Data Collection Survey on Utilizing Inner and Outer Space of Mongolia

REPORT

By Digital Transformation Promoting Association of Mongolia (DX Mongolia)

INDEX

ABBREVIATION

Organizational Names

JICA	Japan International Cooperation Agency
JAXA	Japan Aerospace Exploration Agency
RESTEC	Remote Sensing Technology Center of Japan
JSS	Japan Space Systems
NUM	National University of Mongolia
MUST	Mongolian University of Science and Technology
IRIMHERSD	Remote Sensing Division, Information & Research Institute of Meteorology, Hydrology and Environment
JUIDA	Japan UAS Industrial Development Association
NESTRA	Next Generation Space Systems Technology Research Association
CAAM	Civil Aviation Authority of Mongolia
MDDC	Ministry of Digital Development and Communication
MEDS	Ministry of Education and Science
MUB	Municipality of Ulaanbaatar
NEMA	National Emergency Management Agency
MCUD	Ministry of Construction and Urban Development
MOFALI	Ministry of Food, Agriculture and Light Industry
MET	Ministry of Environment and Tourism
ALAMGC	Agency for the Land Administration and Management, Geodesy and Cartography

Others

EO	Earth Observation
IoT	Internet of Things
RS	Remote Sensing
SATREPS	Science and Technology Research Partnership for Sustainable Development

1. INTRODUCTION

Background

Mongolia, with a total land area of 1.5 million sq.km and a population of 3.3 million people, faces unique challenges and opportunities regarding information communication technology (ICT) and satellite utilization. While over half of the population resides in the capital city, Ulaanbaatar, which covers an area of only 4,704 sq.km, the remaining population is spread across 21 provinces, occupying the rest of the vast 1.559 million sq.km. With Mongolia facing challenges to promote technological development and recognize the potential for growth in the ICT sector and satellite utilization within this expansive territory, the Government of Mongolia aspires to realize its vision of becoming a "Digital Nation" by incorporating this goal into its long-term development policy, "Vision-2050", and actively promoting digital transformation initiatives.

The Government of Mongolia approved the "Mongolian National Satellite Program" in 2012, which aims to promote outer space technologies, international cooperation and human resource development. Recently, the Minister of Digital Development and Communications has approved the Action Plan 2022-2027, which sets a goal to develop satellite technology as one of its measures to ensure infrastructure preparedness. Specifically, the Government aims to

1) develop a legal environment conducive to satellite technology,
2) build and launch a microsatellite into space orbit through experimentation and human development,
3) launch an observation satellite into space orbit to explore its potential utilization in various fields such as meteorology, disaster management, agriculture, mining, and urban development and,
4) launch a national satellite into geostationary orbit and create opportunities for accessing telecommunication services from anywhere.

As mentioned in the Action Plan 2022-2027, utilizing satellite data could address the country's increasing challenges in disaster risk management, agriculture and stock raising industry, forest preservation, etc. thus contributing to its economic growth and sustainable development. Moreover, Mongolia has a potential to promote tourism and educational human resource exchange by introducing appropriate legal framework and implementation for inner space utilization, as other countries with dense populations tend to have strict systems.

Objectives of the Survey

1) Analyze Mongolia's current situation, legal environment, policy, organizational framework and institutions, cooperation, education and human resource development.
2) Utilizing inner and outer space for Mongolian economy.
3) Identifying the potential of JICA's possible cooperation in the sector.
4) Organizing Japan - Mongolian Aerospace symposium to determine and seek real solutions for mutual interest and eco social impact.

2. CURRENT SITUATION

Legal Environment

1) The Law on Communication (1995)
The Law on Communication was amended to the Regulatory Commission by the Law dated October 18, 2001, and updated through the years up until 2023. The purpose of this Law is to regulate relations related to establishing, using and protecting communication networks in Mongolia, promoting efficient and fair market competition and providing citizens and legal entities with qualified product and services of information and communication technology. [1]

2) The Law on Radio Wave (1999)
The Radio Frequency Regulation and Monitoring Office was amended to the Regulatory Commission by the Law dated November 30, 2001, and updated through the years up until 2023. The purpose of this Law is to regulate relations concerning allocation, use, protection, own and possess radio waves. [2]

Policy and Programs

1) The Mongolia National Satellite Project
The project was approved by the Government of Mongolia in 2012 and the following activities have been carried out within the implementation of the current program:
   a) The basic survey on "Feasibility study on launching communication and remote sensing satellite" was conducted in 2011-2012, which defined current situation and future needs and requirements for remote sensing and communications satellite, possible options and related cost estimation for Mongolia to launch a satellite individually or jointly.
   b) ITPTA has conducted satellite technology research, which meets the needs and requirements of Mongolia and introduced stakeholders, which expressed interest in cooperating in this area to the National Security Council and the Government of Mongolia.
   c) ITPTA has submitted the request for orbital position for Mongolian national satellite to ITU. As a part of building capacities of domestic universities to prepare national specialists, the preparatory works have started to introduce a master degree program on Satellite communications in 2016 at the School of Information and Communications Technology (SICT) of the Mongolian University of Science and Technology (MUST) and a master degree program on Space engineering at the School of Applied Sciences and Engineering of the National University of Mongolia (NUM).
   d) As a part of the program to support universities and academic research institutions to develop small research satellites, the national competition to design and launch "CANSAT" satellite has been organized in the last three years. It's planned to cooperate with APSCO and organize this competition at the international level.

2) The Sustainable Development "Vision 2030"
"Vision 2030" was approved by the Mongolian Parliament in 2016. 2.1.5 3rd stage in 2026-2030 and aims to launch and utilize National Communication Satellite

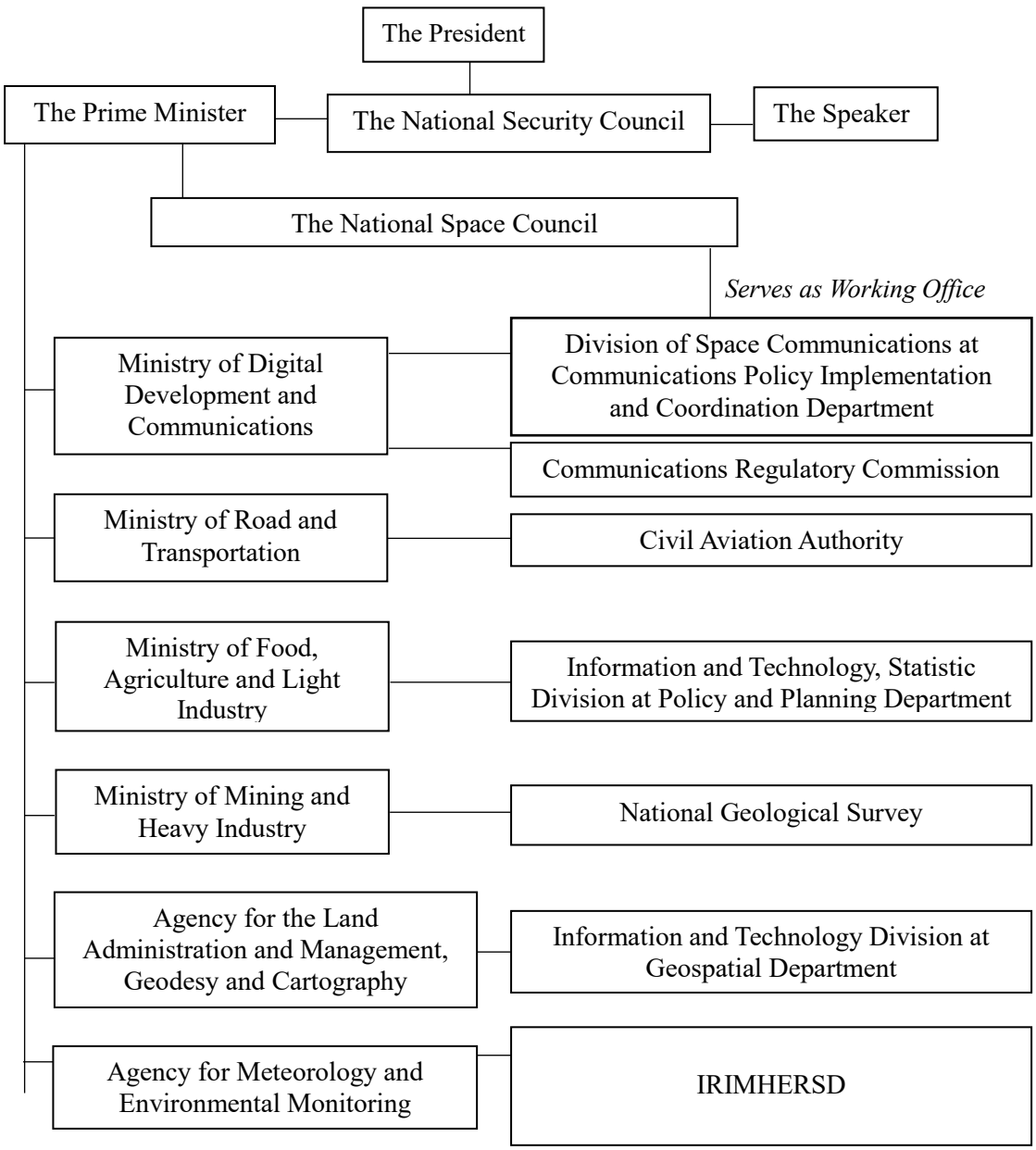
3) Government Action Plan 2016-2020

[1] https://legalinfo.mn/m[1]n/detail/523
[2] https://legalinfo.mn/mn/detail/443

Approved by the Parliament 3.2.40, the Action Plant aims to implement the National Communication Satellite Project and establish the national telecommunication network connecting terrestrial and satellite, protecting information security.

