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Asclepios Mission III: THIRD ITERATION OF THE STUDENT-LED ANALOG MISSION SIMULATING A HUMAN EXPEDITION TO THE LUNAR SOUTH POLE

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Asclepios

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Abstract

Asclepios provides a platform for simulating space missions, training aspiring astronauts, and acts as a testbed for human-spaceflight research. The main focus of Asclepios III, the third mission, is space medicine, engineering, environmental sciences and sustainability. This report will be highlighting the key importance of each of the six main teams of the organization for the successful outcome of the mission and how lessons learned from the Asclepios III mission and the previous ones can be implemented from the beginning for the improvement of Asclepios IV. Several teams work all year long to make this mission possible: Management, Science, Design, Medical, Communication, and Astronaut.

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1. Introduction

Space Analog Missions are missions that take place on Earth aiming to simulate the conditions, challenges, and experiences of space exploration. These missions take place in remote or extreme environments that resemble the physical, psychological, and operational aspects of space missions. Asclepios Mission is an educational initiative, supervised by eSpace, and its goal is to organize an annual analog mission and give students a first experience in the space sector, with a learn-by-doing approach. Asclepios' goals include giving valuable experience to the next generation of space leaders and promoting sustainability, but also becoming a testbed for innovative technologies and space research. Asclepios Mission is composed of five teams: Analog Astronaut and Medical, Management, Science, Design, and Communication.

The primary objective of the Asclepios Mission is education, specifically aimed at inspiring and engaging students and the public in the field of space exploration. The mission is designed to provide educational opportunities and experiences that simulate life on another celestial body, such as the Moon or Mars.

The Asclepios Mission aims to accomplish its educational objective through various means:

1. Student-Led Space Analogue Missions: Asclepios organizes student-led space analogue missions, where students take part in simulating short-term space missions on celestial bodies. These missions provide hands-on training and experience for students interested in becoming astronauts, space engineers, or members of the Mission Control Center.
2. Training and Preparation: The astronaut crew, consisting of six members and two backups, undergoes rigorous training and preparation for the mission. This includes maintaining and repairing their base, conducting scientific experiments, and communicating with the ground team of the Mission Control Center (MCC).
3. Educational Content: The Asclepios Mission creates a diverse range of educational content to promote scientific literacy and innovation. This includes live broadcasts from the base during the mission, interactive sessions, and scientific demonstrations, all aimed at engaging students and the wider community in the field of space exploration. The mission aims to foster curiosity, critical thinking, and creativity among participants.

By providing these educational opportunities, the Asclepios Mission aims to inspire a passion for space exploration, develop scientific knowledge and skills, and cultivate an innovative mindset among students. The mission contributes to the overall objective of promoting education, scientific curiosity, and the pursuit of excellence in the field of space exploration.

2. Methodology

The project's timeline follows a structure similar to Systems Engineering Life cycles, incorporating Design Reviews to assess progress and determine the feasibility of proceeding to subsequent phases. Regular meetings occur between teams, with the project coordinators - the Science Officer and an EPFL supervisor - participating in at least one meeting every two weeks.

Asclepios conducts one mission per year, typically commencing in August and concluding by October of the following summer. At the start of each mission, team leaders -known internally as Heads- define the mission objectives and establish milestones. The five teams involved in the project, namely the management team, astronauts team, design team, communication team, and science team, meet regularly to discuss updates and assign upcoming tasks. Weekly meetings are held among the heads of different teams, led by the Project Leaders, to ensure alignment and progress. The communication and the proper documentation required by each team are mandatory to ensure the robust structure of Asclepios Mission. Each document follows a specific structure, making-up a Standard Operating Procedure (SOP). The contribution of each team requires consistency, planning and effort by all the members. The analysis of how each team is contributing to the organisation is further expanded in the next subsections.

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To showcase progress and receive feedback, Asclepios organizes Design Reviews every three months, inviting sponsors, mentors, partners, Principal Investigators, and stakeholders. For example, in the Asclepios III mission -from now onwards referred to as AIII Mission-, the Preliminary Design Review (PDR) took place on December 16th, 2022, the Critical Design Review (CDR) on March 16th, 2023, and the Qualification Design Review (QDR) on June 8th, 2023. These reviews serve as important milestones in evaluating the project's development.

