The Role of Geospatial Technologies in Social Innovation

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Location matters to our quality of life, and geospatial technologies such as GIS, and satellite imagery provide us with a valuable capability to analyze and understand the relationship between location and our environment, which the authors see as the essence of Hitachi's social innovation concept. Utilization of geospatial technologies leads to better planning and more efficient implementation of energy distribution; more reliable and environmentally conscious agriculture; and faster and smoother traffic. This article summarizes Hitachi Solutions, Ltd.'s geospatial technologies and various implementations especially in the urban infrastructure sector. These implementations cover asset and facility management in the power and gas distribution sector. Also, agricultural information systems such as field and soil management, fertilizer design, and remote sensing are explained. Finally, the article summarizes efforts towards globalizing Hitachi's geospatial technologies.

1. INTRODUCTION

HITACHI describes its Social Innovation Business as providing total solutions for sustainable urban development worldwide, with the role of addressing critical global issues such as the need for creating and improving the transportation infrastructure in urban areas, improving access to clean water, developing technologies that promote a smooth and efficient transition to the smart grid while keeping a sharp eye on sustainability objectives and the conservation of our world's supply of precious natural resources[1]. Providing total solutions in the urban infrastructure sector is at the heart of this concept because the quality of urban infrastructure is the defining indicator for the quality of life of the citizens in that urban environment. Utilization of geospatial technologies based on geographical information systems (GIS) provides a unique key to the overall scheme of social innovation. They provide a location-based common platform where all social innovation technologies can be gathered, analyzed, and displayed in a visual and easy-to-comprehend manner on maps, or on satellite images. This article summarizes Hitachi's geospatial technologies and implementations, especially in the urban infrastructure sector. These implementations cover asset and facility management in the power, gas, and water distribution sector. The usage of geospatial technologies in these sectors are explained, together with how they help clients to regulate their business processes for higher efficiency and cost effectiveness. Moreover, agricultural information systems such as field and soil management, fertilizer design, remote sensing, and traceability are explained.

The final section summarizes efforts being made to globalize our geospatial technologies.

2. GEOSPATIAL TECHNOLOGIES

There are various descriptions and definitions of geospatial technologies in the literature and Internet. Geospatial technologies have three components, the first of which is GIS. The Geospatial Information Authority of Japan (Ministry of Land, Infrastructure, Transport and Tourism) has a very comprehensive definition for this technology: "GIS is a technology that supports the integrated management and processing, visual display, sophisticated analysis, and rapid evaluation of data containing location-dependent information (spatial data) based on geographic position."[2] The second component

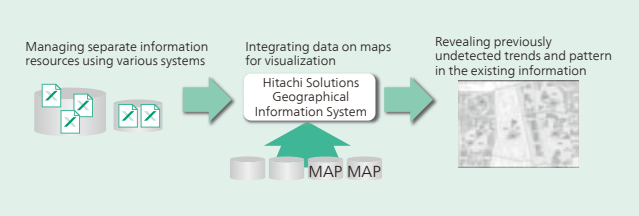

Fig. 1 | Visualization of Interrelation between Data.
Geospatial technologies allow users to detect trends and patterns in the data, which are difficult to detect when using traditional management methods.

is the tools to provide the data for this technology, such as satellite images, maps, and global positioning systems (GPS). The third and final component is the applications that are developed on these two components, and which show interrelations between data in the location dimension that would not be evident if the data were managed in traditional formats, such as alphabetically, in arbitrary groups, or in ledger format (see **Fig. 1**). Some examples of these applications are facility/asset management systems, energy and/or water distribution network models, and agriculture information management systems. It is possible to increase the number of these applications, but this article will focus on these ones, only.

3. UTILIZATION OF GEOSPATIAL TECHNOLOGIES IN URBAN INFRASTRUCTURE SECTOR

3.1 Facility/Asset Management in Power Distribution

The biggest investment of power distribution companies is in their assets. The biggest challenge faced by power distribution companies is to increase the stability and quality of electric power while decreasing operational costs. They need to accomplish this task despite the ongoing depreciation of their assets because of asset aging. This is only possible if they can establish an efficient equipment repair cycle and furthermore an effective maintenance cycle that will prevent accidents and failures before they occur. This is only possible if they can capture real field information related to asset condition (see **Fig. 2**).

The following is made possible by utilizing the geospatial technologies for facility management.

- As the locations of the assets are known, it is possible to create a hierarchical data model. For example, a power pole can be the origin asset, and the insulators or other equipment on the pole can be related to this pole (parent-child relationship).
- It is possible to create a network structure as the locations and hierarchy of assets in the grid are already known. In this way it is possible to estimate the area affected by a failure or accident by tracing it along the distribution network (upstream for the source of trouble or downstream for the affected area).
- It is also possible to use various spatial analyses, such as area analysis and failure/cause and effect analysis, to define and estimate the possible risk areas and to identify areas and assets that have high priority for maintenance.

