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The EuroSpaceHub Project: building the skills of the next generation of Space Entrepreneurs and Astronauts.

Serena Crotti[1,2,3] *, Prof Bernard Foing[1,2,3], Jara Pascual[2,4], Vilma Puriene [2,5]

[1] *ILEWG EuroMoonMars, Netherlands,* [2] *EuroSpaceHub, Europe,* [3] *Space Renaissance International, Italy,* [4] *Collabwith Group, The Netherlands,* [5] *Vilnius Gediminas Technical University, Lithuania.*

* Corresponding Author

Abstract

EuroSpaceHub is a European funded project under the EIT HEI initiative, led by EIT Manufacturing and Raw Materials, as part of the Strategic Innovation Agenda of the European Institute of Innovation. The project was founded by six partners: Vilnius Gediminas Technical University, the International Space University, Universidad Complutense de Madrid, Collabwith Group, the Lunex Foundation and Kyiv Polytechnic Institute. With a wide range of innovative educational initiatives, the mission of the project is training young people for entrepreneurship in Aerospace. Also, EuroSpaceHub facilitates the creation of new collaborations between academia, startups, companies and researchers, breaking down existing barriers.

The educational program of EuroSpaceHub includes courses, resources, masterclasses and classes that are accessible via a dedicated digital platform. Here, each subscriber can not only take advantage of the training sessions, but also form new partnerships and network with other users. The digital content offers practical tools — designed by EuroSpaceHub partners — to improve the skills that are essential to collaborate on innovative projects, to forge new collaborations in the Aerospace ecosystem, and to foster an entrepreneurial mindset in the young generation. The digital medium offers great potential to make knowledge sharing more inclusive and open to all. Users can subscribe from any part of the world and access content virtually. The courses cover the topics of Innovation, Space Technology, Collaboration, Emotional Intelligence and Entrepreneurship for the aerospace sector. Also, users can learn about existing opportunities on the market for collaborations, events, conferences or special calls in Aerospace.

Complementing the digital theoretical training, EuroSpaceHub is committed to training future Space Entrepreneurs with hands-on activities, in the field. As part of its efforts to train the leaders of tomorrow, EuroSpaceHub supports the participation of young students, researchers and PhD graduates in analogue missions, thanks to the expertise in the field of one of its founding partners, Lunex EuroMoonMars. Analog missions replicate the conditions of life in Space, exposing students to unusual and extreme settings. In such unique contexts, students develop strategic skills in two areas. Firstly, they learn technical notions related to equipment and instrumentation. They test new technologies and innovative concepts in Space-like settings, they design and conduct their own experiments. Secondly, they develop strategic soft skills. In isolation and in the extreme context of analogue missions, they develop interpersonal skills within the group, leadership capacity and resilience. These characteristics are essential for young professionals to succeed in the industry.

Keywords: EuroSpaceHub Project, Digital Learning Platform, Space Entrepreneurs, Interdisciplinary Collaboration, Students Training, Analog Missions.

Acronyms/Abbreviations

AATC: Analog Astronaut Training Center
EIT: European Institute of Innovation & Technology
EMM: EuroMoonMars
ESH: EuroSpaceHub
ESH-X: ExoSpaceHab Express
EVA: Extra-Vehicular Activity
HEI (Initiative): Innovation Capacity Building for Higher Education
HI-SEAS: Hawaii Space Exploration Analog and Simulation
ISU: International Space University
ILEWG: International Lunar Exploration Working Group
ICE: Isolated and Confined Environment
ISS: International Space Station
IMA: International MoonBase Alliance

IVA: Intra-Vehicular Activity
KPI: Kyiv Polytechnic Institute
MDRS: Mars Desert Research Station.
VILNIUS TECH: Vilnius Gediminas Technical University
UCM: University Complutense of Madrid

1. Introducing the EuroSpaceHub Project for Aerospace Entrepreneurship and Collaboration.

1.1 The EuroSpaceHub Consortium, Partner and Network.

EuroSpaceHub is a European funded project under the EIT HEI initiative, headed by EIT Manufacturing and Raw Materials, as an integral component of the Strategic Innovation Agenda outlined by the EIT. The Consortium responsible for initiating this project comprises six partners. The project features four partners from the Academic realm: ISU, UCM, VilniusTech, and KPI; and two partners from private companies: Lunex (EMM) and Collabwith. These principal partners are complemented by more associated partners from the Space ecosystem, encompassing an ESA business incubation centre, two venture capital networks, three higher education institutions, two photonics and aerospace research centers, one technology park, one Space foundation, and the Ministry of Economics in Lithuania. The project was initiated in July 2022 and spans a duration of two years, structured into two distinct phases. The first phase took place from July to December 2022, while the second phase encompasses the period from January 2023 to June 2024 [1].

In addition to the main partners, the Consortium has also formed two strategic alliances with specific objectives. To facilitate effective policy advocacy, a strategic partnership with Knowledge4Innovation (K4I Forum of the European Parliament) has been established. This collaboration aims to harness Knowledge4Innovation's expertise in orchestrating events within the European Parliament. Concurrently, another partnership forged by the Consortium is with Ekvita. Ekvita's specialized knowledge is providing support to researchers, entrepreneurs, and business leaders within the Consortium in gaining insights into the Azerbaijan market and Central Asian countries. Its goal is to enhance their ability to navigate and engage effectively within these geographical regions.

