European Space University for Earth and Humanity

UNIVERSEH is an alliance of five European universities established to develop a new way of collaboration in the field of Space, within the "European Universities" initiative.

The alliance aims to create new higher education interactive experiences for the university community, teachers and students, and for the benefit of society as a whole. Such initiatives will enable broadminded, informed and conscientious European citizens to capture and create new knowledge and become smart actors of European innovation, valorisation and societal dissemination within the Space sector, from science, engineering, liberal arts to culture.

Grant agreement number: 101004066

Funding Scheme: Erasmus+ / European Universities

Deliverable 3.2: Identification of future needs for student competences

Due date of deliverable: M12
Actual Submission date: 30/11/2021

Start date of the project: 01/11/2020 Duration: 36 months

Organisation responsible for this deliverable: UT (UT3)

Version: final v3

Dissemination level

PU	Public	
CO	Confidential, only for members of the consortium	X

Contents

Introduction

The UNIVERSEH Alliance is capable of taking into account its wide range of expertise and has already acquired extensive contacts with the space industry and European space Institutes to rapidly adapt to propose the most relevant courses to present European needs in the space Domain. Our primary goal is to work towards tomorrow's needs and the future positioning of Europe as a major actor in space related activities. In order to do this, we prepared, sent and then analysed a questionnaire to identified stakeholders and interested parties concentrating particularly on future employers of our students in a European context. This included not only our close industrial partners in the space domain but also other pertinent institutional partners in the sector. The questionnaire focussed on what they identify as the principal competencies needed by the students they employ and how they consider this may evolve in the years to come. It was based on principles such as technology driven advances, long-term goals, life-long learning, societal challenges, and jobs, industry and life in the future. This report provides a synthesis and an analysis of the results in view of the findings of Task 3.1[1].

I. Methodology

A. The survey

Survey purpose: This survey provides an opportunity to investigate what are the main challenges linked to the evolution of the space sector from a skills perspective. The main objective is to identify what are and will be the key evolutions of the sector and the associated expectations in terms of competences in the medium- and long-term perspectives. The analysis focuses on the possible recruitment difficulties and if there is a mismatch between what skills the industry needs and what skills the UNIVERSEH Consortium Universities currently produce. The development of new courses and programmes within the UNIVERSEH framework will benefit from the insights of this survey.

Structure of the survey: The survey is divided into three parts. Firstly, the questionnaire focuses on the space segments that are key for the sector, now and in the future. Four space segments have been identified in the frame of the UNIVERSEH project to cover all the possible domains of activities. The second part of the questionnaire analyses the "employment needs for graduates" to better understand the key positions and functions that are expected to expand and also to identify the source of job openings (new jobs or replacements). The last part of the

[1] Annex 4: Matrix 3.1

questionnaire is designed to investigate the interdisciplinarity challenges and needs, and to identify what hybrid sets of competences would be beneficial for the space sector industry.

Competences definition challenge: The questionnaire has been created in a collegial manner by a working group composed of at least one representative of each partner university. During the conception of the questionnaire, a challenge regarding the definition of "skills" particularly caught our attention. Indeed, there are different approaches that can be chosen to define skills and competences. There is a demand for a large number of technical skills in the industry but also a demand for soft skills. We differentiate skills associated to our six identified academic fields (Science & Engineering / Economy, Business, Finance, Law / Medicine & Health / Social & Human Sciences / Art & Cultural Studies / Innovation & Patents, Entrepreneurship), and other general skills that graduates can develop in addition to their solid knowledge in their related field of study (this second type of skills includes general IT and technical skills, and general soft skills.) The list of skills provided is non-exhaustive and the respondent is given a chance to suggest other types of skills, if needed. Eventually, the word "competences" includes a set of behaviour and knowledge connected with characteristics expected at a given position. In that respect, it refers to some type of knowledge (developed thanks to a learning process, during the studies), to some type of skills (more precise skills that could be technical or social skills), and to some type of abilities or behaviour that are inherent to individuals and considered as important in a workplace. All three types are interconnected and some specialized training in an academic domain can help developing both technical, social skills and other abilities.

B. The sample and respondents' profile

Global sample (contacts identified for the dissemination of the survey): The samples for the survey were drawn largely from the UNIVERSEH databases of stakeholders already engaged in the project, or supporting it, strongly focused on space-related activities, and from organisations across the partner countries thanks to privileged local contacts. For example, to disseminate the survey in France, UNIVERSEH benefited from the Aerospace Valley network. In total, the survey was disseminated to 90 companies/organisations[2].

Cartography sample: Most of the respondents come from France at 50%, and the other half come from Europe (Europe country non-specified 12%, Poland 8%, Luxembourg 10%, Sweden 9%, Germany 4%, Portugal 3%, Italy / Germany / Belgium 1%)

The closure of the survey was extended in order to try to gather more answers from the less represented countries in the respondents. In order to have a chance to broaden our results and get some answers from the less represented countries, the survey has been kept open after extraction of the data for this analysis on October 8th 2021. Hence the results may be extended at a later date.

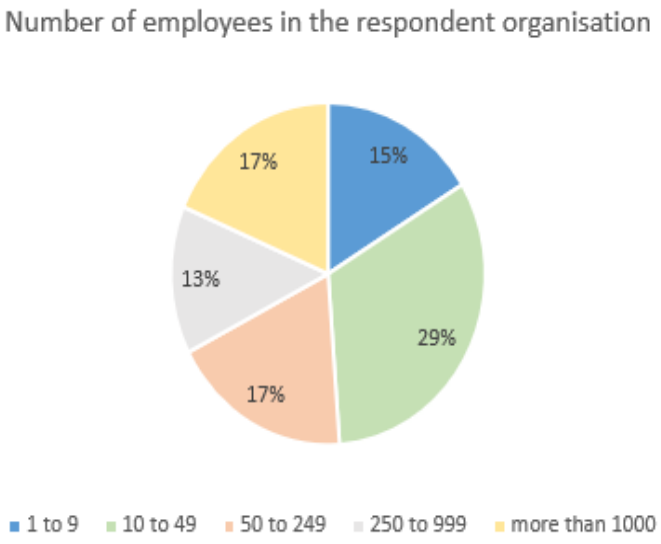
[2] Annex 2: List of organisations contacted

Actual respondents to the survey: 48 answers (27 made the name of their organisations known and 21 anonymously) out of 90 organisations contacted[3].

Type and size: A majority of respondents were businesses/organisations with fewer than 50 employees (44%), and 17 % were larger businesses/organisations with between 50 and 249 employees. 29% belong to organisations with more than 250 employees. (Figure 1: Size of respondents & Figure 2: Type of respondent)

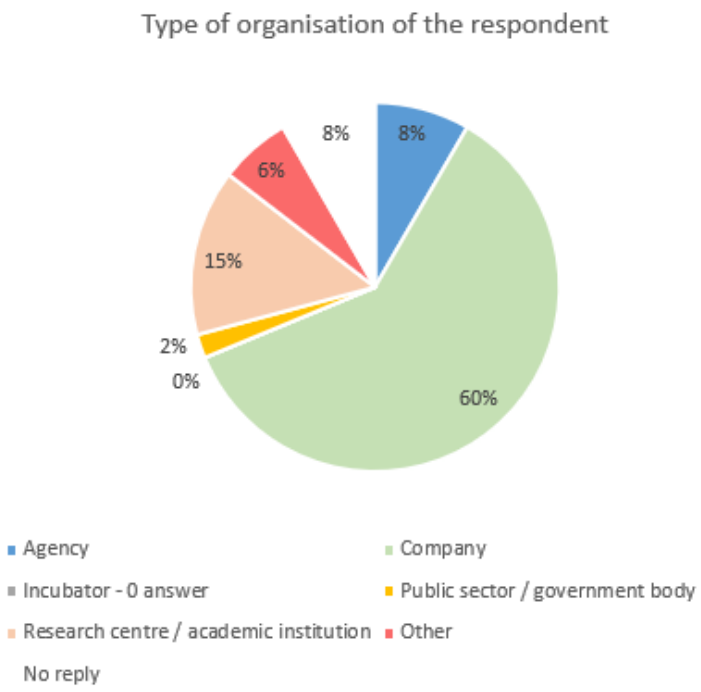
60% of respondents belong to a company, 15% to a Research Center or an Academic Institution, 8% are agencies, 6% belong to another type (non-profit organisations), 2% are from the public sector and/or Government bodies.

Figure 1: Size of respondents



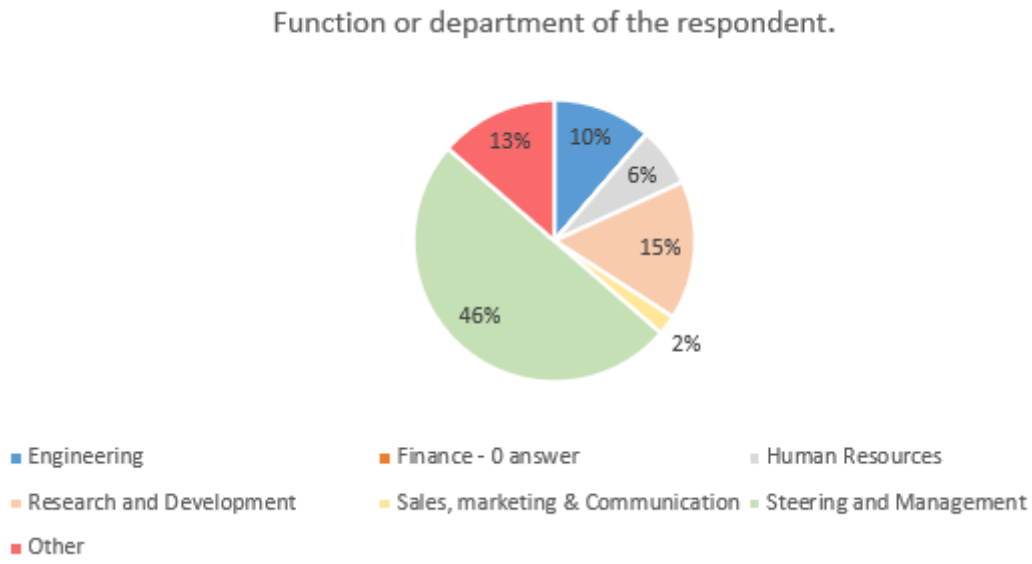
[3] Annex 2: List of organisations contacted

Figure 2: Type of respondents



Functions: 46% of the respondents occupy steering and management functions. 15% work for the Research and Development department, 13% belong to other functions than the ones initially proposed (Other functions: education, advocacy, policy officer, corporate development, administrative staff), 10% have Engineering functions. Finally, 6% are part of Human Resources teams. 2% are from Sales, marketing, and communication departments. (No answer was received from a Financial department representative.) (Figure 3: Functions of respondents)

Figure 3: Functions of respondents



Internationalisation of activities: Same proportion for both national and European based activities, 54% declare that their activities are located in the national country and 54% in the European Union, 27% declare their activities are deployed outside the European Union. Respondents had the possibility to select multiple entries: for example, “activities nationally deployed” and “activities deployed out of EU”.

Experience in the space domain: 21% of the respondents have more than 30 years of experience in the space domain, 33% have between 11 and 30 years of experience, and 35% have less than 10 years. (11% of respondents did not answer this question)

Overall, this survey sample, though limited in size, provides a base for a first examination of various competences issues and needs: several European countries are represented and a majority of respondents have an activity in Europe, all sizes of organisation are represented, and a lot of respondents come from steering and management functions. This sample allows a broad vision towards future skills, which is the core subject of this report.

C. Detailed methodology

Online survey: The list of companies/organisations to which the survey was disseminated (90 organisations) has been defined according to the core space activities, the different fields of applications, and the spatial segments covered. The main source of contacts was the databases of UNIVERSEH Stakeholders, and local network organisations (such as the Aerospace Valley cluster).

Interviews: As an additional effort to gather interesting visions and more detailed results, 25 companies were contacted by phone to organize direct interviews and finally a total of 6 interviews were held with 5 different SMEs (Small and Medium-sized Enterprise), and 1 non-profit association. 2 of the companies interviewed have more than 20 years of experience in the space sector, 2 have around 15 years of experience, and the others are younger companies created during the last 3 years. The six companies cover different areas in the space domain: mechanical and thermal engineering, environmental risk management and sustainable development, GNSS and telecommunications, space systems and software development including deep learning and artificial intelligence, and tele-detection and signal treatment for maritime applications.

The discussions were guided thanks to the layout of the survey and the general questions, but not structured to allow respondents to give a more detailed view of the changing skills needs of the space sectors. Time was allocated to the definition of the space segments, and of the academic fields identified in our matrix[4] so that the respondents were given an opportunity to share their interpretation of how these changing needs can be addressed. The main objectives of the interviews were: to identify the skills that employers need to develop their activities, to identify the current concerns and difficulties that employers can experience in finding the key skills in the current market, and to compare the current concerns to any concerns they might have in the next few years or in the next 10 years, according to the projected development of their activities. Indeed, respondents were more willing to share orally their recruitment difficulties than by answering the survey in an online form.

[4] Annex 4: Matrix 3.1 and Annex 3: Addressing the space sector: a 4-segment approach

II. Results and Analysis

This report summarises the findings of the survey considering both quantitative and qualitative elements, the online survey and the detailed interviews. The analysis of the evolution of the space applications segments and the interdisciplinarity challenge regarding the skills are each discussed separately before findings from both elements are considered together to provide an overview of needs for skills across the industry and some development perspectives for the UNIVERSEH project. Charts and tables are used to illustrate the findings where appropriate. The overall results of the survey with all raw data tables can be shared upon request.

A. Today and tomorrow's space activities and sectors

a) Space application segments

Firstly, in order to identify the key evolutions of the space sector and what would be the associated impact on the employment market and on skills needs, respondents were asked to classify space segment applications according to the importance they have for their activities now and in the future.