Analogue Astronaut Team

The goal of the Astronaut Team is to select and train analog astronauts for the mission in terms of physical and mental health. During the recruitment period -between December 2021 and June 2022-, the Asclepios III crew was selected based on a four-phase process inspired by the selection criteria of the European Space Agency and included close collaboration with former Astronauts, psychologists and other specialists. The recruitment process consists of four different phases:

1. Phase A:
   In this phase, candidates are required to submit their CV and a motivation letter. The motivation letter serves as an opportunity for candidates to express their enthusiasm, passion, and reasons for wanting to be a part of the Asclepios Mission. It should be concise, organized, and persuasive, highlighting the value and qualifications the candidate brings to the mission.
2. Phase B:
   Selected candidates proceed to the next phase, where they are asked to create a video about their motivation for joining the mission. This video allows candidates to showcase their communication skills, creativity, and ability to express their dedication to the mission's objectives. It provides an additional perspective on the candidates' motivation and commitment, as well as an assessment of their English level.
3. Phase C:
   In this phase, candidates undergo cognitive tests inspired by ESA's selection process. These tests assess the candidates' cognitive abilities, problem-solving skills, and adaptability to challenging situations. The tests may include tasks that require critical thinking, decision-making, and working under pressure. The aim is to evaluate the candidates' mental resilience and capacity to handle the demands of the mission.
4. Phase D:
   The final phase involves an in-person weekend assessment that focuses on evaluating the candidates' physical abilities and teamwork skills. This assessment includes various activities such as the Swiss Army Test, which tests physical fitness and endurance. Candidates may also participate in an activity in the lake, where teamwork, cooperation, and adaptability to different environments are assessed. Our mentor, Astronaut Claude Nicollier, also conducts individual interviews with each candidate. Additionally, a medical and psychological assessment is conducted to ensure the candidates' overall health and psychological well-being.

In addition to selecting candidates based on their qualifications, skills, physical abilities, and teamwork capabilities, the crew selection process for the Asclepios Mission also considers the mental readiness of the analog astronauts and their ability to cope with isolation. This is crucial to ensure the well-being of the crew members before, during and after the mission and to minimize the risk of any potential dangers to themselves and others.

The Asclepios Mission involves extended periods of isolation and confinement, where analog astronauts will be separated from their families, friends, and the familiar environment of Earth. These conditions can have significant psychological and emotional effects on individuals. Therefore, it is essential to assess the mental preparedness of the candidates and their ability to adapt and thrive in such challenging circumstances. By considering the mental readiness of the analog astronauts alongside other selection criteria, the Asclepios Mission ensures that the chosen crew members possess the necessary psychological resilience to cope with the unique challenges of deep space exploration. This holistic approach not only enhances the chances of mission success but also prioritizes the safety and well-being of the crew throughout their journey.

The training program for the Asclepios III mission consists of a combination of on-site and online trainings throughout the year. There are three categories of training sessions: Basic, Specific, and Advanced. All the basic training sessions were held online and included space history, nutrition, public speaking, and Russian class. These training sessions aim to equip the analog astronauts with the necessary skills, knowledge, and psychological resilience required for their mission. We will

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now provide you with an overview of the three on-site trainings that took place as part of our comprehensive training program:

1. Extreme Environments with Alban Michon:

One of the on-site trainings involved a collaboration with the renowned French explorer, Alban Michon. During this training, the analog astronauts participated in a four-day camping experience in Verbier. They engaged in various team-building activities while being exposed to extreme environmental conditions. Additionally, the analog astronauts had the opportunity to undergo diving under ice, simulating weightlessness and the coldness of the Moon. This training not only tested their physical endurance but also fostered teamwork and adaptability in challenging circumstances.

2. Medical and Science Trainings with "Dress Rehearsal":

In April, the analog astronauts underwent a two-day medical training session, which covered essential skills such as sutures, CPR, and wound management. Simultaneously, they received two days of science training, focusing on understanding the scientific experiments they will conduct during the mission. To further enhance their preparedness, the analog astronauts participated in a "Dress Rehearsal" that simulated the analog mission. This two-day simulation took place at the Vivalys School, where the analog astronauts lived as if they were in the mission's base. The simulation allowed for the refinement of mission control center protocols and enhanced overall mission protocols.

3. Zero-Gravity (0-g) Flight Training and Scientific Training Weekend:

In April, our analog astronauts also underwent 0-g flight training in Bergamo. This training involved experiencing micro-gravity, which is a crucial aspect of space travel. It allowed them to adapt to the unique physical sensations encountered in a microgravity environment. Additionally, in May, our team conducted a scientific training weekend, focusing on further enhancing the analog astronauts' scientific knowledge and research skills. Moreover, flight lessons were provided to ensure the analog astronauts' familiarity with flight procedures and safety protocols.

