Survey on potential users of satellite data and availability of in-situ big data

Summary Report

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Remote Sensing Technology Center of Japan
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Introduction

This document is the research report which summarized the result of “FY29 Manufacturing Infrastructure Technology Status Survey – Survey on potential users of satellite data and availability of in-situ big data” – which the Ministry of Economy, Trade and Industry (METI) contracted with the Remote Sensing Technology Center of Japan (RESTEC).

The purpose of this survey is to extend the range of satellite data users in private sector. By providing fundamental information and application samples for mainly private companies, ministries and agencies outside of space development industry, RESTEC conducted the followings;

① Extracting users’ comments and requirements to Satellite Data Platform (PF) which is under development by METI
② Identifying in-situ big data to be collaborated with satellite data
1. Survey on potential users of satellite data

1.1. Contents and methods

RESTEC arranged satellite data utilization workshops to explore potential users for satellite data and extract comments and requirements to be reflected the data platform.

1.2. Results

1.2.1. Satellite Data Utilization Workshop – Arrangement –

RESTEC decided the dates of the workshop as February 9th and 21st, and prepare for the followings discussing with METI.

- Calling for and selecting participants
  - Main targets are private companies related to IT, real estate, agriculture, finance, fishery, and infrastructure.

- Workshop Program
  - Purposes and background (METI)
  - Remote Sensing with Google Earth Engine (RESTEC)
  - Examples of satellite data utilization (RESTEC)
  - Case introduction by participants (2-3 companies)
  - Introduction of Idea generation workshop (Keio Univ.)

1.2.2. Satellite Data Utilization Workshop – Result –

The 1st workshop was held on February 9, 2018. A number of participants are 23 including 9 from private sector.

The 2nd workshop was held on February 21, 2018. A number of participants are 29 including 15 from private sector.

1.2.3. Comments and Requirements from Users

RESTEC asked 7 questions to the participants in order to extract the information which should be reflected to the data platform. The summary of comments and requirements from users are as follows.

1.2.3.1. Data Platform Functions

- General Processing and Analysis
  - Cloud removal, Masking, alignment, etc.
  - Land use classification, area detection

- AI and Deep Learning
Specific Purposes

- Detection of farm field, Crop yield forecast
- Forecasting amount of timber and selective logging
- Detection of moving vehicle, measuring a number of vehicles, and monitoring buildings under construction

User Friendly Interface

API

Enough Computing Resources

Display / Import / Export

- Easy 3D visualization
- csv file export
- Satellite data export with standard GIS format
- Importing and combining user's own data

Tutorial

Sample

- Typical reference of sensors, sample codes, and sample applications

1.2.3.2. Satellite Data on Platform

Spatial & Temporal Resolution, and Coverage

- High spatial resolution (1m or higher, identify cars, detect persons)
- High temporal resolution (daily, hourly, minutely, real-time)
- Large coverage (Globe, entire Japan)

Data Contents

- Infrared images indicating heat of activity
- Land use change (long term)
- Temperature, precipitation, soil carbon data
- Crop condition and cultivation status
- Water amount / level of river and coast

1.2.3.3. Other Data to be combined with

Users' own data

- We conduct aerial survey on ground and tree canopy by a helicopter. The data might be worth being combined with satellite data.
- I would like to use the data platform combining the positioning information on electric facility (electric line), however the information is classified.
- “Regional Economy and Society Analyzing System (RESAS)” has the map of
fluid population which displays a number of persons in a certain area and time. This might be combined with satellite data.

- **Open Data**
  - Weather data, Earthquake information
  - Geographical data, Topographic data, Land use information
  - Agricultural production information
  - Fish ground data (released by Japan Fisheries Research & Education Agency), water temperature
  - Information on road, bridge, constructions, real estate, and residence
  - Economic trend, commercial statistics, industrial statistics
  - Census, population distribution, population data for aged persons treatment
  - Foreign tourists trend data for tourism promotion
  - Medical data for public health
  - Transportation information
  - Statistics data released by the Ministry of Internal Affairs and Communications
  - Information on solar power plants locations possessed by METI
  - Open data possessed by local governments

1.2.3.4. **Other Platforms to be collaborated with**
- Platform which has high computing power
- Platform which has analysis functions of Big Data, AI, Machine Learning, etc.
- Platform which has information on sensors related to IoT