4) Action Plan 2022-2027 by MDDC
The Action Plan 2022-2027 aims to set a goal to develop satellite technology as one of its measures to ensure infrastructure preparedness. Specifically, the Government aims to:
a) Develop a legal environment conducive to satellite technology,
b) Build and launch a microsatellite into space orbit through experimentation and human development,
c) Launch an observation satellite into space orbit to explore its potential utilization in various fields such as meteorology, disaster management, agriculture, mining, and urban development and
d) Launch a national satellite into geostationary orbit and create opportunities for accessing telecommunication services from anywhere.

Mapping Related Organization



1) The National Space Council
   The National Space Council has been reestablished under the order of The Prime minister on 4th April, 2022 to develop space studies and technology, determine unified policy for the Government, coordinate cross field process, and support professional insights by reforming the members and its regulation. The members consist of Minister of DDC as a Director, Minister of ES and Space Astronaut as vice directors, State secretary of MDDC as a General secretary, and other related representatives of the ministries, agencies, universities and private companies.[3]
2) Ministry of Digital Development and Communication (MDDC)
   Division of Space Communications at Communications Policy Implementation and Coordination Department at MDDC, who has only official history tackling with space related issues since 2012, mainly focusing on National space policy and Communication Satellite project, but the remote sensing application is implemented by each sector's ministries and agencies.

   The National Space Council has no working office, instead State secretary of MDDC is appointed as a General Secretary of the Council, Division of Space Communications at Communications Policy Implementation and Coordination Department works as a working office and Minister of MDDC as a Director. Thus, MDDC and its Division of Space Communications should be an official responsible organization for space policy and international cooperation.[4]

3) Ministry of Food, Agriculture and Light Industry
   Information and Technology, Statistic Division at Policy and Planning Department, has been developing 2 systems in regard of using satellite data. Under "Sustainable Fodder Management Project" supported by ADB, has developed Decision Support System (DSS) using open source satellite data provided by IRIMHERSD's database, which can determine;
   a) Colored picture
   b) Pasture index
   c) Biomass, deviation
   d) Percentage of snow cover
   e) Livestock
   f) Feed
   g) Grazing capacity and capacity
   h) Layers
   i) GPS tracking device
   j) Email subscription[5]

   Under raising efficiency in livestock and agriculture for the economy project with the support of The World Bank, has implemented Precision agriculture for development as a pilot project, placing 90 IoT sensors in the area of 10 enterprises. The project utilized meteorological data, high resolution commercial satellite data and IoT sensor data for soil moisture, fertilizer, rain etc.[6]

4) Agency for the Land Administration and Management, Geodesy and Cartography

---

[3] https://mmhi.gov.mn/wp-content/uploads/2022/06/%D0%94%D1%83%D0%B3%D0%B0%D0%B0%D1%80-48.pdf

[4] https://mddc.gov.mn/eng/%d0%b1%d0%b0%d0%b9%d0%b3%d1%83%d1%83%d0%bb%d0%bb%d0%b0%d0%b3%d1%8b%d0%bd-%d1%82%d2%af%d2%af%d1%85-2/

[5] www.fodder.mofa.gov.mn www.dss-mongolia.org

[6] http://smartagro.mofa.gov.mn/

(ALAMGC)
Information and Technology Division at Geospatial Department's purpose is to implement spatial information and technology issues or location-based spatial information management and a unified policy, to support social and economic policies, planning and decision-making through basic spatial information and services in nationwide, and to disseminate them to the public.

The organization's main functions are:

a) To ensure the normal, safe and reliable operation of organizational and local networks, hardware, software and systems by introducing advanced information technology and geographic information system solutions in the sector;
b) Integrate spatial information based on geodetic and cartographic themes based on thematic maps, land management, construction, urban development, and land cadaster in accordance with the unified database standard and to establish a distribution system with easy access and search for location-based spatial data and information by building the organization's spatial data infrastructure;
c) Establish a system of policies, legal frameworks and standards related to the collection, processing, storage, protection, dissemination and use of location-based spatial data and information;
d) Ensure innovative, secure, quality, availability, dissemination and transparency of location-based spatial information and services by expanding cooperation with location-based spatial data providers and user organizations, and providing integrated management of spatial databases.[7]
e) Also, has been developing a database platform for the usage of mainly land surveying.[8]

5) Agency for Meteorology and Environmental Monitoring
Remote Sensing Division (RSD) at Information and Research Institute of Meteorology, Hydrology and Environment. RSD receives and analyses real-time data and images from Polar Orbiting Satellites such as MODIS, VIIRS, and NOAA series and the Geostationary Meteorological satellite FY2C. The satellite data and Geographical Information System are used for service as determining and Imaging the actual status of LST, NDVI, snow and vegetation cover, forest and steppe wildfires. The Mongolian Data Cube contains surface reflectance imagery from Sentinel-2, Landsat 8, MODIS and VIIRS. Month long and 10 day indices (NDVI, NDSI, NDWI, NDDI) are also produced within the Data Cube. Using these indices, final products are being generated for determining pasture biomass, pasture anomaly, pasture trend and snow coverage.[9]

6) National Emergency Management Agency (Government Regulatory Agency)
The mission of National Emergency Management Agency (NEMA) of Mongolia is to ensure national security, state social and economic sustainable development, and safe enjoyable life conditions for the people of Mongolia through protecting and preventing the population and their property, ecosystem, cultural value and historical monuments from potential hazards, reducing disaster risks, ensuring public participation in disaster management activities, expanding multilateral cooperation as well as developing disaster research.

Division of Information Technology

[7] https://en.gazar.gov.mn/p/oron-zajn-medeelel-tehnologijn-heltes
[8] https://nsdi.gov.mn/
[9] https://namem.gov.mn/eng/ http://www.icc.mn/

Division of Information Technology has been developing a feasibility study for developing Emergency Rescue Command Platform for comprehensive aggregation, scientific decision-making system; consist of existing satellite data platforms and new sub systems totaling 12. A total of 44 hazard, vulnerability, exposure and capacity indicators linked to the "Space Observation Information and Technology Platform for Real-Time Information and Situation Monitoring" were identified in collaboration with NSO, NEMA, MOFALI, NAMEM, and NAMEM Remote Sensing.[10]

Cooperation with International Organizations

1) Asia Pacific Telecomunity's "*HRD Programme for Exchange of ICT Researchers and Engineers*"
Space Technology Mongolia- Japan joint Forum-Exhibition was held in Ulaanbaatar in 2012, with participation from Japanese Space related organizations, companies and researchers. Research study tour to Japan included activities for visiting and discussions at KDDI foundation regarding International Telecommunication Union's "ITU-RRB" activities, MIC JAPAN regarding policy and current situation, ITU activities, NICT Kashima, JSAT, JAXA Sagamihara, KIT presentation, NEC Sagamihara. [11]

2) Cooperation with French Company Thales Alenia Space
Ulaanbaatar, 13th October 2023 – A landmark agreement to construct a Mongolian national satellite telecommunications system has been reached which will strengthen the strategic partnership between Mongolia and France and boost connectivity for all Mongolians.

The partnership agreement between Thales Alenia Space, a major European satellite specialist, and the Mongolia Ministry of Digital Development and Communications, has been signed in the presence of the President of Mongolia, H.E. Mr. Ukhnaagiin Khürelsükh and the President of France, Mr. Emmanuel Macron, during the Mongolian President's state visit to France.

Thales Alenia Space will be responsible for construction of a high-performance Ku Band satellite, to be named "Chinggis Sat" after Mongolia's national hero Chinggis Khan. Once launched, the satellite will make high-speed internet available throughout Mongolia, including to those in rural areas and underserved nomadic communities, enabling easier and wider access to services such as telemedicine, e-learning, e-government services and supporting the growth of high value add sectors of the economy.[12]

3) Possible Cooperation with Space X to launch Mongolian National Satellite
February 8th (Reuters) - The Mongolian government said on Thursday it is in talks with Elon Musk's SpaceX to launch the country's first national telecommunications satellite, its latest move to improve connectivity and develop its "domestic space economy."

The satellite, currently being constructed by French company Thales Alenia Space, is tasked with improving Mongolia's disaster management and emergency response, increasing broadband internet access and supporting its scientific research and education among other purposes, the government said in a statement.

