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Institutional Issues in Promoting Korean Spatial Data Exchange

Kam-Lae KIM* and Won-Jun CHOI**

Abstract

The information system fields of spatial applications have rapidly grown during the last decade in Korea. Spatial data has been produced for a variety of systems without common standards until national GIS Committee defined the data exchange formats among spatial databases in the middle of 1990's. It aimed at promoting data sharing between the different systems in similar application fields. However, a considerable number of databases built prior to the introduction of the standards are not yet standard compliant but still play the roles of the main producers/consumers in the data collection field such as early developed huge AM/FM systems maintained by governmental organizations. The strong autonomy of these databases keeps their own data models, formats and descriptions from being standardized, which leads the sharing to a more difficult stage.

Sharing is another way of data acquisition with least efforts and time away from direct collection. A data clearinghouse is the core module which directs users to the relevant data resources. The contents of datasets should be described with predefined metadata standards for precise indexing. Moreover, a number of technical problems have to be resolved for the common use of data between heterogeneous spatial database systems. However, the technical issues can be covered by the present information technologies. The difficulties persist in the political/institutional issues.

Institutional issues are derived from the diverse sources such as political background, governmental policies, related laws and/or regulations. The paper will firstly make an analysis of current situation in terms of Korean policies, laws and regulations, secondly abstract the institutional issues from the situation analysis, lastly present guidelines for promoting spatial data sharing in Korea.

Keywords : *Data Exching, Clcaringhouse, Data Standards*

1. Introduction

There is a tendency to integrate a number of GIS databases developed by different organizations for different purposes into a coordinated and integrated system called National Geographic Information Infrastructure(NGII) or National Spatial Data Infrastructure (NSDI). This supports public and private sector applications of geoinformation in such areas as transportation, community development, agriculture, emergency response, environmental management, particularly, fostering information market as well as national economic development[1]. The word "infrastructure" can be defined as the structures and services to make availability, accessibility and use of geographic information as efficiently as possible, i. e. available, accessible and affordable[2]. It is surrounded by institutional, technical and economic arrangements.

The information system field of spatial applications has rapidly grown in the last decade. The need for spatial data infrastructure emerged as an urgent problem because a great number of spatial data sets has been produced and used by private and public sectors without appropriate consideration of data sharing. Korean Geographical Information System Committee launched in 1995 to cope with duplicated investments for spatial data acquisition. The committee has introduced both legal and technical frameworks to encourage the establishment of National Geographic Information System.

The committee consists of 8 commissions and an advisory board. The commissions are running by more than 4 ministries of the central government and the advisory board is filled with people from industrial, academic and research institutes. The main mission ranges from the resolution of institutional issues to

*Professor, Dept. of Civil Engineering, Myong Ji Univ.
**Ph.D. Candidate, Dept. of Civil Engineering, Myong Ji Univ., Lecturer, Cadastral Techniques Education & Research Institute, Korea Cadastral Survey Corp.

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arrangement of technical ones in order to support the needs for a wide spectrum of spatially referenced information in different application domains.

Governmental organizations and the GIS community, as information providers and users, have recognized the importance of NGII. They have been developing NGII at national and regional levels for data sharing purposes in order to reduce the high costs of data acquisition which normally are about 60 to 80% of the total investment when developing a GIS project and to allow accessibility to the existing data in a distributed and heterogeneous database environment.

However, despite these positive impacts provided by rapidly developing GIS technology and attempts at establishing a NGII, the fundamental ideals of democracy and rights of individuals are being frequently threatened by increasing demand for detailed information, advanced computers and communications technologies. Information policies, which deal with an individual's privacy or intellectual property rights and public's rights to access and pricing of government information, are still underdeveloped or unclear in many countries including Korea.

Currently, private and commercial sectors as well as the public organizations are suffering from the lack of appropriate information laws and regulations, and from government non-conformity to the philosophy of freedom of information, particularly for geographic digital data. Problems between public rights to access government information and government attempts to restrict access should be resolved in order to strengthen democratic society and to promote information market.

2. NGII and NGIS

The central government has recognized that a National Geographic Information System(NGIS) is one of the most fundamental infrastructures required to promote national competitiveness and productivity. Levels of governments have provided substantial funding for the development of the NGIS, based on the fact that the public sector will be the major user of the NGIS and recognizing that geographic information is a basic asset of the nation. In the past, many agencies have collected and controlled spatial data to meet their own needs and criteria. This has been done in an uncoordinated way causing unnecessary duplication of efforts, investments, and inconsistent quality of data.

