

GIS, AM/FM, AND AUTOMATED CARTOGRAPHY IN JAPAN

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ABSTRACT

In these five years, introduction of GIS, AM/FM and automated cartography has been increased rapidly in Japan. AM/FM is leading the trend. Very large systems are operated by utilities and a central organization was set up under the control of the national government. CD-ROM data base and PC based GIS is becoming popular. Automobile navigation systems are going to take off. Institutional problems between and within agencies became an obstacle in popularization of new technology.

INTRODUCTION

Although Japan is the third largest country in the world in terms of numbers of users in GIS, AM/FM, and automated cartography, the situation in Japan is not known in English speaking countries. A survey in 1988 September issue of PIXEL magazine figures that there are 31 GIS, AM/FM, and digital mapping systems in Japanese market from 29 companies. This number does not include PC based systems. Some are from US (Intergraph, ARC/INFO, Synercom, McDonnell Douglas, and Computer Vision); one from UK (Laser Scan); and others are Japanese made systems. In 1984, a survey by NICOGRAPH shows there were no more than a dozen systems available in market. This figure shows that Japanese market is rapidly growing. However, under this situation, several problems are found. Compared to widely used AM/FM, GIS attract small users in Japan. Lacking synthetic national policy in spatial information systems, institutional problems became severer.

GIS

National agencies

Although GIS has been attracting interests of national agencies for two decades, very few GIS are used actually. Japanese government has been interested in building a nationwide data base for her land, and the National Grid Data, consists of land use, landform, DTM, soil, geology, transportation, population, economic activities, meteorological data and many other items, was built with several billion yen and twenty years. Unfortunately, this valuable data base is not fully utilized by agencies.

There are two major reasons for small amount of users; (1) access to data is limited to government, university and utility, and (2) agencies do not have tools to use data base. A typical case is found in the Geographical Survey Institute (GSI). Although GSI is the major provider of grid data, GSI does not have GIS. Almost the same situation is seen in the Ministry of Agriculture, Forestry and

Fishery (MAFF), who provides grid data on agricultural census, and the Statistical Bureau providing population census data. The only national agency using GIS for manipulating the National Grid Data is the Land Agency. ISLAND, a Fujitsu made mainframe based GIS has very poor graphic interface and is almost inutile. There are some plans to improve the situation. The Statistical Bureau will introduce ARC/INFO or similar in fiscal year 1989. Kokusai Aerial Survey Co. contracted to build PC-based GIS for MAFF.

Local Governments

Prefectures Prefectures and municipalities are largest GIS users. Saitama, Kanagawa, Chiba, Hyogo and Okinawa prefectural governments have introduced ARC/INFO for regional planning. Planning departments in Tokyo, Osaka, Hokkaido governments have decided to introduce GIS. It is forecasted that more prefectural governments will introduce GIS in 1989.

UIS Very early GIS users in municipalities are Kitakyushu and Nishinomiya, who received grants-in-aid from the Ministry of Construction in the early 1980s. In mid-1980s, several cities introduced GIS made by Japanese mainframe computer companies as "showcases". Numazu, where Fujitsu's research laboratory and factory are located, introduced Fujitsu made GIS "ARISTOWN", and Abiko, where NEC has a PC assembly factory, introduced "WING". In 1986, the Urban Department of the Ministry of Construction started a project UIS II, which promote municipalities to introduce integrated GIS for planning and administration. Koshigaya, Tokorozawa, Ogaki, Okayama and several more mid-sized cities are selected as the test fields.

Institutional problems Generally speaking, it is very difficult to build an single integrated GIS in very large cities. Yokohama, Kawasaki, Nagoya and Osaka are trying hard to build multi-purpose integrated GIS. Obstacles in building an integrated GIS are institutional problems between departments in local governments and between departments in national governments. Japanese administration system is more centralized than those of north American countries, thus the central government is influential in introducing GIS. One of the example is a conflict between the Housing Department and the Urban Department in the Ministry of Construction. The Department of Housing issued a notice that housing construction permit data should not be used in UIS II. Another conflict is between the Ministry of Construction and the Ministry of Home Affairs.