---

[10] http://en.nema.gov.mn/
[11] https://www.apt.int/sites/default/files/140324_APT_ReportMongol-rev8_0.pdf
[12] https://www.thalesaleniaspace.com/en/press-releases/new-satellite-agreement-strengthen-strategic-partnership-between-france-and-mongolia

"Launching our own satellite marks a defining moment for Mongolia's journey towards becoming a spacefaring nation," Mongolia's Minister of Digital Development and Communications Uchral Nyam-Osor said in the statement. "It signifies Mongolia's commitment to fostering a thriving domestic space industry and its pursuit of a digital future driven by cutting-edge innovation," Nyam-Osor added. The talks came after Mongolia granted two licenses for SpaceX to operate as an internet service provider using low-orbit satellites last year, which would enable millions of internet users in the country to access high-speed connection via Starlink. "SpaceX's investment in Mongolia demonstrates the confidence they have in the digital transformation and sustainable development programmes at the Centre of Mongolia's New Recovery Policy and Vision-2050," Nyam-Osor said. Starlink services in Mongolia are expected to be available from late February. The satellite communications service operated by SpaceX has built a fast-growing network of more than 3,500 satellites in low-Earth orbit that can provide connectivity in remote areas.[13]

4) APSCO（Asia-Pacific Space Cooperation Organization）
The Asia-Pacific Space Cooperation Organization (APSCO) headquartered in Beijing was inaugurated in 2008 as an inter-governmental organization. APSCO provides a cooperative mechanism for developing countries in the region to be able to mainstream peaceful use of space as a drive of development. By resource sharing in space science, space technology and space application, APSCO promotes multilateral cooperation to facilitate capacity building of its members which includes: Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey; Signatory State Indonesia, Observer State Mexico.

Ratification of Mongolia to APSCO
Deposit of instrument with the Government of China: 6 July 2006
Date of effect: 12 October 2006
Registration with the Secretariat of the United Nations: China, 10 April 2007[14]

So far, Mongolian Academy of Sciences, NEMA, National Agency for Meteorology and Environmental Monitoring and NUM are members of the APSCO.

Education and Human Resource Development

1) National University of Mongolia (NUM)
Master course for Space Studies at Department of Physics of School of Arts and Science has been established at NUM.[15]

2) Mongolian University of Science and Technology (MUST)
MUST has no space curriculum yet. However, it has conducted space environment research using balloon and drone in cooperation with Japanese organizations. Participants are from Fukuoka University: Masahiko Hayashi, Katsumi Saga, from Kyushu University: Sin-Ichiro Higashino, from JAXA: Kazuhiko Yamada.

Mongolia's Characteristics and Advantage for Inner and Outer Space Projects

1) Fast and Flexible Communication Permission Process
The comparatively ease of communication band regulation and satellite operation license,

[13] https://www.reuters.com/technology/space/mongolia-talks-with-spacex-launch-first-national-satellite-2024-02-08/
[14] https://treaties.un.org/doc/Publication/UNTS/Volume%202427/v2427.pdf
[15] https://sas.num.edu.mn/

and Mongolia's commitment to democratic principles further solidifies its appeal to investors, ensuring a stable and supportive environment for the proposed ground station project.

Recent examples of above can be seen in the event that MDDC has given Starlink company communication license of A and B together, which is rare situation around the world.

The other example was MDDC has applied amateur (433Mhz) communication license to International Telecommunication Union (ITU), who allocates global radio spectrum and satellite orbits, develop the technical standards, for ONDO Space's IoT communication satellite within short period of time. This radio spectrum allocation filing process is normally very time consuming with Japanese authority, as there are plenty of application in Japan.

2) Environmental Factors
   a) Landscape Diversity
      Mongolia's ecosystem includes vast steppes, rugged mountains, expansive deserts, and dense forests, offering diverse terrain for drone exploration.
   b) Temperature Extremes
      Mongolia experiences extreme temperatures, with cold winters and hot summers. Winter temperatures can drop well below freezing, while summer temperatures can exceed 30°C in some regions.
   c) High Altitudes
      Mongolia's average elevation is among the highest in the world, averaging 1,580 meters with much of the country located at altitudes above 1,000 meters.
   d) Windy Conditions
      Mongolia is known for its windy conditions, especially in the spring and winter months. Wind speeds can vary widely across the country, with gusts reaching up to 40-50 km/h (25-31 mph) or higher.
   e) Sandstorms and Dust
      Mongolia's arid and semi-arid regions are prone to sandstorms and dust storms, especially during the spring months.
   f) Air Quality
      Mongolia's air quality can be impacted by dust and particulate matter from desertification, mining activities, and urban pollution.
   g) Limited Precipitation
      Mongolia has low precipitation levels, particularly in the central and southern regions, resulting in dry conditions for much of the year.

      Overall, testing drones and flying cars in Mongolia's atmospheric conditions offers unique challenges and opportunities. By carefully planning and adapting testing protocols to account for temperature extremes, high altitudes, wind, dust, and other factors, researchers and developers can gain valuable insights into the performance and reliability of aerial vehicles in diverse environments.

3) Cultural and Legal Considerations
   Mongolia has regulations governing drone flights, including restrictions on flying near airports, military installations, and cultural heritage sites.

   a) Remote Access and Safety
      Many areas in Mongolia are remote and inaccessible by road, making drones valuable tools for aerial surveys, search and rescue operations, and environmental monitoring.

b) Environmental Conservation and Wildlife
Drone technology can support environmental conservation efforts in Mongolia, including monitoring vegetation health, mapping land use changes, and assessing the impact of human activities on ecosystems. Mongolia is home to diverse wildlife, including migratory birds, endangered species like the snow leopard, and livestock such as horses, camels, and yaks.

Overall, flying drones in Mongolia's ecosystem offers exciting opportunities for exploration, research, and conservation. By respecting local regulations, environmental sensitivities, and safety considerations, drone operators can contribute positively to the understanding and protection of Mongolia's unique natural heritage.

3. DATA COLLECTION FROM RELEVANT ORGANIZATIONS

Challenges and Limitations

1) Policy factors
The Government of Mongolia has the policy to classify the data of any space and geography related fields. Thus, we have implemented hearing with each representative directly.

2) Time constraints
Due to the very short time of 2 months and vacation season for both countries it was hard to get appointments for all relevant organization meetings. Thus, we would prefer them to participate in the Symposium to get the closed data and insights

Data Collection from Relevant Organizations

1) Meetings with relevant ministries and agencies in Mongolia
a) Ministry of Digital Development and Communications (MDDC)

Date	Person and position	Output
19 Feb	Baybayar Vandansambuu Acting Director Division of Space Communications at Communications Policy Implementation and Coordination Department at MDDC	Division of Space Communications at Communications Policy Implementation and Coordination Department at MDDC, has only official history tackling with space related issues since 2012, mainly focusing on National space policy and Communication Satellite project, but the remote sensing sector was relied in each ministries and agencies Since the State secretary of MDDC appointed as a General Secretary of the National Space Council, and Division of Space Communications works as a working office, they should be officially responsible to be a counterpart organization for space policy and international cooperation. Division has only 4 personnel. They need support on developing national space policy and capacity building for any space related field.

b) Agency for the Land Administration and Management, Geodesy and Cartography

Date	Person and position	Output
15 Feb	Nyamdavaa Purevjav Head of Information and Technology Division at Geospatial Department	Information and Technology Division at Geospatial Department's purpose is to implement spatial information and technology issues or location-based spatial information management and a unified policy, to support social and economic policies, planning and decision-making through basic spatial information and services in nationwide, and to disseminate them to the public. Also, has been developing a database platform for the usage of mainly land surveying. Division has only 6 personnel.

		They need precise satellite data and data sharing with other agencies that use them. To do that the Government need new law and policy on the usage of the satellite data. Capacity building is also crucial part.

c) IRIMHERSD

Date	Person and position	Output
15 Feb	Lkhagvadorj Nanzad Remote Sensing Division at Information and Research Institute of Meteorology, Hydrology and Environment	IRIMHERSD receives and analyses real-time data and images from Polar Orbiting Satellites such as MODIS, VIIRS, and NOAA series and the Geostationary Meteorological satellite FY2C. The satellite data and Geographical Information System are used for service as determining and imaging the actual status of snow and vegetation cover, forest and steppe wildfires. The Mongolian Data Cube contains surface reflectance imagery from Sentinel-2, Landsat 8, MODIS and VIIRS. Month long and 10 day indices (NDVI, NDSI, NDWI, NDDI) are also produced within the Data Cube. Using these indices, final products are being generated for determining pasture biomass, pasture anomaly, pasture trend and snow coverage. Current open source data of 10m is not enough for higher determination such as land disputes, which is requested by Police. Center has only 8 personnel. They need higher resolution data and capacity building for advanced remote sensing technologies.

d) Ministry of Food, Agriculture and Light Industry

Date	Person and position	Output
21 Feb	Batsaikhan Jargalsaikhan Head of Information and Technology, Statistic Division at Policy and Planning Department	Under Sustainable fodder management project with the support of ADB, has developed Decision Support System (DDS) using open source satellite data provided by IRIMHERSD's database. Under raising efficiency in livestock and agriculture for the economy project with the support of The World Bank, has implemented Precision agriculture a pilot project, placing 90 IoT sensors in the area of 10 enterprises. The project utilized meteorological data, high resolution commercial satellite data and IoT sensor data for soil moisture, fertilizer, rain etc. Division has only 4 personnel. Since they use data from IRIMHERSD, the need for higher resolution data and capacity building for advanced remote sensing technologies is same. And above projects are funded by International

		funds, they need sustainable access and budget to continuous development and improvement.

e) Spatial Data Research Department at The Centre for Policy Research and Analysis of Ulaanbaatar city

Date	Person and position	Output
27 Feb	Enkhjargal Natsagdorj Director of Spatial Data Research Department	This organization is established August 2022. The Department of Spatial data analysis was established with 6 analysts which are director, 2 senior analyst and 3 data analysts. Our analysts are specialized and professional at GIS and Remote sensing. They conducted surveys using satellite data for Public transport accessibility, Sub-center regional analysis, Centralization of schools, criminal analysis and Flood analysis. They need more high resolution data of Digital Elevation Model (DEM) and Digital Surface Model (DSM) for more precise results. Current open data offers 12.5m resolution, which is not good for planning and decision making.