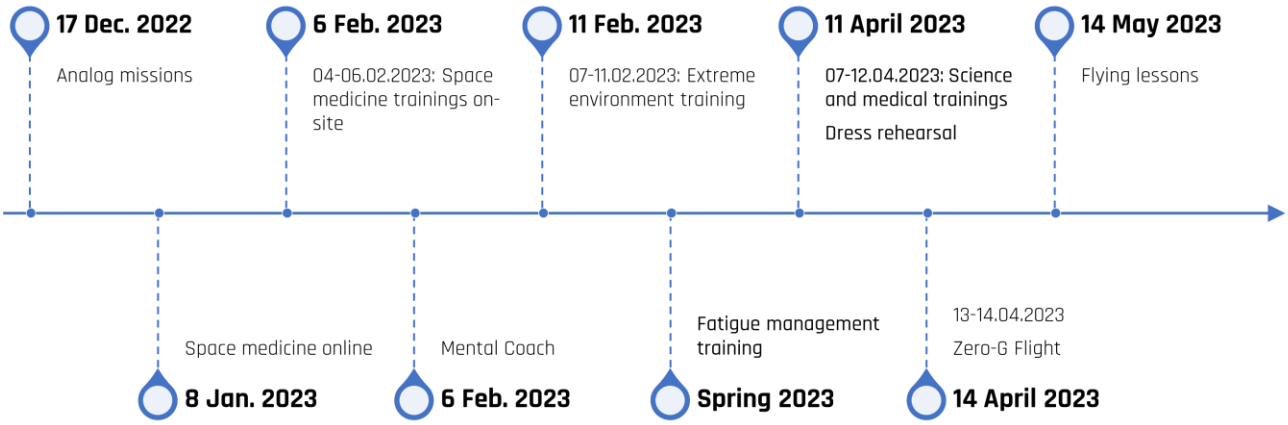

Figure 1: Astronauts training timeline

In addition to the on-site trainings, a series of online trainings were conducted as can be seen in Figure 1. These online sessions covered a wide range of topics essential for the astronauts' success and well-being during the mission. The online trainings included Russian lessons to facilitate communication with international crew members, space medicine lessons to address medical challenges specific to space travel, stress and isolation management techniques, public speaking skills, and testimonials from other analog astronauts, offering insights into their experiences.

The combination of on-site and online trainings enables our analog astronauts to acquire the necessary skills, knowledge, and resilience to face the physical, psychological, and emotional demands of isolation during their mission. We firmly believe that this comprehensive training program equips our team with the tools needed to ensure their well-being and successful completion of the mission's objectives.

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The crew of the Asclepios mission consists of various roles, each with specific responsibilities and expertise. These roles are essential for the success of the mission and the well-being of the crew members. Here are the different roles within the Asclepios crew:

1. Commander: The Commander is the leader of the crew and is responsible for overall crew coordination and decision-making inside the base. They provide guidance, ensure effective communication, and oversee the execution of mission objectives in base.
2. Health Officers (x2): The Health Officers are responsible for monitoring the physical and mental health of the crew members. They conduct regular check-ups, assess vital signs, and address any medical concerns that may arise during the mission. Their expertise in space medicine helps them manage and mitigate health risks associated with space travel.
3. Base Specialist: The Base Specialist focuses on the efficient operation and maintenance of the mission's base. They oversee the technical systems, ensure the functionality of essential equipment, and manage the living quarters and workspaces within the base. Their role is crucial for creating a conducive and safe environment for the crew.
4. Science Specialist: The Science Specialist is responsible for the scientific aspects of the mission. They oversee and conduct experiments, collect data, and analyze scientific findings. Their expertise contributes to advancing our understanding of space-related phenomena and achieving the mission's scientific objectives.
5. Communications Officer: The Communications Officer handles all communication activities within the mission. They establish and maintain communication links with the Mission Control Center, relay information between the crew and MCC, and ensure effective communication between crew members themselves. Their role is vital for coordination and efficient exchange of information.
6. CAPCOM (Capsule Communicator): The CAPCOM is a critical role inspired by NASA's mission control. They act as the primary communication link between the crew in space and the MCC on Earth. The CAPCOM relays important information, instructions, and updates from the MCC to the crew during the mission. They provide guidance, answer crew questions, and facilitate real-time communication for mission-related activities. This position is part of the Mission Control crew.

Finally, the Astronaut Team also consists of Nutrition and Sports officers who ensure that astronauts can perform at their best and stay healthy in the challenging conditions of the Asclepios mission. The demanding analog space environment is characterized by resource limitations and challenges faced by the crew, thus the paramount importance of ensuring adequate nutrition and optimal sports plan cannot be understated. Freeze-dried food is the only chosen food option for the mission and it presents distinctive advantages by providing a lightweight, compact, and enduring solution to effectively meet the nutritional requirements of analog astronauts during our fourteen-day mission.

Medical team

The medical team of Asclepios possesses a pivotal role in ensuring the health and safety of crew members during the mission, while also actively contributing to the broader research objectives by focusing on three main pillars, namely preventive, primary and secondary medical care, providing clinical guidance and ensuring good clinical practice.

The team is comprised of a proficient Head of Medical, who provides leadership and oversees all medical aspects of the mission, and three specialized medical officers focusing on ethical compliance, data management and mental health.