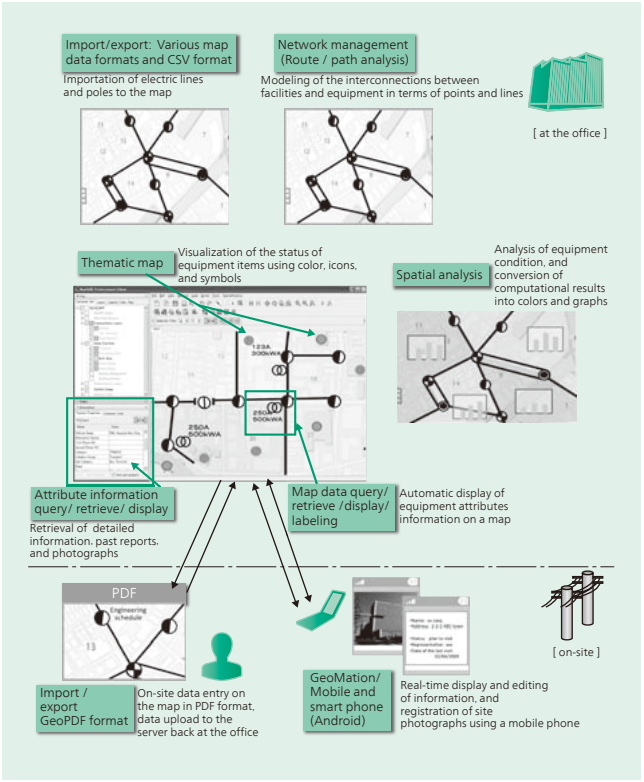

Fig. 2 | Image of Facility/Asset Management System for Power Distribution Sector.
Geospatial technologies allow the user to manage their assets at the enterprise level.

As can be seen from the system image in **Fig. 2**, it is also possible to use mobile technologies with GPS capabilities. The system can be used for customer support, accident support, and task checking by exchanging information between staff managers and field workers. This leads to better customer service through the quick and accurate response to customer complaints or accidents using mobile technology. Also, it improves efficiency in the field by viewing detail information on the current staff and status of utilities from mobile phones or tablets.

The facility/asset management system can also be used for gas utility companies, and our dedicated software application is currently running in more than 12 gas utility

companies.

3.2 Agricultural Information Management System

Hitachi Solutions has been developing and enhancing its agricultural solutions since 2004, and these have been adopted by approximately 50 agricultural cooperatives and other organizations, mainly in Japan.

The same principle applies in the agriculture sector as in other sectors. Farmers have to increase their efficiency while decreasing their operating costs. However, there is another dimension in agriculture which is the environmental burden that fertilizers impose on farming fields. This agricultural information management system provides various tools not only to estimate the best harvest time, operate the agricultural machinery efficiently, and optimize the farming work, but also to generate solutions and/or advice for farmers on how to use fertilizers or agricultural chemicals. This leads to more efficient farm practice as well as less burden on the environment (see Fig. 3)[3].

Also, when it comes to agricultural practices, another very important aspect is the safety and security of the food. Registering and recording all fertilizers and chemicals used in the field makes it possible for third parties to audit these records for the safety and reliability of the crop and the food.

Although this system provides a wide range of GIS tools for more efficient and environmentally conscious agricultural practices, there is another aspect that the authors would like to emphasize in this chapter: the utilization of satellite imagery.

Hitachi Solutions has been providing DigitalGlobe* satellite imagery, which provides the world's highest resolution commercial satellite images, to Japanese and Asian customers since 2001. For this reason, Hitachi has accumulated a depth of know-how relating to satellite imagery and its use in different fields and sectors. Applying this know-how to the agriculture sector yielded an important application: planning the harvesting sequence of wheat. The harvest time for wheat depends on its dryness. Traditionally, the dryness level is decided manually at the time of harvest by the farmers. However, there can be differences in wheat dryness even within the same field, and this usually leads to harvesting some of the wheat before it is dry enough, which means a lower quality crop. By using the satellite image analysis function of the agricultural information system to analyze wheat fields and ascertain the growth in each field so that harvesting

* DigitalGlobe is a registered trademark of DigitalGlobe.