2) Private companies

a) ONDO Space

Date	Person and position	Output
22 Dec	Erdenebaatar Dashdondog Associate Professor at NUM, CIO at ONDO Space	Within 10 months they developed engineering model of half unit of cube satellite for IoT communication satellite, and build 2 flight models at Kyushu Institute of Technology within one week, using their testing machines and clean room environment, since no of these are not available in Mongolia. Their first 2 satellites are expected to be launched with SpaceX on 2nd March, 2024. They need domestic satellite developing environment, capacity building, cooperation with other companies and investment.

b) Sanchir Tech

Date	Person and position	Output
24 Jan	Bat-Ulzii Dashtseren CEO at Sanchir Tech	They have good experience and expertise of 15 years for building IoT devices. Sat IoT Backhaul Service • Lowest connection cost per IoT • OTA configure • Hybrid mode • Very low Power Mode • Private infrastructure ology Service • Limiting power usage in IoT

		• Power-Saving Mode (PSM) • Multiple power sources • Predictive Algorithms • Dual Power and Energy Harvester • IP67 enclosure They need IoT communication satellite in order to utilize their devices throughout the Mongolia. Applications can be from livestock, smart agriculture, disaster presentation and monitoring.

3) Meetings with organizations and experts in Japan

a) Ministry of Economy Trade and Industry (METI)

Date	Person and position	Output
1 Feb	1. Rie Kanauchi Deputy Director (Chief of Taiwan and Mongolia Affairs) Northeast Asia Division, 2. Eimitsu Abe Assistant Director Northeast Asia Division, 3. Takashi Takeda Deputy Director Space Industry Office, 4. Takashi Hiramatsu Deputy Director Space Industry Office	Implementing a training program to prepare Mongolian engineers for employment in Japan's space sector, fostering collaboration and knowledge exchange between the two countries and supporting to establish space industry in Mongolia. Space might be one of the keywords for strategy cooperation.

b) Japan Space Systems (JSS)

Date	Person and position	Output
29 Jan	1. Kazuyo Hirose Director General Satellite Data Solution Division, 2. Tomomi Takeda Chief senior researcher Earth Remote Sensing Department, 3. Tetsushi Tachikawa Vice Director General Research and Development Division	J-SpaceSystems conducts research and development, international cooperation, human resource development, and promotes the utilization of space technology including the Quasi-Zenith Satellite System, 'Michibiki'. JSS has been implementing remote sensing technology short-term internship program for JICA international students. JICA in conjunction with JSS, could implement short training programs in Japan and in Mongolia. Mongolian researchers could apply for HISUI's Hyperspectral data to research variations of the specific vegetation in order to find mining deposits.[16]

c) Japan Aerospace Exploration Agency (JAXA)

16 https://www.jspacesystems.or.jp/jss/files/2021/06/HISUI%E7%A0%94%E7%A9%B6%E5%85%AC%E5%8B%9F%E6%A1%88%E5%86%85ver30.pdf

Date	Person and position	Output
18 Dec	1. Takehiro Nakamura Deputy Director JAXA Bangkok Office	Promoting the Cooperation with JAXA projects and The Asia-Pacific Regional Space Agency Forum (APRSAF)

d) Remote Sensing Technology Center of Japan (RESTEC)

Date	Person and position	Output
25 Dec	1. Takahiro Endo Principal Senior Researcher Environment Analysis Section, 2. Naofumi Yoshida Manager Planning Section	JICA's Technical Cooperation for DRC Based on “Framework document of the partnership on cooperation in field of satellites” between Japan and Democratic Republic of the Congo (DRC), RESTEC supported Japan and DRC governments in organizing training workshops in Kinshasa and Tokyo with participants from the Southern African Development Community (SADC) in 2015. RESTEC also supported DRC in establishing the Centre National de Télédétection (CNT) of which His Excellency Daniel Madimba Kalonji, the Minister of Research, Science and Technology mentioned the idea of establishment at the second workshop in Tokyo. After DRC submitted the official request for technical support, the Japan International Cooperation Agency (JICA) started a technical cooperation with CNT with the experts from RESTEC in 2019. RESTEC organized 3 trainings in Japan and 7 trainings in South Africa from 2015 to 2017. The trainings were fully funded by the Japan International Cooperation Agency (JICA) and in the collaboration with the South African National Space Agency (SANSA). The trainings focused on the Synthetic Aperture Radar (SAR) technology and covered very wide application areas including agriculture, maritime observation, natural disaster, and sinkhole analysis. Mr. Aubrey Kekana, the head of the delegation in 2015, stated, “The South African delegation is impressed with the level of excellence and professionalism with which the training program on SAR was conducted by RESTEC” RESTEC organized a training course “Tropical Forest Conservation using the Forest Monitoring System with ALOS-2 Satellite” from October 15 to November 1, 2017, funded by the JICA. This course was one of the JICA Knowledge Co-Creation Programs and aimed to contribute to the capacity development and networking of governmental officers who are responsible for tropical forest conservation by remote sensing and

		GIS, including "JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)." Implementing or taking more participation of RESTEC training short programs in Japan and in Mongolia through JICA cooperation.

e) JICA Headquarters

Date	Person and position	Output
29 Jan	1. Tomohiro Ogawa Office for STI, and DX Governance and Peacebuilding Department 2. Others	Implementing or taking more participation of JICA x JAXA Projects. JJ-Fast for forest degradation monitoring program and JJ-Nest for HR development program for remote sensing and space technology in Japanese Universities.

4) Japanese University and Research organizations

a) Kyushu Institute of Technology

Date	Person and position	Output
22 Dec	1. Kentaro Kitamura Professor Director Laboratory of Lean Satellite Enterprises and In-Orbit Experiments (La SEINE) 2. Seiji Kawano Manager La SEINE	The Laboratory of Lean Satellite Enterprises and In-Orbit Experiments The development of nano-satellites (especially the CubeSat, which is a cubic satellite that is 10cm by 10 cm by 10cm) is blossoming around the world. Introduced in the early 2000's, the application of the CubeSat initially focused on student education. Nearly 20 years have passed since then and, on average, around 200 units have been launched all over the world each year. CubeSat applications have expanded into: [1] business (earth image acquisition, maritime data collection, meteorological observation, etc.), [2] scientific observation, and [3] deep space exploration. CubeSats are useful for demonstrating new technology to be used in space. Due to their low costs and ease of development, nano-satellites also provide an economical entry for developing nations that seek to become space faring nations. Over two dozen countries have launched a CubeSat as their first satellite into space. In addition, these days, companies are taking a good look at CubeSats for new business opportunities. As well, "New Space" startup companies have utilized CubeSats as a low-cost platform for testing out ideas for new space-related enterprises. Implementing cooperative education program for cube satellite development at MUST and Mongol Koosen College of Technology. Nano satellite test laboratory equipment research

		and cooperative usage possibilities of the Lab.

b) Wakayama University

Date	Person and position	Output
23 Dec	Symposium for setting up a Space Education Center at Wakayama University	Networking with Space industry companies and organizations for future cooperation.
24 Dec	1. Hiroaki Akiyama Professor and Head of Space education Center, Wakayama University	Implementing cooperative education program for cube satellite development at MUST and Mongol Koosen College of Technology. Building and managing Ground stations with low-cost experience.

c) Tohoku University

Date	Person and position	Output
5 Feb	1. Kazuya Yoshida Professor Head of Space Exploration Lab Tohoku University	The Space Robotics Laboratory designs and develops micro satellites in a format of 50 cm cubic size and 50 kg mass. They have developed the first and second micro satellites of Tohoku University, named “RISING” and “RISING-2”, launched by using JAXA’s H-IIA rocket vehicle in January 2009 and May 2014, respectively. Both satellites are operated from our ground station in the university. Particularly, RISING-2 has succeeded in capturing high precision color images of the Earth's surface at a spatial resolution of 5m, the highest in the world among 50kg-class satellites. Now the third micro satellite for international science mission is under the development. Implementing cooperative education program for micro satellite development at MUST and Mongol Koosen College of Technology.