Emergency information systems One of recently emerging applications of GIS is emergency information system. The Fire Department of Nagoya City introduced Fujitsu's system in 1987. The place of fire or ambulance request is identified by address and large scale maps displayed in CRT. Explosive materials and homes of assistance required persons are also displayed. The system automatically makes up a fire extinguish plan, and send it to every fire station by facsimile. A copy is also sent to commander vehicles by radio facsimile. This type of system is being introduced into several cities including Osaka. The River Department of the Ministry of Construction set up the River

Information Center, from where local rainfall data and the water level of rivers are sent to local governments to prevent flooding.

Private industries

Utilization of mini-computer based GIS in private industry is limited to consultants, general constructors and surveyors with a few exception in forestry business. Recent trend is emerging utilization of PC based GIS. Zenrin, a map publisher in Kyushu, started distributing CD-ROM based large scale digital data with every individual household in 1987. Z-map includes a CD-ROM, basic handling software, a GIS construction kit, and a sample program. Equivalent products are in the market from several vendors including NTT. Stellar Co., a small software house in Tokyo, sells PC and EWS based GIS construction kits. Lion, one of the largest soap manufacturing companies in Japan, has formed a network of POS registers, and process sales data using a system based on Stellar's kit. MAFF's system, which was described previously, is also based on Stellar's kit. Users of PC based systems are increasing in banks, insurance firms and super market chains.

Research organization and universities

Only a few sets of GIS have been used in research organizations (e.g. The Geological Survey Institute) and universities. In Japan, cartography and surveying have not been concerned much in university. There is not even a single chair for cartography in Japanese universities! Recent recognition of importance of GIS education and research in geographers and planners resulted to reorganize university curriculum in several universities.

AM/FM

Background

Utilities now seems enthusiastic in introducing AM/FM systems. One of the strong motivations is strong yen and OPEC. Electric power and Gas companies now can buy oil less than the half price which they paid several years ago. Three quarters of the extra benefit from cheap oil is paid back to their customers, but a quarter is left to companies for new investments such as new plants, building utility conduit, and information systems.

Gas

Tokyo Gas Gas industry is a pioneer in introducing AM/FM in Japanese utility industries. Tokyo Gas, the largest gas company in Japan which owns total length of 36,000km pipes, serving to nearly seven million customers in the Tokyo Metropolis and the suburbs, has been building AM/FM system named Total Utility Mapping System (TUMSY). The service area of Tokyo Gas is covered by 27,000 sheets of 1:500 scale maps. Tokyo Gas started building the system in 1977. In the first stage, Tokyo Gas searched U.S.A. built systems, but found the existing systems are not suitable for the requirements, especially in processing kanji, then decided to build a system by itself. After seven years of development, the system was completed in 1983. TUMSY is operated on several VAX CPUs networked by

a VAX Cluster system. All CPUs are located in the headquarters in downtown Tokyo. Terminals are placed in the headquarters and several satellite offices where workmen can pull down the newest map or they can input altered information of piping. The system was recently improved to enable interchanging data to IBM mainframes where customer information including user family or corporate data, monthly gas consumption is stored. With this capability, TUMSY can be used as an integrated corporate information system. Tokyo Gas has sold TUMSY to nine gas and water utilities including Hokkaido Gas, Seibu Gas, Shizuoka Gas, and the Water Department of the Tokyo Metropolitan Government.

Osaka Gas The second largest gas company, Osaka Gas, is also developed a system named "IIS-MAP". Osaka Gas serves gas to Osaka, Kyoto, Kobe and their suburbs. The company started to develop a AM/FM system in 1974, but after three years the development was suspended. The problems were in the performance of computers and costs. The development restarted in 1983, and in the same year, the company decided to build a pilot system. In 1984, 471 map sheets are digitized, and the evaluation of the system was finished in December 1985. Building of an operational system was started in 1986. The system is consisted of an IBM mainframe, located at the central computing center, and distributed six IBM 9370 computers at branch offices. Each branch has about ten workstations. The software is a joint product of OG Information System (a subsidiary of Osaka Gas) and IBM. The software was sold to five users. These two large gas companies are becoming providers of AM/FM systems to smaller gas companies.