Lastly, the project leverages a network of ambassadors to comprehensively reach the European ecosystem, encompassing both academic and non-academic domains.

1.2 The EuroSpaceHub Project Goals

Marked by a diverse array of educational initiatives, the primary objective of ESH is to equip individuals with the skills requisite for Entrepreneurship within the Aerospace domain. Moreover, EuroSpaceHub aims to facilitate the establishment of new collaborations among academic institutions, startups, corporate entities, and researchers, thereby dismantling prevailing barriers.

Foremost among ESH Project Objectives is the creation of an innovative educational program. This program is crafted to be responsive to the specific demands of Space Entrepreneurship and Innovation. By aligning educational content with the dynamic requirements of the Space sector, the project seeks to instill a collaborative entrepreneurial ethos. This entails not only equipping individuals with technical knowledge, but also fostering a mindset that thrives on interdisciplinary collaboration and innovative thinking. The outcome is the training of young professionals capable of tackling the challenges in the complexities of Space Entrepreneurship and ready to lead new initiatives in this domain.

In parallel, the project aims to redefine the landscape of Technology Transfer within universities. A key goal is to establish an advanced Tech Transfer strategy. By fostering entrepreneurship liaisons within academic institutions, the project aims to bridge the gap between research outcomes and real-world applications. Moreover, the project aims to cultivate a network of dedicated ambassadors within Space-related organizations. This network — strategically positioned to facilitate cross-stakeholder collaboration — is envisaged to act as a catalyst for engagement, thus fostering productive interactions among Academia, Industry, and other stakeholders.

Integral to the ESH roadmap is also the establishment of synergistic connections facilitated through a dedicated EuroSpaceHub Digital Platform, developed by the partner Collabwith. This platform serves as an enabler, connecting academic institutions and industry players. Through this digital tool, the project aims to harness the power of connectivity, thereby amplifying its impact within the Space sector. Furthermore, the digital platform grants access to new actors within the Aerospace ecosystem who were previously excluded, thus rendering collaboration more open [2].

The project's commitment to professional engagement is underscored by its efforts to promote diverse events. These initiatives — which are tailored to cater to a diverse audience encompassing students and non-academic personnel — are thought as magnets for multidisciplinary Space professionals. By offering platforms for participation in innovation workshops, training and ecosystem networking events, the project seeks to cultivate a cross-disciplinary environment.

Among its objectives, ESH also aims to nurture new on-field skills in students. Analog missions serve as the program's flagship in this regard, embodying an unprecedented approach. The EuroSpaceHub project extends its support to such missions, contributing to the

training of young students in the acquisition of essential competencies. More specifically, the project leverages the expertise of the partner Lunex EuroMoonMars, which has been engaged for years in organizing such activities and field missions [3-5].

1.3 Nurturing Entrepreneurship and Fostering Essential Competencies in the Aerospace Sector.

In the realm of Space Entrepreneurship, it is crucial to acknowledge the diverse range of backgrounds that potential entrepreneurs can stem from. This diversity encompasses a spectrum of motivations and aspirations that converge under the umbrella of Entrepreneurship. This includes students harboring ambitions of launching start-ups, PhD researchers aiming to translate their research into tangible ventures, industry professionals looking to give life to their innovative ideas, and individuals within Space agencies seeking a more creative work environment. Clearly, the project targets a wide audience. When mapping out the involved stakeholders, the list of participants becomes intricate. Referring to Fig.1 from Pascual, J. (2021), "Innovation & Collaboration in the Digital Era", one can identify additional players in the field [6].

However, despite this diversity, a common thread emerges: the need for strategic fundamental skills and competencies. These competencies constitute a comprehensive skill set that is vital for navigating the intricate landscape of Space Entrepreneurship.

Soft skills play a pivotal role in enhancing entrepreneurs' prospects of success. These encompass critical thinking, time management, stress management, and more. The ESH project places emphasis on the significance of soft skills. Research indicates that, beyond the operational demands to uphold project efficacy, the technology sector confronts a growing workforce diversity, which introduces the challenge of fostering soft skills like Emotional Intelligence within project teams. The outcomes of research in this direction convincingly suggest a significant correlation between Emotional Intelligence competencies and project performance [7]. In addition to Emotional Intelligence skills, leadership abilities and decision-making capabilities are also fundamental. Finally, proficiency in areas such as branding, design, legal aspects, accounting, finance, IT, communications, public relations, sales, marketing, collaboration, innovation, creativity, and human resources management are also critical to master.

To strengthen the ecosystem, a multifaceted approach is therefore crucial. This involves shifting from a scientific mindset to one focused on entrepreneurial and transformational leadership qualities through specialized training. Additionally, creating training programs that cover a wide range of entrepreneurial activities is fundamental. Importantly, setting up a support network with experts in various fields is also essential. This is crucial in order to provide the necessary guidance and insights for navigating the diverse landscape of Entrepreneurship in the Aerospace sector.