The medical team conducts meticulous medical monitoring in the training as well as the mission phase. An initial health screening during the recruitment of the analog astronauts is done. In fact, the team is responsible for recruiting analog astronauts, employing rigorous selection criteria to identify individuals with the physical and psychological resilience required for the mission. Moreover, regular medical assessments of crew members including vital signs monitoring, check-ups and tracking of physical and mental health parameters are performed to respond to any medical issue that may arise. To maintain crew health, strategies are developed on a regular basis and implemented in the mission and training phase. This involves the planning and execution of comprehensive medical training programs, equipping crew members with the necessary knowledge and skills to handle medical emergencies and perform routine medical procedures. Analog astronauts are trained to handle a wide range of medical situations, from minor injuries and illnesses to more severe conditions.

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Medical procedures for both the crew members in the base and members of the MCC (Mission Control Center) are provided through a thorough Medical Procedure Manual (MPM).

Science Team

Given the rapid development of the field of human space exploration and potential long-term missions, the main objective of scientific experiments for Asclepios III mission orbits around space medicine and advances in the health sector. Key research areas include identifying and evaluating medical risks in the lunar environment, space nutrition, life support systems, sleep quality, human behavior in isolation, microbiology and astropharmacy. Additionally, several experiments in the fields of engineering, environmental sciences, and space law were selected to create a diverse selection of projects.

The first and biggest responsibility of the Science team is the selection of the scientific projects that will be performed during the Asclepios Mission. The timeline followed is illustrated in Figure 2. The selection is based on the SPEL project, developed by Veronica Orlandi [1], the project leader of Asclepios II and current Head of Management of Asclepios III. The selection process involves two phases.

1. In Phase A, Principal Investigators (PIs) submit an abstract of their project, which is then evaluated using a decision matrix by all heads and science team members. The proposed experiments are ranked according to various weighted criteria, and those with higher scores proceed to Phase B.
2. In Phase B, the PIs present a complete protocol and pitch their projects to the Asclepios Science (SC) team. Once again, the Heads and Science Officers assess the projects using a different decision matrix, and the highest-ranking experiments are chosen to be conducted during the mission.

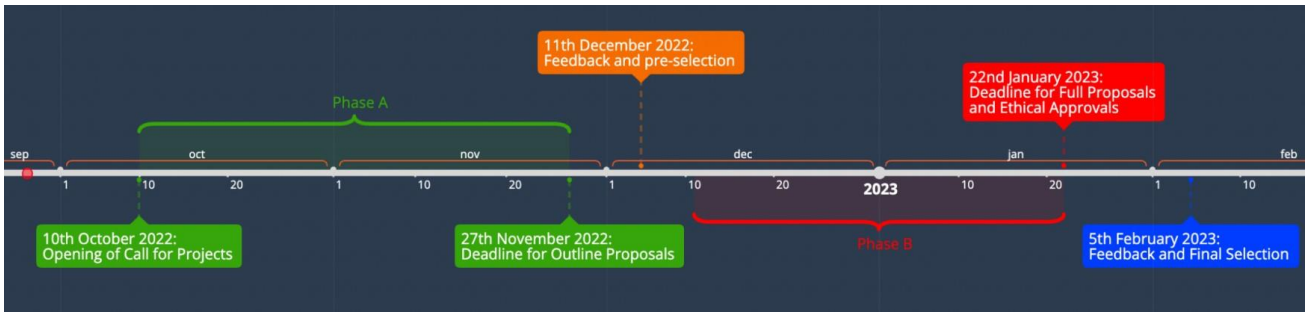

Figure 2: Timeline of the Asclepios III Call for Projects based on the SPEL matrices.

The scientific experiments carried out during the Asclepios Mission cover a wide range of research areas, aiming to advance our understanding of space exploration. The experiments are performed by the astronaut crew, who receive thorough training and support. The data collected from these experiments undergo meticulous analysis and interpretation by the principal investigators (PIs) of the respective experiment. This rigorous process ensures the accuracy and reliability of the findings. The results obtained contribute to the scientific community and hold the potential to drive new discoveries, technological advancements, and improved strategies for future space missions. The Asclepios Mission provides a unique platform for collaboration and hands-on research, allowing participants to gain practical experience in conducting space-related experiments.

The final selection of the project is marking the start of the project monitoring. The responsibility of the science team is not just to select the projects, but also to monitor them from their concept until their implementation during the mission. The responsibilities of overseeing the scientific projects and communicating with PIs were shared amongst Science Officers to provide effective incorporation of the projects into the mission. Each Science Officer supervises two projects and serves as a point of contact for the respective PIs, providing professional and adequate support. This collaboration has proven successful, demonstrating the Science Team's ability to implement the projects of external professionals into the analog mission and ensure its success. Additionally, each Science Officer was nominated to look after the broader aspect of the performance of experiments. Those were: organizing the scientific training for the astronauts, discussing the ethical aspect

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of the mission, facilitating the data transfer, keeping track of the materials needed for the mission and controlling the budget and logistics. To ensure smooth and successful operation, the Science Team works with the Design Team to create the astronauts' schedule (Flight Plan), ensuring that each experiment has the necessary time to be completed in the mission, along with the space and resources required. During the mission, Science Officers part of the Mission Control Center work to correspond between the astronauts and the PIs as the crew performs the experiments. Any issue that occurs are communicated by the crew to the Science Officers, who then consult with the PI to troubleshoot any potential problems. After the mission, some experiments require some follow-up which will be filled by the astronauts accordingly.