The space segments identified in the UNIVERSEH project are the following:

- **Our Earth:** e.g. Earth Science, climate change, teledetection and earth observation, natural resources, geo data, mobility, telecommunication, navigation, precision agriculture;
- **Access to Space and Around Earth**: e.g. Sustainable Space, space debris, on-orbit servicing, science & technology, space environment, launchers and rockets, reusable launch vehicles, earth observation & telecom satellites, green propulsion, law;
- **Space Settlement and Resources:** e.g. architecture & construction, agriculture (breeding), sociology of sciences, sociological studies on human behaviour and interactions, space environmental psychology, medicine, health, telemedicine, psychology, space tourism, ISRU resources, space navigation (space ports, operations);
- **Space Exploration and Discovery**: e.g. space mission planning, space energy system architecture, our origins (cosmology, star formation, exobiology, philosophy), space probes, AI & robotics.

Figure 4: Question 2 - "Which of the space application segments are most important for your current activities?"
Number of answers for each segment:

Q2:	Most important	Very important	Important	Least important	Total answers
Our Earth	**24**	8	7	5	44
Access to Space and Around Earth:	**13**	**19**	8	3	43
Space Settlement and Resources	7	5	14	18	44
Space Exploration and Discovery	4	11	11	15	41
Total answers	48	43	40	41	

To build the table above, the scale of importance has been replaced by numbers : 4 = most important, 3 = very important, 2 = important, and 1 = least important. The score available in the table is the result of the number of answers received multiplied by the scale number for each level of importance. For example, 24 respondents classified "Our Earth" as level 4 / most important, which gives a score of 96.

New table based on a score of importance calculated with the level of importance and the number of answers received:

Q2:	Most important	Very important	Important	Least important
Our Earth	**96**	24	14	5
Access to Space and Around Earth:	**52**	**57**	16	3
Space Settlement and Resources	28	15	28	18
Space Exploration and Discovery	16	33	22	15

The question asked was "Which of the space application segments are most important for your current activities?". Respondents were asked to classify the space segments identified by order of importance (they could not classify two segments as "most important".) The segments Our Earth and Access to space and around Earth reach the highest scores with respectively 96 (most important) and 52 (most important) and 57 (very important). Space settlement and resources appears in third position with a score of 28 (most important.) Space exploration and discovery does not reach very high scores globally but obtains a score of 33 for the classification "very important".

Figure 5: Question 2 - "Which of the space application segments are most important for your current activities?" Space segments classified as "most important" in the question 2 by type of respondents:

Space Segments classified as "most important" / Type of respondents	Our Earth	Access to Space and Around Earth	Space Settlement and Resources	Space Exploration and Discovery	No answer	General total
Agency	3		1			4
Company	14	10	4	1		29
Non-profit cultural organization			1	1		2
Public sector / Government body	1					1
Research centre / academic institution	3	2		1	1	7
Space association	1					1
Type unspecified	2	1	1			4
General total	**24**	**13**	**7**	**3**	**1**	**48**

Considering the type of respondents and the links with the answers to the question 2 (Figure 5: Question 2 above): the "Our Earth" segment is considered as the most important by half of the companies (14 out of 29), by agencies (3 out of 4), by research centres/academic institutions (3 out of 7). Access to space and around Earth is the second most important segment and is considered as most important by companies (10 out of 29), and by 2 research centres/academic institutions (out of 7).

Respondents were then asked to provide examples to illustrate their answers (Q3 - summarised table in figure 6.) 62% of respondents provided some examples to illustrate their opinion. In fact, a lot of examples were given for the Space Settlement and Resources segment, which is classified as one of the least important, with several examples linked to the Moon or other lunar resources and other forefront activities in this field. Moreover, during the interviews and through the examples given, the concern about sustainability of space was often emphasised: "ESG [Environment, Social and Governance] is becoming an essential part of strategy and we integrate more and more Environment, Social and Governance considerations into our strategy including requests to suppliers." Green propulsion, risk management linked to water or fire on Earth, climate change monitoring, importance of a sustainable near space environment, reusable launchers are part of the recurring themes. Another comment received is that the proposed division into space segments was missing planetary science, space science, solar physics, space instruments, which could be considered as more transversal topics and included in different segments. During the interviews, the space segment classifications were deeply explained and discussed since this classification is not exhaustive and it is only one view that can be challenged. When the respondents answered the questionnaire directly online, one can suppose they did not have the same understanding of the classification, and it might have led to some misunderstandings.

Figure 6: Question 3 - "Could you provide some examples to illustrate your previous answers for one of the space segments or for all of them?"

Q3 - Synthesis of examples provided by segments	
Our Earth	Earth monitoring from the stratosphere, agriculture and fire monitoring, water management, risk management, vessel detection on satellite Search and Rescue (SAR) imagery, climate change, telecommunication and navigation, new algorythm for earth observation, satellites mission planning, satellite derived bathymetry, concept studies for satellites in low-earth-orbit, Artificial Intelligence, optical remote sensing
Access to Space and Around Earth:	Importance of near space environment and sustainable space, space safety for space debris avoidance, launchers and rockets, reusable launch vehicles, understanding the physics and chemistry of the near-earth space environment, green propulsion, Environmental, Social and Governance (ESG)
Space Settlement and Resources	Development of lunar and martian analog simulations, anticipation studies rearding a scenario for 2069: first 1000 individual Cislunar likely to exist, robotics for ISRU (In situ resource utilization), how space resources will enable a future in space economy and in particular, how oxygen produced on the lunar surface can be used to produce propellant, capability to scrutinise all living species needs in large territories (continental view) and not only human beings, architecture and construction of optimized platforms (miniaturization: techno bricks, ultra-integrated avionics).
Space Exploration and Discovery	Research concerning space biology and space medicine, space robotics for spacecraft refueling, robotics for space exploration

If we consider the answers received regarding the classification of the space segments in the near future (Figure 7: Question 4 below), one can note that the importance of the segment "Our earth" is still significant with 41.3% of respondents answering it is "very likely to be developed in the near future". Access to space and Around Earth remains one of the segments of main interest with 33.3% of respondents considering it is "very likely to be developed in the near future". The answers are quite different if one observes the results for the long term: the segment Space exploration and discovery is considered as the most likely to be developed in the long term with 45% of answers. It is followed by Space settlement and Resources (22.5%.)

Figure 7: Question 4 - "Regarding the following Space Application Segments, how do you see future developments in your company / organisation? Free choice, no restriction on multiple entries in the same column." The results are presented as % of replies of each statement (column) for each sector.

Future developments of space application segments (%)		
	Very likely to be developed in the near future	Likely to be developed in the long term
Our Earth	**41,3**	12,5
Access to Space and Around Earth	33,3	20
Space Settlement and Resources	13,3	22,5
Space Exploration and Discovery	12,0	**45,0**
Total	100,00%	100,00%

Respondents could select different segments for the same category (example: select two different segments as very likely to be developed in the near future), but after verification, the overall result for this question is not impacted by multiple entries in the same column.

Figure 8: Question 4 - Segments considered as "very likely to be developed" by type of respondents - "Regarding the following space application Segments, how do you see future developments in your company / organisation? Free choice, no restriction on multiple entries in the same column."

Segments considered as "very likely to be developed in the near future" by type of respondents *(respondents could select multiple segments with the same status)*

	Agency	Company	Non profit cultural organization	Public sector / government body	Research centre / academic institution	Space association
Our Earth	4	18	1	1	4	1
Access to Space and Around Earth	2	16	2		3	
Space Settlement and Resources	3	4	1		2	
Space Exploration and Discovery		6			3	

It is possible next to check if there are any tendencies according to the type of respondents. It is reminded that respondents had the possibility to choose multiple entries. Companies are divided in their judgment: the segment Our Earth is selected 18 times as "very likely to be developed" and the segment Access to space and around Earth is selected 16 times. Agencies

also tend to highlight the Our Earth segment (selected 4 times), and Space Settlement and resources (selected 3 times.) The results are more even for Research centres/Academic institutions with less difference between the sectors. They, (as well as companies to a lesser extent) are also more interested in the Space exploration segment (selected 3 times by the Research centers/Academic institutions and 6 times by the companies.)

Following this question about the future developments of segments, 54% of respondents provided examples (Answers received are summarised in the table below) Most of the examples provided were linked to the "Our Earth" segment, with several comments linked to sustainable topics (climate change, space debris, impact of man-made object.) Robotics, space missions and resources are also part of the examples often provided. Artificial intelligence has also been mentioned as well as the development of digital twins, which can both concern different space segments depending on the objective of their use.

Figure 9: Question 5: "Could you provide some examples to illustrate your previous answers for one of the space segments or for all of them?"

Q5 - Synthesis of examples provided by segments (future development)	
Our Earth	Artificial Intelligence and digital twins, connected ports, maritime monitoring, military applications, environmental applications, New Space, Microsats for LEO (Low Earth Orbit), In-space robotics, arrival of launch facilities for nanosatellites in 2025, climate change challenge and the use of spatial technology to optimize water availability, agriculture adjustment
Access to Space and Around Earth	Sustainable space/natural space environment, on-orbit demonstration of space debris deorbit, impact of man-made object, on-orbit servicing
Space Settlement and Resources	Teleoperation and autonomy of ISRU (In-Situ Resource Utilization), robotic arms, grippers, interplanetary transport and logistics, space resources utilization
Space Exploration and Discovery	Telemedecine, space missions development, adaptation of existing satellites for deep-space missions

b) Employment needs for graduates

The next part of the questionnaire was focused on the respondents' employment needs for graduates, in order to identify what are and will be the key positions/functions where they need a workforce now or where they will hire graduates in the future. (**Figure 10: Question 7 "For your organisation, what are the key positions / functions to which graduates will be recruited in the next few years and in the future (next 5-10 years)? "**)

Respondents had the possibility to choose between several possible answers: a position/function important for the next few years (option 1), for the next 5-10 years (option 2), or for both the next few years and in 5-10 years (option 3). One can note the importance of **engineering positions** (60% of respondents consider it is important for both the near future and the longer term) **Research and Development** is also highlighted as a key function with 40% respondents considering it as key for both the next few years and 5-10 years, and 33% who answered it is important for the next few years. **Project management** functions are also stressed as important (38% answered for both the next few years and in 5-10 years, and 29% answered that it is key for the next few years) Globally, there is also an interest for **Finance, Accounting and marketing** functions for which 29% of respondents answered it is key for both the next few years and in 5-10 years. There are more answers received for the needs in the next few years or for both the short and long term, and less for the 5-10 years, which can be a sign that it is more difficult to project the needs in a longer perspective.

Figure 10: Question 7 - ”For your organisation, what are the key positions / functions to which graduates will be recruited in the next few years and in the future (next 5-10 years)? ”

Percentage of key positions / functions needed by the respondent over 3 different periods of time

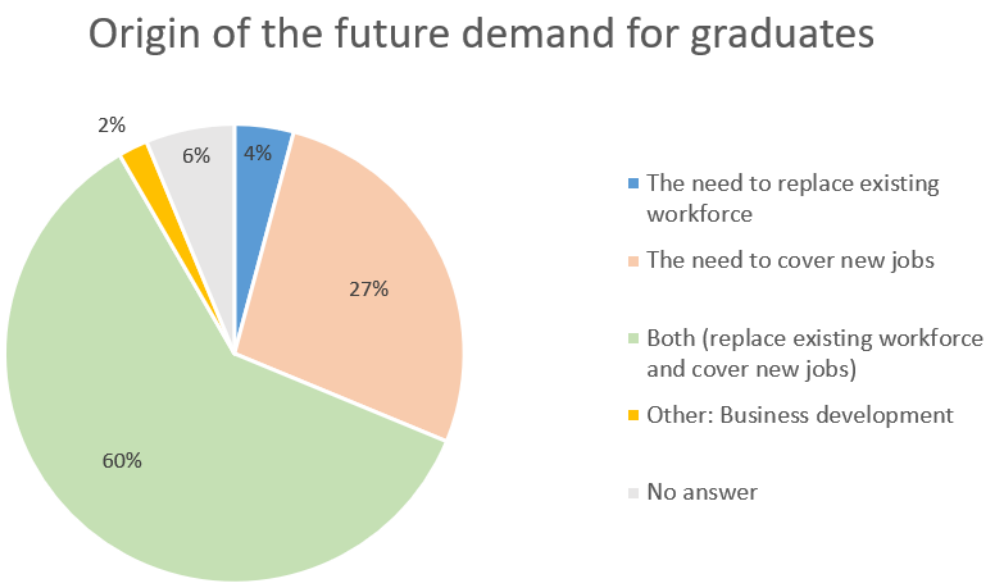
	The next few years	5-10 years	Both	No answers	Total
Engineering	25%	2%	60%	12%	100%
Finance and Accounting	8%	13%	29%	50%	100%
Human Resources	6%	15%	25%	54%	100%
Logistics	8%	13%	13%	67%	100%
Marketing	17%	8%	29%	46%	100%
Project Management	29%	4%	38%	29%	100%
Quality	8%	13%	25%	54%	100%
Research and Development	33%	2%	40%	25%	100%
Sales	23%	8%	27%	42%	100%

Respondents could classify different functions in the same category: for example, one can answer Engineering and Logistics are both key for the next years.

Among the non-exhaustive list of positions and functions provided, respondents had also the possibility to suggest other types. “Production / manufacturing / integration, customer service, Communication and policy, Legal advisers, Professional GIS (Geographic Information System trainer)“ were proposed. (Question 8)

To understand what would be the origin of their future employment needs, respondents were asked to specify if it would be linked to creation of new jobs, or replacing the existing workforce. According to the graph below (Figure 11: Question 9), 60% of respondents consider that the demand for graduates will arise due to both needs. **27% consider this demand will be linked to uniquely the need to cover new jobs**, and 4 % consider it will be uniquely linked to the need to replace the existing workforce. 2% highlighted that the demand will arise due to business development needs, and 6% did not answer this question.