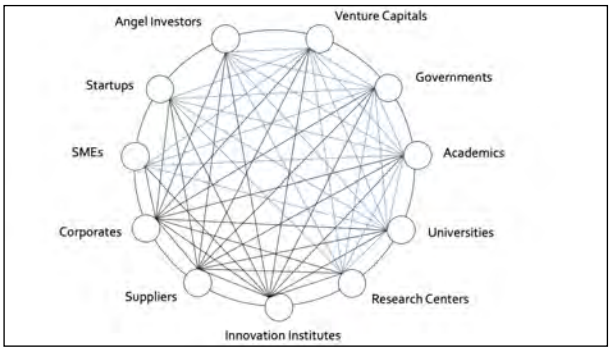

Fig. 1. Players in the New Space Arena. Pascual, J. (2021), "Innovation & Collaboration in the Digital Era"

2. The Multilevel Strategy of EuroSpaceHub for Training Young Students in the Aerospace Sector.

EuroSpaceHub's comprehensive approach to training young students within the Aerospace sector involves a multilayered strategy that encompasses various levels of engagement and educational initiatives. By incorporating a range of activities, resources, and experiences, EuroSpaceHub aims to foster a new generation of skilled professionals who can contribute to the advancement of the industry.

Through a combination of theoretical learning, practical experiences, and industry collaboration, EuroSpaceHub's approach seeks to address the diverse needs and demands of the Aerospace landscape. By examining the various layers of this strategy, this section sheds light on the ways in which EuroSpaceHub aims to create a robust foundation for the future workforce of the Aerospace industry.

2.1 Analyzing the Space Ecosystem Actors and Users to understand their needs and challenges.

During the initial stages of the project, the ESH partners undertook an extensive analysis to delve into the complexity of the Aerospace Ecosystem. This examination aimed to provide a comprehensive grasp of the sector's dynamics, enabling a more informed approach to ESH project development.

This preliminary phase aimed at understanding the sector's nuances before embarking on strategic initiatives. Central to this endeavor were research questions such as: "What are the needs of users in the Aerospace Ecosystem?" and "How can we provide assistance to these users?"

Each ESH partner undertook this preliminary analysis using their distinct methodologies, with surveys emerging as a primary tool for data collection.

During the initial phase, the two partners UCM and ISU carried out a benchmark analysis of the existing European training programs. The study conducted by UCM and ISU also had the objective of identifying the training requirements within the sector. The diversity of participants in the ecosystem, as highlighted in Section 1.3, encompasses a wide range of entities, including companies of varying sizes, emerging start-ups, individuals aspiring to establish their entrepreneurial ventures, Research & Technology Transfer Offices within academic networks, and the academic institutions themselves. This intricate amalgamation of stakeholders contributes to a multifaceted landscape, thereby rendering the task of defining comprehensive training needs a complex undertaking. In order to effectively navigate this complexity, a series of questionnaires was devised. These questionnaires were designed as tools to extract insights into the training requisites, as perceived across the entirety of the sector's stakeholder spectrum. The findings of this comprehensive study are briefly reported in Section 4.1.

In conjunction with the previously mentioned benchmark report, the project also employed workshops to facilitate a more interactive and dynamic approach to data gathering. Within these workshops, a dedicated methodology was applied, drawing upon canvases developed by J. Pascual [6]. Notably, the *Ecosystem and Community Canvas* (Fig. 2) played a pivotal role as a navigational tool to guide the analysis of the Aerospace Ecosystem. Similarly, the *Collaboration Canvas* (Fig.3) provided strategic guidance for facilitating collaboration within this ecosystem.

These informal sessions were instrumental in fostering stronger bonds among industry partners, while the feedback received tended to spark constructive debates during the sessions. These sessions — qualitative and ethnographic in nature — were designed to provide a deeper understanding of the root causes behind challenges such as limited collaboration, an absence of an innovative mindset, and a low ratio of entrepreneurial success in the sector.

Numerous sessions also took place online, engaging the EuroSpaceHub team in dedicated conversations with various user typologies within the ecosystem. Both individual and workshop sessions shared the common goal of identifying pain points experienced by different actors. The online workshops lasted for two hours and their agendas encompassed key aspects such as the definition of an innovation ecosystem, understanding the digitalization of ecosystems, exploring the innovation ecosystem canvas, and cultivating an innovation ecosystem mindset. The individual sessions were personalized, adopting a one-to-one approach, where participants' roles within the ecosystem were discussed using the *Innovation Ecosystem Canvas* as a guiding framework.

In the process of gathering insights and inputs from the different stakeholders, an essential activity was undertaken to systematically organize the feedback, notes, and comments received from the diverse range of participants involved, thus ensuring a comprehensive record of the discussions. The collected data were catalogued in different clusters, such as issues, needs, challenges, solutions, and activities. This meticulous approach enabled the identification of patterns, connections, and underlying trends that emerged from the feedback, providing a valuable framework for the the project.

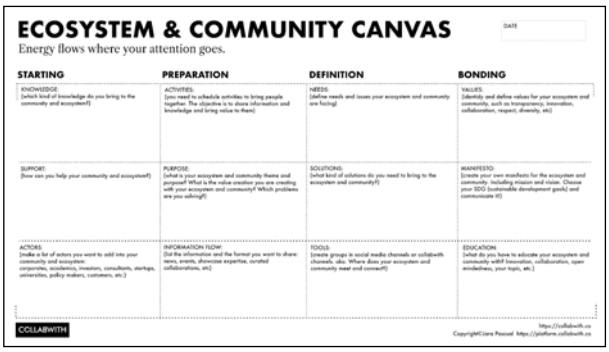

Fig. 2. The *Ecosystem and Community Canvas* was a tool to guide discussion and ignite debate with the Workshops participants in the preliminary stage of EuroSpaceHub (J. Pascual, 2021)