Design Team

The Asclepios III Design Team is responsible of designing, implementing and ensuring the correct functioning and operation of the analog elements of the mission, such as spacesuits, lunar base, Mission Control Center (MCC) and supporting systems while balancing the practicality and realism of these elements according to logistical and budgetary requirements. The team is currently divided into two distinct but integrated sections: Ground Segment, in charge of MCC and Mission Management Team (MMT) Design and training and the Space Segment, in charge of Base, Spacesuits, and general mission operations, such as Flight plan, simulations and mission profile.

The Analog Lunar Base for the Asclepios III Mission will be located inside the Sasso San Gottardo historical fortress. This will be the habitat of the analog astronauts for the duration of the mission. Most of the experiments and daily activities of the astronauts will be carried out inside the base, with just a small part of them being carried outside during Extravehicular activities (EVAs). As such, the design of the analog base must provide a safe and realistic environment for the astronauts to live and work in for two full weeks. In order to accomplish this goal, the Base Design Officer has implemented a new strategy of design, with the core of it being:

1. Reduce the total living space inside the base to increase realism,
2. Developing a strategy for quickly readapting different rooms for multipurpose functionality.

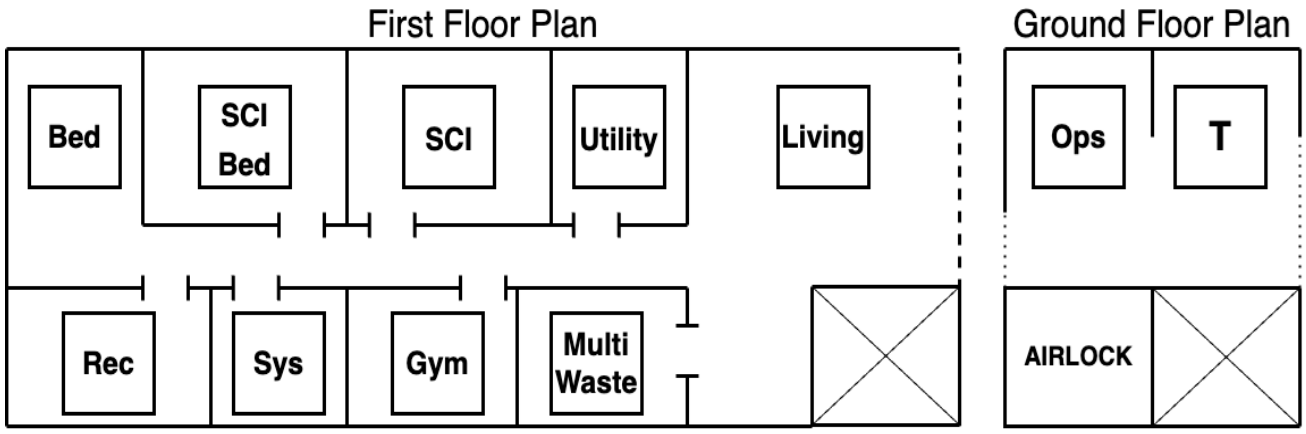

Figure 3: Floorplan of the Asclepios III Base with: Bed: Sleeping Room , SCI: Science Room, Rec: Recreational Room, Sys: Systems, technical room for repairs and device storage., Gym: Space for sport activities., Multi/Waste: separated room for waste, multipurpose if required., Utility: Non-Technical storage room (liquids,food, others), Living: Multiroom for cooking, eating and day to day living., Ops: Working space for EVA communicator / EVA prep.

The Analog Spacesuits are a requirement for EVA operations. The spacesuits act as a personal accessory for the astronauts, in order to provide a livable environment outside of the habitat, and enough safety in lunar environments. The priority is to make them realistic, both in appearance and feel, while still allowing the astronauts to carry out all the activities and experiments required outside of the base. For Asclepios III, the spacesuits have been heavily inspired by the xEMU suits used in the NASA Artemis missions, featuring a rigid upper body frame, with the helmet and back entry hatch integrated into the frame.

