Three Editions of Inter-University Studies on Space and Satellite Technology. Candidate and/vs. Graduate, a Case Study

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***Abstract*—Currently, there is a growing demand for most up-to-date academic courses that will fulfil the needs of modern society. Each candidate has to make choices and judgements carefully, in order to succeed on the market. This is particularly important when educating individuals with different backgrounds, especially on an inter-university course in the field of space sciences and technology. This paper describes a case study carried out on a group of candidates and graduates from different editions of Space and Satellite Technologies interdisciplinary master studies at Gdansk University of Technology as well as two maritime universities in Gdynia. The education process itself is realized in cooperation with business partners. The paper provides both qualitative and quantitative data, considering the whole group and particular individuals. In addition, some examples of individual achievements of outstanding students are presented.**

Keywords—Inter-University Studies on Space and Satellite Technology; candidates and graduates; university and business cooperation; career in space sector

I. Introduction

Three big Universities in Tricity (the agglomeration of 3 cities: Gdańsk, Gdynia and Sopot, in Northern Poland), namely, Gdańsk University of Technology (GUT), Gdynia Maritime University (GMU) and Polish Naval Academy in Gdynia (PNA), in co-operation with the Polish Space Agency in Gdańsk, started in 2017 an interdisciplinary M.Sc. studies on Space and Satellite Technologies (SST). Each of these Universities offer specialized education in unique specialties.

The Faculty of Electronics, Telecommunications and Informatics (GUT), recruits students for specialty: *Information and telecommunications technologies in space and satellite engineering*. Faculty of Mechanical Engineering (also GUT), recruits students for specialty: *Mechanical and mechatronic technologies in space engineering*. Faculty of Electronics (GMU), recruits students for specialty: *Marine satellite and space systems*. Whereas, Faculty of Command and Naval Operations (PNA), recruits students for specialty: *Space and satellite applications in security systems*.

This new initiative, in the field of education in Northern Polish Pomerania region, is the answer to the development of a new innovative industry sector of space exploration and utilization technologies. This development can be examined by the vast introduction of numerous companies and other entities related to the space sector in Poland, and also Pomerania itself. These new entities are both Polish branches of well recognized international corporations, operating for a long time in the space industry, as well as other smaller local firms offering various services, including satellite telecommunications, satellite navigation, Earth observation, and of course GIS (Geographic Information Systems).

II. Description of the University Studies

The detailed curriculum of the SST studies has been presented in [1]. The curriculum of the studies combines the contents of basic courses, like mathematics, physics or astronomy, with advanced topics of satellite technology utilization (satellite telecommunications, remote sensing and navigation), space missions, space mechanisms and constructions, as well as space applications in security systems.

Each graduate of SST studies also obtains skills, concerning design and operation of specialized space equipment. Students are also provided with principles of legal regulations, with respect to space activities. The wide spectrum of topics, covered by the SST studies curriculum, results in a good background in a number of fields related to space.

Within the scope of educational activities intended for SST students, they directly take part in a number of scientific research projects, under the supervision and in cooperation with both academic and research staff. As a result, they are prepared for independent formulating and solving scientific problems, conducting research, communicating with others, and presenting their research results. Each individual is also able to solve several technical issues effectively, both in individual, as well as teamwork. These activities depend on the profile of a given specialty, carried out on different Universities, and include both technical and non-technical skills.

It should be emphasized, that the SST studies have received financial support from the Polish National Centre for Research and Development (NCBR), as a part of the European Social Fund resources allocated for implementation of the educational project entitled "Adjusting the M.Sc. studies – Space and Satellite Technologies – to the needs of the employment market". These activities, necessary to fulfill the goals of the project, rely strictly on co-operation between potential employers from the space sector and participating Universities. The business partners are directly taking part in preparing classes, including lectures, laboratories, projects, seminars, etc. Moreover, both team project and student dissertation projects are realized in co-operation with those firms. As a result, students are expected to be adequately prepared to the requirements of their future employers.

III. Case Study Results

Up to now, three editions of the SST studies have been started so far, namely, 2017/2018, 2018/2019 and 2019/2020. Currently, the third edition is in progress. The case study has been carried out in April 2019 on a group of 20 people. It covered students from both the first and second year of the SST course. The survey consisted of closed and opened questions with single and multiple choices, in order to provide the best possible feedback and freedom of speech in case of each individual. The main aim of this case study was to determine their background, source of information, motivation, as well as expectations related with the SST course, as well as space science, as a novel and broad field of study. The results of this study are presented graphically.

Fig. 1 describes the background of current first and second year SST students. As shown, in both cases the vast majority had chosen the SST course after B.Sc. studies. In case of the current first-year students, only approx. 10% had chosen SST as an additional M.Sc. specialty.