Figure 11: Question 9 - "If applicable, the future demand for graduates will arise due to…:"



After this question, respondents were given the chance to provide some comments in a blank space, which 38% did (Question 10). They highlighted that their needs would be linked to Human resources management with replacement first, and possible job openings in the future. Some comments also highlighted the importance of finding "transversal engineers" with project management, team management and business skills. Other respondents with support functions mutualised in a big group, considered that the job needs would be more linked to engineering, research and development and technical functions. It has also been pointed out that "for all areas there will be a partial need to replace existing workforce, albeit not with the exact same skill sets", and the need for skills in the "new technological trends" is also mentioned. Two respondents (both SMEs) stressed that their organisation will grow rapidly in the next few years with important hiring plans, and even "triple" in size.

Most of these answers are provided by companies. Among 29 companies, 17 consider that the future demand for graduates will arise due to both the need to cover new jobs and replace existing workforce, 9 due to only the need to cover new jobs and 2 due to only the need to replace existing workforce. The tendency is similar for the other types of respondents who globally think in majority that the origin of jobs opening will be linked to both reasons. (Figure 12 - Question 9 by type) Regarding the size of the organisations who answered this question, organisations with more than 1000 employees all consider it will be linked to both new jobs

opening and replacing workforce. The answers are more divided for the other sizes of organisations. Between 10 and 999 employees, most of the respondents answered “both” or “the need to cover new jobs”, with a bit more of respondents answering “both”. Nevertheless, for the organisations with less than 10 employees, the need to cover new jobs got the same number of answers as both new job creation and replacing existing workforce. (Figure 12 - Question 9 by size) Most of the respondents occupy Steering and management functions, but the proportion of answers for each option is quite similar for the other functions. (Figure 12 - Question 9 by functions)

Figure 12 - Question 9 by type / by size / by functions - “If applicable, the future demand for graduates will arise due to…:”

Q9 - Origin of the employment needs by type

	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	Total
The need to cover new jobs	1	9	2				13
The need to replace existing workforce		2					2
Both	3	17		1	6	1	29
Other: Business development		1					1
No answer					1		3
Total	**4**	**29**	**2**	**1**	**7**	**1**	**48**

Q9 - Origin of the employment needs by size

	1-9	10-49	50-249	250-999	1000+	Total
The need to cover new jobs	3	3	3	2		13
The need to replace existing workforce	1	1				2
Both	3	9	5	3	8	29
Other: Business development		1				1
No answer				1		3
Total	**7**	**14**	**8**	**6**	**8**	**48**

Q9 - Origin of the employment needs by functions

	Advocacy	Corporate Development	Education	Engineering	Human Resources	Policy Officer	Research and Development	Sales, marketing & Communication	Steering and Management	No answer	Total
The need to cover new jobs			1	2	1	1	1		6	1	13
The need to replace existing workforce							1		1		2
Both	1	1	1	3	2		5	1	13	2	29
Other: Business development									1		1
No answer									1	2	3
Total	**1**	**1**	**2**	**5**	**3**	**1**	**7**	**1**	**22**	**5**	**48**

c) Summary of key findings and other general comments

Summary of key findings:

This first section addressing the space sector insists on how the space domain is perceived now and what would be the future evolution. Nevertheless, the analysis of answers received represents the near future more than long term perspectives.

Space segments of interest now and in the future are mostly “Our Earth” and “Access to Space and Around Earth”, which is stressed especially by agencies and companies.

On the contrary, segments very likely to be developed in the long term are “Space settlement and resources”, and “Space exploration and discovery” which imply new areas to be covered in the training and curriculum.

According to the answers received to the questions concerning the employment needs, one can note that the space job market is expanding and changing. Answers received take into account projections especially for the next few years, or for both the short and longer term. The projections in 5-10 years received less answers from respondents, but still, indicated an increase in the job market. Considering the origin of job openings, one can note the importance of the need to cover new jobs: these new jobs are associated with new skills and new competences to be anticipated. The new courses and new European curriculum should take into account the evolution of already existing jobs and the creation of totally new types of jobs. This observation will be complemented by an analysis of another question asked in the survey concerning new positions where respondents were asked to provide examples of totally new positions.[5]

To go further: other general comments

Furthermore, it is possible to analyse the comments received in the blank spaces, or in the open questions, together with some outputs generated following two events dedicated to the space job market and space sector evolution:

- Workshop on the future of work in the space sector: the perspective of industry organized by the European Space Agency and held on September 8th, 2021[6].

[5] Figure 21: Questions 16, 17 and 18 in the section “Required Interdisciplinarity of space education”.
[6] Workshop based on 3 previous forums gathering large system integrator groups (LSIs – 5 companies Ariane Group, Airbus, OHB, TAS, Ruag), Midcaps (24 companies) and SMEs (contributions from 35 companies with questionnaire and interviews)

- Space and the Universities of the Future in Europe: UNIVERSEH kick-off meeting held on October 4th in Toulouse: Roundtable “Employability and future skills: the role of SMEs and corporations in UNIVERSEH”[7]

The issues covered during these two events and the comments received in our survey (online survey and interviews) raise different points that can be stressed and included in the survey overall analysis.

Firstly, one can stress a common concern about the link between **Space and Society** and how space can help to address societal challenges. The space sector is gaining more public visibility: a growing economic sector and greater awareness about the role of the space economy as a source of information (connectivity, data in daily life). This element is also linked with the perceived role of Space in society: the image of space faces several problems such as poor knowledge and understanding, and some kind of bashing similar to the plane-bashing. An element also raised by the companies interviewed and during the three roundtables of the ESA workshop is the need to move towards greener space activities. This is also perceived through the comments received which includes some key words: how to deal with space debris, reusable rockets, impact of man-made objects, climate change challenge and the use of space technology for agriculture, water management… In short, there are 3 types of concerns regarding greener space activities: greener production methods, energy-friendly/efficient facilities and products, and compliance with environmental regulations.

Moreover, beyond the importance of specific space segments, comments received allude to the integration of **new technologies, concepts and processes.** For the space segment “Our Earth”, the challenge of managing increasing data volumes is linked with the need for professionals able to deal with cybersecurity issues, for example. Specific new technologies are also listed as examples: Artificial Intelligence, machine learning, digital twin concepts, space debris mitigation technologies, robotics, big data, quantum technologies… One can assume there could be a need for a trained workforce in these new technologies. Another change affecting the space sector and stressed during the ESA workshop concerns the production. Some SMEs and companies operate a transition from manufacturing to serialization, and integrate model-based systems engineering. It refers to a formalized process to support the production phases from systems requirements, design, analysis, and validation, from the beginning phases to the late life cycle phases. These models encourage a structured approach with all successive engineering phases with a distinction between operational needs and systems needs. The objective is to reduce significantly the design phase, allow mass scale customization and greatly reduce the cost of designing new satellites based on existing designs, for example. This new approach in production raises a challenge for an important type of workforce in the space domain: need for an evolution of the mind-set of the system engineers. New technologies and production processes also imply more complex environments with new commercial and technical interfaces. These interfaces mix different

[7] Annex 5: UNIVERSEH: The Conference on Space and the Universities of the Future in Europe

aspects of a project: production organization with suppliers, sub-contractors and procurement, new software interfaces, new clients management interfaces (use of CRM, Customer Relationship Management tools), new integration interface… Globally, professionals of the space sector are working and will work in complex and technology rich environment and this must be taken into account when developing a new curriculum.

Finally, some comments were received in the survey but also formulated during the UNIVERSEH roundtables regarding the **digitalization of the sector**, especially following the Covid-19 crisis. Space is confirmed as a strategic and resilient sector but the sanitary crisis accelerated the digitalization process of the sector. As in other sectors, remote working is now developed and there is a growing need for remote team management skills. In the European Space Agency Agenda for 2025, there is a notion of "full digital continuity with industry"[8]. It is also referring to digital nomadism which has been mentioned during the ESA workshop: this new tendency is not yet developed in space activities but it could be a future evolution of the employment space sector. It will imply new ways of remote management and new mindsets. There also could be an evolution of the way Research and Development is conducted: tools favouring online interaction and new skills for remote R&D teams.

[8] European Space Agency Agenda 2025, page 12: https://esamultimedia.esa.int/docs/ESA_Agenda_2025_final.pdf

B. Required interdisciplinarity of Space Education

After analysing the projected evolution of the space sector and the application of the different space segments, the respondents were next asked for information about how they consider interdisciplinarity in the future of space education. **Interdisciplinarity refers here to different combinations of two or more academic fields to build cross-sectorial curricula outside of the traditional boundaries, as new needs and professions emerge in the space sector. UNIVERSEH seeks to reinforce links with the disciplinary areas outside of Science & engineering, for example in Economy-business-finance & law, Medicine & health, Social & human sciences, Art & cultural studies, and Innovation, patents & entrepreneurship.**

Firstly, respondents were directly asked if they think it is useful to recruit graduates who have interdisciplinary competences? (Question 11) 67% of respondents consider that it is useful to recruit graduates who have interdisciplinary competences, 21% consider that it is better to recruit two people with complementary skills, and 6 % prefer to hire specialists. 6% did not answer this question. It is possible to look further into the answers provided by taking into account the type, the size and the functions of respondents. (Figure 13 - Question 11 by type / by size / by functions) Most companies think it is a good idea to recruit graduates with interdisciplinary skills (22 out of 29), 6 companies prefer to recruit two different people with complementary skills, and 1 prefers having specialists. Regarding the agencies, 3 out of 4 think it is a good idea to recruit graduates with interdisciplinary skills, 1 prefers having specialists. For the Research centres and academic institutions, results are more divided: among 7 answers, 2 think it is a good idea, 2 prefer hiring specialists and 2 think it is better to recruit two different people with complementary skills. For steering and management functions, 12 out of 22 think it is a good idea, and 7 think it's better to recruit two different people with complementary skills. All respondents from engineering functions think it is a good idea to recruit graduates with interdisciplinary competences, and all HR representatives as well. For R&D functions: 4 think it is a good idea, 2 prefer hiring specialists, 1 thinks it's better to recruit two different people with complementary skills. Lastly, considering the size, for the respondents representing less than 250 employees, 21 out of 29 think it is a good idea to recruit graduates who have interdisciplinary competences. For the respondents between 250 and 999 employees, the answers are quite divided with the same proportion of respondents answering "it is a good idea" and "it's better to recruit two different people with complementary skills. Respondents with more than 1000 employees mostly think it is a good idea (7 out of 8.) Globally, the answers provided are similar for SME or bigger companies. Our sample being limited (48 answers), a further study for this type of question could help to analyse more deeply the results and the possible correlations with the type, the size or the functions of respondents. The cross-analysis provided for the next questions on interdisciplinarity below also supplements these first observations.

Figure 13 - Question 11 by type / by size / by functions - Do you think it is useful to recruit graduates who have interdisciplinary competences? e.g. Space Engineering + another subject

Q11 answers by type

	Agency	Company	Non-profit cultural organisation	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
Yes, this is a good idea (please provide examples in the text box)	3	22	1	1	2	1	2	32
It's better to recruit two different people with complementary skills	1	6			2		1	10
No, we only need specialists		1			2			3
No answer			1		1		1	3
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

Q11 answers by function

	Advocacy	Corporate Development	Education	Engineering	Human Resources	Policy Officer	Research and Development	Sales, marketing & Communication	Steering and Management	No answer	Total
Yes, this is a good idea (please provide examples in the text box)	1	1	1	5	3	1	4	1	12	3	32
It's better to recruit two different people with complementary skills			1				1		7	1	10
No, we only need specialists							2		1		3
No answer									2	1	3
Total	**1**	**1**	**2**	**5**	**3**	**1**	**7**	**1**	**22**	**5**	**48**

Q11 answers by size

	1-9	10-49	50-249	250-999	1000+	No answer	Total
Yes, this is a good idea (please provide examples in the text box)	3	11	7	2	7	2	32
It's better to recruit two different people with complementary skills	3	3		2	1	1	10
No, we only need specialists	1		1	1			3
No answer				1		2	3
Total	**7**	**14**	**8**	**6**	**8**	**5**	**48**

a) Hybrid skills sets

To identify the most important academic fields for the space activities for companies and at a larger scale, for the European space sector, the respondents were asked to graduate the importance of academic fields from 1, which means not important at all to 5, very important (Figure 14: Question 12-A and Figure 15: Question 13-A below).

Regarding **Science and Engineering**, one can observe it is considered as very important for both the companies and the EU space sector (77% and 79% of answers), and this academic field is never classified with the lowest levels, 1 or 2 (Figure 14: Question 12-A and Figure 15: Question 13-A below.) This academic field is classified with the highest level of importance (5) by most of the companies (25 out of 29), and 2 agencies out of 4. Research Centres and academic institutions present more divided results with 5 out of 7 classifying it at 5, and 2 out of 7 classifying as important level 3 (Figure 16: Question 12-A by type).

Economy and business also attracted high interest from respondents who classified it as very important or important (level 4, 27% and level 5, 23% for the companies; 35% for both levels 4 and 5, for the EU Space sector / Figure 14: Question 12-A and Figure 15: Question 13-A below) When looking at the type of respondents answering this question, one can observe that agencies attach high importance to this field (2 out of 5) classify it with the most important level of importance (5), and 2 with a level 3. The answers of the companies are more divided, but 16 out of 29 classify this field at levels 5 and 4. (Figure 16: Question 12-A by type).

Moreover, one can observe that **Medicine and Health** are perceived as more important for the EU space sector globally than for the companies surveyed which are not involved in the Medicine and Health domain. Indeed, this field reaches levels 3 and 4 (6% for both) for the companies, and 25% level 4 plus 10% level 5 for the EU space sector (Figure 14: Question 12-A and Figure 15: Question 13-A below) If one looks at the answers received by type, it is possible to observe that Medicine and health does not reach the highest level of importance in this question. However, it should be noted that among the organisations contacted and the respondents who answered in a non-anonymous form, medicine and health is not a field of work really represented. (Figure 16: Question 12-A by type).

Social and Human Sciences are perceived slightly more important for the EU space sector globally than for the activities of the companies interviewed. 19% classified it as important (level 4) for the EU space sector. (Figure 14: Question 12-A and Figure 15: Question 13-A below) For this field, the answers from the agencies are quite divided: 1 out of 4 answered that Social and human sciences are of level 5 of importance and 2 respectively chose the levels 1 and 2. This field is also classified at level 5 of importance by one of the Research centres/Academic institutions. (Figure 16: Question 12-A by type.)

