Statement of Work

Study on Technology Development in Digital Health Market for Deep Space Exploration Healthcare Needs

Objectives:
The objective of the proposed study is to examine the potential development of digital health solutions in the context of deep space exploration. The study intends to inform decision-makers about priority areas of technology development in areas such as diagnostics, clinical decision support, simulation and training based on their potential to be used in future exploration of deep space and to provide details on important economic benefits that may result from technological development in this area.

Background:
The international space exploration community is in the process of developing plans for the next steps in human space exploration beyond the international space station (ISS)on low-Earth orbit (LEO). These will include missions to the lunar vicinity, the lunar surface, and, later, missions to Mars. As part of this planning process, space agencies are exploring technology areas that could contribute to the success of these missions. The Canadian Space Agency (CSA) intends to be part of this international exploration effort and is exploring contribution options, such as robotics, rovers, telecommunication, and health technologies. The health and well-being of space crews are the primary limiting factors in the achievement of long-duration space missions and is a key area of interest for all ISS partners as they plan the next steps in space exploration beyond the ISS.

The CSA is looking at options for Canadian leadership and technology contributions to support future missions. CSA is interested in assessing the potential to translate investments in deep space healthcare into new knowledge and capabilities that leverage digital technologies in order to empower innovation, value creation and improve the quality of life for Canadians.

Astronauts face multiple health challenges in space, including variable gravity, high radiation, and isolated, confined and extreme environments. Long duration travel into deep space will bring additional challenges, such as communication delays and no possibility for emergency evacuation and resupply. This will require a shift in the astronaut healthcare delivery model, from current reliance on earth-based medical support to an enhanced medical autonomy for the crew. For example, on-board systems will be more intelligent than healthcare delivery systems in any previous spacecraft. Digital information networks will incorporate physiologic crew-worn sensors, clinical decision-support systems and artificial intelligence to assist crew medical officers with the diagnosis and treatment of illnesses.

In a deep space healthcare system, health data collection will consist of diagnostic devices for laboratory analysis (bio-analytics), continuous and periodic crew health monitoring (bio-monitoring), and imaging, as well as tools to capture medical event histories and physical exams. Health data would also include periodic health surveys and self-assessments (fitness, nutrition, behavioural) and environmental data. Data collection should be highly automated, and intuitive, requiring minimal interaction from the crew. Due to power, mass and volume constraints, data sources and devices would serve both health maintenance and research functions. Commercial technologies or those with a commercial potential, would need to be adapted for long-duration spaceflights. For example, miniaturizing a table-top device into a hand-held device, reducing the need for and extending the shelf-life of consumables, and improving ease-of-use.

There are many synergies between space and terrestrial healthcare needs (e.g. remote care, aging populations, military and tactical medicine), as well as synergies in technology trends (e.g. miniaturization, artificial intelligence, digital health, wearable and multi-sensing technologies, advanced bio-analysis, human-machine interactions, genomics and 3D printing). The practice of clinical medicine on Earth also happens to be evolving to become more patient-centric and point-of-care focused similar to

what is envisaged for the care of deep-space astronauts. In addition, advances in personalized or precision medicine promise to transform the delivery of healthcare on Earth and in space. Healthcare both on Earth and in space is evolving from a reactive "one-size-fits-all" system towards a system of predictive, preventive, and precision care. Thus, this new autonomous model for deep space healthcare could potentially be evaluated by health-practitioners working in analogous situations on Earth and by patients being remotely monitored at home.

Innovative point-of-care technologies developed for deep space, such as rapid and automated lab-on-chip technologies, could allow the widespread screening of populations for key predictive markers of diseases, the development of health policies that facilitate associated personalised preventive approaches and the rapid delivery of tailored care if it still becomes needed in spite of preventive efforts. Innovative decision support technologies developed for deep space could, for example, contribute to community self-sufficiency by providing trained nurses in Northern and remote communities with refined clinical decision-making capabilities and reducing the need and cost of medical transportation. Innovative simulation systems for skills maintenance and skills acquisition inflight, could be translated to empower physicians and nurses working in northern regions where access to clinical specialists, biomedical engineers and advanced technologies is limited.

The CSA is interested in supporting industrial innovation and advancing knowledge and technology in support of space and terrestrial healthcare delivery challenges. The purpose of this study is to help the CSA better understand the state of the digital health market in Canada as well as the potential impact of space investments on the companies and on advancing technological innovation. The information from this study will allow the CSA to make strategic investment decisions that will support a potential Canadian leadership role in deep space healthcare while contributing to the improvement of healthcare delivery on Earth.

Scope and Timing:
This study will consist of a literature review and industry profile; categorization of technologies or services; development and application of a clear methodology to assess the feasibility and potential for digital health technologies to be further developed for space use, as well as the economic impact potential of selected technologies or services; consultations with private sector companies, government departments or other organizations as required; analysis and recommendations of select priority technologies or services; and reporting on findings.