Electric power

In Japan, in the World War II time, a single electric power company was formed, and after the war, it was divided to nine regional companies. Among them, Tokyo Electric Power (TEPCO) is the largest private electric power generator and supplier in the world, who has approximately 20 million users. TEPCO has been developing a AM/FM system with Toyo Information System for managing half million maps. TEPCO also developed an automatic scanning system with Mitsubishi Electric. This AI based digitizing system can recognize crossing lines and eliminated objects in underpasses. IBM and Fujitsu are major distributors of AM/FM systems to electric power industry. Toshiba, Meidensha and Meitech also developed AM/FM for the same purpose.

Telecommunication

Nippon Telephone and Telegram (NTT), which was a part of national government until 1986, became one of the largest private companies in Japan. NTT developed several series of spatially referenced information systems. In AM/FM market, NTT is distributing "INS-SPACER" through INS Engineering, a joint company with Mitui Ship Building. NTT also developed a semi-automatic scanner "INS-CHASER".

Water supply and sewage

Water supplying and sewage service belongs mostly to municipalities in Japan. Compared to privately-owned energy and telecommunication service industries,

introduction of AM/FM is somewhat slower in government owned services. Tokyo, one of the largest cities in the world, populated more than 10 million, has been testing AM/FM for sewage service, and recently purchased a system from Tokyo Gas for water supplying service. Yokosuka City purchased a system from Fuji Electric. Sapporo, Osaka, Nagoya, Hiroshima, Okayama and other major cities also decided to introduce AM/FM. These cities are now in process of selecting systems or in performance evaluation stage. Before 1980, water supply services are in financial difficulties mainly from construction of new dams, waterways, and water reservoirs for increasing water demand. But precepts from severe water shortage in Kyushu Island and publicity for saving water thereafter decreased water consumption. At the same time, bursting of old mains laid a century ago became frequent. Cave-in in the main street of Ginza caused from leaking mains became head line news of TV. Maintenance of facility became a critical issue in the late 1980s. Almost the same situation is in sewage service. In the 1970s, rapid suburban development and river water pollution problem caused by septic tanks requested extension of piping networks. In 1980s, improvement of older systems in inner city and maintenance became more important. AM/FM for water supply and sewage service is forecasted as a promised market because there are more than 3,000 municipalities. A bunch of vendors are providing systems; they are Fujitsu, Hitachi, Intergraph, Fuji Electric, Tokyo Gas, Osaka Gas, Computer Vision, and value added resale agents such as Kubota Iron Works and Nippon Steel Pipe.

ROADIC

According to increasing utilization of AM/FM in utilities, exchange of data became essential. In 1985, the Department of Road in the Ministry of Construction set up a new organization "Road Administration Information Centre (ROADIC)". This semi-government organization aims to maintain data bases of roads and utilities in eleven cities with over million population. The center converts and updates road data base under contracts with road departments of national and local governments. Utility enterprises provide piping and wiring data to the center, and in return, they can access to both road data base and utility data base, so that they can exchange data base with governments and other utility enterprises. Governments can access data bases in order to manage roads as well as to charge utilities for using roads. Construction of a pilot system was started in July 1987 at their Kanagawa Branch (where maintains data bases for Yokohama and Kawasaki) using NTT's INS SPACER. In fiscal year 1989, the system at Kanagawa Branch will start operation. In other cities, operation will be started in fiscal year 1990. It is already decided that in Tokyo Branch, TUMSY will be used, and in Osaka, IIS-MAP will be used in ROADIC. There is a future plan to use this data base for city planning, property assessment and other purposes, but at the present moment, this plan is difficult to carry out because of institutional problems between and within ministries.

AUTOMATED CARTOGRAPHY

GSI

Two major projects have executed by the leadership of GSI. The first project is to establish a standard procedure and formats in digital cartography. This standard is limited to computerized photogrammetry and lacks viewpoints in future data production and GIS development. Another project is building a system called "Computer Aided Cartographic Processing System (CCPS)". CCPS is a EWS based map editing and printing system for 1:25,000 topographic maps. GSI plans to digitize all 1:25,000 maps within several years. When GSI started a project of digitizing 1:2500 scale maps in 1986, managers in GSI forecasted that sales of digitized maps would be increasing. GSI formed a semi-government organization for management and sales, and the organization requested surveying companies to digitize 1:2500 maps of Nagoya area by their costs. The data base was completed in early 1988, but GSI could find no user after all. Utilities rejected to use 1:2500 scale data because they need more precise maps for underground pipe description, Nagoya City evaluated that any data base without updated are not usable, and found digital map used by their fire department has better quality because it is updated every two months.