One can note the same trend for **Innovation, Patents and Entrepreneurship** which is considered as more important for the EU space sector than for the companies surveyed. This

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field reached higher rates with 29% who consider it important and 15% very important (level 5 of importance) for the companies, and 25% (level 4 of importance) and 46% (level 5 of importance) for the EU space sector. Agencies considered this field with a level 4 of importance (3 out of 4) or level 3 (1 out of 4). The answers from the companies are more divided but half of them (14 out of 29) chose to classify this field at levels 5 and 4, the other half chose the lower levels. (Figure 16: Question 12-A by type below)

Lastly, **Art and cultural studies** did not reach very high levels of importance but is considered more important globally for the EU space sector (4% of answers for level 5, 6% for level 4, and 15% for level 3. - (Figure 14: Question 12-A and Figure 15: Question 13-A below) There is no particular correlation with the type of respondents. The very nature of the sample should, however, be considered here. Indeed, to date, "Art and cultural studies" are not a prominent field for the space sector activities, and the sample itself does not include many "Art & Cultural" players. This should be reinforced in any future investigation.

Figure 14: Question 12-A - For your Company/Organisation: which of the disciplines do you consider generally important in 5 - 10 years for graduates to be hired in the space domain? *5 means definitely very important and 1 means not important at all*

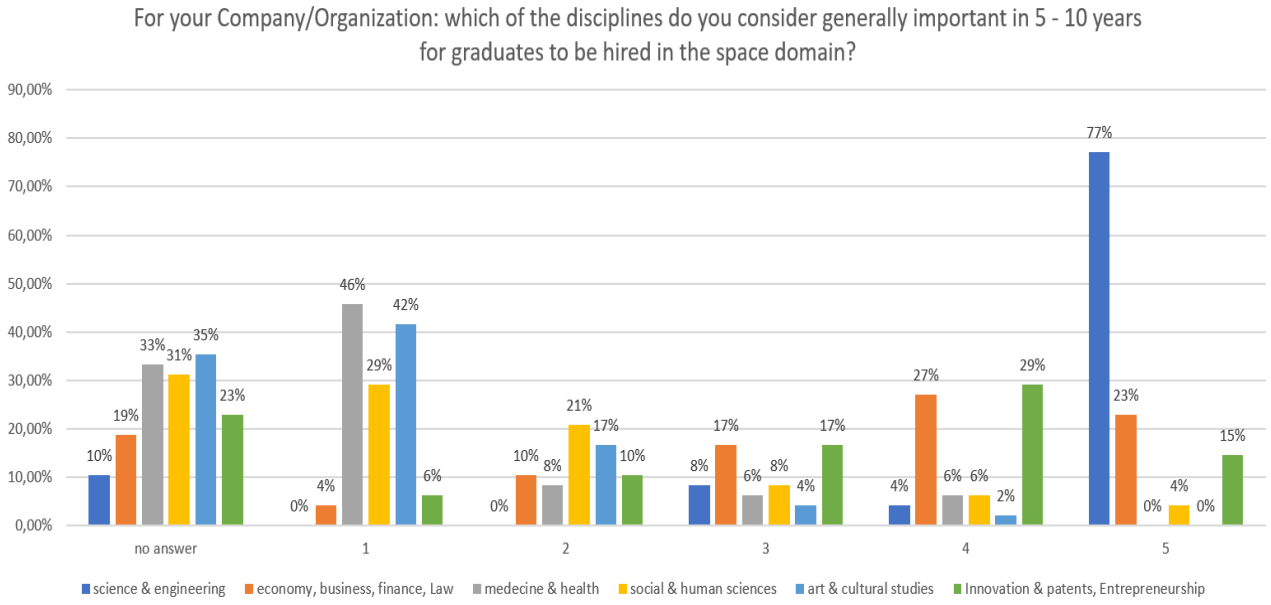

Figure 15: Question 13-A - For the EU Space Sector: which of the disciplines do you consider generally important in 5 - 10 years for graduates to be hired in the space domain? *5 means definitely very important and 1 means not important at all*

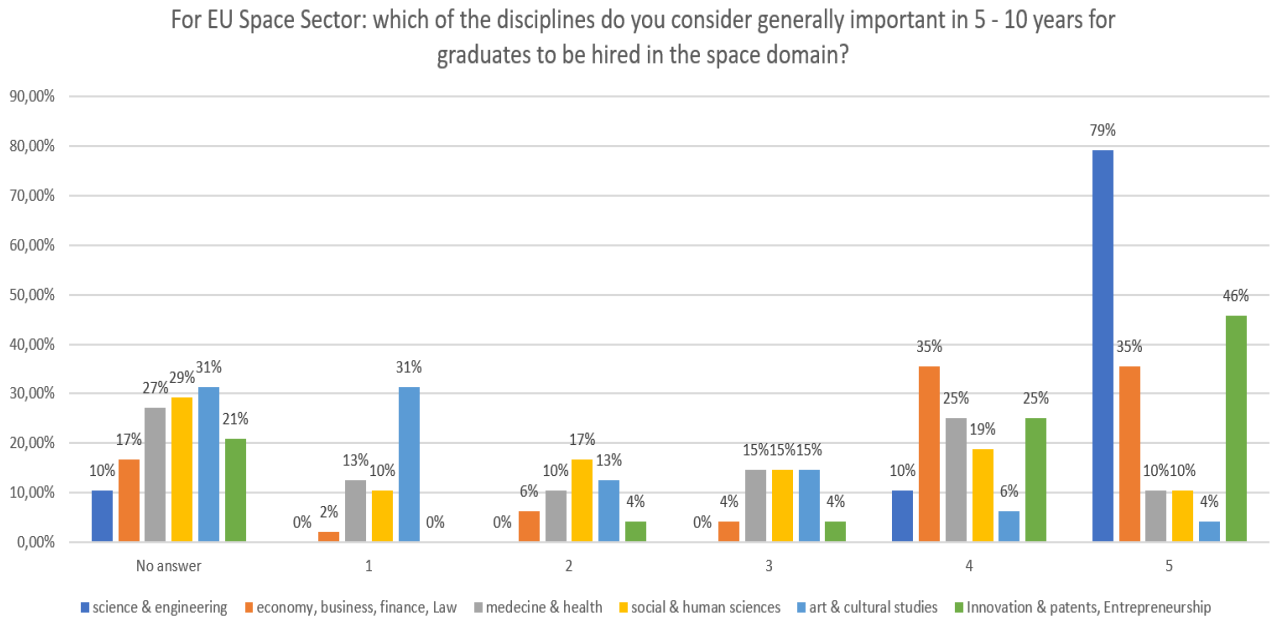

Figure 16: Question 12-A and 12-B by type / function

A - "For your Company/Organisation: which of the disciplines do you consider generally important in 5 - 10 years for graduates to be hired in the space domain?" ***5 means definitely very important and 1 means not important at all -***

B - "How easy or difficult is it to recruit graduates in the fields you consider generally important in 5-10 years for graduates to be hired in the space domain?"

Q12 results for Science and Engineering								
A - Level of importance by type								
	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
3	1	1			2			4
4	1	1						2
5	2	25	2	1	5		2	37
No answer		2				1	2	5
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B - Recruitment difficulty by type								
	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
Difficult to recruit	1	15		1	2		1	20
Easy to recruit	3	5	2		3			13
No answer		9			2	1	3	15
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B- Recruitment difficulty by function											
	Advocacy	Corporate Development	Education	Engineering	Human Resources	Policy Officer	Research and Development	Sales, marketing & Communication	Steering and Management	No answer	Total
Difficult to recruit			1	3			5	1	9	1	20
Easy to recruit		1	1		2	1			7	1	13
No answer	1			2	1		2		6	3	15
Total	**1**	**1**	**2**	**5**	**3**	**1**	**7**	**1**	**22**	**5**	**48**

Q12 results for Economy Business Finance Law								
A - Level of importance by type								
Level of importance	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
1		2						2
2		3			2			5
3	2	5					1	8
4		9	1	1	2			13
5	2	7	1				1	11
No answer		3			3	1	2	9
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B - Recruitment difficulty by type								
Recruitment difficulty	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
Difficult to recruit		7		1	2			10
Easy to recruit	4	11	1		2		1	19
No answer		11	1		3	1	3	18
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

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B - Recruitment difficulty by function											
	Advocacy	Corporate Development	Education	Engineering	Human Resources	Policy Officer	Research and Development	Sales, marketing & Communication	Steering and Management	No answer	Total
Difficult to recruit					1		2		7		10
Easy to recruit		1	2	3	1	1	2	1	7	1	19
No answer	1			2	1		3		8	4	19
Total	**1**	**1**	**2**	**5**	**3**	**1**	**7**	**1**	**22**	**5**	**48**

Q12 results for Medicine and Health								
A - Level of importance by type								
Level of importance	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
1	2	15		1	3		1	22
2		3					1	4
3	1	1	1					3
4		2			1			3
No answer	1	8	1		3	1	2	16
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B - Recruitment difficulty by type								
Recruitment difficulty	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
Difficult to recruit	2	5	1					8
Easy to recruit		1		1	2		1	5
No answer	2	23	1		5	1	3	35
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

Q12 results for Social and Human sciences								
A - Level of importance by type								
Level of importance	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
1	1	10		1	2			14
2	1	7			1		1	10
3		4						4
4		1	1				1	3
5	1				1			2
No answer	1	7	1		3	1	2	15
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B - Recruitment difficulty by type								
Recruitment difficulty	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
Difficult to recruit	1	2			1			4
Easy to recruit	1	3	1	1	2		1	9
No answer	2	24	1		4	1	3	35
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

Q12 results for Innovation, Patents, Entrepreneurship

A - Level of importance by type

	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
1		2			1			3
2		5						5
3	1	4			2		1	8
4	3	8	1	1	1			14
5		6					1	7
No answer		4	1		3	1	2	11
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B - Recruitment difficulty by type

	Agency	Company	Non-profit cultural organization	Public sector / government body	Research centre / academic institution	Space association	No answer	Total
Difficult to recruit	3	11	1	1	1		1	18
Easy to recruit	1	4			2			7
No answer		14	1		4	1	3	23
Total	**4**	**29**	**2**	**1**	**7**	**1**	**4**	**48**

B - Recruitment difficulty by function

	Advocacy	Corporate Development	Education	Engineering	Human Resources	Policy Officer	Research and Development	Sales, marketing & Communication	Steering and Management	No answer	Total
Difficult to recruit		1	2	1		1	4		8	1	18
Easy to recruit					1				6		7
No answer	1			4	2		3	1	8	4	23
Total	**1**	**1**	**2**	**5**	**3**	**1**	**7**	**1**	**22**	**5**	**48**

With regard to the combination of academic fields, the respondents were asked to select different mixes of disciplines that they consider useful for graduates to be hired in the future (Figure 17: Question 14 and Figure 18: Question 15 below) They had the possibility to select different answers and to choose a combination while indicating what would be the major or the minor.

The first clear result is that there is an interest for **hybrid sets of Science & Engineering and Economy/Business/Finance/Law skills.** 9.3% of the answers received to this question concern this combination - there is a slight decrease in the figures for the projection in 5-10 years but globally the result and interest for this set is the same. This point has also been illustrated during different interviews where the respondents gave the example of an engineer able to understand the commercial aspects of the development of a product or a space project. Candidates with business profiles were also considered as interesting when they can also provide some technical information and understand the engineering challenges of a project. This is one of the examples taken during interviews to introduce the notion of “conversion course” where students with a specific background follow a conversion course to add a space dimension to their initial training. Another set of interests is Science and Engineering and management skills: project management

skills but also competences usually attributed to the Human Resources function like team management skills.

A second clear result is the interest for the combination of **Science and Engineering with Innovation, Patents and Entrepreneurship** (11.7% of answers for a major in Engineering and minor in Innovation, Patents and Entrepreneurship and 8.6% for a Major in Innovation, Patents and Entrepreneurship with a minor in Science engineering) During an interview, the importance of managing the European rules associated with Patents was mentioned. The interest for this combination in 5-10 years is also very clear with a slight decrease (respectively 8.8% and 7.1% of answers.)

Another combination of interest for the respondents is a set of **Innovation, Patents and Entrepreneurship with Economy, Business, Finance, Law**. 4.8% of answers consider it useful for graduates to be hired now with a major in Innovation, Patents and Entrepreneurship, and 4.1% with a major in Economy, Business or Law. In 5-10 years, this result is a bit different since 4.1% of the respondents consider having a major in Economy, Business and Law useful, and 7.1% of answers prefer a major in Innovation, Patents, and Entrepreneurship.

Regarding the combination of **Science & Engineering and Social and Human Sciences** a respondent stressed that it is important that engineers as well as management (finance and Human Resources for example) get Social and Human Sciences background, in particular in the following domains: Geography, Political sciences, History, Literature. This hybrid skills set reached important levels for both results “now” and “in the next 5-10 years”: between 3.4% and 5.1% of answers depending on the choice “major/minor”. A major in Social and Human Sciences with a minor in Science Engineering obtained slightly more important results.

Finally, another combination that can be of interest is **Science and Engineering with Medicine and Health** and the result is slightly growing for the projections in 5-10 years. Indeed, 3.8% of answers stressed that it is useful now for newly hired graduates to mix both disciplines with a major in Medicine, and 3.4% with a major in Science and Engineering. In 5-10 years, this figure reached 4.4% of answers without distinction major/minor.

Figure 17: Question 14 - "What mix of disciplines would you consider useful for graduates to be hired now in the space domain?"

Q14 – What mix of disciplines would you consider useful for graduates to be hired now in the space domain? Please tick what you find important.