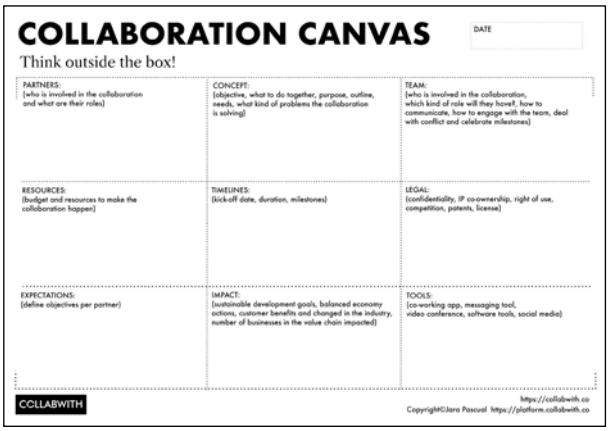

Fig. 3. The *Collaboration Canvas* was a tool to facilitate Collaboration with the Workshops participants in the preliminary analysis of EuroSpaceHub (J. Pascual, 2021)

2.2 Dedicated Training and Resources within the EuroSpaceHub Digital Platform.

As previously detailed in Section 1.2, one of the main objectives of the ESH Project is to establish a digital ecosystem that strategically interconnects the diverse stakeholders of the Space and Aviation innovation landscape in Europe. The ESH Digital Platform has been established by the Consortium to create coherence within the vast expanse of the internet, thus breaking down silos that often isolate local ecosystems and organizations. ESH's overarching mission is to digitally unite the European space ecosystem, encompassing entities ranging from tech transfer offices and industries to Space accelerator networks, research centers, and Universities. To accomplish this, the EuroSpaceHub Digital Platform was developed, with Collabwith Group serving as the responsible partner for its creation thanks to its proprietary software and methodology.

The platform is designed identifying five main User categories: Researchers, Universities, Industry, Startups, and Accelerators, each benefiting from distinct functionalities [8, 9]. The main functionalities which are incorporated in the ESH Digital Platform are:

1. *Marketplace*: This feature aggregates funding opportunities, services and solutions, collaboration avenues, and technology platforms. Funding calls, innovation procurements, challenges, and technical platforms are all featured, facilitating comprehensive engagement.
2. *Notifications*: Tailored notifications are sent to users based on their preferences, encompassing funding opportunities, collaboration prospects, and expert interactions.
3. *Partner Directories*: A comprehensive database of academics, universities, startups, and professionals is provided, complete with contact details, chat features, collaboration proposals, and status updates.
4. *Working Groups and Discussions*: Users can initiate team chats or channels to foster discussions, share information, and build a collaborative community. These groups are by invitation only, and the messaging tool is secured and encrypted.

The ESH Digital Platform also features functionalities such as *Profile Pages*, a *Marketplace Page* for sharing research opportunities and collaborations, an *Academy Page* for accessing digital courses, an *Events Page* for tracking webinars and workshops, and a *Resources Page* providing demos, guidelines, and masterclasses to enhance Space knowledge and expertise [Fig. 4-6].

Going into more detail regarding the *Resources Page*, this dedicated section provides every member with access to a range of valuable resources, including demos, guides, free webinars, and training sessions aimed at enhancing their understanding of Space knowledge and expertise, innovation, collaboration, innovation ecosystems, and entrepreneurship. The EuroSpaceHub platform offers various types of resources and training options, catering to different needs. The resources page serves as a hub for continuous learning and growth within the community.

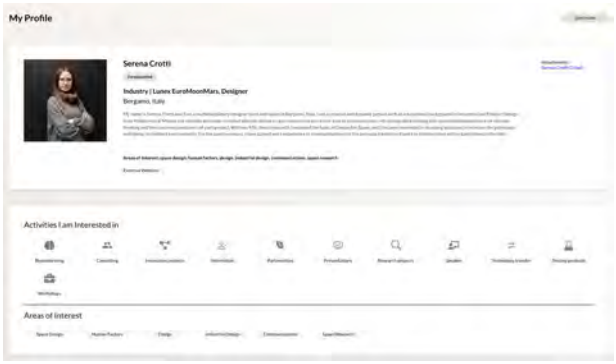

Fig. 4. The *Profile Page* feature of the EuroSpaceHub Digital Platform developed by Collabwith Group (EuroSpaceHub, 2023).

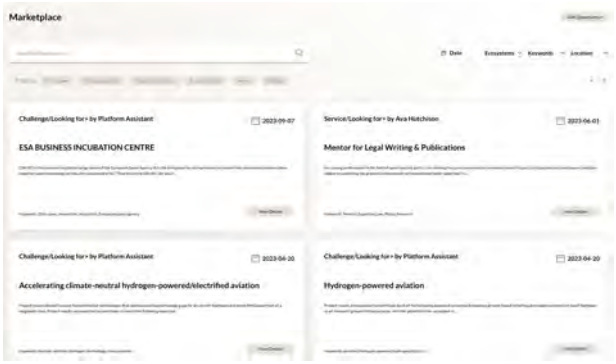

Fig. 5. The *Marketplace Page* feature of the EuroSpaceHub Digital Platform developed by Collabwith Group (EuroSpaceHub, 2023).

Fig. 6. The *Resources Page* feature of the EuroSpaceHub Digital Platform developed by Collabwith Group (EuroSpaceHub, 2023).

Summarizing, the platform offers two main clusters of Resources:

1. *Free Resources.* These encompass a collection of valuable materials such as demos, best practices, guidelines, and reports.
2. *Paid Masterclasses and Trainings.* For more in-depth learning contents.