d) Hokkaido University

Date	Person and position	Output
TBD 9 Feb	1. Takahashi Yukihiro professor at Hokkaido University	The microsatellite “RISING-2” 5 m resolution, measuring 50 cm wide and weighing around 40 kg, which has been co-developed with Tohoku University and launched in May, 2014. This telescope is equipped with a filter utilizing liquid crystal technology, which was not only used for the spectral camera on the Pirka telescope, but it is the first in the world to be developed for space use. This enables high resolution imaging at a 400 wavelength, which large satellites were unable to achieve. Implementing cooperative education program and Remote sensing technology for micro satellite development at MUST and Mongol Koosen

		College of Technology.

e) Yamaguchi University

Date	Person and position	Output
5 Feb	Masahiko Nagai Professor Director of Center for Research and Application of Satellite Remote Sensing	Center aims to further develop satellite remote sensing utilization techniques, as well as train scientists and engineers in the field, spreading satellite remote sensing utilization across the entire globe. The benefits that remote sensing technology offers are immeasurable, ranging from helping protect peoples' lives in disaster areas to stable harvesting of foods. In addition, remote sensing can contribute to environmental conservation across the globe by providing accurate information on environmental issues such as illegal deforestation and marine pollution. There are many potential global issues looming in our future, and we believe that with sensor improvement and analysis development, satellite remote sensing will play a major role in the solution of these significant issues. We see great potential for the future of remote sensing techniques. Remote sensing technology capacity building cooperation through JICA SATREPS program for Mongolia which is already applied.

f) Kyoto Sangyo University

Date	Person and position	Output
2 Feb	1. Segawa Norihisa Professor Fab lab expert	Implementing cooperative Fab lab for nano satellite development at MUST.

g) Next Generation Space System Technology Research Association (NESTRA)

Date	Person and position	Output
20 Dec	Koji Yamaguchi Director	Works on technological development in the ultra-small satellite where high performance, low-cost, and reliability are achieved. Utilizing full potential and network of expertise we could cooperate on Space technology transfer, capacity building and Nano-satellite development.

h) Japan UAS Industrial Development Association (JUIDA)

Date	Person and position	Output
22 Dec	Iwata Kakuya	Associations work experience towards implementing ISO drone regulation, training of for drone operators, free zone and

5) Japanese Private companies

a) Synspective

Date	Person and position	Output
2 Feb	1. Toshihiro Obata Board Director and Head of Technology Strategy Office 2. Vincent Kessler GM of Synspective Singapore 3. Seiko Shirasaka Professor Keio University	Synspective provides SAR data and remote monitoring services to government agencies and companies worldwide. We also provide SAR data from our satellites to data analysis companies developing their own data products and solutions. Together, a SAR data ecosystem is taking shape that will transform how we as humans manage our environment, natural resources, and exposure to risk. Their small 100kg class SAR satellites can monitor the world with high precision, regardless of the time of day or weather conditions. With 3 satellites successfully launched, we aim to build a constellation of 30 satellites that will enable near real-time observation of any part of the world. Possible cooperation on co-development of the SAR satellite and sharing the constellation.

b) ArkEdge Space

Date	Person and position	Output
2 Feb	1. Takayoshi Fukuyo CEO	3U Satellite is a microsatellite weighing about 3 kg and the size of a plastic bottle. Based on the University of Tokyo's Nakasuka-Funase Laboratory's TRICOM-1R," which is the world's first successful LoRaWAN communication between space and ground for IoT, we are developing and providing this product in cooperation with companies in Fukui Prefecture. Major achievements: RWASAT-1, OPTIMAL-1. 6U Satellite is a nano-satellite the size of a drawer. It is now expected to be used not only for Earth observation but also for various practical missions such as Mars exploration and positioning. We have developed an earth observation satellite in collaboration with the Nakasuka-Funase Laboratory of the University of Tokyo, and have already received orders for it. Possible cooperation on co-development of the IoT satellites and sharing the constellation.

c) Orbital Engineering

Date	Person and position	Output
2 Feb	Koji Yamaguchi Director	Orbital Engineering handle the development, design, and manufacturing of equipment for spacecraft. By consistently performing everything from design

		to manufacturing, we are able to provide products that take into consideration multiple fields (structure, heat, electricity, software, and radiation resistance). In addition, for product manufacturing that spans multiple processes, we are able to provide low-cost, highly reliable equipment by optimizing the processing process, including special processes. Possible cooperation on space technology transfer, capacity building and nano to micro satellite development.

d) Mathematical Assist Design Laboratory

Date	Person and position	Output
2 Feb	Masato Yazawa	Setting up Japan Mongolia System Laboratory for developing IoT and space technology.

e) SCP Japan

Date	Person and position	Output
2 Feb	1. Mitsuteru Kaneoka Director	SCP Japan is space survey and consulting company. Sharing information on the latest international space technology and trends.

f) NEC

Date	Person and position	Output
27 Dec	1. Kentaro Sakagami Senior Professional Space Marketing Group	Lead manager of the Vietnamese satellite development ODA project sharing the lessons and results.

g) Mitsubishi Heavy Industries

Date	Person and position	Output
31 Jan	1. Keita Fukuzawa Manager Space Exploration Group	One of the major Japanese rocket development and launch company. Verifying the spot for the H3 rocket for satellites. 2nd test launch successfully flown on 17th Feb 2024 from Tanegashima.

Japan-Mongolian Aerospace Symposium (JMACS) 2024

JMACS was successfully held at Tuushin Hotel Soyombo Hall on 2nd of March, 2024 with the participation of more around 100 people specialized in the aerospace sector.

1) Symposium Program

No	Time	Session and Topic	Speaker Name	Position and Organization
	9:00	Opening Speech	TANAKA Shinichi	Chief Representative of JICA Mongolia office
I	**09:15 - 12:00**	**Session I. GIS and Remote Sensing**		
1	9:15	Mongolian current condition and needs for future development	Dr.NYAMDAVAA Purevjav	Head of IT Division at Agency for the Land Administration and Managemenet, Geodesy and Cartography
2	9:30	Remote sensing applications	Dr.ODBAYAR Mishigdorj	Information And Research Institute Of Meterology, Hydrology And Environment
3	9:45	Fodder management and Smart agriculture	BATSAIKHAN Jargalsaikhan	Head of Information and Technology, Statistic Division at Policy and Planning Department at MOFALI
4	10:00	Multi-satellite Data Utilization for Mongolian Grassland Monitoring	Dr. NAGAI Masahiko	Professor of Center for Research and Application for Satellite Remote Sensing at Yamaguchi University
5	10:15	Remote sensing with micro-satellite	Dr.TAKAHASHI Yukuhiro	【ONLINE】Dept. Earth and Planetary Sciences and Space Mission Center at Hokkaido University
6	10:30	GIS and Remote sensing current applications for Agrilcultural sector in Mongolia	Dr. BATBILEG Bayaraa	School of Agroecology, Mongolian University of Life Sciences
7	10:45	Introduction of pilot project for satellite imagery of Mongolian platform	Dr. JAVZANDULAM Bataa	School of Geology and Mining, Mongolian University of Science and Technology
8	11:00	Overseas trainig and possibilities of utilizing Japanese satellite data	Dr.KAMEI Masatoshi	RESTEC Japan
9	11:15	New urban use cases of Digital twins in Mongolia	Dr.BUYANDELGER Myagmarsuren	Head of Strategy and Innovation Center at Ulaanbaatar City Office
10	11:30	Panel Discussion I, Setting Up a Cross organizational WG for GIS	Moderator: Dr. BUYANDELGER Myagmarsuren, Participants: All Speakers	All Speaker Organizations
	12:00	Lunch Break		

II	**13:00 - 15:00**	**Session II. Aerospace Education, Innovation and Start-Up**		
1	13:00	Welcome Speech	UCHRAL Nyam-Osor	Minister for MDDC
2	13:15	Supernova Education Program at MUST and SYSLab: Japan-Mongolian IoT and Space Co-Laboratory	Dr. NANDINBAATAR Tsog	Chairman at DX Mongolia
3	13:30	Education at Kyushu Institute of Technology Education at Kyushu Institute of Technology and Space Start Up	Dr. ERDENEBAATAR Dashdondog	Associate Professor at NUM, CIO at ONDO Space
4	13:45	Connecting the unconnected. IoT satellites Transforming Industries	BAT-ULZII Dashtseren	CEO at Sanchir Tech
5	14:00	Space Balloon Education and Global Summit in Mongolia	MAEDA Keisuke	Researcher at Chiba Institute of Technology
6	14:15	Capacity Building for Asian Micro-Satellite Consortium	Dr. YOSHIDA Kazuya	【ONLINE】Professor at Tokoku University
7	14:30	Develop at ultra-high speed and Implementing Fablab	YAZAWA Masato & Dr. SEGAWA Nohirhisa	Director at MAD Lab & Professor at Kyoto Sangyo University
8	14:45	Converting to Space Technology	KIYOHARA Kosuke	Director at Kiyohara Optics
9	15:00	Panel Discussion II, MOU Signing and Setting Up a Working group for Education	Moderator: BAT-ULZII Dashtseren Participants: All Speakers	All Speaker Organizations
III	**15:30-18:00**	**Session III. Aerospace Industry, Strategy and Cooperation**		
1	15:30	Drone Operation Regulation and Training, Flying Cars, Test environment	IWATA Kakuya	Executive Director at JUIDA, Principal Investigator of National Institute of Advanced Industrial Science and Technology
2	15:45	Lessons from the Vietnam Space ODA project	SAKAGAMI Kentaro	Senior Professional at 1st Space Marketing Group, NEC Corporation
3	16:00	SAR satellite and applications	VINCENT Kessler	Director at Synspective Singapore
4	16:15	IoT Communication Satellite Constellation	FUKUYO Takayoshi	CEO at ArkEdge Space
5	16:30	Space Industry and Development	YAMAGUCHI Koji	Director at NESTRA and Orbital Engineering