Q14 - Dual competences that respondents consider the most useful now (% of answers)						
	Major Science & Engineering	Major Economy, Business, Finance, Law	Major Medicine & Health	Major Social & Human Sciences	Major Art & Cultural Studies	Major Innovation & Patents, Entrepreneurship
Minor Science & Engineering	3.4	9.3	3.8	4.5	2.1	8.6
Minor Economy, Business, Finance, Law	9.3	1.0	1.4	1.0	0.7	4.8
Minor Medicine & Health	3.4	0.7	0.3	1.4	0.7	2.1
Minor Social & Human Sciences	3.4	2.4	2.7	0.0	2.1	1.7
Minor Art & Cultural Studies	2.4	1.0	0.3	2.1	0.0	1.4
Minor Innovation & Patents, Entrepreneurship	11.7	4.1	2.7	1.4	1.4	0.7
					Total: 100%	

Figure 18: Question 15 - "What mix of disciplines would you consider useful for graduates to be hired <u>in the next 5-10 years</u> in the space domain?"

Q15 - Dual competences that respondents consider the most useful in the next 5-10 years (% of answers)						
	Major Science & Engineering	Major Economy, Business, Finance, Law	Major Medicine & Health	Major Social & Human Sciences	Major Art & Cultural Studies	Major Innovation & Patents, Entrepreneurship
Minor Science & Engineering	3.7	7.8	4.4	5.1	3.4	7.1
Minor Economy, Business, Finance, Law	8.4	1.7	2.0	2.4	0.7	3.0
Minor Medicine & Health	4.	1.4	0.3	1.4	0.3	2.4
Minor Social & Human Sciences	3.7	2.7	2.7	0.3	2.0	1.4
Minor Art & Cultural Studies	2.4	1.4	0.3	2.4	0.0	1.0
Minor Innovation & Patents, Entrepreneurship	8.8	4.1	2.4	1.7	1.7	1.4
					Total: 100%	

b) Recruitment difficulty

For the different academic fields identified in the frame of the UNIVERSEH project, respondents were asked to stress from which field they have more difficulties to recruit. They had to choose if it is “easy to recruit” or “difficult to recruit”, or they had the possibility to not answer the question for all fields. Results regarding **Science & Engineering** are divided, since 42% of respondents have difficulties recruiting in this field and 27% think it is easy to find a workforce in this domain. (Figure 19: Question 12-B above) If one looks at the type of respondents answering this question, one can observe that 15 companies out of 29 said it is difficult to recruit in this field, 5 answered it is easy to recruit, and 9 did not answer this question. 1 agency out of 4 answered that it is difficult to recruit graduates in this field. The difficulty to recruit is especially expressed by the main functions of the person filling in the questionnaire: 3 respondents from the engineering functions out of 5 and 5 respondents from the Research and Development functions out of 7 answered it is difficult to recruit in Science and Engineering. This concern is also expressed by Steering and management with 9 respondents out of 22 answering they have difficulties to hire in this field. (Figure 16: Question 12-B by type/function above.)

A second clear result is the difficulty respondents have to find graduates in the **Innovation, patents and Entrepreneurship domain** (38% consider it is difficult to recruit in this field for their company/organisation - Figure 19: Question 12-B) 3 agencies out of 4 answered it is difficult to recruit in this field, and 11 companies out of 15 who answered this question (among 29, only the half answered this question.) The respondents who stressed that they have difficulties recruiting in this field occupy Corporate development (1), Education (2), Engineering (1), Policy officer (1), Research and Development (4) and Steering management positions (8) (Figure 16: Question 12-B by type/function.)

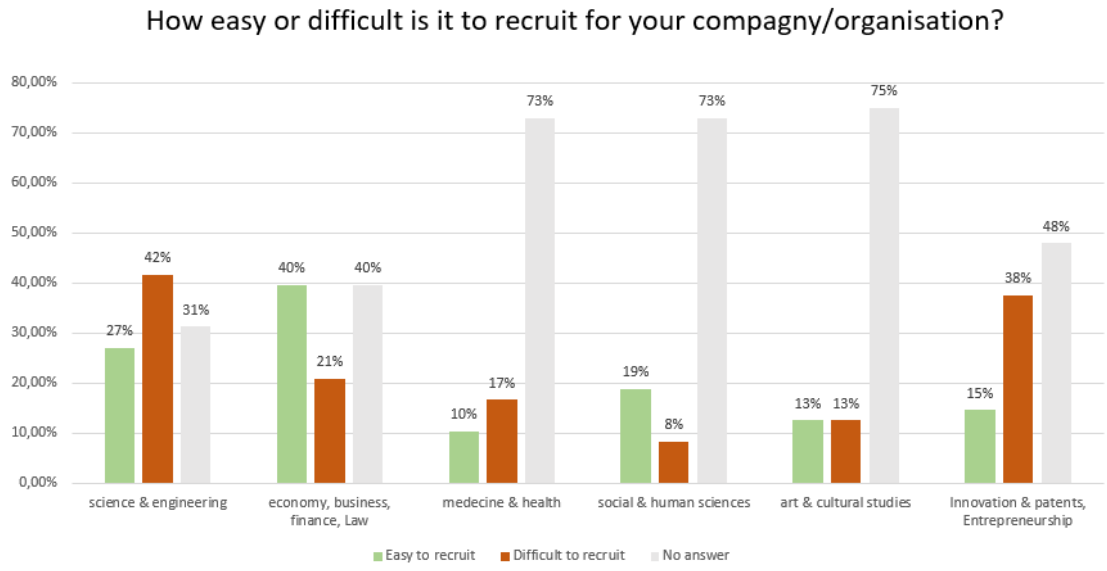
The results are more qualified for the other fields: 21% find it difficult recruiting in the domain **Economy, Business, Finance, Law** (Figure 19: Question 12-B.) 7 companies out of the 18 who answered this question consider it difficult to recruit in this field. 1 organisation from the public sector and 2 Research centres or academic institutions also consider it is difficult to hire in this field. Respondents who consider it difficult to recruit in this field occupy mainly Human resources, Research and development and Steering and management functions. (Figure 19: Question 12-B by type/function.)

17% find it difficult recruiting in the domain **Medicine and Health** (Figure 19: Question 12-B.) When looking at the type of respondents, 2 agencies out of 4 have difficulties to recruit in this field, and 5 companies out of the 6 who answered this question also consider it is difficult to

recruit in this field. (Figure 19: Question 12-B by type.) It should also be noted that 73% of respondents gave no answer indicating that either this sector is yet to be developed or the lack of respondents chosen with interests in this sector. It would be useful to follow up this point in a future study.

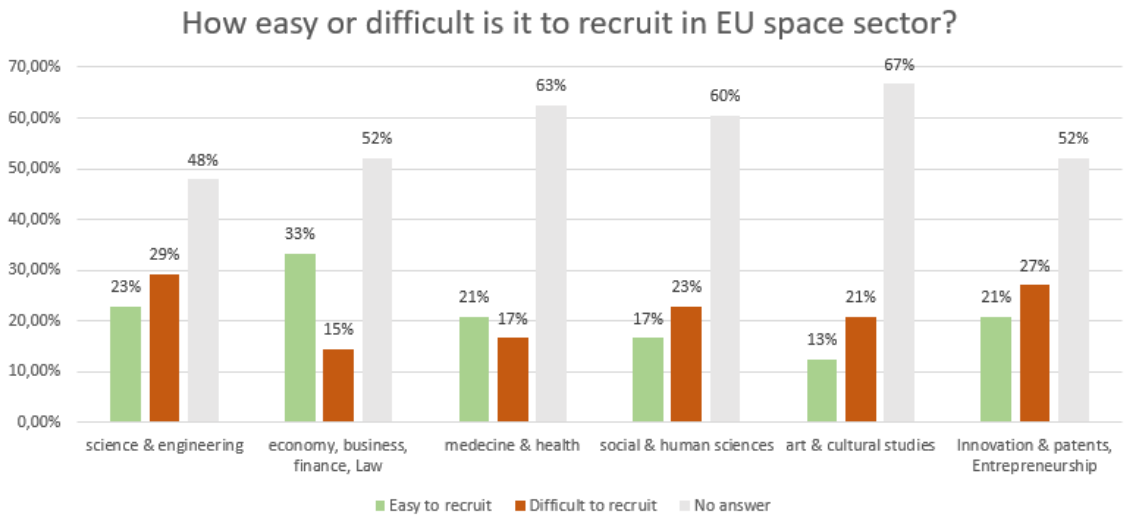
Medicine and Health, Social and Human Sciences, and Art and cultural studies did not receive as many answers as the other fields but these fields are less represented in the overall respondents' domains of activities. (Figure 19: Question 12-B). For Social and Human Sciences, and Art and cultural studies, respectively 73% and 75% of respondents gave no answer with similar conclusions as above.
The same question was asked more generally for the EU space sector and results are slightly different even if we have still an important percentage of "no answer". The fields where respondents consider it is more difficult to recruit at the EU space sector scale are Science and Engineering (29%), Innovation, patents, Entrepreneurship (27%), and Social and Human sciences (23%), followed by Art and Cultural studies (21%), Medicine and health (17%), and Economy, business finance and law (15%.)

Figure 19: Question 12-B "How easy or difficult is it to recruit graduates in the fields you consider generally important in 5-10 years for graduates to be hired in the space domain? FOR YOUR COMPANY/ORGANISATION"



Reading example for the table: in Science & engineering, 27% of the respondents think it is easy to recruit, 42 % think it is difficult to recruit and 31% do not answer.

Figure 20: Question 13-B - Question 12-B "How easy or difficult is it to recruit graduates in the fields you consider generally important in 5-10 years for graduates to be hired in the space domain? IN EU SPACE SECTOR"



c) The challenge for new positions and skills

In the context of the previous questions, respondents were then asked to provide some examples of new positions with associated competences (Figure 21: Questions 16, 17 and 18.) The proposed new positions have been summarised and classified in the table below. 18 respondents out of 48 gave one example of new positions, 11 gave 2, and 7 gave 3.

Figure 21: Questions 16, 17 and 18 - "Based on the mentioned mix of disciplines, do you see any totally new position(s) for graduates in the next 10 years in your organisation? (E.g.: space mining expert, space tourism manager, …)"

	New positions	Associated competences
New positions linked to Human Resources	Human Resources functions with missions linked to well being at work or positions such as happiness officer	Well being, intercultural exchanges, Human Resources management, social management of a company, social challenges
	Engineer with polyvalent functions : technical background and Human Resources competences / dual profile : Engineer-Manager	Technical competences and team management, clients relations
New positions linked to business /marketing	Communication/marketing combined with technical comprehension	Support the company in a growing phase in terms of development and visibility
	Marketing digital & communication	Growing start up strategy, visibility and image management and strategy, link with public affairs, institutional relations.
	Head of innovation	Lead innovation policy
	Space Business Conceptor	Able to identify and set-up a (new) Space Business
	Space business manager	Space derived services business manager
More technical and specialized new functions	Engineer ergonomist	Check adaptation of the user interfaces
	Engineer	Meca-Thermal Activities
	Space Mining Expert	
	Commercial astronaut	Same as astronaut but working for private companies
	Cyber specialist	security systems and new challenges
	Hardware developer	Radio frequency
	Earth data mining expert	Analyse datasets from temperature…
	Head of Licensing and Supervision	Licensing and supervision
	Ethics in Space	
	Space activity operator	Plan and operate production activities in space

We were able to identify three major categories of positions. The first is linked to **Human Resources skills.** Respondents stressed once again the importance of having engineers with Human Resources skills especially competences associated with the position of manager and team management. Another type of function was raised during an interview: the employees' well-being. The example taken to illustrate this point was the necessity to accompany the growing phase of a company by making sure the employees are involved in strategic decisions, that they are not overloaded with work, that communication and transparency are ensured, and that roles are well understood. This kind of position involves also a larger scope of

missions linked not only to well-being, but also to happiness. The example of the position “happiness officer” was mentioned.

The second category of new functions is linked to **business and marketing**. Concern was also expressed regarding the growing phase of a company suggesting that respondents considered that these new positions are more likely to be created in a business development phase. The importance of image and of visibility were emphasised. Managing skills linked to communication together with technical skills were also stressed several times during the interviews. Indeed, concern was raised regarding the image of space activities and how to refute space bashing. Innovation is also a key topic for the creation of new positions.

Thirdly a category of new positions were proposed which are **more technical and specialized**. Among the propositions one can note the following which are more likely to be developed in the future according to the suggested evolutions of the space sectors as presented in the previous part of this report “Today and tomorrow’s space activities and sectors”: positions linked to mining, to ergonomics, to cybersecurity, to ethics and space, or to the increased role of astronauts. The other positions suggested already exist in one form or another in the space sector (example: hardware developer.)

d) Interdisciplinarity and soft skills

With respect to competencies that are not directly linked to a specific academic field, respondents were asked to stress the importance of different skills that graduates should have in addition to solid knowledge in their related field of study. (Figure 22 Question 19) The same question was asked for the projection over 10 years.

Figure 22: Question 19 "What are competencies that graduates you hire for your company should have in addition to solid knowledge in their related field of study? How important for the company now?"