1.2.3.5. **Other Ideas and Requirements**
- **Application fields**
  - Economic status, social infrastructure, agriculture, forestry, fishery, disaster, finance, insurance, regional development, tourism, auto industry, behavioral marketing, merchandising, and real estate.
- **Specific ideas**
  - Safe control of school route, car delivery service, sharing craftsmen’s techniques, industrial water quality control, location selection for winery, improvement of agricultural productivity, search rescue and affected area detection in case natural disasters, and residence evaluation.
- **Requirements to use the data platform in the participants’ own work**
  - I would like to use the data platform for maintenance of virtual electric lines
for electric power companies.

- I would like to use the data platform for maintenance of our facilities.
- I would like to satellite information on our own WebGIS service.
- Satellite data is similar to marine observation. AIS and VMS would be appreciated if the platform can provide.
- I would like to consider combining the data platform with our maritime domain awareness system.
- I would like to connect with industrial development in Hokkaido.

1.3. Conclusions

1.3.1. Functions

In addition to data distribution, the participants have requirements of analysis functions including AI, Deep Learning, and the common functions which commercial satellite data analysis software has. API and enough computing resources are also required to realize those analysis functions. On the other hand, many of them expect user friendly interface and easy operation, which is an important aspect to attract many users.

1.3.2. Data

The demand for data to be loaded on the data platform is high, the participants require 1m spatial resolution and real time observation. As there are limitations to satellite observation, it would be the future issues how the data platform can meet these demands.

There were many comments about the data to be consolidated with satellite data. Some participants have interests in the data consolidation in the areas of weather, geographic, disaster, agriculture, forestry, and fishery. The others have interests in the data related to economic, population, and tourism.

1.3.3. Applications

An electric company made specific comments about combining with “location information of electric facilities (electric line)” and expectations to the data platform for “maintenance of electric line” and “developing electric line network”. The data platform has a possibility to evaluate the effect of subsidence to electric line towers by interferometric analysis with the SAR data on the platform. The coherent pairs of SAR data and the analysis function of interferometry are necessary to be installed to the platform for the analysis. As the location information of electric line is classified, the
platform also needs to equip the function of uploading user’s own data to be analyzed on
the platform.

By combining with “meteorological data such as precipitation”, the data platform can
be used for maintenance of infrastructure against natural disaster such as landslide.
Availability of the data platform will be improved by connecting with the meteorological
data released by the Japan Meteorological Agency (JMA) and the precipitation data
observed by satellites through GSMaP operated by the Japan Aerospace Exploration
Agency (JAXA). In addition, the platform can be used for preparation for water related
hazards by combining with DEM data and ground information.

There were some comments about connecting with “Maritime Domain Awareness
Visualization System” under development by the Japan Coast Guard (JCG) and
consolidation of AIS and VMS data. As one of their main purposes is Maritime Domain
Awareness (MDA) and JCG has a plan to include satellite data, combining their system
will extend availabilities of the platform into the other application areas. For example,
combining with coastal environmental information might produce additional
information which is useful for tourism. AIS and VMS data can be used by connecting
with “Global Fishing Watch” since the AIS and VMS data is available on it.

There were also some comments about combining agricultural data. By combining soil
data and agricultural production information which The Ministry of Agriculture,
Forestry and Fisheries or Japan Agricultural Cooperatives possess, the data platform
can be used to select proper land for proper crops. In addition, if the platform can
connect with JAXA's Satellite based Monitoring Network system for FAO AMIS outlook
(JASMIN) where satellite observation data of precipitation, soil moisture, and solar
radiation are available and crop yield model which research institutes have, users will
be able to predict crop yields.
2. Survey on possibility of big data utilization except satellite data

2.1. Survey method

To extract useful information through private sectors hearing regarding expected big
data affinity to satellite data. Details are below.

- Appropriate information for big data, candidate list, and questionnaire sheet
  should previously prepare.
- To be visited at least 10 or more private sectors and select useful and specific
  companies with impartial point of view.
- To gather necessary information by analyzing the data obtained from this survey to
  contribute user-friendly PF development.
- Visiting company to be determined with METI prior to implementation.

2.2. Results

Cooperate with METI for review of candidate list for private sector and its business
fields and questionnaires, our survey begins around the end of February.