6	16:45	Space Collaboration Opportunities	Dr. AKIYAMA Hiroaki	Head of the Space Education Center, Advisor for the President of Wakayama University
7	17:00	Co-creation through Partnership through JAXA Projects, APRSAF and CONSEO	NAKAMURA Takehiro	Director, JAXA Bangkok Office
8	17:15	JICA Cooperation Opportunities	HIROSAWA Jin	Director for Scientific and Technical Cooperation at JICA Headquarter
9	17:30	Panel Discussion III, Working group for Space Coopeartion	Moderator: Dr. AKIYAMA Hiroaki Participants: All Speakers	All Speaker Organizations
	18:00	Closing by Batbayar Tuguldur Director at DX Mongolia		

2) Symposium Outcome

Symposium had 3 sessions and in the end of each session there were panel discussions, in which participated all presenters and the moderator regarding the topic.

a) Session I. GIS and Remote Sensing

Moderated by Dr. BUYANDELGER Myagmarsuren, Head of Strategy and Innovation Center at Ulaanbaatar City Office. In the panel discussion, all participants at Session Ⅰ. agreed to establish WG for remote sensing to cooperate and share their satellite data, platform and common purpose in order to get deliver efficient policy making suggestions to the local government. The common need for the remote sensing current situation was use higher resolution satellite imagery at lowest cost and fastest repeat rate, due to lack of budget allocation. Given data is not enough for decision-making even in the last years flood event in Ulaanbaatar, they only used free DEM and DSM data of 12.5m resolution. Also capacity building needs were crucial and catching up latest technology training such as AI in remote sensing was highly anticipated and even asked Mr. Kamei how much was their training course costs. The answer was around 4 million yen for 2 weeks training excluding all travel and accommodation costs.

b) Session II. Aerospace Education, Innovation and Start-Up

Moderated by BAT-ULZII Dashtseren, CEO at Sanchir Tech. In the panel discussion it was mentioned that there were some educational initiatives and cooperation MOU signing between the MUST and DX Mongolia for developing space technology pilot curriculum at MUST supported by Japanese companies to set up a laboratory. ONDO Space , first space spinoff company from NUM and has long cooperation with Kyushu Institute of Technology announced that it has developed 2 pieces of 0.5 unit IoT communication cube-sat, which is later successfully launched by SpaceX rocket on 5th of March and received the payload package data. Sanchir Tech company has been developing and testing various IoT ground sensors through-out the country, such as low cost animal tracking device that needs IoT communication satellite constellations in the rural area where there is no mobile signal reaches. It showed that Mongolia has in some extent the basic technology know-how in the field of developing IoT devices and cubesats, but main needs seemed to be in foreign investments, business model and cooperation in advanced technology transfer.

c) Session III. Aerospace Industry, Strategy and Cooperation
Moderated by Dr. AKIYAMA Hiroaki, Head of the Space Education Center, and Advisor for the President of Wakayama University. In the panel discussion it was mentioned that aerospace industry is just starting to develop in Mongolia, in case of drones while the CAAM has basic regulations operating drones, we need to give proper drone operation trainings to provide more safety. While tightening the regulation it is very important not to stop the innovation itself by excessive regulations. It was also pointed out that Mongolia could use small population density and vast land we could open up special free flight zone for drones and space balloons as a sandbox, which could attract international organizations to come and test their latest technology with a least hassle. A key message was that a successful technology transfer only occurs when the training provided with the equipment or the laboratory and public-private-academic partnership is crucial for the future sustainable development as seen in JICA's international support programs.

d) Speech by Minister for MDDC
The Minister for MDDC and the Director of National Space Council UCHRAL Nyam-Osor addressed that the symposium would provide further cooperation between Japan and Mongolia in the space sector, officially announcing that the President of Mongolia has agreed with the President of France to developed national communication satellite named Chinggis Satellite, and seeks opportunity to launch it with Japanese support. He also expressed the planning to set up a Mongolian Space Agency to bolster national space industry to develop multilateral economy. During the Symposium, persons in charge of Chinggis Sat project at MDDC met with JAXA and Japanese Space council representatives and discussed the opportunities to take Japanese support for establishing Space Agency and launching the Chinggis Sat from Japan.

4. JICA'S STRATEGY AND ACTIVITIES FOR DEVELOPING COUNTRIES WITH REGARADS TO INNER AND OUTER SPACE UTILIZATION

Recent Technical Cooperation in Space Sector

Country	Project Title	Outputs	Activities
Rwanda [17] (Technical Cooperation)	Human resources development in the space field	Satellite and related infrastructure development will be promoted at the Rwanda Space Agency (RSA), and at the same time, satellite data utilization will be strengthened at RSA and related organizations (end users).	Analyze the status of satellite development and related infrastructure at RSA, the status of satellite data utilization, and the status of collaboration between RSA and related organizations (end users).
			Develop training programs for satellite development and satellite data utilization for RSA and related organizations (end users).
			Implement training programs on satellite development and satellite data utilization for RSA and related organizations (end users).
		The University of Rwanda (UR)'s educational and research capabilities related to satellite development and the use of geospatial information will be strengthened.	Analyze the current state of UR and recommend necessary interventions for the development of an aerospace engineering program.
			Create a plan to prepare aerospace engineering-related human resources and facilities at institutions other than UR that are involved in the aerospace engineering program (such as research institutions that have the research facilities necessary to implement the program).
			Implement training programs that contribute to the formulation of aerospace engineering programs for UR.
		Collaboration between the Rwanda Space Agency and international organizations (World Bank, GIZ, etc.) and Japanese organizations (JAXA, etc.) will be strengthened.	We will propose ways of collaboration between RSA and international organizations (World Bank, GIZ, etc.) and Japanese organizations (JAXA, etc.).
			Through training in Japan, we will create networking opportunities and strengthen collaboration with Japanese organizations (JAXA, etc.).

[17] https://www2.jica.go.jp/ja/announce/pdf/20230712_235352_1_01.pdf

		The social and economic effects of space technology in Rwanda will be measured.	Create quarterly and annual reports that focus on the social and economic effects of satellite data utilization.
			A workshop will be held to promote understanding of the social and economic effects of satellite data utilization.
Paraguay [18] (Technical Cooperation)	Space program management project for socio-economic development	Human resources and infrastructure related to satellite development and satellite data utilization of the Paraguay Space Agency (AEP) will be strengthened.	Conduct an evaluation of AEP's existing satellite data analysis methods and tools.
			Based on the evaluation of satellite development facilities available at AEP, policies for strengthening them will be formulated.
			Training related to satellite development and operations will be provided.
			Training will be provided on the processing and application of satellite data and other data.
			Collaborate between AEP and Japanese government agencies, universities, and private companies.
		A pilot project will be implemented at AEP and related organizations to strengthen disaster risk analysis and natural disaster prevention and response capabilities.	AEP and related organizations will establish a consultative body to identify issues and implement pilot projects.
			Issues for which the application of space-related technology is effective in the disaster prevention field will be identified.
			Determine the scope of applying space-related technology to the problem and design experimental efforts.
			Develop a purchase plan for equipment (hardware and software) for satellite imagery and data processing.
			We will develop human resources on satellite data analysis and usage methods that contribute to the prevention and reduction of disaster risks.
			Leverage existing agreements with academia and other governmental and non-governmental organizations to carry out pilot projects.
			Publicize the results of the pilot project locally/internationally.
		A pilot project will be implemented at	The EP and related organizations will establish a consultative body to identify issues and implement pilot projects.

[18] https://www2.jica.go.jp/ja/announce/pdf/20230712_235352_1_01.pdf

		AEP and related organizations to strengthen the capacity of information management related to agricultural and livestock productivity and quality.	Issues to which space-related technology can be effectively applied in the agricultural and livestock fields will be identified.
			Determine the scope of applying space-related technology to the problem and design experimental efforts.
			Develop a purchase plan for equipment (hardware and software) for satellite imagery and data processing.
			Human resource development will be carried out on satellite data analysis and usage methods that will contribute to improving the productivity and quality of agriculture and livestock farming.
			Leverage existing agreements with academia and other governmental and non-governmental organizations to carry out pilot projects.
			Publicize the results of the pilot project locally/internationally.