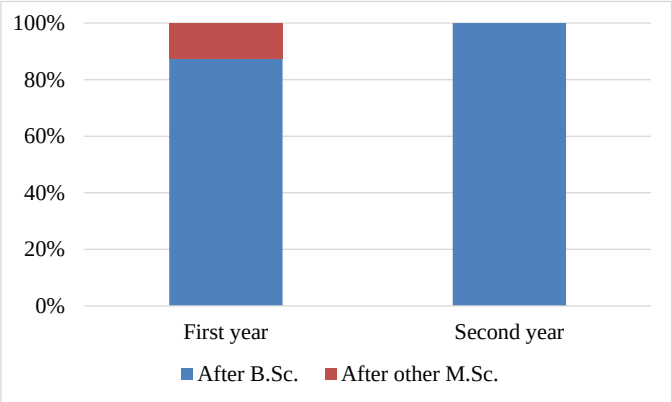

Fig. 1. Student background

Their main sources of information, considering the third edition of SST course, are shown in Fig. 2. As observed, in case of approx. 50%, their main source of information was the GUT's recruitment website. Internet advertisement campaigns, considering various adds as well as data distributed using social media, came in second. Other sources, including printed media, came in third place.

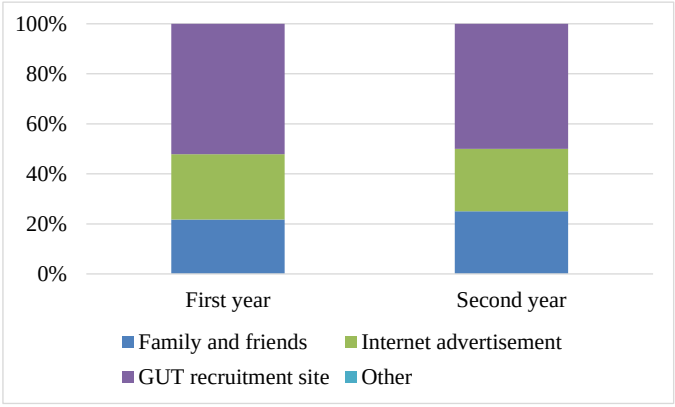

Fig. 2. Source of information concerning SST studies

The main reasons and motivations for choosing this field of study, are shown in Fig. 3. According to obtained results, the vast majority perceived SST as an interesting and bold field of study. Some of them wanted to simply raise their qualifications or become a graduate of the GUT. Not surprisingly, a number of students pointed out the fact of founding the Polish Space Agency, headquartered in Gdansk.

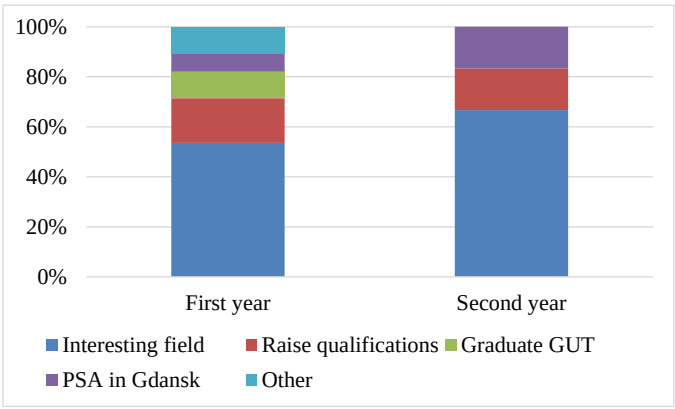

Fig. 3. Motivations for choosing SST studies

As young engineers, SST students prefer laboratory and project classes over classical lectures, as shown in Fig. 4.

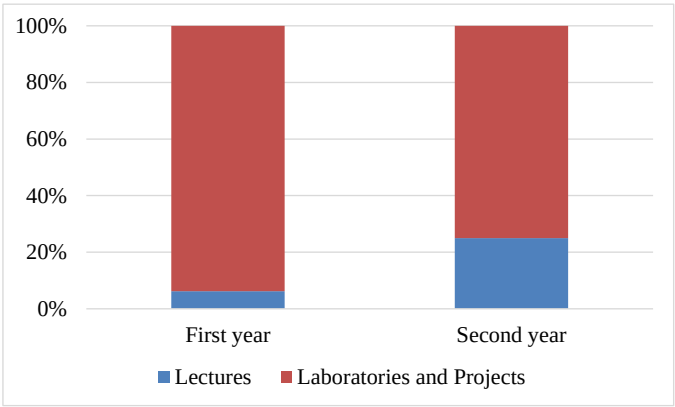

Fig. 4. Preferred type of classes

As pointed out, they desire to gain practical knowledge, along with typical engineering skills, that can help them not only in private life, but mostly in their professional career. Currently, our SST course offers more laboratories and project classes, and most students would like to keep it that way. According to numerous answers, this course enables them to pursue their passion and learn unique knowledge and skills, that can help them find interesting jobs on the market.