Due to the lack of standards, data sharing and cooperation among agencies have not been easy to accomplish. In order to integrate and share data more effectively and easily, both private and governmental sectors recognize the need to introduce National Geographic Information Systems. However, there are limits on the ability of the private sector to develop GIS alone since it requires a huge financial investment. It is in the context the government has undertaken the development of the national geographic information infrastructure[3].

2.1 Roles of Governments

The central government is playing a major role in acquisition of the NGIS, focusing on the establishment of spatial databases and the standardization of information. The application of spatial databases, including technology development and training of GIS specialists, is also considered as one of the basic roles of the government. In the development of NGIS, the government is responsible for the following items:

- Enactment and amendment of legislative background
- Establishment of framework database
- Standardization of data exchange format
- Coordination between private and public sectors
- Financial support

2.2 NGIS Project

Several sub-committees have been established to manage the development of NGIS. The Minister of Ministry of Construction and Transportation chairs NGIS Committee. The committee is composed of 8 sub-committees and an advisory board. Figure 1 depicts the structure of the committee and the functions of the sub-committees are as follows:

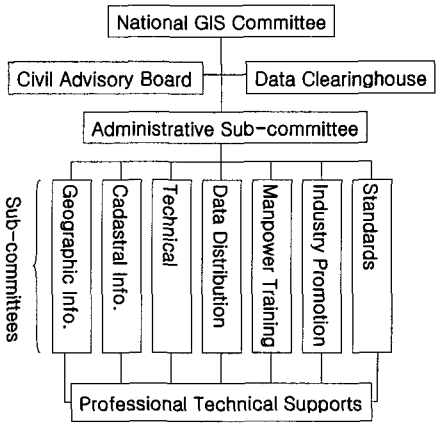

Fig. 1. Structure of NGIS Committee.

- *Administrative sub-committee* provides overall administrative management and supports other commissions. It is also responsible for financial management of the project.
- *Cadastral Information sub-committee* is responsible for the preparation and distribution of digital cadastral database and development of applications.
- *Geographic Information sub-committee* is responsible for the digitising of topographic maps and facility maps.
- *Technical sub-committee* is a technical and planning part of NGIS. It is responsible for the development of GIS technology and education/training of manpower.
- *Data Distribution sub-committee* takes charge of fast, accurate and convenient distribution of spatial data among the users in a electronic environment like Internet.
- *Manpower Training sub-committee* is responsible for planning and execution of GIS training and education in cooperation with industrial, academic and research institutes. In addition, It promotes understanding and utilization of GIS to let the public enjoy better information lives.
- *Industry Promotion sub-committee* is in charge of raising and developing the new-born industry to have international competition.
- *Standards sub-committee* is responsible for developing various standards required in NGIS, which cover data formats, system specifications and mapping codes.

There are two distinct phases in the development of NGIS. Basically, Phase I focuses on developing a GIS infrastructure phase II will concentrate on the application and maintenance of the database developed in Phase I:

- Phase I (1995 - 2000) During the first phase of NGIS, the focus will be on the construction of various framework databases as well as conducting some pilot studies.
- Phase II (2001 - 2005) In this phase, a variety of application fields will be introduced with appropriate maintenance skills for the maximal utilization of the acquired framework data sets.

3. Data Clearinghouse

The most critical, essential questions arising in the data sharing environment are: "What spatial data exists? Who owns the data? How to access to the data?". It can be said that the Clearinghouse is one of metadata service system that can remove barriers of data awareness and accessibility as well as encourage the wider and more effective use of GIS technology. FGDC describes NGDC as *a distributed electronically connected network of geospatial data producers, managers, and users. The clearinghouse will allow its users to determine what geospatial data exist, find the data they need, evaluate the usefulness of the data for their applications, and obtain or order the data as economically as possible*[4].