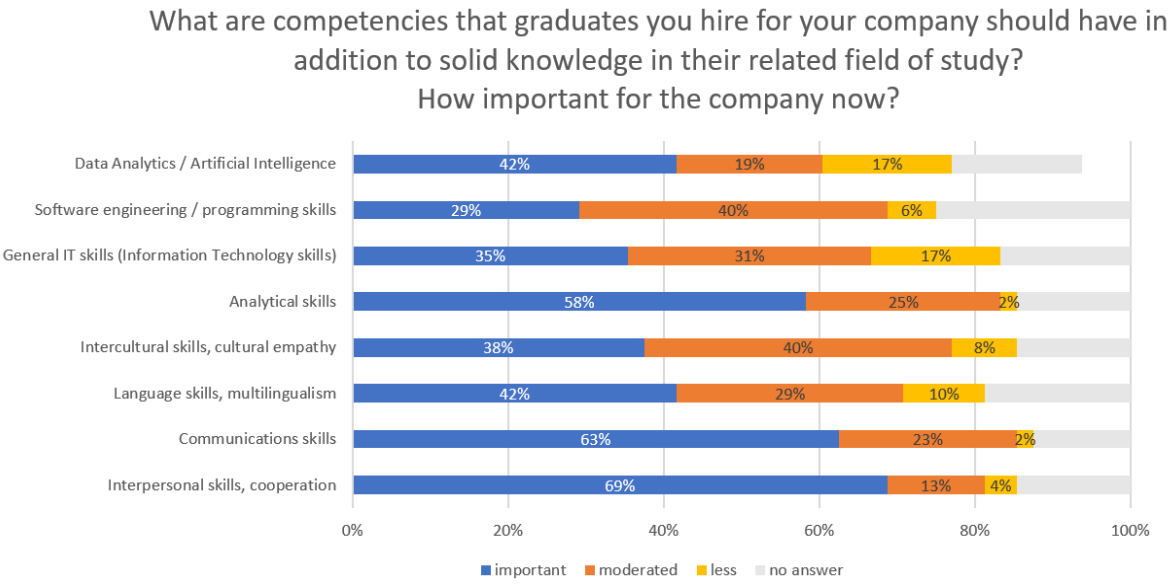
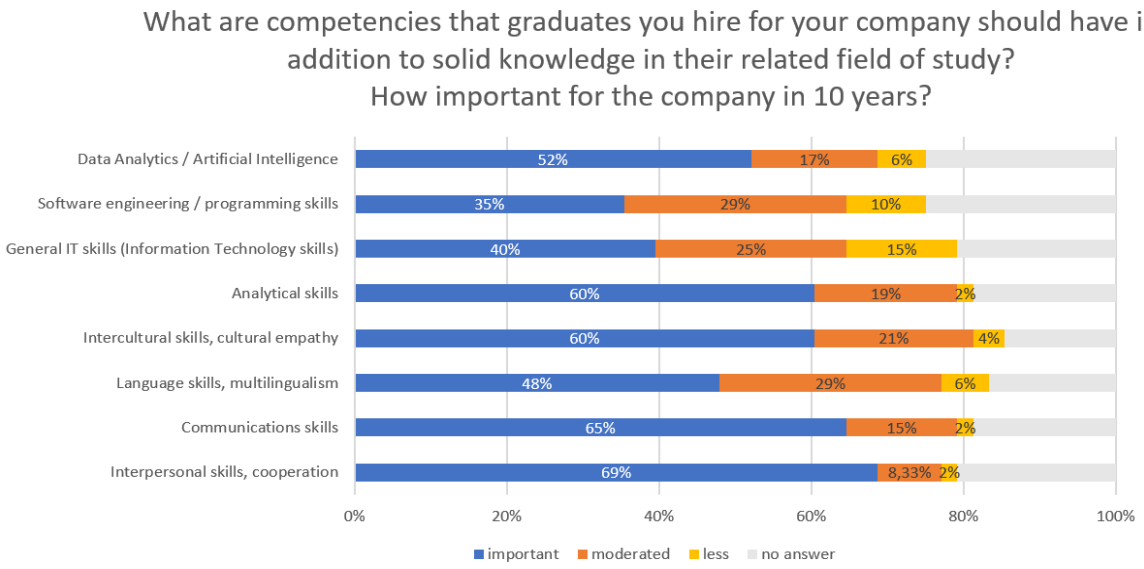


Figure 23: Question 19 "What are competencies that graduates you hire for your company should have in addition to solid knowledge in their related field of study? How important will it be for the company in 10 years?"



The top 3 most important competencies presently for the respondents are Interpersonal skills and cooperation (69%), Communication skills (63%) and analytical skills (58%). The results are quite similar for the projection over 10 years with Interpersonal skills and cooperation (69%), Communication skills (65%) and analytical skills (60%) plus Intercultural skills and cultural empathy (importance growing from 38% now to 60% in 10 years.) One can note that the skills considered as most important can also be associated with competencies often developed in the frame of Social and Human sciences training. The skills associated with more classical scientific profiles (Information Technology skills, data analytics, programming) did not reach particularly high levels of interest for this question. One can assume graduates already have these competencies with their field of study.

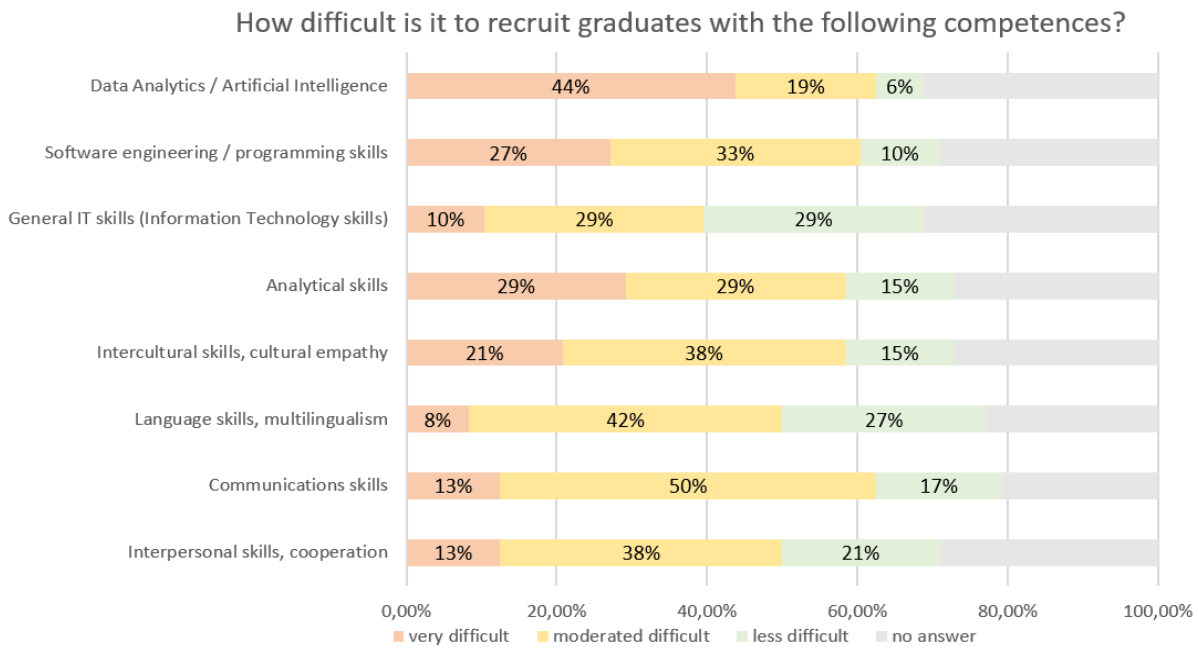
In addition to this question, respondents had the possibility to suggest other types of skills. The propositions are summarised in the table below. (**Figure 24: Question 20**)

Figure 24: Question 20 - "Other competences than the one already proposed in the question 19"

Categories	Details
Adaptation	Adaptation skills, autonomy, flexibility, humble, learning adaptability, openness to new ideas and contexts, curiosity.
Communication	Social media management, communication linked to digital, management of international teams, marketing, increased visibility in a growing phase, communication and policy depeding on the policies' development.
Methodology	Methodological approach, problem solving skills.
Analysis skills	Analysis skills, understanding of economical models.
Hard skills	AI (Artifitial Intelligence), data analytics, software engineering, digital twins, high speed communication, IT (Information Technology) skills.

The suggestions have been classified by different types, with firstly, several suggestions regarding **adaptability** and **communication**. Adaptability was also something emphasised during interviews. The following skills were highlighted: **change management skills**, and learning adaptability in a more complex technological and commercial work environment. In the communication category, there are several items referring to the new ways of communication in a remote way, day to day work exchanges, or how research and development is conducted. Skills regarding **methodology** and **analytical competences** have been very often stressed. Interviewed companies mentioned twice that the main role of engineers was to solve problems and to have a **specific mindset and approach**. Other types of skills which belong more to the hard skills category were suggested by the respondents, referring for example to software engineering, and **digital twin technology**. Artificial Intelligence skills, Information and Technology skills, and data analytics were already part of the proposed competences.

Figure 25: Question 21 - "How difficult is it to recruit graduates with the following competences?"



Regarding the same set of competencies as initially proposed, respondents could highlight the difficulties that they encountered to recruit graduates with such skills. Data analytics and Artificial Intelligence did not gather lots of answers and interest with the previous question although respondents consider difficult to find graduates with these skills (44% very difficult, and 19% moderately difficult) The same observation applies for Software engineering and programming skills (27% very difficult, and 33% moderately difficult) Another type of skills important for respondents is Analytical skills (29% very difficult, and 29% moderately difficult to find graduates with these skills)

When respondents were free to suggest different types of competencies for the identified academic fields, one can note that analytical skills were proposed for each academic field. This is also linked to a specific work methodology with project management skills and problem-solving approach. This category is particularly developed for the field of Science and Engineering.

Figure 26: Question 22 - "For the following domains, could you suggest up to 3 key competences that graduates should have? (from the previous list or additional ones)"

For the following domains, could you suggest up to 3 key competences that graduates should have?

Sciences and Engineering	Adaptation/flexibility	Communication	Methodology	Hard skills
	Interdisciplinary mindset	Team spirit and cooperation technical background with interpersonal skills, communication skills, language skills / multilingualism	Analysis of situations and adequate conclusions and actions, link reality and theory, analytical skills, practical cases, problem solving approach, independence in thinking, economical view of tasks, project management	Artificial Intelligence, image treatment, optical, software, continental hydrology, programming, cyber security, telecom, propulsion, business knowledge, basic physics, analog electronics, arts

Economy, Business, Finance, Law	Adaptation/flexibility	Communication	Methodology	Hard skills
	Curiosity, learning attitude	Interpersonal skills, communication, intercultural skills, language skills, cooperation	Analytical skills	Sales, finance engineering and client relations, knowledge of commercial tools and mechanisms, company management, BtoC (business to consumer), IT (information technology) skills, marketing, space law specialist, industrial supply chain, analytics, science & engineering, arts

Social and Human Sciences	Adaptation/flexibility	Communication	Methodology	Hard skills
	Change management and growing strategy	Interpersonal skills, communication, intercultural skills, language skills, cooperation	Analytical skills	Management of Human Ressources aspects, Artificial Intelligence, IT (Information Technology), programming, space sociology, demography studies and space applications, languages skills in english and chinese, data analytics, engineering, arts

Medecine and Health	Communication	Methodology	Hard skills
	Communication, empathy, interpersonal skills	Analytical skills	Well being management for Human Ressources functions, signal treatment, biology modelisation with space application, IT (information technology) skills, programming, engineering, arts

Art and cultural studies	Communication	Methodology	Hard skills
	Interpersonal skills, communication, intercultural skills (example given: Israel and Japan), language skills, cooperation	Analytical skills	Engineering, programming, art and engineering linked together (example given: Anilore Banon project with the Moon and engineering aspects)

Innovation, Patents, Entrepreneurship	Communication	Methodology	Hard skills
	Interpersonal skills, communication, intercultural skills, language skills, cooperation	Analytical skills	Patents, secret management, European expertise on patents and entrepreneurship (relations with specialized cabinets), programming, analytics, IT (information technology) skills, ethics, arts and engineering

Interpersonal and intercultural skills have also been proposed for all six academic fields. Other new items proposed can be gathered in the category adaptation/flexibility: interdisciplinary mindset, curiosity, learning attitude, change management and growing strategy. These skill suggestions echo the underlying purpose of the UNIVERSEH project and can be encouraged with the new interdisciplinary courses. Further proposals refer to hard skills and one can note again the interest for business skills with a science and engineering background. Engineering also appears in Social and Human sciences, and in Medicine & Health. In the Medicine & Health domain, one can note the interest for biological modelling with space applications and for signal treatment.

UNIVERSEH – European Space University for Earth and Humanity is an alliance of

Arts have also been proposed for the following fields: Science and engineering, Economy, business, finance and law, Social and human sciences and Medicine & Health. For this open question, suggestions concerning “arts” have been formulated several times. An example of an artistic project mixing science, arts and space industry was given: the Vitae project launched by Anilore Banon. This project is a living sculpture realised for a lunar environment. Thousands of handprints will be collected and put on a structure which will be deposited on the Moon by Vitae, as first men put their hands on caves walls. Industry is associated with the project, in particular Dassault Systems and Thumbsat.

Regarding the field Social and Human Sciences, precise examples have been formulated in particular with respect to sociology: space sociology and demography studies and space applications. Human resources management and topics have been also mentioned in the answers received and by two respondents during the interviews.