2.2.1. Candidate

Candidate selection was done by considering business fields and utilization of big
data date based on following reasons.
<table>
<thead>
<tr>
<th>Field</th>
<th>Company</th>
<th>Business Outline</th>
<th>Reasons, Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td>Market and business developer of agricultural sensor (e.g. soil moisture) and related internet service development.</td>
<td>Utilizing big data for soil moisture content and so on.</td>
</tr>
<tr>
<td>Fisheries and Marine</td>
<td></td>
<td>To estimate fishing area by applying satellite data and numerical marine model to provide it to fishing boat on the sea through satellite communication.</td>
<td>They are in charge of satellite data and numerical model results.</td>
</tr>
<tr>
<td>Energy (IT)</td>
<td></td>
<td>Providing weather forecast system operation, development, operation, diagnosis of power plant, drone monitoring services and so on.</td>
<td>In addition of weather data, they conducts analyze and visualization of big data using AI.</td>
</tr>
<tr>
<td>Finance (agricultural sector)</td>
<td></td>
<td>Based on estimated satellite data analysis of rainfalls amount (GSMaP), they provides weather index insurance for farmers in Asian countries.</td>
<td>They provides insurance planning obtaining various data including satellite data.</td>
</tr>
<tr>
<td>Finance</td>
<td></td>
<td>Providing real time sales forecast, Nikkei CPINOW (world’s first daily price index using POS data which is used for monetary policy.)</td>
<td>They are presently examined that to develop the new index using big data including POS data provided by other companies.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
<td>Providing design and development of micro sensing devises, data mining services (crowd data/big data analysis and so on).</td>
<td>Utilizing crowd for bid data and crowd data analysis.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
<td>Gathering information and promoting sales regarding the ground, environment, disasters etc.</td>
<td>They are utilizing geological map and hazardous map to the field of their surveys.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
<td>As a group company of [redacted], they are conducting of highway construction management.</td>
<td>They are processing monitoring systems for inspection of construction situation using satellite data and ground observation monitor.</td>
</tr>
<tr>
<td>IT</td>
<td></td>
<td>Based on machine learning method, they are promoting abnormal sound detection system and/or service.</td>
<td>They are utilizing various range of big data and machine learning method.</td>
</tr>
<tr>
<td>IT</td>
<td></td>
<td>IT consultation (IT, strategy, planning, system development, maintenance etc.)</td>
<td>Collaboration with Orbital Insight for satellite imagery analysis.</td>
</tr>
</tbody>
</table>

2.2.2. Result

Hearing survey was proceeded based on their business subject especially needs for required data, information and data plat forms (“PF”) to improve its efficiency.

2.2.2.1. [redacted]

(1) Business subject

Satellite date will be utilized as new added value for The Bank of Japan and other investors.
(2) Required data and information
Both for open and closed (chargeable) date are used as Bloomberg economy date (open and free), POS data.
On the other hand, they purchase satellite data from NOAA. To set up new indicator, High-resolution satellite data might be required to capture source of light.

(3) Requirement regarding PF
- Connection between economic, statistics data and open data at API.
- Interoperability with Google Map to provide a linkage for related place, data and so on.
- Cloud storage and processing function for interferometry and statistics data etc.

2.2.2.2. Business subject
In response to stakeholders (trading company, property insurance company and so on), appropriate information and/or system has been provided.
In preparation for future demand, on-demand basis data analysis will be implemented. Thus an objective satellite data will become necessary to respond customer's various uses.

(2) Required data and information
Open data such as meteorological data is obtained from Japan Meteorology Agency although try to collect related information from customers. On the other hand, although satellite data is not being used in particular, use in other field (insurance calculation, generation of electricity and traffic volume estimation, etc.) is considering.

(3) Requirement regarding PF
Interoperability to be required with the other PF (e.g. GoogleEarth) when output the data. Data can be recognized by index basis, and it is expected to be operated within storage systems in the PF. Also PF promotion is the vital point to increase awareness.
2.2.2.3. Business subject

From their business perspective below, to obtain information of the work site (past and present) is important.

- Investigation, analysis, prediction, diagnose of natural disaster risk.
- Technical work for evaluation and countermeasure construction.
- Provide a data for Earth observation, data processing, sales.

Required data and information

Making original geological map based on site investigation and also obtained from customers. Although aerial photograph is being applied, satellite data does not used at the present moment.