In addition to the resources which are included in the Digital Platform, the Consortium has also established other focused training services and programs. An example of these concerns the Startup Mentoring service. EuroSpaceHub actively engages with startups and scale-ups, offering mentorship to these emerging businesses. The support and consultancy provided are multidisciplinary, offering guidance and support across various facets of the Aerospace industry. Other examples in this direction are the numerous in-person training sessions organized by the partners at various institutions. For the outcomes related to the supported startups and the dedicated trainings organized by the ESH Consortium, please refer to section 4.2.

Finally, one more general aspect to mention regarding the ESH Platform is its inclusive and gender neutral design. With gender-neutral imagery, colors, vocabulary, design, and style guides, the platform aims to offer equal opportunities and access. This extends to embracing gender actions that emphasize role models, communication, accessibility, networking, and training, all seamlessly integrated within the digital ecosystem. Through these endeavors, EuroSpaceHub envisions a dynamic platform that not only connects the Space and Aviation sector but also fosters a collaborative, innovative, and inclusive environment for all.

2.3 The EuroSpaceHub Academy and the Analog Missions as a Field Learning Method for Aerospace Students' Training.

The ESH Academy and its program of Analog Missions represent an innovative educational initiative aimed at equipping students, Space entrepreneurs, and aspiring astronauts with a multifaceted set of skills, relevant to the contemporary Space industry. Situated under the overarching ESH project, the Academy was established to bridge the gap between STEM education and entrepreneurship through a field-oriented and multidisciplinary approach. The initiative is led by the ESH partner Lunex EuroMoonMars.

The Academy's methodology emphasizes experiential learning, facilitated through engagement in analog missions. These missions are designed to simulate astronaut experiences in environments that recreate lunar and Martian conditions. Students are called to participate as analog astronauts in diverse terrestrial sites of research interest. The program builds on the decade of experience of Lunex EuroMoonMars in the organization and running of Analog Campaigns. In fact, EuroMoonMars has orchestrated analog missions in multiple terrestrial sites, such as the Mauna Loa Volcano (at the HI-SEAS Analog Base in Hawaii), in the Utah Desert (at the MDRS Station), at the Analog Astronaut Training Center in Poland (EMMPOL Missions), in Iceland (CHILL-ICE Missions), in the Atacama Desert in Chile (LICA-UDA-EMM High Altitude Campaign) and more [3-5, 11-17].

The Analog Missions cultivate a practical approach to learning, enabling students to gain both specific Space-related technical proficiency, as well as soft skills. Over the course of these missions, students have the chance to operate onboard instruments, conduct experiments, and analyze data effectively. The value of analog missions extends beyond technical competence. Participants acquire transversal skills vital for success, including teamwork, problem-solving, and stress management within confined and challenging environments. Analog missions serve as experiences for nurturing interpersonal skills, making them a pivotal testing ground for effective collaboration and innovative thinking [18].

2.4 EuroSpaceHub KPIs to evaluate and monitor the impact of the Project.

The comprehensive set of Key Performance Indicators (KPIs), Analytics, and Metrics formulated for the ESH project serves as a fundamental tool to assess the efficacy, engagement, and accomplishments across multiple dimensions of the project's endeavors. These KPIs are strategically organized into distinct categories, each contributing to a holistic understanding of the project's performance and success.

Within the Digital Platform realm, metrics are gathered and analyzed to gauge actual platform usage. These metrics encompass crucial data points, including the number of platform users, interactions, and opportunities within the marketplace. The KPIs outlined here encompass a wide spectrum of metrics, such as the count of platform members, initiated and completed collaboration requests, various collaboration types, and area-specific interactions. Furthermore, financial transactions, innovative solutions purchased, investments in startups, and gender diversity indicators are among the KPIs incorporated, providing a comprehensive insight into the platform's utilization.

The Innovation Ecosystem KPIs, instead, are defined so as to evaluate the overall performance of the European Space and Aviation ecosystem fostered by EuroSpaceHub. These KPIs evaluate essential facets of the ecosystem, including the overall number of ecosystem members, diverse actors, available funding (private and public), and participation from universities, startups, accelerators, industries, and collaborations. Additionally, KPIs related to training courses, technology availability, and ecosystem partnerships contribute to a comprehensive overview of the Ecosystem performance. In addition to these, the EuroSpaceHub project KPIs also encompass mandatory

indicators specified within the project proposal for the EIT HEI initiative. These KPIs outline specific targets for startups supported, students trained, students mentored, academic and non-academic training and mentoring, new partnerships established, and new structured initiatives implemented.

Finally, it is also important to mention the Communication Performance KPIs. These encompass data sourced from the ESH communication platforms, such as LinkedIn, Instagram, and other socials, along with other relevant data streams. These KPIs measure the project's communication effectiveness, tracking website visits, social media followers, press mentions, podcast downloads, published articles, research publications, events attended and organized, policy briefs published, and more.

Methodologically, these KPIs, Analytics, and Metrics provide a comprehensive evaluation framework that describes the project's progress, impact, and alignment with its multifaceted objectives. The integration of these complementary sets of metrics ensures a holistic assessment of ESH's efforts, contributing to the project's continuous refinement and advancement.