3.1 Clearinghouse Components

- *Spatial data*: spatial data sets that are used in a GIS (e. g. map data, statistical data, or complete GIS projects).
- *Metadata*: Content Standard for Digital Geographic Metadata of FGDC outlines the pieces of information that must be included in a useful metadata record. It includes both obligatory and optional among 220 metadata items stored in a form of HTML, SGML or TEXT files. The conversion tools are available for the data provider to convert/validate their native metadata context into a CSDGM compliant metadata[5].
- *Metadata Index*: It allows users to search through the metadata for a dataset, which meets the desired criteria, using keywords in the text or field, and spatial bounding area. It is stored in a form of text.
- *Search Interface*: It allows users to enter queries in an intuitive way. It is based on the open interface system which is widely accessible, like World Wide Web.

3.2 System Architecture

From various experiments conducted by the FGDC Clearinghouse Working Group, the clearinghouse was concluded to be a distributed archive of information-distributed among several nodes, but accessible to all potential users through a single point-of-entry or gateway, managed by the FGDC. Figure 2 shows the general system architecture for FGDC Clearinghouse. Spatial Data are distributed all over the Internet to enable data providers to update and manage the data easily, while metadata and indexes are located in several Clearinghouse nodes. Each node collects metadata from the data holder and makes indexes to allow a search in the dataset.

FGDC arranged a single web site that enables the user to enter to one of the current available three Clearinghouse gateways. Each gateway that manages a typical user interface allowing different metaphors for

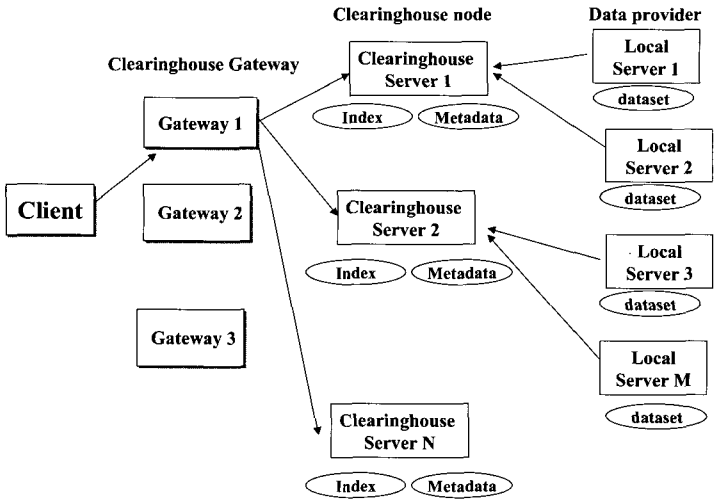

Fig. 2. System architecture of FGDC National Clearinghouse.

querying (e. g. map-based spatial query, placename lookup, keyword search) enables users to simultaneously search any or all indexes stored in several Clearinghouse nodes.

3.3

Successful and affordable implementation of GISs obviously demands national level efforts to minimize the duplication of data collection, to facilitate coordinated activities, and to maximize the use of existing datasets. According to Groot[6], the GII should be in a form of utilities such as electricity, TV, water, and gas system to make access to and use geographic information efficiently possible, i.e. accessible, affordable, and available. Many countries have already initiated many researches and projects to develop their GII such as National Spatial Data Infrastructure in the USA, ANZLIC of Australia/New Zealand, RAVI in the Netherlands, Delta-X project in Canada and European Umbrella Organization for Geographic Information of European Union. However their approaches are quite different in terms of institutional, economic and technical aspects.

One of the most important critical success elements of the GII is a Data Clearinghouse that allows the user to make known what geographic data exists, the condition of the data, and instructions for accessing the data. The National Geospatial Data Clearinghouse activity in the USA, sponsored by the Federal Geographic Data Committee, promotes the documentation, service, and discovery of digital geospatial data on the Internet. The Internet is increasingly becoming an important way for people to access government or other information at anytime and at anyplace regardless of the computer platforms. The Internet based spatial data searching facility might be one of the most essential elements of the GII, because the most important thing is to know what kind of data exists, and how to access it by means of a commonly accessible network[7].

Internet is changing the way of analysis and visualization of GIS data. Internet-based GIS is a network-centric GIS tool that uses Internet as a major means to access and transmit distributed data and analysis tool modules, and to conduct analysis and visualization. Some of the GIS vendors such as ESRI, Intergraph, Autodesk, MapInfo are trying to put their proprietary data and GIS functions on the web pages, but the approaches are quite different in terms of map visualization technique, client-level requirements and the amount of geographic analysis available through Internet. Furthermore, a lot of Internet technologies have emerged to support the development of Internet based GIS services.

