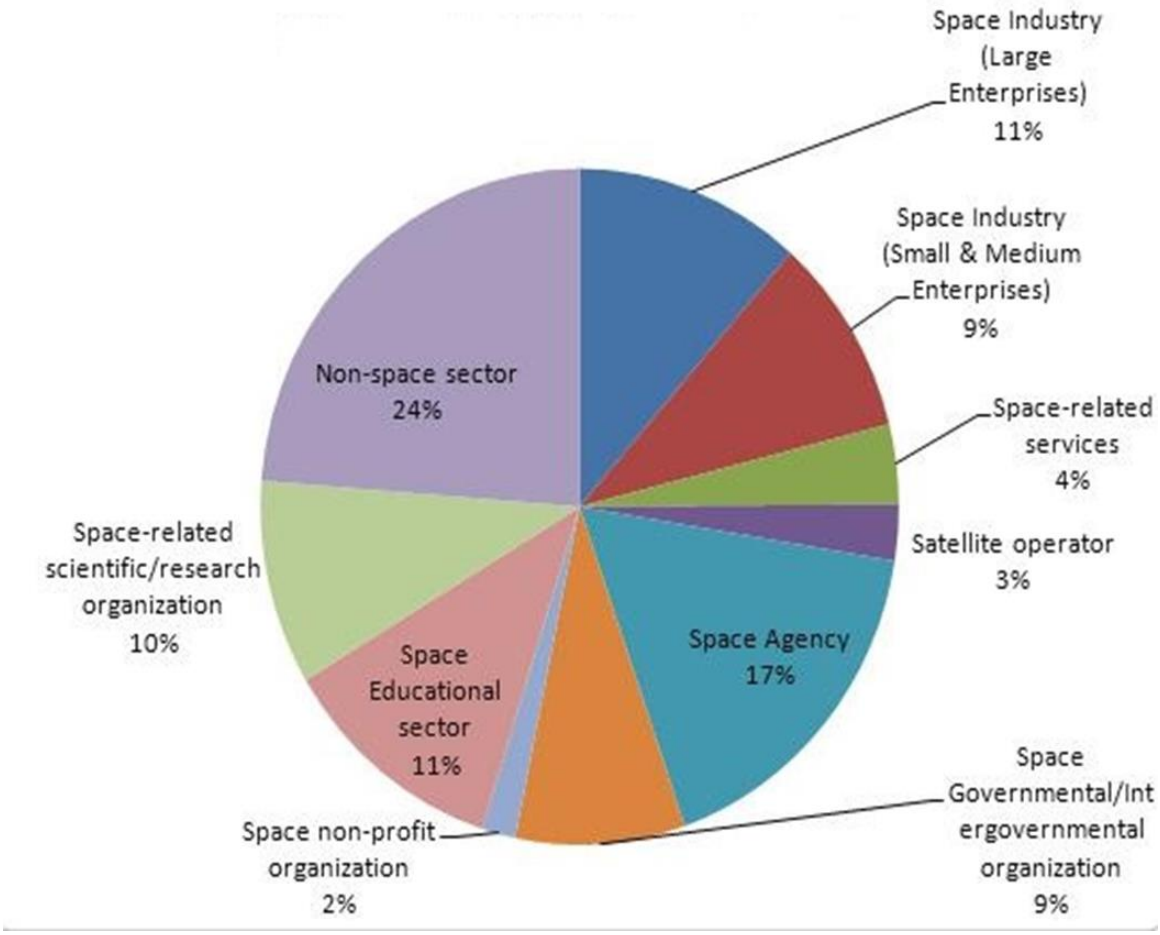

Fig. 9: Distribution of alumni over the various space sector areas

Many of the early alumni found employment in the Space Agencies, other governmental organizations and major space companies. We see, however, also a gradual shift to commercial start-up companies and space education and research.

This shift is facilitated by the fact that Masters students are offered a second research year in ISU which has allowed ISU to develop space experiments.

The first experiment of ISU flew on board the ISS and returned to Strasbourg on 19 March 2017. MMARS1 is a public-private partnership (PPP) program under ISU lead with Strasbourg University and Airbus, with a grant received from the local authorities, Eurometropole.

Fig.10: MMARS1 container that flew on board of ISS

The idea behind this experiment is to try to explain the traces of Methane gas discovered on Mars. At the origin of this could be methanogen micro-organisms.

MMARS1 was therefore intended to demonstrate that such micro-organisms can function in low gravity conditions.

Another experiment, SMILE, in the field of fluid mechanics, will also be launched by the end of 2017. This experiment has been developed in cooperation with UNSW in Sydney, Australia.

ISU intends to continue this flow of experiments in 2018, with

- MMARS2: a follow-on experiment, again in cooperation with the local University in Strasbourg and Airbus, and with the maecenas support of GROUPAMA.
- A greenhouse bio-manufacturing experiment, in cooperation with NASA scientists and Berkeley University.
- An Art experiment.

In order to stimulate research, in close cooperation with the Eurometropole, modifications in the ISU campus are planned to enhance the incubator function of ISU, by the provision of a small clean room for experiment integration and other augmentations.

4. Team Projects

As discussed above, gaining team-working skills within international and intercultural teams was identified as one of the major needs of education expressed in the survey. In order to meet this very specific need, an important part (25 to 30%) of both the Masters and the Summer Session Programs of ISU is devoted to international and intercultural team projects. These activities are organized in such a way that the students have the opportunity

- to learn the process of organizing and managing a team project in an international and intercultural team, and
- to perform a feasibility or concept study on a topic of interest to the space sector, which integrates all the disciplines involved and the international and intercultural perspectives.

The team project has three main objectives:

i). The team project provides students with the opportunity to put into practice what they have learned from the lectures, workshops and other presentations. Students are faced with the challenge of dealing with the design of a complete system involving all disciplines and where conflicting requirements emerge and tradeoffs must be made. The capabilities of all current national and international space programs are taken into account.

ii). The team project provides students with the opportunity to experience and experiment with top-level decision-making processes within a multicultural environment. It is a considerable challenge to the student group to develop their own method for this process. The intensity of the teamwork rapidly exposes the great diversity of approaches stemming from the cultural backgrounds of the students. Every single student has to make adjustments to his or her way of working in order to achieve a successful group effort.

iii). The end-product of the team project activity is a report, which is the subject of a formal presentation at the end of each program. The report describes a conceptual design for the chosen space activity or initiative, covering all aspects - technical, financial, organizational, political, etc. These reports have served, as a whole or in part, as resource material to the world space community.

Note that all recent team project final reports and executive summaries can be downloaded from the ISU Library website under

https://isulibrary.isunet.edu/opac/?lvl=etagere_see&id=4

5. Outlook

ISU has achieved an important number of its original goals in the last 30 years. Starting with “borrowed” office space and solely a summer program in the Northern Hemisphere’s summer, it now has a permanent central campus, offers a Masters program during the normal academic year, programs during the summers of both the Northern and Southern Hemispheres, and short courses (e.g., one week). The University has an increasing number of applicants each year for its programs, based upon its growing reputation in the space field.

Each year, some 150 new alumni join the present group of 4200 alumni, and the ever-increasing emphasis on social networks increases the influence and collaboration opportunities and potential of the ISU community.

With the creation of the research year option for the Masters program, yielding increased research activities and space experiments, this will enhance ISU’s already proven role as a cradle for space entrepreneurs.

Thanks to the vision of its founders, dedicated faculty, the contributions from its many supporters, and the success of its alumni, ISU has become “the gold standard” in interdisciplinary space education worldwide.

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