4. EuroSpaceHub Project Results and Discussion

4.1 Preliminary Analysis Results: Benchmark Reports and User Insights

The EuroSpaceHub (ESH) report, conducted by UCM and ISU, sheds light on the limited availability of postgraduate courses specifically tailored to Entrepreneurship and Space start-up management in Europe. The analysis aimed to gain a comprehensive understanding of the educational landscape within the Aerospace Ecosystem. The advancement of Space research and industry has fostered an expanding spectrum of educational offerings, encompassing disciplines from space law and business-oriented training to traditional science and engineering curricula. In line with this, the European Space Policy Institute (ESPI) published a comprehensive report in March 2022, delving into the European Space Education panorama, covering bachelor's and master's programs, PhD initiatives, and other space-related endeavors. This document served as an important reference to guide the benchmark analysis [10].

Moreover, a thorough search was also conducted across specialized platforms like educations.com, masterstudies.com, mastersportal.com, and others. Various keywords such as *astronomy*, *space sciences*, *aerospace engineering*, *astrophysics*, *earth observation*, and *geospatial data* were employed as filters for the search. This was subsequently followed by a meticulous exploration on a country-by-country and university-by-university basis.

Interestingly, only a limited number of engineering or multidisciplinary-profile programs in countries like Spain, the Netherlands, France, and Latvia offer one or two courses that touch upon project management within the context of Space Entrepreneurship. Scarcity exists when it comes to postgraduate programs that effectively amalgamate Space sciences with Entrepreneurship education. Moreover, it is noteworthy that universities in France, Spain, and the Netherlands housing space-related programs provide Entrepreneurship training, primarily within economics and business departments. However, these training offerings fail to address the distinctive attributes and intricate legal framework intrinsic to the Space industry.

In summary, the EuroSpaceHub report conducted by UCM and ISU highlighted the need to bridge the gap between Space Sciences and Entrepreneurial education. The report's insights offered a foundation for targeted ESH strategies to enhance Entrepreneurship in the Aerospace Ecosystem.

4.2 Achievements on the EuroSpaceHub Digital Platform and Trainings

During the IVAP Workshop 2023 — held by IET HEI in Prague from May 31st to June 1st — the EuroSpaceHub project shared results that highlight the dedication to advancing the Space and Aviation sectors.

One standout achievement was the participation of a significant number of trainees to the overall ESH trainings – a total of 345. This shows the strong interest and engagement EuroSpaceHub has generated among individuals seeking to enhance their knowledge and collaboration within the industry. This number of trainees was achieved over a span of time starting from July 2021 to May 2023. This substantial number underscores the consistent and sustained efforts of the EuroSpaceHub project in providing valuable training and educational opportunities within the Space and Aviation sectors.

In addition, the project showcased its commitment to nurturing start-ups and scale-ups. It provided support to 6 of them over the same span of time. This accomplishment underlines EuroSpaceHub's role in fostering innovation and supporting emerging entrepreneurs.

As of August 2023, the Digital Platform showcases a total of 29 resources which have been uploaded and made freely accessible to users, contributed by various consortium members. These resources encompass a broad spectrum, ranging from methodological tools to multidisciplinary webinars and workshops. This diverse collection reflects the collaborative efforts of consortium members to enrich the platform with valuable content that supports learning, collaboration, and innovation across the Space and Aviation domains. The contributions of these resources underscore the platform's commitment to nurturing a vibrant ecosystem of knowledge sharing and skill development for the

benefit of all stakeholders involved. Registered members of the Ecosystem on the platform hail from a diverse array of countries, reflecting a global engagement with EuroSpaceHub's initiatives. These countries encompass the Netherlands, France, Italy, Spain, Lithuania, Latvia, the United States, Georgia, Germany, and Belgium. This international participation underscores the platform's reach and impact, fostering collaboration and innovation transcending geographical boundaries.

Offline training sessions organized by each ESH Consortium partner have significantly contributed to EuroSpaceHub's educational efforts. Following is an overview of the conducted trainings.

The Universidad Complutense de Madrid (UCM) has organized four courses:

1. *The Space Exploration and the CubeSat revolution:* Held on October 7th, 2022, this 2-hour training focused on the intricacies of defining Space scientific missions and the role of CubeSats in implementing them (Fig. 7). Targeting university graduates, postgraduates, and professors, the training covered mission components and the opportunities offered by CubeSats and the NewSpace sector.
2. *1st Lobby Lunar Latino Congress, The Moon as next destination, the OUL project:* Spanning 4 hours on November 24, 2022, this session highlighted Hispanic America's capabilities in lunar exploration, using the OUL project as an example. It provided insight into compact scientific missions and catered to Hispanic American space stakeholders.
3. *Employment Orientation Days:* Conducted on February 22, 2023, for 2 hours, this seminar aimed to guide Mathematics graduates and postgraduates towards employment opportunities in the Space sector. It emphasized Entrepreneurship prospects within the NewSpace sector and introduced the EuroSpaceHub platform.
4. *Course: "Regulation and Entrepreneurship in the Spanish Space sector":* This comprehensive course, from March 21st to 24th, 2023, spanned four days. It offered a thorough overview for those entering the Space industry, covering company establishment, regulatory frameworks, funding search, and specific considerations for Space entrepreneurship. It targeted students, entrepreneurs, the public interested in Space, and professors.