In Korea, also a lot of research and other activities are being carried out to establish a National Geographic Information Infrastructure. National Land Information Center, a component of Korean NGII, was established in 1995 to provide data about parcels registered in the cadastral records quickly and correctly by using the computer network[8]. NLIC, operated by Ministry of Government Administration and Home Affairs, has central databases which store cadastral data updated by 15 provincial-level land information centers which get the updating information from approximately 230

municipalities, resident registration data and posted land price data provided by major participants through the modem. It is running a centralized parcel-based land information system which links the whole data provided by each participant database by means of a key identifier. However, due to the lack of a geoinformation infrastructure, there hardly exists cooperation between data producers to avoid duplication of data collection, and furthermore, the public can not access to these data sets. Connection to NLIC is only allowed to local government offices.

Consequently National GIS Committee recognized the necessity of establishing the National Clearinghouse system in order to improve the data sharing environment and to maximize the use of existing geoinformation.

4. Situation Analysis

In Korea, there are a number of organizations supplying geographic information. The three main government organizations, which provide topographic and cadastral information, are identified as the most important producers of geoinformation in the country in terms of main operations, products, activities, and information flow. Those main providers are:

- Ministry of Government Administration and Home Affairs (cadastral information).
- National Geography Institute (topographic and facility maps and geodetic controls)
- Korea Military Mapping Center (small scale topo maps)
- Supreme Court(property rights information)

Many public and private organizations are dealing with geoinformation either by producing, selling or using it, but unfortunately, without coordination among them in terms of standards and data exchange, under the lack of legal supporting regimes, thus not knowing where is what? or who has what? Inevitably, similar data are being produced thus wasting time and money to collect data. Problem and deficiency areas are clearly identified by analyzing the current situation of information flow as described in the following sections.

4.1 Ministry of Government Administration and Home Affairs

Korean cadastral and property registration systems are administered by the executive and the judicial bodies respectively. Cadastral registration is based on Cadastral Act, which governs the activities of the Korea Cadastral Survey Corporation(KCSC) and Cadastral Division of Ministry of Government Administration and Home Affairs(MOGAHA) while property registration is based on Real Estate Registration Act which gives guidelines to land registry offices. In general, the cadastral system can be grouped into the following three categories:

MOGAHA supervises the administration of Cadastral Divisions at municipalities. At each level, the local cadastral division stores and maintains cadastral books and maps. MOGAHA also oversees the work and issues guidelines to KCSC on all surveying matters. Whenever surveying activities are carried out, KCSC provides new information updated by its local survey offices. The organizational structure of cadastral administration consists of 3 levels of governments, municipal, provincial and central. Their major operations are:

- Revision of the cadastral laws and regulations
- Operation of the National Land Information Center
- Preservation and management of the cadastral records
- Guidance and supervision of the affiliated cadastral offices and agencies

The cadastral books and maps kept in the Cadastral Divisions in municipalities are governed by Cadastral Act. Computerization of the cadastral books, which became operational in 1992, contains about 17 items of data for every parcel such as parcel identification number, location, land use category, boundary, area, yield class, owner's name, owner's address, owner's civic number, map scale and so on. However, information about buildings, public utilities, mortgage, easement, and other rights on land are not included in the cadastral records.

4.2 National Geography Institute

National Geography Institute originated from the Survey and Cartography Division of the National Construction Research Institute of the Land Development Agency in 1961. It is now the central surveying and mapping organization under the Ministry of Construction & Transportation. It has long been Korea's topographic map authority and as such gives case by case permission to private mapmakers to produce various maps. It serves other government entities such as government departments, municipalities, government-invested companies, individuals, etc. In response to these user requirements, its main tasks are:

- Establishment and maintenance of geodetic control network including precise leveling controls
- Geographical work such as the compilation of topographic and facility maps at various map scales

- Information service for geodetic data, aerial photographs, maps and national land information;

The NGI is producing topographic maps at various scales and a 1/25000 scale land use map sheets. Since 1993, large-scale maps have been converted into digital form. With such great experience in mapping it was natural that the NGI was put in charge of establishing the Digital Topographic Map Database which includes 1/1000, 1/5000, and 1/25000 scale maps.