Marine Safety Agency

Two activities are pointed at the Marine Safety Agency. The first activity is a discussion on standards for electronic charts. Computerization of ships has been accelerated in these years and already numbers of ships are equipped with plotters, which plot the traces of navigation on CRT and recording devices. But at this moment, there is no standard in digital navigation charts. Determination of an international standard for electronic chart was requested by IMO/IHO. Another activity is building a data base of coastal zones along Japanese islands.

AUTOMOBILE NAVIGATION SYSTEMS

Toyota Crown, a flagship in small car line of big Toyota, received a full model change in 1987, and the top model was equipped with a navigator. Although there are still a bunch of arguments whether an automobile navigation system can be helpful or not, Japanese industry and government agencies are moving fast for realization. There are major two opposing groups; AMTECS, led by the National Police Agency, and a group organized by the Ministry of Construction. The National Police Agency and the Ministry of Construction have been argued for over twenty years on traffic control and guidance on highways. The basic concepts in two groups are identical. The location of an automobile is identified by XY coordinate information from the sign posts and sensors equipped with the automobile. Sign posts also send real-time information on traffic condition and parking facilities. Digitized map is stored in a CD-ROM with auxiliary information (e.g. amusement, restaurant). A CRT display shows a trace of vehicle on a map, and a voice synthesizer gives turning information and warning. GPS will be used auxiliary, because in urban

areas, the radio wave of GPS is difficult to catch in urban areas. It is not certain whether automobile navigation systems will be accepted by Japanese drivers or not, but it is obvious automobile industry likes it because they can mark higher price tags on new cars.

STANDARD

A committee to discuss on determining Japanese standards on digital cartographic data was organized in 1987. The members are from national agencies, local governments, utilities, surveying companies and a university. The committee published two reports in 1988 concerning basic ideas and activities in the United States. GSI refused to send members to the committee, and interfered the activity of the committee. The reason of opposition is that the committee is organized by the Standard Division of the Ministry of International Trade and Industry (MITI). GSI's refusal weakened the activity of the committee.

LEGAL ISSUES

Problems of data security and copyrights became a critical issue in public opinion. Over 400 communities have security acts and more than 700 have rules. In some communities, it is stated in act that collected data for a specific purpose should not be used for other purposes. Strictly reading the statement, a planning map cannot be used for tax assessment, or resident register cannot be used for making population statistics. This would be a future obstacle in using integrated GIS in local governments.

The focal point of the copyright problem is that whether GSI can claim copyright on digital maps. GSI only publishes small and mid scale maps, where large scale maps are mostly published by local governments. In Paper maps, when a publisher reproduces or use GSI maps for a base map, he should ask GSI for permission. But in digitizing a GSI map, does one have to ask permission? It is still unclear. In large scale maps, copyright problem is more complex. GSI claims for partial copyright for using GSI's public survey data. And in many cases, it is not clear that whether copyright belongs to local governments or to surveying companies.

THE NATIONAL MUSEUM OF CARTOGRAPHY

In April 21, 1988, the Science Council of Japan Issued a recommendation to the Prime Minister of Japan, Mr. Noboru Takeshita, on establishment of the National Museum of Cartography. The recommendation insists that in the era of globalization, it is urgent and national requirement to have a center to collect, store, process retrieve, and provide domestic and international geographic information including maps, charts, atlases, aerial photographs, ground landscape photographs, satellite images and various statistics.

Although the recommendation carries the name of museum, it is more than a display place of old maps. The museum will have five major functions; (1) map library, (2) research

center on geographic information and spatial analysis, (3) map exhibition and social education, (4) data base service, and (5) training and graduate level education.

The recommendation is being processed by the National Council of Science and Technology. Nine ministries and national agencies have expressed their interests in establishment of the museum. Also several prefectures and cities are inviting the facility. The main hurdle is a strict policy of reducing government employees kept by the Japanese Government.

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