The VilniusTech University initiated diverse programs, including:

1. *The Commercialization Skills Development Training*: Designed for scientists, researchers, and doctoral students, this two-day training aimed to enhance entrepreneurial capabilities and understanding of technology transfer. Over 16 hours, participants delved into identifying project opportunities, preparing applications, and the process of commercializing research outcomes. The training consisted of two stages: the first, focusing on "Market Research of High-Tech Products/Prototypes", explored business's role, R&D paradigm, and innovation diversity. The second stage, centered on "Identification, Preparation, and Administration of Opportunities for Projects with Business Entities", delved into technology evolution, state assistance, public support for innovation, and Horizon Europe EIC R&D Commercialization Instrument.

Fig. 7. The Space Exploration and the CubeSat revolution Course organized by UCM in October 2022 (UCM, ESH, 2022)

2. *The Hack4Vilnius Hackathon:* The hackathon encouraged participants to generate innovative solutions for Vilnius during a three-day event, providing a platform to address the city's challenges with creative ideas. Over 20 mentors from diverse companies guided participants in refining their concepts and preparing for the final competition. Workshops complemented the mentorship, covering topics such as the essential mindset and tools for successful hackathon solutions, protecting hackathon ideas, and presenting business concepts to investors.
3. *VilniusTech Acceleration Program*: This 14-week acceleration program was tailored to students, teachers, and community members with entrepreneurial aspirations with a structured framework. The program aimed to develop business skills and provide insights into business models and financial planning. Each week included a 1.5-hour lecture, a 2-hour workshop, and homework assignments, followed by individual 40-minute sessions in the subsequent week. The program was guided by a team of six experienced mentors who conducted workshops on a range of topics, such as user identification and value proposition, business models and marketing strategy, human resource

management and leadership, financial planning, attracting funding sources, and idea presentation and storytelling in sales.

Fig. 8. The VILNIUS TECH Acceleration Program organized in Vilnius by VilniusTech (VilniusTech, 2023)

Fig. 9 The ISU team at the Business Plan Training organized in the framework of the ESH project (ISU, ESH, 2023)

The International Space University (ISU), organized a workshop titled "Business Plan Training", which aimed to foster a conducive environment for Space Entrepreneurs by emphasizing both technical expertise and soft skills (Fig. 9).

The workshop spanned nine days, involving 22 participants divided into interdisciplinary teams. These teams were tasked with developing business plans for downstream Space applications, adhering to a concise pitch deck format. The first week encompassed basic courses and workshops, followed by focused group work in the second week to refine business ideas and plans. Expert specialists and experienced entrepreneurs led the sessions, contributing to the practicality of the workshop. The participation of equity investors and mentors further enriched the experience by offering insights into early-stage financing and business plan evaluation. The four teams presented innovative business proposals addressing diverse challenges. The workshop's training-oriented nature culminated in a jury assessment based on content quality, presentation, and responses to questions. The lessons learned from the workshop highlighted the significance of proper scheduling, the role of professionals as coaches, and the value of soft skills in Entrepreneurship.

Feedback from workshop participants provided valuable insights to enhance the workshop's dynamics in future iterations. The appropriate distribution between schedule and work time, the engagement of professionals as coaches, and the presence of equity investors were key elements that enriched the workshop experience. Soft skills emerged as a common thread throughout the sessions, underscoring their integral role in Entrepreneurship. Participants expressed a desire for more workshops to consolidate and apply the knowledge gained.

In addition to the aforementioned training initiatives, the project offered also specialized training on using the digital platform through Monthly Welcome Sessions, fostering networking with professionals from diverse sectors. Moreover, a series of workshops held in June 2023 covered various specific skills: the Innovation Ecosystem Training, the Collaboration Training, the Space Habitats workshop, the Space Diplomacy Training, and the Social Media Expert Influencer Training. These workshops collectively contributed to developing a well-rounded skill set among participants, aligning with EuroSpaceHub's commitment to fostering soft and technical skills in the Aerospace community.

4.3 The ESH Academy and the Training with Analog Missions, Achieved Results

Between 2022-2023, the EuroSpaceHub Academy has orchestrated a series of EMMPOL missions in collaboration with EuroMoonMars and the Analog Astronaut Training Center, supported by funding from both EuroSpaceHub and Lunex. The EMMPOL missions are hosted at the Analog Astronaut Training Center's MoonBase in Poland, offering participants a unique opportunity to engage in immersive experiences akin to those faced by astronauts (Fig. 10).

Operating with a crew size of five to six individuals, these missions simulate life within a confined environment, where resources are limited, natural sunlight is absent, and even basic amenities like showers are made unavailable. In this context, participants actively engage in physical activities that mirror those undertaken by astronauts, while also navigating challenges such as the alteration of circadian rhythms due to the prolonged absence of natural light cues. Importantly, these missions extend beyond mere technical training, fostering the development of essential interpersonal skills. Through shared experiences in close quarters, participants learn to coexist and collaborate properly, manage stress effectively, and navigate the complex dynamics that

emerge within a diverse crew. This immersive and holistic approach not only empowers participants with hands-on skills but also provides valuable insights into the psychological and physiological demands that astronauts encounter during extended missions.

Fig. 10. Students of the EMMPOL15 Crew during their Analog mission at the MoonBase simulator of the Analog Astronaut Training Center in Poland (AATC, EMMPOL 15, March 2023)

Another noteworthy mission orchestrated by the Academy was the *EMMIHS2023 Hana Hou* Mission, which took place at the HI-SEAS base in Hawaii in March 2023 (Fig. 11). Bringing together a multicultural and diverse crew of six individuals, this mission further highlights the Academy's dedication to fostering essential skills within a real-life mission context.