In summary, respondents insist on having graduates with **commercial awareness, flexible to respond to innovation, with particular skill combinations across the ‘hard’/’soft’ skills divide, and an emphasis on analytical skills, project management skills and communication skills.**

C. Summary of key findings and way forward:

a) Perspectives from 3.1 and 3.2 task deliverables

Considering the required interdisciplinarity in Space education, one striking observation is the interest for the link between Science & engineering and Economy & Business & Finance and Innovation & patents & entrepreneurship. This interest appears in different ways: students with a scientific background developing skills in economy, and the contrary, students with a business background developing an engineering understanding and more technical skills. The interest for Social and Human sciences or Art and cultural studies is more qualified but soft skills that are of most importance are generally associated with these academic fields: analytical skills, interpersonal skills and communication skills. Concerning Medicine and Health, even if a lot of respondents did not answer this question for this field, some of them stressed that they have difficulties recruiting in this domain: 2 agencies out of 4 and 5 companies out of 6 who answered this question also consider it is difficult to recruit in this field. (Figure 19: Question 12-B by type.) A comment stressed a specific interest in biological modelling with space applications and signal treatment. Globally, when comparing the answers received with the findings of the mapping of competences[9] one can note that even if Science & Engineering is naturally of interest, respondents also consider other fields as important for the space sector. The interdisciplinarity of space education is a topic that brought attention and interest: when asked if they think it is useful to recruit graduates who have interdisciplinary competences? (Question 11) 67% of respondents replied positively. Economy & Business & Finance and Innovation & patents & entrepreneurship are fields which are not the most represented in the mapping of competences (mapping realized for task 3.1[10]) whereas there is a clear interest from respondents. Medicine and Health and Social and Human Sciences are also less represented and could be developed.

b) “Introductory”, “opening” and “conversion” courses

Another key observation is the interest for hybrid skill sets and combination of fields according to the major/minor results (question 14 and 15). This raises the question of the type of courses that could be created. Introductory courses or opening courses could hence be appropriate for students to develop their skills in another field complementary to their initial background. This would lead to professionals with mutual understanding of dual issues: for example, a commercial professional understanding engineering problems and challenges, and an engineer benefiting from commercial skills to improve client relations and challenges. This format of introductory/opening courses has another advantage of including students who are

[9] Annex 4: Matrix 3.1
[10] Annex 4: Matrix 3.1

not necessarily in the space sector according to their initial background. Indeed, proposing "conversion courses" will allow students with relevant skills and qualifications from other fields to add a "space" dimension to their background. Regarding semesters and programmes to be built in the frame of UNIVERSEH, they could have an *à la carte* basis: this flexibility will allow students to choose appropriate courses and build unique and tailored training to address new challenges in the space domain.

c) Importance of project-based learning

Considering the results linked to soft skills, some comments and also the discussions during the UNIVERSEH event[11] and ESA workshop, stressed the difficulty to find professionals with the right "mindset". This observation is also linked with the importance highlighted for adaptability and flexibility skills. During the ESA workshop, a difficulty was raised regarding the low proficiency in problem-solving skills. These types of competence can be developed through interdisciplinary trainings to make students from different backgrounds work together and try new approaches when facing problems. Moreover, confronting students with real life problems is a key to build new courses which integrate student projects as if they were working in a real company. Including student projects with topics and practical cases inspired by real work life problems that can be tackled with an interdisciplinary approach would be a key asset for new UNIVERSEH courses.

[11] Annex 5: UNIVERSEH: The Conference on Space and the Universities of the Future in Europe

III. General conclusions

Key observations regarding the survey sample and the space sector

The sample achieved in the quantitative and qualitative survey, though modest in size, allows one to have an overview of the expectations of industry and of other professionals in the space sector in terms of skills. In general terms, the sample was revealed as a dynamic one, engaged in the questions asked, and very often willing to comment and share observations:

- Recruitment is a key concern for respondents, who were not all from Human Resources functions, at managerial, professional and technical levels.
- Industrial companies of all sizes who participated in the survey are heavily involved in training and staff development (many respondents agreed to be re-contacted afterwards or proposed contributing to a university/industry cooperation.)
- Respondents are generally supportive of a new interdisciplinary approach to train future professionals of the space sector.

Key observations linked to interdisciplinarity and skills; lessons learnt

The survey showed willingness of respondents to hire people with both sector specific and non-sector specific skills, hence an interest stressed for profiles requiring a combination of skill sets. This is particularly true for SMEs which often need to employ people who can work across a range of different positions.

The combination of skills that were mostly highlighted are engineering and management skills, engineering and business skills, engineering and innovation or entrepreneurship skills. Other fields such as Medicine & health, Social & human sciences and Art & cultural were less represented in the sample but one can draw some observations. Not all respondents answer questions regarding these particular fields but difficulty to hire people with a space medicine background or basic knowledge was raised, with a precise example given: biological modelling with space application. Art & Cultural studies was also a field where only a few respondents engaged, but giving another precise example of art mixing science. Last but not least, Social & human sciences were also stressed in a more indirect manner. The survey not only showed that there is a demand for technical skills but also identified the sector's needs for soft skills. It showed demand for collaborative working, analytical skills, adaptation skills and interpersonal skills.

To sum up the workforce needed to tackle the future evolutions of the space sector and the future needs of the sectors in terms of skills, ideally has:

- a combination of technical skills (hard skills including a growing demand in Artificial Intelligence, machine learning, robotics…) or a basic knowledge of technical issues;
- sales and marketing skills, or at least a commercial awareness to be able to speak coherently with clients about products;
- an agile and flexible attitude to respond to innovation in technologies and complex environments and to be able to apply a problem-solving mindset;
- an ability to work in interdisciplinary teams with not necessarily space sector-specific skills: there is also a demand for transferable skills from other fields, such as communication, project management, managerial skills and soft skills.

Given the complexity and breadth of demand, new UNIVERSEH courses could include:

- **Introduction, opening and conversion courses:** to provide students with the learning and training opportunity to mobilize their basic knowledge from initial training, transfer their skills and directly apply them to roles within the space sector.
- **Project-based learning courses:** to develop technical and non-technical skills by putting together students from different backgrounds and to develop problem-solving skills by applying methods from different academic fields. This problem-based learning method will already be part of most of the courses which are currently under development in the framework of UNIVERSEH. The need for more problem-based-learning courses put in evidence by the survey confirms our choices.
- **Flexible programs**: to allow students to give a space dimension to their training and to encourage the transfer of skills from an academic field to others; through semesters specifically related to different fields mixed together (engineering and business, or engineering and medicine for example), or through programs built with a common basis and an "*à la carte*" dimension thanks to a common database of shared elective courses.

Future perspectives to follow up this work

This survey and its analysis have been achieved in a very short period of time with limited resources and could be followed up in the future based on the lessons learnt:

- The sample is limited in size even if lots of types of organisations are represented and prominent actors answered the survey (space agencies and big industrial groups) The sample does not represent equally all countries involved in the UNIVERSEH project.
- The sample does not cover all the domains and the survey could be specifically shared with organisations from identified sectors not represented: medicine, art & cultural studies or social & human sciences.

- The survey results show more a picture for the short-term future. More answers were received to the questions regarding the situation now than for the projections, especially for very long-term projections (10 years+).
- There is an interest for language skills in the survey and some questions could be more detailed to define what are the needs in which specific language. This could involve a deeper collaboration with Work Package 2.

For a future study complementary questions could now be designed drawing on our present results, and including a more qualitative method with focus groups is also a possible way forward to build on this first analysis.

The UNIVERSEH team will remain engaged to develop innovative courses in line with these survey findings, to answer future European challenges in the space sector and to stress that innovation usually occurs at the boundary of different disciplines.

Acronyms

AGH: University of Science and Technology of Kraków (Akademia Górniczo-Hutnicza), Poland

AI: Artificial Intelligence

ECTS: European Credit Transfer and accumulation System

ESG: Environmental, Social and Governance

FSI: Engineering Sciences Faculté (inside Université Paul Sabatier), France

INP: Institut National Polytechnique de Toulouse, France

ISAE-Supaero: Institut Supérieur de l'Aéronautique et de l'Espace, France

ISRU: In-Situ Resource Utilization

IT: Information Technology

LEO: Low Earth Orbit

LTU: Luleå University of Technology, Sweden

SAR: Search and Rescue

SME: Small and Medium-sized Enterprise

TBS: TBS Education - Toulouse Business School

UDUS: Heinrich Heine University Düsseldorf (HHU), Germany

UniLu: University of Luxembourg, Luxembourg

UT2: Université de Toulouse 2 Jean Jaurès, France

UT3 / UPS: Université de Toulouse 3 Paul Sabatier, France

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1. QUESTIONNAIRE - LIME SURVEY

The survey was sent on July 16th, 202, the first reminder end of August and the last reminder mid-September. We extracted the sample on October 10th, 2021.

About UNIVERSEH - UNIVERSEH Website

The European Space University for Earth and Humanity is an alliance of the University fédérale de Toulouse (France), the University of Luxembourg (Luxembourg), Heinrich-Heine-Universität Düsseldorf (Germany), Luleå tekniska universitet (Sweden) and Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie (Poland). The alliance focuses on the development of educational activities and innovative collaborations in the European space sector. Reflecting European values, UNIVERSEH's objectives are to facilitate mobility and multilingualism, promote student inclusion and diversity, support interdisciplinary programmes, and strengthen pedagogical innovation and entrepreneurship in Europe. UNIVERSEH encourages the thematic mobility of students and teachers, promotes cooperation between higher education institutions and facilitates interaction on issues common to the European education systems. The alliance draws on its expertise, experience and relations with industry and public institutions in the space sector. UNIVERSEH was created in 2020 as part of the Erasmus+ "European Universities" initiative of the European Commission. Together, partners have the potential to reach more than 140,000 students, researchers and staff.

To propose the most relevant courses and present European needs in the space domain, the alliance needs to identify the main competences needed by graduates you employ today and how you consider this may evolve in the years to come.

In particular, we are interested in interdisciplinary competence areas that you see as most useful in the future. We want to concentrate on the disciplinary areas outside of science and engineering, for example in economy-business-finance, medicine and health, social and human sciences, art and cultural studies, innovation patents and entrepreneurship.

The UNIVERSEH partners are committed to design an innovative employment-oriented and interdisciplinary curriculum - which will only be possible with your support and your expertise!
We kindly ask you to fill in the following form before October 8th.

Looking forward to reading your feedback,
Thank you in advance for your collaboration.

The following survey takes around 20 minutes to respond to. You are not obliged to answer all questions.

We would happy to share with you the overall analysis of the study. This analysis will not be linked to individual companies and care will be taken not to divulge individual data.

GDPR Consent

GDPR CONSENT:

The information you provide will be used for research purposes only, according to the objectives of the project described in the introduction.

Please note that all data collected and your answers regarding your organisation will be reported in aggregate form (data may be linked to general information regarding your organisation: organism and function types, size but not specifically the name of company...)

Note that if you choose 'no' you will not be able to complete the survey. Would you be so kind as to contact us if you have specific queries or concerns regarding use of the data.

If respondent wishes to confirm validity of survey or get more information about aims and objectives, they can contact: toulouse@universeh.eu

* 1 I have read and agree the terms and conditions in the GDPR consent notice :

Choose one of the following answers

- Yes
- No

Previous

Next

Space Application Segments

In UNIVERSEH, we have identified different major application segments for space-based activities.

2 **Which of the space application segments are most important for your current activities? Please tick only one box in each column or 'no answer'.**

	Most important	Very important	Important	Least important	No answer
Our Earth: Earth Science, climate change, teledetection and earth observation, natural resources, geo data, mobility, telecommunication, navigation, precision agriculture	○	○	○	○	●
Access to Space and Around Earth: Sustainable Space e.g. space debris, on orbit servicing, science & technology, space environment, launchers and rockets, reusable launch vehicles, earth observation & telecom satellites, green propulsion, law	○	○	○	○	●
Space Settlement and Resources: e.g. architecture & construction, agriculture (breeding), sociology of sciences, sociological studies on human behaviour and interactions, space environmental psychology, medicine, health, telemedicine, psychology, space tourism, in-situ resources utilization/ISRU resources, space navigation (space ports, operations)	○	○	○	○	●
Space Exploration and Discovery: e.g. space mission planning, space energy system architecture, our origins (cosmology, star formation, exobiology, philosophy), space probes, AI & robotics	○	○	○	○	●

Segments need to be classed by order of importance.

3 Could you provide some examples to illustrate your previous answers for one of the space segments or for all of them?

4 **Regarding the following Space Application Segments, how do you see future developments in your company / organization? Free choice, no restriction on multiple entries in the same column.**

	Very likely to be developed in the near future	Likely to be developed in the long term	Considered interesting but not open to development for the moment	Irrelevant	No answer
Our Earth: Earth Science, climate change, teledetection and earth observation, natural resources, geo data, mobility, telecommunication, navigation, precision agriculture	○	○	○	○	●
Access to Space and Around Earth: Sustainable Space e.g. space debris, on orbit servicing, science & technology, space environment, launchers and rockets, reusable launch vehicles, earth observation & telecom satellites, green propulsion, law	○	○	○	○	●
Space Settlement and Resources: e.g. architecture & construction, agriculture (breeding), sociology of sciences, sociological studies on human behaviour and interactions, space environmental psychology, medicine, health, telemedicine, psychology, space tourism, ISRU resources, space navigation (space ports, operations)	○	○	○	○	●
Space Exploration and Discovery: e.g. space mission planning, space energy system architecture, our origins (cosmology, star formation, exobiology, philosophy), space probes, AI & robotics	○	○	○	○	●

Please specify how important the following segments will be in the future according to the rating scale in order to classify the segments by order of importance.

5 Could you provide some examples to illustrate your previous answers for one of the space segments or for all of them?

6 **If you wish to make any comment or remark regarding your answers to the questions in this section, please do so in the space provided below:**

Employment needs for graduates

UNIVERSEH will offer innovative and multi-disciplinary courses to train students for the jobs of today and tomorrow. We rely on your expertise to understand the employment needs for graduates and implement the most relevant Teaching & Learning environment covering European needs in the area of Space.

7 **For your organization, what are the key positions / functions to which graduates will be recruited in the next few years and in the future (next 5-10 years)?**

In alphabetical order:

	Plan to recruit in the next few years	Plan to recruit in 5-10 years	Both	No answer
Engineering	○	○	○	●
Finance and Accounting	○	○	○	●
Human Resources	○	○	○	●
Logistics	○	○	○	●
Marketing	○	○	○	●
Project Management	○	○	○	●
Quality	○	○	○	●
Research and Development	○	○	○	●
Sales	○	○	○	●
Other: (please specify)	○	○	○	●

8 Other, please specify:

9 **If applicable, the future demand for graduates will arise due to...:**

- ○ The need to replace existing workforce
- ○ The need to cover new jobs
- ○ Both
- ○ Other:
- ● No answer

10 **If you wish to make any comment or remark regarding your answers to the questions in this section, please do so in the space provided below.**

Required Interdisciplinarity of Space Education 1/2

In UNIVERSEH, one major focus is on the development of new curricula in space education with a higher level of interdisciplinarity. We consider that graduates could have knowledge from the following disciplines:

1. Science & Engineering
2. Economy, Business, Finance, Law
3. Medicine & Health
4. Social & Human Sciences
5. Art & Cultural Studies
6. Innovation & Patents, Entrepreneurship

11 **Do you think it is useful to recruit graduates who have interdisciplinary competences ?** e.g. Space Engineering + another subject

- ○ No, we only need specialists
- ○ It's better to recruit two different people with complementary skills
- ○ Yes, this is a good idea (please provide examples in the text box)
- ● No answer

Please enter your comment here:

12 **For your Company/Organization:** which of the disciplines do you consider generally important in 5 - 10 years for graduates to be hired in the space domain?
(5 means definitely very important and 1 means not important at all)

	5	4	3	2	1		Easy to recruit	Difficult to recruit		No answer
Science & Engineering	○	○	○	○	○		○	○		●
Economy, Business, Finance, Law	○	○	○	○	○		○	○		●
Medicine & Health	○	○	○	○	○		○	○		●
Social & Human Sciences	○	○	○	○	○		○	○		●
Art & Cultural Studies	○	○	○	○	○		○	○		●
Innovation & Patents, Entrepreneurship	○	○	○	○	○		○	○		●

13 **For EU Space Sector:** which of the disciplines do you consider generally important in 5 - 10 years for graduates to be hired in the space domain?