4.3 Korean Military Mapping Center

The Korea Military Mapping Center, which is the only military mapping organization under the Ministry of Defense, was created in 1952 as a survey organization to produce and distribute smaller-scaled topographic maps for military purposes and government security operations. Externally, from its inception, the KMMC has had a strong relationship with National Imagery Mapping Agency (NIMA) in USA in the exchange of data under the Agreement of Mapping, Charting & Geodesy. In order to produce maps of North Korean areas, the assistance of NIMA is critical. Internally, there is an agreement between KMMC and NGI to exchange data such as aerial photograph, survey results, films for printing, and so forth. The KMMC's main functions are[9]:

- Conducting surveying activities (collection, analysis, and assessment of topographic information)
- Production and Distribution of geoinformation for military operations

The mapping activities are being done using primary methods (using photogrammetry and image processing with satellite image) and secondary methods (using scanner and digitizer) together. However, there are many obstacles to perform digital mapping, particularly manpower. Staff has had only on-the-job training without any previous academic and technical background; this is the main problem, which is reducing the speed of establishment and improvement of digital mapping techniques. Therefore, private contractors are executing about 50% of digital mapping projects(Koh, 1998).

4.4 Supreme Court (property information)

The Korean Land Registration System was established in 1912; all land registry activities are governed by the Real Estate Registration Act. It consists of 193 City, county, and district land registry offices and 2,334 government employees who manage and provide land registry information based on the cadastral records under the guidance and supervision of Supreme Court. Its main tasks are to keep and provide the land register, building register, shipping register, and to maintain and update registration on rights and subjects.

The local registry offices manage land register, building register, ship register, etc. including the information of ownership, leasehold, easement, and mortgage in paper form under the control of Local Courts. The Supreme Court has started the Project of Land Registration Computerization since 1994 in order to realize epoch-making improvements for registry application and issue of certificate and/or show-sheets, to support the following objectives:

- Information provision for capturing all types of tax sources according to deals with real estate
- Information provision for policy-making and for eradicating real estate speculation
- Information provision in digital form to reduce time of issue

The project began with the development of an on-line system, which stores and manages property information in the central center, 12 local center, and 240 land registery offices including future extension of installations with advanced systems. Secondly, the conversion of the conventional land registers into digital form until 2003. As a result of this long-term project, a reduction of waiting-time for issuing (5 to 30 minutes) can be expected regardless of when, where and who within Korea. Another benefits is that persons wanting relevant information do not have to visit the registry office, it will be possible to review and obtain land register and other related information at home or office at anytime.

4.5 Problem Domain

Having examined the current situation of supplies and use of topographic and property information, many problem areas have been identified. The identified areas are summarized as follows:

- No mechanism to search desired data
- Limited availability of digital topographic maps
- Data exchange
- Data duplications
- Lack of legal and regulatory supporting regimes;

The current information system should be improved in these problem areas. Therefore, apparently, new system and information policy will have to be created and formulated through the proper changes of the existing situation in institutional, technical, and econo-

mic perspectives. It is in this context that a National Geographic Information Infrastructure (NGII) is justified as the only solution to resolve these problems. The role of clearinghouse is to allow users to locate relevant datasets and to provide essential information (metadata) to seamlessly interact with the datasets located on a remote site. Different disciplines can exchange data each other through Internet by finding appropriate data sources with the aid of clearinghouse, and eventually manipulate remote data efficiently and effectively.

4.6 Resolutions

The recommended ways to resolve the problems are as follows:

○ To develop a proposal for a Korean legal and regulatory model to facilitate access to and use of government held topographic and property information

Among these problems, one could recognize that the most serious and fundamental areas in Korean information society were institutional problems, particularly information policy that should be the basis to support and guide the development and implementation of a NGII.

In this context, the legal supporting regimes (access right, copyright, privacy rights) should be prepared. Each of them were examined in the following contexts:
- The current Korean information policy and economic trends;
- The successful experiences elsewhere in terms of pricing policy and legal issues;
- Defining the characteristics of open access and cost recovery policies;
- Identifying the main influencing factors on the adoption of information dissemination policies.