A particularly significant experience was woven into the fabric of the *EMMIHS2023 Hana Hou* Mission. This experience entailed a specialized training in Emotional Intelligence provided by the Mission Psychologist, Dr. Celia Avila-Rauch. As a clinical psychologist and certified Emotional Intelligence trainer, Celia Avila-Rauch designed and led daily group exercises throughout the mission with the rest of the crew. [19, 20]. Moreover, participants were provided with a comprehensive workbook that aided in enhancing their Emotional Intelligence skills. This deliberate inclusion of Emotional Intelligence training underlines the Academy's commitment to equipping participants with not only Space-related technical proficiencies, but also with the interpersonal skills that are crucial for successful collaboration and teamwork in projects and Entrepreneurial activities.

The Consortium's dedication to analog missions is also exemplified by the ExoSpaceHab Express initiative. This collaborative project — developed by the EuroSpaceHub Academy in collaboration with Lunex EMM — introduces a new idea of terrestrial analog. The ExoSpaceHab-X facility is a portable base designed to facilitate simulations and event hosting across multiple European locations (Fig. 12). The ESH-X habitat is conceived to enhance both experiential

Fig. 11. The EMMIHS 2023 Mission Crew during an EVA at the HI-SEAS Base in Hawaii, on the Mauna Loa Vulcano (EMMIHS2023, IMA, ESH-EMM, March 2023)

Fig. 12. The ExoSpaceHab-X transportable habitat for analog missions, developed under the EuroSpaceHub Academy by Lunex EuroMoonMars (S. Crotti, B. Foing, Lunex EMM / ESH, 2023)

Fig. 13. Interior view of the working area of the ExoSpaceHab-X habitat for analog missions (S. Crotti, B. Foing, Lunex EMM / ESH, 2023)

learning and outreach efforts within the ESH Consortium. The project has been designed by the Italian designer Serena Crotti together with Prof. Bernard Foing, CEO of Lunex EuroMoonMars.

Inside the habitat (Fig. 13) researchers can study how confinement affects the crew, thus collecting valuable insights into challenges faced by astronauts on Space missions. The habitat mimics conditions of future missions to Gateway or Mars and can host a crew of four. Its design focusses on crew well-being and human factors. Though portable, the module keeps all essential functions to simulate life in a hypothetical Space base. It includes a trailer module for crew needs and an inflatable area for various uses like EVAs prep simulations, events, workshops, and demos. The design is modular for future scalability. The inflatable structure is designed taking into account the possibility of connecting it to a second module, so as to create a Lunar Village for simulations [21].

6. Conclusions and Next Steps of EuroSpaceHub

The EuroSpaceHub project has yielded significant achievements and advancements in the field of Space entrepreneurship and education to prepare the next generation of Space workforce.

Through a comprehensive analysis of the educational landscape, the project identified the need for bridging the gap between Space sciences and Entrepreneurial education. The results from benchmark reports and user insights underscored the scarcity of postgraduate programs that effectively combine Space Sciences with Entrepreneurship education, setting the stage for EuroSpaceHub's strategic interventions.

The results achieved so far by the project have been encouraging, both in terms of the Digital Platform and offline training. With a substantial number of trainees and support provided to start-ups and scale-ups, EuroSpaceHub has demonstrated its commitment to nurturing a thriving community within the Space and Aviation sectors. The contributions from consortium members, resulting in 29 freely accessible resources, reflect the platform's dedication to fostering a collaborative ecosystem of knowledge sharing and skill development across these domains. The varied participation from different countries underscores the platform's international reach and impact, fostering collaboration and innovation without geographical constraints.

The offline training sessions conducted by Consortium partners have been instrumental in enhancing educational efforts for Space Entrepreneurship. The training programs have covered a diverse range of topics, from commercialization skills development to hackathons and acceleration programs, catering to individuals at different stages of their Entrepreneurial journey. The workshops organized by EuroSpaceHub on specialized topics like innovation, collaboration, emotional intelligence, and Space diplomacy have provided participants with a comprehensive skill set, aligning with the project's commitment to fostering both soft and technical skills within the Aerospace community.

The EuroSpaceHub Academy's engagement in analog missions has significantly contributed to practical skill development and experiential learning. The EMMPOL missions and the EMMIHS2023 Missions have provided participants with immersive experiences mirroring the challenges faced by astronauts. These missions not only enhanced their technical knowledge but also cultivated essential interpersonal abilities, fostering effective teamwork and Emotional Intelligence capabilities. The ExoSpaceHab Express initiative further exemplifies the project's dedication to analog missions, offering a portable base for simulations and event hosting, enhancing both learning and outreach efforts of the ESH Consortium.

In conclusion, the EuroSpaceHub project's holistic approach to Space entrepreneurship and education, coupled with its digital platform, offline training initiatives, and engagement in analog missions, has collectively contributed to shape a vibrant SpaceTech ecosystem. The project's accomplishments underscore its role in advancing the Space and Aviation sectors, empowering aspiring entrepreneurs, and fostering a collaborative and innovative environment for stakeholders within the industry.

As the project continues to evolve, it seeks to build upon these preliminary results, further optimizing training programs, enhancing strategic skills development, and promoting Entrepreneurship within the Aerospace community. Through its multifaceted endeavors, EuroSpaceHub strives to equip individuals with the skills and knowledge needed for success in this competitive and rapidly evolving industry.

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