Requirement regarding PF

As an interface of data distribution,

- To retrieve an optional part in a database.
- The timing of data distribution.
- Inter-operability with API.

2.2.2.4. Business subject

Their response to is to implement an inspection and detection of hazardous place on the highway. And Smart Management Highway (SMH) plan is currently being implemented both for being mechanize and sharing know-how of construction technology.

Required data and information

Since there’s no past of the work site available, verification of ground movement is being implemented, and work priority will be set in accordance with a result of their 5-year basis inspection.

Meteorological data, map (allocated by the Geographical Survey Institute) and smartphone carrier’s prove information are also utilized for traffic congestion prediction system.

Requirement regarding PF

Interoperability with satellite would be applied as a part of SMH plan.
As an interface with the PF, timely data distribution (especially in the event of disaster) through API is required.

2.2.2.5.  

(1) Business subject
They are providing data service solution for farmers and plantations about an amount of soil moisture. In the near future a package system including vinyl house will be developed aiming for unmanned operation. In this point their concern is that risk of automated agricultural operation did not wipe away yet.

(2) Required data and information
Using a sensor placed in the vinyl house, they are distributing appropriate data through data cloud to farmers such as amount of soil moisture, weather information and CO2 data. No satellite data used at this present moment.

(3) Requirement regarding PF
As described above, interoperability with satellite would be applied as a part of SMH plan. As an interface with the other PF, timely data distribution through API is required.

2.2.2.6.  

(1) Business subject
They are providing “Onboard Tredas Data” to university and fishery association. (Onboard Tredas Data is originally developed by them using technology for fishing spot research. Marine information will be shown on specific terminal of each fishing boat).
Also they have been conducted GIS and web systems development and maintenance, analysis using remote sensing technology. But it supposed to be difficult to expand businesses due to shortage of human resources.

(2) Required data and information
Using satellite data provided by and storage in crowd. Processed satellite data is distributed to ocean fishery boat through communication satellite once a day basis.
(3) Requirement regarding PF
In addition of real-time satellite data distribution, linkage of meteorological data and way of thinking for the PF usage fee is also requested as a necessary function of PF.

2.2.2.7. Business subject
(1) Business subject
owns analytical technology based on Deep Learning as key technology to companies such as processors and also provides hardware and software environments for this purpose.
In the future, this company plans to start offering solutions.
The problem of this company is that Deep Learning data does not gather because it collects learning data for Deep Learning by himself according to client's request.

(2) Required data and information
The data to be used is moving image data such as a drive recorder in addition to information to be learning data. In addition, these data are collected by themselves, stored and provided using the cloud system.
Currently, satellite data is not used, but aircraft data, map data, weather data, land change data are useful in addition to satellite data.

(3) Requirement regarding PF
As a request for data PF, the following were mentioned.
• Linking with Google Map during data search
• Preprocessing function for machine learning
• Output function that the input image and the output of deep learning output have the same format
• Secure storage function
• Use of data PF such as providing applications

2.2.2.8. Business subject
(1) Business subject
conducts business such as insurance in the field of agriculture, meteorology, etc., development and operation of risk evaluation model, operation, calculation of insurance premiums.
As in the banking industry, the Property insurance industry has a trend to reduce personnel and is focusing on digitizing business. Especially, the agricultural insurance problem is that farming information of each individual farmer is not available.

(2) Required data and information
The data used uses global resolution and high resolution satellite data for insurance development.
For other data, weather data is used for natural disaster model owned by our company.
Further, Automobile driving data and health data is used for various insurance developments.

(3) Requirement regarding PF
As a request for data PF, the following were mentioned.
・ Storage of archive data for about the past 10 years
・ Cooperation with other PFs such as agricultural data platform
・ Setting of usage fee when using data PF

2.2.2.9. 
(1) Business subject
develops instruments equipped with chips using GPS and QZSS IMES, sells these instruments to local governments and road management companies, and analyzes using AI based on GPS data.
As a problem such as analysis, if various data can be used, it will be possible to offer various suggestions to users.

(2) Required data and information
GPS data is mainly used.
This data is created as fluctuation prediction information using the cloud or its own server, and is provided to the user.
In the future, this company is considering using the satellite data, meteorological data (wind direction, rainfall, atmospheric pressure) in conjunction with the hazard map of the local governments, for disaster prevention etc.