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The Mission Control Center is responsible for the continuous monitoring and direction of the mission. 4 Shifts of on-console staff will complete the 24/7 monitoring of the base and astronauts, with 7 different roles. These roles are:

1. Flight Director, who makes all the decisions and coordinate the information in the MCC.
2. CAPCOM, who communicates with the astronauts in base.
3. Biomedical Engineer, who monitors the astronauts' health during the missions.
4. Records, who transcribes everything that happens in the MCC.
5. Science, who coordinates the scientific experiments from the MCC.
6. Flight Plan/Procedures who organizes the astronauts' schedules.
7. Contacts who is the point of contact with anyone external to the mission.

These individuals will oversee the continued monitoring of the mission, including the astronauts physical and mental health, activities scheduling, experiments, and environmental conditions of the base, while directing the simulated events and maintaining external contact with journalists, investigators and visitors. MCC members are chosen from Asclepios members from all teams and trained in the use of communications software, procedures and other skills required for the correct development of the mission. Further details about the Mission Control Center will be given in the "Asclepios as a unity" section.

Communication Team

The Communication team's main responsibilities are to oversee media relations, outreach events, social media, and the website management. Asclepios has its own independent social media accounts that are continuously maintained to be at high standards, in order to raise the publicity of the organisation. The Instagram and Facebook platforms were used to entertain the public and share daily and weekly updates, while the LinkedIn platform was focused on branding and communication over official information. Scheduling and analytics tools were used to predict audience behaviour and extend the Asclepios II outreach. The only official language used for communications was English, considering the Asclepios public's internationality.

The Asclepios website is frequently updated with the news of the organisation. The changes are done by following the patterns, colours, fonts, and aesthetics that will potentially attract more people to get involved with the organisation. Google Analytics tracked the audience's preferences and improved the website's content. The website was translated into English, French, and German, to improve accessibility to information. As learned from prior Asclepios missions, outreach events are imperative when working in space science outreach and divulgation. Different events were planned according to the objective public. Part of the events the project took part in:

- CHASM Conference: conference in Pila, Poland, resembling analog astronaut missions from all around the world.
- Fantasy Basel: stand about the Asclepios II mission during the Fantasy Basel event, in Basel, Switzerland, marking the continuation of the collaboration between Asclepios and the Swiss Space Museum.
- EPFL Industry Roundtable: "Space careers: a galaxy of opportunities": conference in Lausanne, Switzerland, informing targeted EPFL students of the opportunities to volunteer in the organisation.

These are some of the exposures that Asclepios Mission III had so far in events along with other several media and social media exposures to raise the credibility of the mission. The Communication team is responsible along with the management team to promote crowdfunding through the platforms of the organisation as well as through direct communication with emails with potential donors. Finally, the team will be in direct collaboration during the mission with the crew in order to instruct them and guide them on how they can create the necessary videos to show their everyday lives through social media platforms.

Management Team

The management team of Asclepios is the backbone of the organization and ensures the realization of its mission through the achievement of key organizational tasks. These tasks include: fundraising, accounting, handling relationships with third

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parties, allocating resources, legal supervision, and coordinating logistics. Since the beginning of our third mission, the team has been led by a Head of Management.

In the past two Asclepios missions, the Management team was directly handled by the Project Leaders. However, the lessons learned [2], highlighted the need for a new distribution of responsibilities that would allow the Project Leaders to focus less on sponsorship tasks and more on their coordination role. Therefore, the introduction of a new, complementary, Head of Management role enabled the Project Leaders to concentrate on tasks such as team coordination, timeline management, setting milestones, and making key decisions regarding the mission's design.

The most notable improvement of the Asclepios III mission was the implementation of a precise funding strategy. To cover an estimated budget of approximately 195,000 CHF (data from September 2022), which included a 10% contingency margin, a detailed sponsorship timeline was established. The strategy was presented to the team in September 2022 during the Preliminary Design Review (PDR). An overview of the fundraising strategy was updated and presented during the Asclepios Qualification Design Review (QDR) in May 2023. The summarized strategy is outlined below:

1. Until March 2023: The team conducted research to identify foundations or major sponsors that could contribute a significant portion of the required budget, alongside parallel research for minor sponsors. Major sponsors were contacted through formal applications and established channels, while minor sponsors were engaged using a well-prepared "ready-to-use" strategy that could be utilized by any team member. Sponsorship packages were designed to capture the attention of potential sponsors, with a particular focus on the mission's international media visibility. It is worth noting that sponsors had the option to contribute in cash or in-kind (services or goods) donations, and the sponsorship packages could be tailored to their preferences.

2. Since March 2023: Alongside the ongoing research for minor sponsors, a crowdfunding campaign was initiated and launched in May 2023. Learning from the lessons of Asclepios II, the crowdfunding campaign was hosted on an international platform and translated into five languages to reach a broader audience. The campaign sets a realistic goal of 6,000 CHF, which would allow for the conversion of a portion of the most urgent expenses. The crowdfunding was promoted through targeted communication strategies on Asclepios' social media channels and lasted for 45 days.