Human Resource Development in the Field of Space Technology and Space Policy

1) Long Term Training (Scholarship Program)
During the Japan-Mongolian Aerospace Symposium held on 2nd March, STI Office of JICA announced that target country for scholar ship program "*Human Resource Development for Space Technology Utilization*" will be expanded to Mongolia from FY 2025. The program will enable selected trainee to obtain master/doctor degree in Japanese university, with plenty of networking opportunities, special lecture, site visit and seminars arranged by JICA.

2) Short Term Training (Knowledge Co-Creation Program (Group and Region Focus))
JICA has implemented "*Capacity Development of Space Technology Utilization for SDGs*" in FY2023 and one of officers from MDDC participated in the training course.

5. POSSIBLE AREAS FOR JICA'S COOPERATION

Mongolian Space Strategy and Organizational Support

The Minister for MDDC and the Director of National Space Council UCHRAL Nyam-Osor addressed that the symposium would provide further cooperation between Japan and Mongolia in the space sector, officially announcing that the President of Mongolia has agreed with the President of France to developed national communication satellite named Chinggis Satellite, and seeks opportunity to launch it with Japanese support. And he also said that they are planning to set up a Mongolian Space Agency to bolster national space industry to develop multilateral economy.

Since, JICA has been implementing Technical Cooperation for Rwanda and Paraguay from 2023, to assist their Space development programs, both countries could utilize this initiative.

During the Symposium persons in charge of Chinggis Sat project at MDDC met with JAXA and Japanese Space Council representatives and discussed the opportunities to take Japanese support for establishing Space Agency and launching the Chinggis Sat from Japan with Japanese rocket.

Remote Sensing and IoT Devices Applications

It was found through meeting with relevant Mongolian governmental organization or open-source information that the following cooperation in each sector from JICA would meet Mongolia's development needs.

1) Disaster Risk Management
   a) Background
      Mongolia experienced severe flood which affected Ulaanbaatar city center in July and August 2023, as well as dzud which caused significant loss of livestock of herders in winter 2023-2024.

   b) Needs
      i. High resolution of below 5m of SAR and EO data for flood, dzud and drought management for precise monitoring and planning swift response.
      ii. IoT devices and integrated system for environmental monitoring and disaster detection.
      iii. Drone for faster disaster monitoring.

   c) Relevant Organizations
      i. Flood
         Policy making: ……MCUD/MUB
         Infrastructure planning and management: ‥MCUD/MUB
         Disaster response:……NEMA/MUB
      ii. Dzud and drought
         Policy making: ……MOFALI
         Policy implementation:……Local governments
         Satellite data collection/analysis: ……IRIHMERSD
         Disaster response:……MOFALI/NEMA

   d) Possible Cooperation
      Providing equipment (IoT devices, monitoring drones) high resolution data and capacity development for relevant organization through technical cooperation.

2) Agriculture and Stock Raising
   a) Needs
      i. High resolution of below 5m of SAR and EO data for fodder management and statistical data collection (e.g. counting the live stocks)
      ii. IoT devices for smart agriculture as well as IoT communication satellites for remote areas without cellular network connection.

   b) Relevant Organizations
      Policy making: ····· MOFALI
      Policy implementation: ····· MOFALI/Local governments
      Satellite data collection/analysis: ····· IRIHMERSD

   c) Possible Cooperation
      Providing equipment (IoT devices, monitoring drones), high resolution data and capacity development for relevant organization through technical cooperation.

3) Forest Preservation/Desertification Management
   a) Background
      It is noteworthy that Mongolia will host COP17 of "*United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD)*" in 2026 and cooperation in desertification management would be particularly visible and beneficial for Mongolia.

   b) Needs
      i. High resolution of below 5m of SAR and EO data forest preservation and desertification management.

   c) Relevant Organizations
      Policy making: ····· MET
      Policy implementation: ····· MET/Local governments
      Satellite data collection/analysis: ····· IRIHMERSD

   d) Possible Cooperation
      Providing high resolution data and capacity development for relevant organization through technical cooperation.

4) Education (MUST and NUM)
   As we confirmed interest from the abovementioned national universities in developing satellite technology curriculums to build nano to micro satellite, JICA could support them with know-how and knowledge through technical cooperation.

5) Road Infrastructure
   As high resolution of below 5m of SAR and EO data could improve road infrastructure maintenance efficiency and quality, Support from JICA for MRTD with provision of high resolution data and capacity building through technical cooperation would be beneficial.

6) Urban Development
   As drone LiDar mapping and high resolution EO data should be useful to introduce Digital Twin which can significantly improve Ulaanbaatar city's urban planning, support from JICA with provision of LiDar mapping system, high resolution EO data, and capacity development for MCUD and MUB would be beneficial.

7) Aviation and aerospace
   a) Background
      Since the establishment of the satellite communication network for air navigation data transfer in 2008, the CAAM (Civil Aviation Authority of Mongolia) has been leveraging satellite data for air traffic services on a daily basis. The integration and utilization of satellite data in air traffic services represents a significant innovation in the field. However, challenges have arisen due to equipment aging and communication technology limitations, resulting in a decrease in the effective utilization of satellite data as flight volumes increase.
   b) Current Situation
      The CAAM currently utilizes the MCAA VSAT system, which functions by collecting and analyzing data transmitted by CEFD satellite modems, as well as managing and monitoring the network status.
   c) Planning
      In order to enhance the utilization of satellite data, the CAAM has outlined the following strategic initiatives:
      i. Conduct a feasibility study, as recommended by the ICAO (International Civil Aviation Organization), to explore the possibility of transitioning from HF communication to Voice & Data-based satellite communication.
      ii. Introduce the satellite-based automatic surveillance system known as "Space-based ADS-B".
      iii. Implement the "SATVOICE" system to serve as the voice communication system for air navigation services.
      iv. Introduce the Ground-Based Augmentation System (GBAS) to enhance the accuracy of data obtained from GNSS for earth navigation.
      v. Implement the Satellite-Based Augmentation System (SBAS) to improve the accuracy of data obtained from GNSS satellites.

      These planned initiatives are aimed at modernizing and optimizing the utilization of satellite data within the CAAM's air traffic services framework and support from JICA in those areas would address challenge and problems CAAM faces.

8) Mining
   With mining sector of Mongolia accounts for about 80% of exports and 25% of GDP, introduction of cutting-edge technologies in the sector would contribute to economic development of the country. JICA's SATREPS[19] cooperation scheme or joint research framework of "Higher Engineering Education Development Project" would be helpful to find efficient and sustainable solution.

[19] https://www.jica.go.jp/english/activities/schemes/science/satreps.html

6. RECOMMENDATION FROM DX MONGOLIA

Remote Sensing Data Utilization and Training

The choice between open-source, commercial, and proprietary EO satellite data depends on factors such as cost considerations, resolution requirements, data availability, and user expertise. While open-source data offers accessibility and cost-effectiveness, commercial and proprietary data provide higher resolution and customization options, albeit at a financial cost and potential licensing restrictions. Mongolia can benefit from a combination of these data sources, leveraging each according to their specific needs and priorities across various applications.

Comparing the utilization of open-source satellite data, commercial satellite data, and proprietary Earth observation (EO) satellite data in Mongolia:

IRIMHERSD receives and analyses real-time open-source satellite data and images from Polar Orbiting Satellites such as the MODIS, VIIRS, and NOAA series, and the Geostationary Meteorological satellite FY2C. The satellite data and Geographical Information System are used for service as determining and imaging the actual status of LST, NDVI, snow and vegetation cover, forest and steppe wildfires.

The Agency for the Land Administration and Management, Geodesy and Cartography has developed online portal infrastructure to gather all geo spatial data in one place for data standard, analysis and information management of geodesy, cartography, base research, land monitoring, land management, land cadaster in the territory of Mongolia. Aiming to enable evidence based policy making process at ease.

Spatial Data Research Department at The Centre for Policy Research and Analysis of Municipality of Ulaanbaatar conducts research and applications using open-source and limited commercial satellite data specifically solve problems within the Ulaanbaatar city.

However, due to resolution and delays of open source data and cost of commercial data users face limitations for real life problem solving and the lack of proper law and regulation agencies could not share the data.

Also, human resource development problem to handle satellite data is widely seen in governmental agencies. However, the problem could be solved by setting the Ground station in Mongolia to acquire real-time data from Japanese satellites and use the data for capacity building through JICA’s cooperation programs.

Satellite Operation and Ground Station

The vast territory of Mongolia, situated strategically between Russia and China, offers a prime location for a Satellite operations and satellite data acquisitions by setting up Ground Stations. This positioning in the heart of Central Asia and 2,392 km from west to east, not only provides access to a broad range of orbits for satellite communication but also enhances the station's potential to serve as a critical hub for international space collaboration.

Education, Innovation and Technology Transfer

IoT communication satellites play a crucial role in addressing various challenges faced by Mongolia, from enhancing agricultural productivity with a successful pilot project done by MOFALI case, to supporting environmental conservation and improving access to essential

services in remote regions.