(3) Requirement regarding PF
As a request for data PF, the acquisition function, the display function, and the processing function with the use of the hazard map etc. were mentioned.

2.2.2.10. Business subject

(1) Business subject

considers digital change as a business integrator suitable for clients by making use of advanced digital technologies such as analytical techniques using AI, machine learning etc. and Robotic Process automation (RPA) for management tasks.

Considering the data acquisition cost when seeing the situation in a bird's-eye view among various data, they are looking for ways to combine the satellites, aircraft and drones separately and to combine it well.

(2) Required data and information

Basically, this company collects the necessary data from the client or collects it on its own in each project.

In collaboration with Orbital Insight, they provide analysis results from ABeam Cloud.

(3) Requirement regarding PF

As a request for data PF, the role and mechanism of each layer (part of promoting use of satellite data and data) in data PF were mentioned.

2.3. Conclusions

Expected big data affinity to satellite data to be a useful PF, our survey result can be classified below.

2.3.1. Expected big data affinity to satellite data

Considering our survey result of 2.2.2.1~10 (2), not only satellite data itself but also quasi-zenith satellite (GPS) information supposed to be required. It is expected to raise usability by integrating those user requirements.

On the other hand, the satellite data is raster (image) data, for example, change extraction is performed using two pieces of data, and those extracted as lines and points are vector data.

Raster data has position information for numerical values. The numerical data of the ground observation points having this position information is easy to be consistent.
As for raster data, it is also easy to match with satellite data, since it also corresponds to images looking at pinpoints as the surveillance cameras, narrow areas as the drone in the same area, different directions as the in-vehicle camera.

Furthermore, if data is in the same area, it is easy to superimpose raster data and vector data.

These combinations may have relatively high affinity with satellite data.

Given these characteristics, the following are examples of big data expected to have high affinity, from this research results.

- Meteorology data (temperature, rainfall amount), weather prediction data.
- Aircraft data, drone data.
- Base map (land record map, geological map, hazard map).
- Electric reference point data.
- Monitoring camera data.
- Soil moisture content, CO2 data.
- Economic data (POS data, credit card data etc).
- Statistical data(e-stat, Ministry of Internal Affairs and Communication).
- Proved information of smartphone carrier.
- Fishing vessel positioning data, The catch data.
- Agricultural data (agricultural data base—Ministry of Agriculture, Forestry and fisheries).
- Automotive vehicle data.
- Health care data, etc.

2.3.2. Required information to be user-friendly data PF.

With reference to our survey result, user’s requirement can be categorized two parts: one is contents of PF and the other is usability. In this point, important feature to establish an appropriate PF is not just as free storage of data but to provide a data source with favorite usability. In addition, to provide useful PF, search service function, processing speed, data storage capacity and the other surrounding environment to be considered.

(1) PF function to be required

- Interoperability with Google Map to provide a linkage for related place, organization and so on.
- Variation of data distribution. (Real-time, day/week basis)
Data coordination between API and land use data, meteorology data, economic data and statistical data etc.

Data cooperation between API and the other appropriate API (data accessibility, allocation).

Obtain data of WMTS (WebMapTile service) and an optional area requested by municipal corporation through API.

Storage for data and information (e.g. Current satellite data stage capability is more than decade.)

Original (unique) data’s security when using crowd.

Data categorize by index basis.

Analyze tool for interferometry and a numerical statement.

Interoperability to be required with the other PF (e.g. GoogleEarth) when output the data.

Output to be encrypted as needed.

(2) PF utilization

Just not be a storage place of data, but chargeable for free-use purpose only.

Promotion like as satellite utilization image video distribution to arouse business operator’s interest.

A basic concept about PF usage fee (e.g. will be charged in case of excess a define amount.)

Provide availability with web app (e.g. drone, satellite) like as Apple Store (both charged and free).

Even though PF usage fee is not free, it would be accepted if database usability for a user is superior than to use the other software.

Usage example, development of PF usability.

A plan to increase the number of users (clarification of satellite data handling by the 1st hierarchy, increase of the effect of attracting users by the interpretation of a client problem in data use promotion by the 3rd hierarchy).

Data variability gathering from start-up-company, acquisitions of major enterprises.

Clarification of copyright for data source and information usage.