Throughout the year, budget cuts were still necessary to align with the outcomes of the funding strategy. During the Asclepios QDR, the total budget collected by the team amounted to approximately 90,000 CHF, against a newly estimated budget of approximately 120,000 CHF.

Asclepios as a unity

During the Asclepios Mission, the Mission Control Center (MCC) plays a vital role in monitoring and supporting the crew members throughout their activities. The MCC serves as the central hub for communication, coordination, and data analysis. It is staffed by a team of Asclepios members who have been trained, and who work together to ensure the smooth operation and safety of the mission.

The MCC of the Asclepios Mission incorporates various roles inspired by NASA and ESA. These roles are crucial for the smooth operation and safety of the mission, involving constant communication, coordination, and monitoring of the crew members.

1. Flight Director: The Flight Director is responsible for overseeing the entire mission and making critical decisions. They provide guidance, set objectives, and ensure the overall success of the mission. This role is inspired by NASA's Flight Director.
2. CAPCOM (Capsule Communicator): The CAPCOM serves as the primary point of communication between the MCC and the crew members. They relay instructions, updates, and support from the MCC to the crew members and vice versa. The CAPCOM role draws inspiration from NASA's CAPCOM position.
3. Procedures/Flight Plan Specialist: This specialist is responsible for maintaining and executing the mission's procedures and flight plan. They ensure that all activities are carried out according to the established protocols and guidelines. This role aligns with the responsibilities of the Flight Operations Directorate at NASA.

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4. Science Specialist: The Science Specialist focuses on the scientific aspects of the mission. They provide expertise in relevant research areas, monitor scientific experiments, and assist the crew members in conducting their scientific tasks. This role is similar to the NASA Science Officer position.
5. BME (Biomedical Engineer)/Flight Surgeon: The BME/Flight Surgeon plays a crucial role in monitoring the crew members' health and well-being. They assess physiological data, provide medical support, and are trained to handle potential medical emergencies. This role is inspired by NASA's Flight Surgeon position.
6. RECORDS: The RECORDS role is responsible for maintaining accurate records and documentation related to the mission. They ensure that all relevant information, data, and reports are properly recorded and organized.
7. CONTACT: The CONTACT role handles external communication for the MCC. They manage interactions with stakeholders, authorities, and external teams, ensuring effective communication channels are established.

By incorporating these roles, the MCC of the Asclepios Mission effectively supports the crew members throughout their activities, ensuring their well-being, communication, and overall mission success.

At all times during the mission, 24/7, there are at least three individuals present in the MCC. One of these individuals is a trained Biomedical Engineer specializing as a Flight Surgeon. The BME/Flight Surgeon is responsible for monitoring the crew members' health and well-being, assessing their physiological data, and providing medical support if needed. They have expertise in aerospace medicine and are trained to handle potential medical emergencies that may arise during the mission. Mission Control Center members are students who have participated in the preparation of the mission for the entire school year. They have been trained on the different communication protocols meant to ensure a safe and efficient communication.

Interaction between the MCC and the crew members is established through a reliable and secure communication system - a software called Mumble. This system allows for two-way communication, enabling crew members to report their status, ask questions, or seek guidance from the MCC. Likewise, the MCC can provide instructions, updates, and support to the crew members as needed. The software has a “chat” function, but also allows for video calls for the daily briefing and debriefing, where the objectives for the day are set up, and discussed, respectively.

In the event of an emergency, the MCC is equipped to provide immediate assistance and guidance. They can quickly assess the situation, coordinate with relevant personnel or authorities, and initiate necessary actions to ensure the safety and well-being of the crew members.

During the entire duration of the crew's activities, the Mission Control Center maintains constant visual contact of the crew members through cameras installed in the base. These cameras serve as the eyes of the MCC, allowing them to have real-time visibility and monitoring of the crew's activities and well-being. The MCC personnel closely observe the camera footage, paying attention to any potential safety risks, anomalies, or signs of distress.

The cameras in the base are strategically positioned to provide comprehensive coverage of the crew's work areas, living quarters, and other essential locations while keeping the necessqry privacy. This allows the MCC personnel to observe the crew's movements, actions, and interactions, ensuring their safety and the efficient operation of the mission.

Overall, the MCC serves as a critical support system for the crew members during the Asclepios Mission. Through continuous monitoring, communication, and analysis, the MCC team ensures the crew's health and safety, provides guidance and support, and contributes to the overall success of the mission.

3. Lessons Learned

The successful execution of any mission relies on effectively identifying and managing potential risks. Lessons learned from previous missions have played a crucial role in developing preventive measures and mitigation strategies for the Asclepios analog mission. The implementation of thorough analyses and estimations, involvement of experts, and establishment of contingency funds demonstrate the mission's proactive approach to budget management, drawing from experiences where budget underestimation posed significant challenges. Similarly, aligning project schedules with

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academic calendars, promoting open communication, and prioritizing time management reflect the mission's emphasis on addressing conflicts arising from school-work commitments, a lesson learned from previous endeavours.