To develop and operate IoT communication satellites and harness their potential applications in Mongolia, establishing capacity-building programs at universities is essential. These programs should focus on multidisciplinary education and training in satellite technology, telecommunications, data analytics, and relevant fields.

Department of Physics at School of Arts and Sciences at NUM has Master course for Space Study (index E 05880101) and its spin-off company ONDO space, which has already developed 2 pieces of IoT satellite, which was launched on 5th March 2024, for technology proof of concept However, there is still a lack of the appropriate education program and environment for sustainable development.

Thus, utilizing existing Higher Engineering Education Development Project and partnerships with Japanese industry leaders and research institutions could provide students with practical experience through internships, collaborative projects. In addition, setting up a joint laboratory would be beneficial. The joint laboratory with clean room, and equipped with state-of-the-art facilities including shock testing, vibration testing, and vacuum temperature testing machines as seen at Kyushu Institute of Technology, which become the standard for developing small satellites, will serve as a collaborative hub for Mongolia and Japanese companies.

We propose to set up 2 groups for developing 10 pieces of 3U IoT satellite program in Mongolia. One is NUM with Ondo space, and the other is MUST with Japanese companies.

Moreover, there exists a substantial opportunity for the developed IoT communication satellites to integrate seamlessly into Japanese satellite constellation project.
In addition to IoT communication satellites, with up to 5m resolution EO satellites offer valuable insights for various sectors in Mongolia, including land management, environmental protection, disaster resilience, infrastructure development, and agriculture, contributing to sustainable development and informed decision-making.

Collaboration with various Japanese universities, associations, and private company initiatives, we could lower the development cost significantly. EO satellite constellations, as well as Synthetic Aperture Radar (SAR) constellation, are anticipated.

This involvement positions Mongolia as an active contributor to global Earth observation efforts, fostering international cooperation in monitoring and managing the Earth's resources.

Utilizing Inner Space - Open Aerospace Zone provision and impact

Utilizing both inner and outer space holds immense potential for bolstering Mongolia's economy across various sectors. Inner space, referring to terrestrial and atmospheric domains, presents opportunities for leveraging aerospace technologies such as drones for agriculture, land surveying, and infrastructure inspection, thereby enhancing productivity, efficiency, and resource management. Additionally, the establishment of Open Aerospace Zone can attract investment, foster entrepreneurship, and stimulate innovation in aerospace-related industries, driving economic growth and job creation. Outer space, on the other hand, offers opportunities for satellite-based services such as telecommunications, remote sensing, and navigation, which can improve connectivity, facilitate disaster management, and support environmental monitoring efforts. Furthermore, exploring space tourism and space mining ventures could unlock new revenue streams and position Mongolia as a key player in the emerging space economy. By harnessing the potential of both inner and outer space, Mongolia can diversify its economy, foster technological innovation, and secure a sustainable future for its citizens.

The provision of free flight zones for drones, space balloon experiments, space travels with balloons, flying cars, and beyond carries significant usage and impact implications for Mongolia.

1) Facilitating Innovation and Research
   Free flight zones offer a conducive environment for innovation and research in aerospace technologies. Researchers and entrepreneurs can conduct experiments, test new prototypes, and develop cutting-edge solutions without regulatory constraints, fostering a culture of innovation in Mongolia's aerospace sector.

2) Encouraging Entrepreneurship
   By providing free flight zones, Mongolia incentivizes entrepreneurship in the aerospace industry. Startups and technology firms could explore novel applications of drones, flying cars, and space balloons, leading to the creation of new businesses, job opportunities, and economic growth.

3) Supporting Education and Training
   Free flight zones serve as valuable educational resources, providing students and professionals with hands-on experience in aerospace technology. Universities, schools, and training centers can use these zones to offer courses, workshops, and practical training programs, nurturing the next generation of aerospace professionals in Mongolia.

4) Promoting Tourism and Recreation
   Space balloon travels and other aerial activities in free flight zones can attract tourists and enthusiasts, contributing to Mongolia's tourism industry. Visitors have the opportunity to experience breathtaking aerial views, participate in space balloon expeditions, and engage in recreational activities such as drone racing and aerial photography.

5) Enhancing Connectivity and Accessibility
   Flying cars and drones operating in free flight zones improve connectivity and accessibility, especially in remote and underserved areas. These aerial vehicles can provide vital services such as emergency medical transport, goods delivery, and infrastructure inspection, overcoming geographical barriers and improving quality of life for residents.

6) Promoting Sustainable Development
   The adoption of environmentally friendly aerospace technologies, such as electric-powered drones and flying cars, aligns with Mongolia's commitment to sustainable development. By reducing reliance on fossil fuels and minimizing environmental impact, these technologies support efforts to mitigate climate change and preserve Mongolia's natural resources.

7) Fostering International Collaboration
   Free flight zones create opportunities for international collaboration and partnerships in the aerospace sector. Mongolia can collaborate with foreign governments, research institutions, and industry players to exchange knowledge, share best practices, and jointly develop innovative aerospace solutions for mutual benefit.

   In conclusion, the establishment of free flight zones represents a pivotal stride forward for Mongolia's aerospace ambitions, offering a platform for innovation, economic growth, and societal advancement. By providing a conducive environment for experimentation, research, and entrepreneurial ventures in drone operations, space balloon experiments, space balloon space travels, and flying cars, Mongolia fosters a culture of innovation and creativity in the aerospace sector. These free flight zones not only stimulate economic development by attracting investment and fostering entrepreneurship but also serve as educational hubs,

nurturing a skilled workforce and driving technological advancement. Moreover, by embracing environmentally sustainable practices and promoting responsible aerospace activities, Mongolia underscores its commitment to shaping a future where aerospace technologies propel inclusive prosperity, connectivity, and progress for its citizens and the global community.

Satellite Launching Opportunities

Opportunities for satellite launching with the H3 rocket by Mitsubishi Heavy Industries (MHI) for communication satellites and Space One's rocket for remote sensing satellites offer distinct advantages and opportunities for Mongolia's aerospace ambitions.

1) H3 Rocket by MHI for Communication Satellites
   - The H3 rocket, developed by MHI, represents a reliable and cost-effective option for launching communication satellites into geostationary orbit (GEO).
   - Leveraging the H3 rocket for communication satellites offers enhanced connectivity and telecommunications capabilities, supporting economic development, disaster response, and social connectivity initiatives in Mongolia.
   - With its payload capacity and reliability, the H3 rocket enables Mongolia to deploy advanced communication satellites that provide high-speed internet access, telecommunication services, and remote connectivity to even the most remote regions of the country.

2) Space One's Rocket for Remote Sensing Satellites
   - Space One's rocket presents an opportunity for launching micro (up to 150kg) remote sensing satellites, which are essential for environmental monitoring, resource management, and disaster mitigation efforts in Mongolia.
   - Utilizing Space One's rocket for remote sensing satellites allows Mongolia to enhance its capabilities in Earth observation, agriculture monitoring, forest preservation, and disaster risk management.
   - Remote sensing satellites launched by Space One's rocket provide valuable data and insights that support informed decision-making, sustainable development, and environmental conservation initiatives across Mongolia's diverse landscapes.

   By strategically leveraging both the H3 rocket by MHI for communication satellites and Space One's rocket for remote sensing satellites, Mongolia can strengthen its space infrastructure, enhance its capabilities in telecommunications and Earth observation, and drive socioeconomic development and environmental sustainability initiatives across the country. These opportunities position Mongolia as a key player in the global aerospace industry and pave the way for continued progress and innovation in space exploration and utilization.

Conclusion

The proposal recommends leveraging JICA’s diverse training programs to enhance human resource development and provide assistance in establishing a robust legal framework and strategic direction in the field of space exploration in Mongolia. Through harnessing JICA’s expertise, Mongolia endeavors to enhance the skill set and knowledge base of its workforce in satellite technology and related fields. This strategic investment in human resources is in alignment with the overarching objective of fostering enduring capability and innovation with the space sector.

By strategically utilizing JICA's funding initiatives, Mongolia seeks to optimize resources,

fostering a cost-effective yet impactful approach to satellite development.

In conclusion, Mongolia's multifaceted space initiative, encompassing satellite development, strategic collaborations, and ground station establishment, is a testament to its commitment to becoming a prominent player in the global space community.

The proposed funding models, combining Japanese ODA, JICA's resources, and private investments, underscore Mongolia's strategic and responsible approach to space exploration. This comprehensive strategy positions Mongolia for a transformative journey in the dynamic field of space technology and international collaboration.

7. ACKNOWLEDGEMENTS

We extend our sincere gratitude to JICA Mongolia office for their invaluable support and assistance in facilitating the survey and symposium. Their dedication to promoting international cooperation and fostering development initiatives has been instrumental in the success of our endeavors. We deeply appreciate their commitment to creating positive change and enhancing collaboration on a global scale.

And we are truly grateful for the invaluable contributions of Mr. Akiyama, Mr. Yamaguchi and others, as well as their unwavering support in making this initiative a reality.