Based on the four main influencing factors, a feasibility study should be carried out, comparing the characteristics of both Open Access and Cost Recovery policies and the current Korean information policies and economic trends to derive a feasible Korean legal and regulatory model. The Cost Recovery Policy was proposed as the Korean model and guidelines for implementation of this policy were formulated.

○ To develop associated guidelines relating to access and use of government held topographic and property information

For developing guidelines, the questions What government geoinformation should be made available to the public or limited users?, Under what conditions?, At what price? should be considered in the legal and economical perspectives.
- Firstly, it was concluded that the Korean Government should amend the existing legislation to ensure access rights to government held digital geoinformation; to define clearly what comprises digital geoinformation; to define mandatory and discretionary exemptions of access and use rights for reasons of national security and defense; for protection from terrorism and personal privacy.
- Secondly, in order to adopt the Cost Recovery Policy, it was concluded that Korean Government needs to develop mechanisms to recover the invested or estimated costs necessary to develop and implement a NGII. Therefore, government organizations were recommended to introduce and enforce copyright and licensing according to different uses of geoinformation and products. Differentiation to set licensing was suggested for fair use (e. g. research and educational use, libraries and archive activities, and legal proceedings, etc.).
- Thirdly, to remove privacy concerns, privacy protection measures were recommended in legislative and policy perspectives.
- Finally, pricing guidelines were proposed to support the information dissemination policy. Notwithstanding the complicate pricing differentiation in the geoinformation market, the basic principles were highlighted according to different users and different types of geoinformation.

Consequently, it was recommended that harmonization between broad access (for maximizing geoinformation welfare and benefits) and cost recovery should be considered.

○ To develop a national spatial data clearinghouse and making it into function

There are some different way to building a National Clearinghouse in terms of institutional, economic, and technical aspects: centralized system, decentralized system and the hybrid system. The decentralized system stores metadata in several clearinghouse nodes and enables users to search these nodes simultaneously through a single entry point. It provides detailed information(metadata) residing on each clearinghouse node to allow the users to judge the fitness for use

of the existing data. The centralized system stores the metadata of all providers in a single clearinghouse server providing details of the metadata. The hybrid system stores the general description of data in one place while details are stored in the several local systems. Thus the hybrid system can be called a meta-metadata system because at the highest level it only contains core information derived from the detailed metadata at the local systems. For the management of the metadata, the hybrid approach need to be adapted, where the metadata are stored at two different levels: the "global" metadata which gives a brief description on the status of the dataset and access constraints and the "local" metadata which provides detailed information of the dataset. As a result of the comparison, the hybrid system was proposed as an appropriate system architecture for the National Clearinghouse system in Korea for the following reasons (Jeong, 1998);

- Firstly, the hybrid system provides more flexibility and freedom to the data provider for registering, updating, and managing the metadata.
- Secondly, the hybrid system is easy and fast to establish and maintain since at the higher level only a small amount of information about the dataset is required, and it can be derived easily from an existing arbitrary metadata system managed for the internal purpose within the organization. Once the highest level of the metadata system is established, the availability and the awareness of the spatial data can be achieved.
- Thirdly, the hybrid system provides a more efficient search capability to the user. From the highest level of the metadata (general description of the data set), the user can compare different datasets easily. If the user has an interest in a particular dataset, more detailed information can be found at a lower level.
- Lastly, the hybrid system provides a capability to monitor nationwide datasets.

5. Conclusion

Sharing is another way of data acquisition with least efforts and a data clearinghouse is the core module which directs users to the relevant data resources. The contents of datasets should be described with predefined standards for precise indexing. Moreover, a number of technical problems has to be resolved for the common use of data between heterogeneous spatial database systems. However, the technical issues can be covered by the present information technologies. The difficulties persist in the political/institutional issues.

An analysis was done concerning the current situation of Korean spatial data production and use. Institutional problems are derived from the results of the analysis. Some guidelines are proposed to resolve the things in the problem domain as follows:

- To develop a proposal for a Korean legal and regulatory model to facilitate access to and use of government held topographic and property information
- To develop associated guidelines relating to access and use of government held topographic and property information
- To develop a national spatial data clearinghouse and making it into function

Koreans currently have an act and a complementary executive order for the establishment and utilization of NGII in addition to the specifications of spatial data exchange formats. However, they are too rough to cover every detailed item. Additional amendments and legislation activities are required with web-based data clearinghouse in operation.

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