Efforts to foster a positive team culture, recognize achievements, and conduct regular check-ins demonstrate the mission's commitment to maintaining high motivation among team members, inspired by past experiences where decreased motivation hindered progress. The establishment of effective communication channels, clear roles and responsibilities, and regular coordination meetings exemplify the mission's focus on addressing coordination issues that have previously impacted similar projects. Furthermore, the emphasis on communication protocols, transparency, and regular updates showcases the mission's proactive stance towards overcoming challenges related to communication.

Diversifying funding sources, building strong sponsor relationships, and developing contingency plans reflect the mission's proactive response to potential funding disruptions, drawing from lessons learned from prior experiences. Additionally, measures to ensure clear communication of expectations, foster a supportive environment, and engage with team members address the risk of members leaving the project, leveraging insights gained from previous missions. The mission also demonstrates preparedness in mitigating risks associated with laboratory or professor withdrawal through maintaining relationships, establishing alternative resources, and effective communication with potential collaborators.

Furthermore, the mission's focus on robust quality assurance processes, regular equipment maintenance, and contingency planning acknowledges the lessons learned from previous technical failures. Similarly, strategies to stay updated with regulations, seek legal advice, and adapt to changes signify the mission's awareness of the potential impact of regulatory changes or legal hurdles. The newly identified risks, such as the lack of EPFL student applications and team members leaving with critical know-how, have prompted the mission to enhance outreach, implement knowledge-sharing practices, conduct regular knowledge transfer sessions, and foster a culture of continuous learning and development.

By drawing on the lessons learned from past missions, the Asclepios analog mission has proactively incorporated preventive measures and mitigation strategies to overcome potential challenges and ensure the mission's continuation and success.

4. Future

. The vision for the Asclepios project over multiple years is to continue its growth and development as an interdisciplinary and international student project focused on organizing space analog missions. Implementing lessons learned in future missions will be steppingstones paving the way towards increasing the realism of the mission The project aims to provide a platform for researchers and companies to test their experiments and prototypes in an analog mission setting, while also serving as a pedagogical tool for students to engage in space-related projects and develop the necessary skillset for a future career in the space industry.

In terms of the project's evolution over the years, there are several aspects to consider. Firstly, the format of the missions is expected to remain consistent, with the project running one mission every year, starting around July and lasting until the end of the next summer. Each mission will focus on a different aspect of space exploration, serving as a topic for the implementation of different projects. The missions build upon one another, allowing for the continuous development and improvement of the project's objectives.

Additionally, the project aims to establish long-term objectives. One of the main long-term objectives is to achieve a fully functional and sustainable space base design, integrating engineering, architectural, and space systems principles. This objective will be realized through the completion of a comprehensive base plan and layout that ensures structural integrity, functionality, and efficient resource management. The project also seeks to develop advanced life support systems that effectively sustain human life in the base, showcasing practical application of both engineering and environmental science expertise.

Furthermore, a key long-term objective is to minimize the ecological footprint of the Asclepios project. This will be achieved by implementing sustainable practices throughout the project, such as utilizing renewable energy sources,

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reducing waste generation, and optimizing resource usage. The team will focus on reducing energy consumption, implementing efficient waste management systems, and adhering to sustainability standards set by ESA and NASA.

In summary, the vision for the Asclepios project over multiple years includes a continued focus on organizing space analog missions, with the evolution of the project's format driven by collaborations with stakeholders. The project has long-term objectives that involve achieving a functional and sustainable space base design, developing advanced life support systems, and minimizing the ecological footprint. Through these objectives, the project aims to contribute to the advancement of space exploration and provide valuable educational opportunities for students.

5. Conclusion

Asclepios has proven to be a valuable platform for simulating space missions, training aspiring astronauts, and conducting research in space medicine, engineering, environmental sciences and sustainability. Through its educational initiatives and student-led space analogue missions, Asclepios has successfully inspired and engaged students and the public in the field of space exploration. By providing hands-on training, educational content, and fostering curiosity and critical thinking, Asclepios aims to cultivate the next generation of space leaders while promoting scientific literacy and innovation.

Asclepios' multidisciplinary approach, encompassing the efforts of the management, medicine, science, design, communication, and analogue astronaut teams along with the dedicated support from the Mission Control Center, demonstrates the organization's commitment to excellence in space exploration. By stimulating education, scientific curiosity, and sustainability, Asclepios not only contributes to the advancement of space research but also inspires a passion for space exploration among students and the wider community. The lessons learned from Asclepios III will undoubtedly shape the future improvements of Asclepios IV, paving the way for further advancements in human-spaceflight research and fostering the new generation of space leaders.

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