(5 means definitely very important and 1 means not important at all)

	5	4	3	2	1		Easy to recruit	Difficult to recruit		No answer
Science & Engineering	○	○	○	○	○		○	○		●
Economy, Business, Finance, Law	○	○	○	○	○		○	○		●
Medicine & Health	○	○	○	○	○		○	○		●
Social & Human Sciences	○	○	○	○	○		○	○		●
Art & Cultural Studies	○	○	○	○	○		○	○		●
Innovation & Patents, Entrepreneurship	○	○	○	○	○		○	○		●

14 **What mix of disciplines would you consider useful for graduates to be hired now in the space domain?** ***Please tick what you find important.***

	MAJOR Science & Engineering	MAJOR Economy, Business, Finance, Law	MAJOR Medicine & Health	MAJOR Social & Human Sciences	MAJOR Art & Cultural Studies	MAJOR Innovation & Patents, Entrepreneurship
Minor Science & Engineering	☐	☐	☐	☐	☐	☐
Minor Economy, Business, Finance, Law	☐	☐	☐	☐	☐	☐
Minor Medicine & Health	☐	☐	☐	☐	☐	☐
Minor Social & Human Sciences	☐	☐	☐	☐	☐	☐
Minor Art & Cultural Studies	☐	☐	☐	☐	☐	☐
Minor Innovation & Patents, Entrepreneurship	☐	☐	☐	☐	☐	☐

Please link columns and rows as appropriate to indicate dual competences that you consider the most useful.

15 **What mix of disciplines would you consider useful for graduates to be hired in the next 5-10 years in the space domain?** ***Please tick what you find important.***

	MAJOR Science & Engineering	MAJOR Economy, Business, Finance, Law	MAJOR Medicine & Health	MAJOR Social & Human Sciences	MAJOR Art & Cultural Studies	MAJOR Innovation & Patents, Entrepreneurship
Minor Science & Engineering	☐	☐	☐	☐	☐	☐
Minor Economy, Business, Finance, Law	☐	☐	☐	☐	☐	☐
Minor Medicine & Health	☐	☐	☐	☐	☐	☐
Minor Social & Human Sciences	☐	☐	☐	☐	☐	☐
Minor Art & Cultural Studies	☐	☐	☐	☐	☐	☐
Minor Innovation & Patents, Entrepreneurship	☐	☐	☐	☐	☐	☐

Please link columns and rows as appropriate to indicate dual competences that you consider the most useful.

16 **Based on the mentioned mix of disciplines, do you see any totally new position(s) for graduates in the next 10 years in your organization?** (E.g.: space mining expert, space tourism manager, ...)

	Name Position	Tasks
New Position 1		

Required Interdisciplinarity of Space Education 2/2

19 **What are competencies that graduates you hire for your company should have in addition to solid knowledge in their related field of study?** (non-exhaustive list)

	How important for the company now?					How important for the company in 10 years?					
	Very important	Moderately important	Less important	No answer		Very important	Moderately important	Less important	No answer		No answer
Interpersonal skills, cooperation	○	○	○	○		○	○	○	○		●
Communications skills	○	○	○	○		○	○	○	○		●
Language skills, multilingualism	○	○	○	○		○	○	○	○		●
Intercultural skills, cultural empathy	○	○	○	○		○	○	○	○		●
Analytical skills	○	○	○	○		○	○	○	○		●
General IT skills (Information Technology skills)	○	○	○	○		○	○	○	○		●
Software engineering / programming skills	○	○	○	○		○	○	○	○		●
Data Analytics / Artificial Intelligence	○	○	○	○		○	○	○	○		●

20 Others (please specify the competence and time frame):

21 How difficult is it to recruit graduates with the following competences?

	Very difficult	Moderately difficult	Less difficult	No answer
Interpersonal skills, cooperation	○	○	○	●
Communications skills	○	○	○	●
Language skills, multilingualism	○	○	○	●
Intercultural skills, cultural empathy	○	○	○	●
Analytical skills	○	○	○	●
General IT skills (Information Technology skills)	○	○	○	●
Software engineering / programming skills	○	○	○	●
Data Analytics / Artificial Intelligence	○	○	○	●

22 **For the following domains, could you suggest up to 3 key competences that graduates should have? (from the previous list or additional ones)**

Science & Engineering:

Economy, Business, Finance, Law:

Medicine & Health:

Social & Human Sciences:

Art & Cultural Studies:

Innovation & Patents, Entrepreneurship:

Please only fill those domains you consider relevant for your organization.

Your organisation

General questions regarding your organisation:

23 **What type of organization are you representing?**

In alphabetical order:

- Agency
- Company
- Incubator
- Public sector / government body
- Research centre / academic institution
- Other:
- No answer

24 **Your functions and department belong to...**

In alphabetical order:

- ○ Engineering
- ○ Finance
- ○ Human Resources
- ○ Research and Development
- ○ Sales, marketing & Communication
- ○ Steering and Management
- ○ Other:
- ◉ No answer

25 **Where are your activities mostly located?**

Check all that apply

- ☐ Activities nationally deployed
- ☐ Activities internationally deployed: EU
- ☐ Activities internationally deployed: out of EU

26 **How many employees work for your organization?**

- ○ 1-9
- ○ 10-49
- ○ 50-249
- ○ 250-999
- ○ 1000+
- ● No answer

27 **How many years is your organization active in the space domain?**

- ○ Less than 5 years
- ○ 6-10 years
- ○ 11-20 years
- ○ 21-30 years
- ○ More than 30 years
- ● No answer

28 **If you wish to make any comment or remark regarding the questionnaire, please do so in the space provided below:**

Contact

Thank you very much for your time and contribution! We will be happy to share with you the results of this study.

Finally, would it be possible for a member of the UNIVERSEH team to have a more open discussion with you about the spatial sector, your organisation, and the skills issues it faces?

This would help to get more qualitative depth on the issues than the structured questionnaire has allowed.

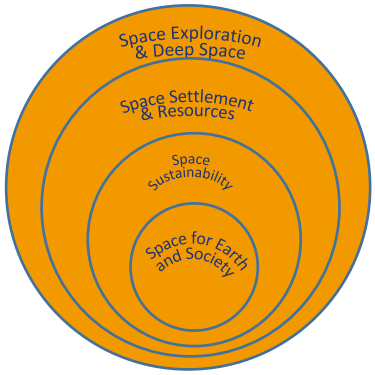
29 **Would you accept to be recontacted by the Universeh team for followup and/or a short interview?**

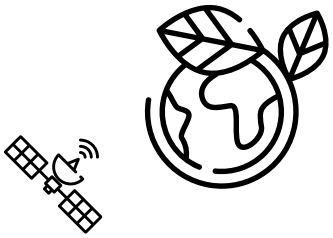
- ○ Yes
- ○ No
- ◉ No answer

2. List of organisations contacted

Name of the company	Country	Name of the company	Country
WaltR	France	Deimos Elecnor group	Europe
AGENIUM	France	Edisoft	Portugal
vorteX.io	France	GKN Aerospace	Europe
VISIOTERRA	France	GMV innovating solutions	Europe
Geo4i	France	OHB Sweden	Sweden
IDGEO	France	Omnidea	Europe
REFLET DU MONDE	France	Omnisys instruments	Sweden
HD Rain	France	Pasq	Sweden
NOVELTIS S.A.S.	France	RUAG Space AB	Europe
ABBIA GNSS TECHNOLOGIES	France	Satrevolution	Poland
MEOSS	France	Spire	Luxembourg
MURMURATION	France	Campus France	France
TerraNIS	France	CERFACS	France
I-SEA	France	Cité de l'espace	France
Globeo	France	Club Galaxie	France
NEXT4	France	GLAE	Luxembourg
PIXSTART	France	Center for near space	Italy
GISAIA	France	Chaire Jean monnet Grenoble	France
KINEIS	France	Fonds national de la recherche Luxembourg	Luxembourg
ACRI-ST	France	MEDES	France
MECANO ID	France	NEREUS	Europe
EREMS	France	ONERA	France
COMAT - AGORA	France	Tecnico Lisboa	Sweden/Germany
Exotrail	France	Women in aerospace Europa	Europe
HEMERIA	France	EISCAT Scientific association	Sweden
U-SPACE	France	IRT Saint Exupery	France
ANYWAVES	France	Swedish Institute of Space Physics Office	Sweden
Loft Orbital Technologies	France	3i3s-Europa	Europe
DELFOX	France	ESA	Europe
XERIUS	France	CNES	France
Expleo Group	France	DLR - German Aersopace Center	Germany
Astronaut Center	Poland	Luxembourg Space Agency	Luxembourg
Euroinbox	Europe	Polish Space Agency	Poland
Blue dot Solutions	Poland	Portugal Space	Portugal
Piap Space	Poland	ARP-industrial dvpt agency	Poland
Rhea Group	Belgium	Toulouse tech transfer	France
Luxspace	Luxembourg	Technoport	Luxembourg
Local network Astropreneurs	Europe	Luxembourg city incubator	Luxembourg
Airbus DS	France/Germany	IFRI	France
Thales Aliena Space	France	LMO space	Luxembourg
SSC Space	Sweden	Cimpa / Sopra Steria	France
SES	Luxembourg	Isar Aerospace Sweden AB	Sweden/Germany
Artic Space technologies	Sweden	Arctic Space Technologies	Sweden
CLS	France	Vodafon	Germany
Creotech	Poland	Wissensregion e.V.	Germany

3. Addressing the space sector, a 4-segment approach





Our Earth: Social, Societal & Environmental Challenges


Climate Change


Navigation & Mobility


Geo Data & AI


Agriculture


Social Geography


Earth Sciences


Geopolitics

Sustainable Space


Space Law


Access to Space


Military Issues


Space Debris

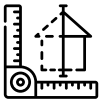

Satellite Constellations

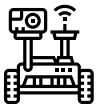

Earth Observation

Space Settlement & Resources


Telemedicine


ISRU


Architecture


Robotics @ AI

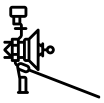

Water Mgmt


Confinement

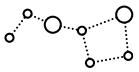
Space Exploration & Deep Space


Deep Space


Sci-Fi


Space Probes


Litterature


Cultural Studies

4. Matrix combining academic fields and major application segments for space-based activities considering ECTS credits

	Our Earth and space	Sustainable Space (e.g. earth orbit)	Space Settlement and resources	Space Exploration & discovery
Science & Engineering	1647,6	2053,4	1769,5	1367,5
Economy, Business, Finance	40,0	79,5	18,7	18,7
Medicine & Health	115,0	45,0	85,0	15,0
Social & Human Sciences	132,5	172,5	172,5	92,5
Art & Cultural Studies	160,0	160,0	280,0	60,0
Innovation & Patents, Entrepreneurship	159,5	189,5	143,7	76,2

ECTS Credits
>1000
Between 100 and 1000
<100

Methodology:

Based on the map of the partners' areas of competence (Annex 1), and considering ECTS credits for each programme and each course, this synthetic vision has been built combining the results for the academic fields and for the spatial segments. The ECTS credits have been proportionally divided by the number of crossed combinations of academic field and space segment for each programme. For example, if 60 ECTS are associated to a programme which combines 2 academic fields and 1 spatial segment, the 60 ECTS have been divided by 3 and distributed in the academic fields and spatial segment covered by the programme.

5. UNIVERSEH: The Conference on Space and the Universities of the Future in Europe

UNIVERSEH – European Space University for Earth and Humanity is an alliance of


UNIVERSEH
Keynote addresses
14:30 – 15:15
iMax Room
Master of ceremonies: Lisa Burke
Speakers:
Christophe Grudler — Member of the European Parliament
Géraldine Naja — Acting Director, Industry, Procurement and Legal Services, European Space Agency
Stéphane Pallage — Rector, University of Luxembourg
Birgitta Bergvall-Kåreborn — Vice-Chancellor, Luleå University of Technology
The universities of the future and their ecosystem
15:15 – 16:45
iMax Room
Future skills in Europe in the space sector
Panelists:
Charlotte Mathieu — Head of Industrial Policy and Economic Analysis Section, European Space
Catherine Delmotte — HRD Space Systems, Defence and Space, Airbus
Marek Moszyński — Vice President for Science, Polish Space Agency
Olivier Lesbre — General Director, ISAE-SUPAERO
Magali Vaissière — President, IRT Saint-Exupéry
Adam Walters — Université Toulouse III Paul Sabatier
How can stakeholders and UNIVERSEH benefit from each other?
Panelists:
Florence Dufrasnes — Head of Space Systems Technical Strategy, R&D/T, IP & Spectrum Management, Airbus
Mathias Vanden Bossche — Director, research, development and product policy, Thales Alenia Space
Tomasz Kozlowski — Head of Mandate and Product Development, European Investment Fund
Stéphane Pallage — Rector, University of Luxembourg
Gilles Rabin — Director of Innovation, Applications and Science, Centre National d'études spatiales
Georges Zissis — Vice-president for International Affairs, Université Toulouse III
Alessio Buscemi — UNIVERSEH Student representative, University of Luxembourg
Pascal Maussion — Vice-President for International Affairs, Toulouse INP

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