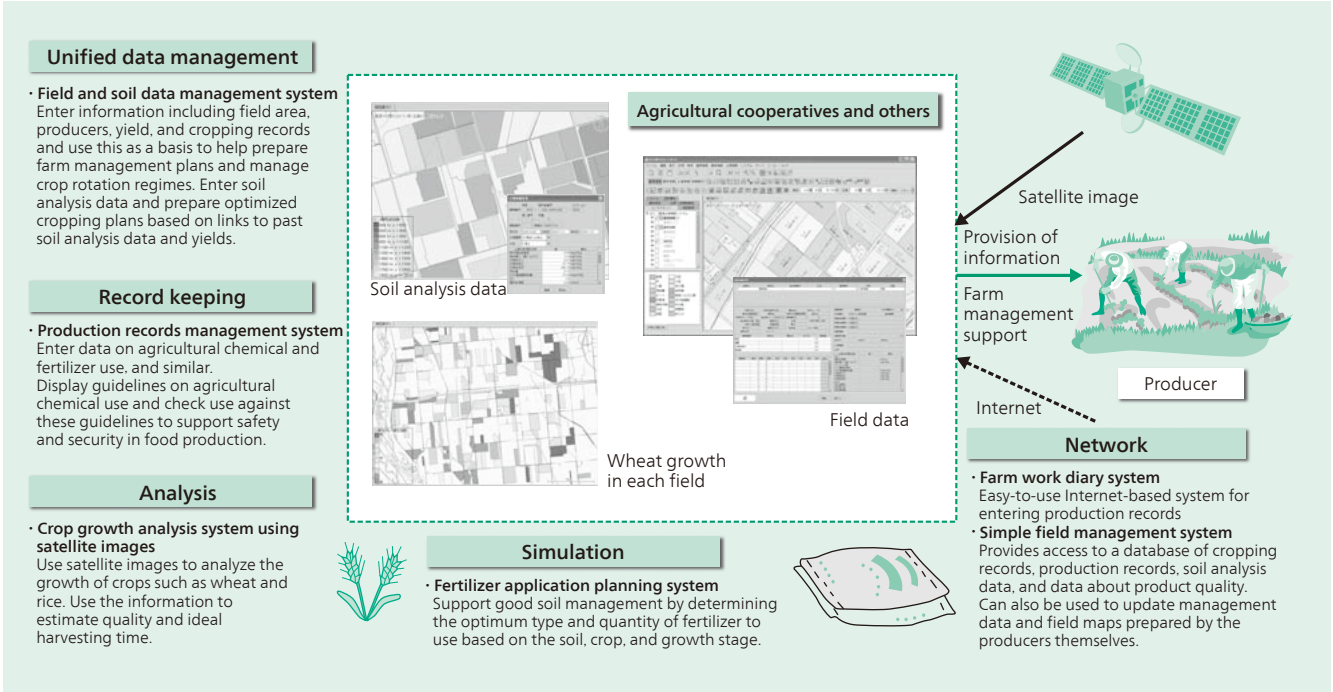

Fig. 3 | Overview of Agricultural Information Management System.

Hitachi Solutions, Ltd.'s agricultural information management system was developed on geospatial technology (GIS and satellite imagery). It has been developed according to user needs to overlay a wide range of different information and provide various analysis tools to create a more efficient and environmentally conscious agriculture business.

can be performed in the order in which each field dries out, great reductions were made in fuel oil use for drying. This also cut CO_2 emissions dramatically and helped to avoid quality loss as less chemicals were used to dry the wheat[3].

This application provides a very good example of social innovation utilizing geospatial technologies in the farming and agriculture sector.

4. GLOBALIZATION OF GEOSPATIAL TECHNOLOGIES

The geospatial technologies and their applications in the urban infrastructure and agriculture sectors are suitable for expansion in the global market, especially in emerging countries such as Brazil, Russia, India, and China (BRICs), Turkey, Vietnam, etc. In these countries the necessary infrastructure investments have already been made. However, there is a need for efficient and cost effective management systems for these existing investments. For this reason, Hitachi Solutions has been trying to promote its geospatial solutions in those countries for the last three to four years in collaboration with other Hitachi group companies, and has been getting some promising results. As mentioned in the previous chapters, geospatial technologies provide a common platform for social innovation. There is another article in this issue about probe data and its use in solving traffic problems in Hanoi, Vietnam and Istanbul, Turkey in which our geospatial technologies were used. Hitachi Solutions is also working on projects related to the power transmission and distribution sector in countries like India, Turkey, and Russia through local partners; agricultural information solutions in the BRICs, and disaster management systems in South East Asian countries like Vietnam in collaboration with Hitachi group companies. Hitachi Solutions is dedicated to promoting its know-how and expertise in geospatial technologies more and more, and will contribute to Hitachi's social innovation concept.

5. CONCLUSIONS

In an article back in 2009, one of the authors, Bahadir Gultekin, mentioned that there are two hurdles for Hitachi group companies in the global market that result from its being a traditional and large company. The first is adaption to different cultures and business habits, the second is flexibility and speed of reaction to changes in the global context. Now, in 2014, he believes that Hitachi has recognized these hurdles and is making great efforts towards solving these problems by introducing its social innovation concept whereby Hitachi becomes a total solution provider and can realize its true power[4].

Hitachi Solutions will continue to develop and adapt its geospatial technologies to the needs of the global market as it has been doing for the last 25 years. Its target is to become a leading solution provider in geospatial technologies in the global market in collaboration with other Hitachi group companies.

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