According to obtained results, shown in Fig. 5, half of our students combines M.Sc. studies with professional work. Most of them have part-time jobs, while other individuals favor self-employment. It should be noted, that some students had experience in IT and related fields from previous B.Sc. studies. Others, that came from a different background, started their professional career after the first year of SST studies.

Fig. 5. Combining studies with professional work.

Many individuals would like to pursue their passion, and continue studies as Ph.D. students. As shown in Fig. 6, their main motivation would be grants, closely linked with conference and publication activities.

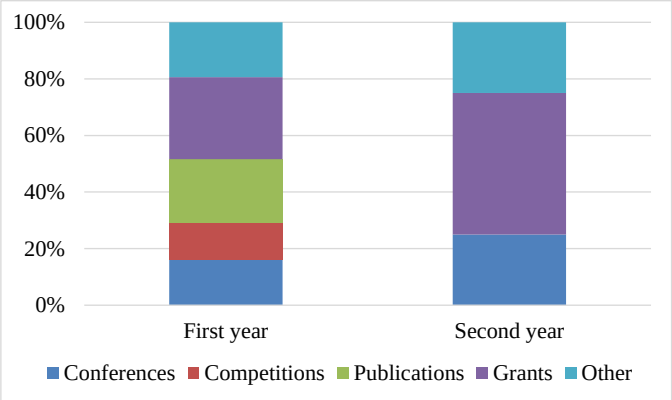

Fig. 6. Motivation for starting Ph.D. studies

Naturally, the possibility of testing ones knowledge and skills in academic and scientific competitions, would be an important factor.

IV. Student Activities

In addition, it should be emphasized that SST students have accomplished numerous achievements. The HEDGEHOG team [2] has qualified to the REXUS/BEXUS program, organized by the German Space Agency (DLR) and the Swedish Space Agency (SNSB), coordinated by ESA. The successful flight of the rocket, including the main experiment, took place in March 2019. Currently, another group of students takes part in the Spin Your Thesis! program. Apart from that, a number of students participated in many space related conferences, workshops and other activities, including hands-on courses carried out by the ESA Academy. These activities enabled to expand their knowledge in space engineering, such as Concurrent Engineering Workshop, or Cubesat Workshop.

The group of most active students founded a student organization, called SpaceCube. Its main goals involve fostering cooperation with academia and space sector companies, as well as broadening the gap between course curriculum and future careers skills required by employers. Their main project is a nanosatellite 1U Cubesat, which will test new types of solar cells developed at GUT. SpaceCube's activities also include popularization of STEM sciences among middle and high school students. Furthermore, their concept of a Space Navigation System, enabling a precise navigation using LEO satellites, received 2nd prize at Poland's edition of Galileo Masters Competition in 2017.

The joined co-operation of three Universities in the field of space engineering resulted in some scientific results as well. To begin with, the first Ph.D. thesis in dynamics of spacecraft payload vibration is currently ongoing. Furthermore, we have developed cooperation with the Centre for Space Research of the Polish Academy of Sciences. This collaboration involves work concerning a space robot testing facility [3].

Additionally, members of the Faculty, together with local companies from the space sector, have proposed numerous research and development projects. Some of them are currently funded by the National Centre for Science and Development and/or the European Commission. One of these projects is focused on the design of very light and durable lattice structure materials, that can be utilized in the design of satellites.

Another group of students was engaged in a project concerning floodplain inundation mapping using SAR data processing [4]. The study had been carried out in Biebrza floodplain, North-East Poland, with the use of automatic thresholding method for processing Sentinel 1 data. It can be estimated, that the number of scientific activities, including academics and students, as well as government and non-government institutions, will continue to grow over time.

V. Conclusions

To sum up, although the SST studies were opened relatively short time ago, a representative group of students has been covered by the mentioned study. The majority of students were well motivated to their educational, as well as research activities, usually indicating their real interest in space sciences

and technology, as the main reason for choosing this field of study.

Due to the interdisciplinary character of SST, students have different backgrounds. However, each individual is opened to learning new knowledge and skills, as well as participating in many activities, including workshops, competitions, etc. Moreover, our students are characterized by a high level of self-reliance, as they are well prepared for combining M.Sc. studies with simultaneous professional work.

As shown, the field of Space Sciences, in which our Space Science Technologies course is settled, is a novel and broad research area. It attracts many young people, with different backgrounds, motivations and expectations. Most of all, it opens new frontiers and enables them to pursue their passion in one of the most rapidly developing field.

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