The study will be conducted over a period of 7 months from the award date of the contract.

In recognition of the health-focus of this study and the advantages of a multi-disciplinary team with knowledge of the healthcare system and the digital health market, the CSA would like to facilitate partnerships between the selected suppliers and experts in the healthcare field. The CSA will therefore send out an email to our distribution list of individuals or companies interested in the field of space health, in order to encourage interested experts to contact selected suppliers directly if they would like to collaborate. Selected suppliers may contact CSA for a copy of our distribution list.

Tasks:
Task 1 (Deliverable 1) – Kick-Off Meeting
- Set the agenda for the meeting with CSA
- Prepare a presentation to discuss objectives, timeline and next steps; highlight any requirements for data or otherwise (e.g. literature review recommendations) from CSA
- Take meeting notes and send to Project Authority for approval

Task 2 (Deliverable 2)- Conduct literature review and develop an industry profile of the digital health market in Canada, with a particular focus on point-of-care diagnostics, clinical decision support, and simulation and training industry segments. The literature review should include:
- Industry sector profile (e.g. geographic distribution, number of companies, large vs. SME distribution, key companies, networks and associations)

- Types of technology or services (categorized into spreadsheet or a table)
- Technology trends (e.g. miniaturization, automation, augmented and artificial intelligence, robotics)
- Challenges faced by companies in this sector (e.g. access to venture capital, regulation barriers, technology adoption issues)
- Market size and forecasting; Canada in the global context

Task 3 (Deliverable 3) – Develop a methodology report and conduct consultations

- Develop a methodology to inform the analysis discussed in Task 4, below (e.g. potential returns on investment, baseline vs. projected scenarios for industry earnings, input-output tables or other methods to be discussed with Project Authority).
- Develop a list of potential interview or survey candidates.
- Develop a consultative document (survey questionnaire and/or interview guide).
- Conduct interviews as required using pre-approved contact list and consultation document.

Task 4 (Deliverable 4) – Analysis and Progress Report

- Using the categorization of technologies developed in Task 1 for each of the three industry segments (point-of-care diagnostics, clinical decision support and simulation and training), analyse:
    - Feasibility and Potential for Space Health Technology Development:
        - Analyse and describe the importance of / link between each category of technology or service stream and priority space health challenges. Information on space health challenges will be provided by the CSA at the beginning of the contract.
        - Assess the current maturity of the technology or service and the expected level of innovation required to meet space healthcare needs (including interest of companies to invest internal R&D).
        - Describe existing ecosystem support for companies (e.g. availability of financing and other support programs) and analyse opportunities to leverage these support mechanisms for space healthcare investments.
    - Potential Economic Impacts:
        - Analyse impacts of space healthcare investments on company global positioning, commercial returns and jobs, export potential, and diversification of domestic market (e.g. new products and services in the space sector or in terrestrial market).

- Provide Project Authority with a Progress Report detailing progress with the analysis and initial findings or gaps in the analysis.

Task 5 (Deliverable 5) - Draft Report

- Integrate findings and results from Tasks 1-4 (literature review and methodology report may be considered in an annex)
- Provide recommendations for technology investment priorities
- Include an executive summary
- Include references for statements made (e.g. interviews, data sources, background documents); include methodology details or assumptions on economic impact figures
- Provided as a text document (.docx)

Task 6 (Deliverable 6) - Final Report

- Integrate comments from CSA Review Team and Project Authority into a final report

Task 7 (Deliverable 7) - Presentation

- Develop a draft presentation with key results and findings for review and approval by Project Authority
- Deliver presentation at CSA in-person (6767 Route de l'Aéroport, St-Hubert, Quebec).
- Identify problems encountered with data collection process or other aspects of the study; provide guidance on further studies required to improve understanding on subject matter

Deliverables and Milestones:

Task #	Deliverable	Description	Anticipated Milestone
1	Kick-Off Meeting	Meeting with Project Authority to be held at CSA (6767 Route de l'Aéroport, St-Hubert, Quebec). Submit meeting agenda and presentation to facilitate meeting; meeting minutes.	July 5th, 2019
2	Literature Review	Submit Task 2 document and technology categorization table to Project Authority for review.	August 9th, 2019
3	Methodology Report and Consultations	Submit list of companies targeted for consultation; consultation guide; anticipated methodology for analysis and technology investment recommendations	September 6th, 2019
4	Analysis and Progress Report	Submit progress report	October 4th, 2019
5	Draft report	Submit draft report that includes Tasks 1 to 4 for review.	October 25th, 2019
6	Final report	Submit final and complete study report (.docx for text, .xlx for tables). Must consider CSA comments and get CSA approval prior to completion; provide summary transcripts or raw data from consultations, TBD with Project Authority.	November 29th, 2019
7	Presentation	Submit draft presentation detailing conclusions and recommendations. Deliver the presentation to CSA (6767 Route de l'Aéroport, St-Hubert, Quebec).	December 10th, 2019