DATA MODEL OF THE GEOGRAPHIC INSTITUTE 'AGUSTIN CODAZZI' "SIGAC"

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SUMMARY

The Data Model **SIGAC** is the result of a multi-stage research and development project of the working Committee of the Geographic Institute 'Agustín Codazzi' of Colombia. This Data Model was based in the german Data Model ATKIS[3], but with some adjustments depending of the specifics requirements of the Integrate Geographical Information Systems of IGAC.

In maps the information is coded with cartographic symbols and signs, therefore it is not available in its original form. Now with SIGAC the information is stored and offered in two different conditions: Digital Landscape Model (DLM) and the Digital Cartographic Model (DCM).

The Digital Landscape Model (DLM) contain topographic and thematic objects with its geometric, shape, position an attributes. In SIGAC the objects are clasified in Themes, Groups and Object class. The Digital Cartographic Model (DCM) contains the topographic and thematic objects being transferred to its cartographic representation according to scale and specific drawing rules.

SIGAC is a very important step in standarization of digital information in the country with an advantage the access to data is flexible and can be orientated according to the user's requeriments.

1. INTRODUCTION

The Geographic Institute 'Agustín Codazzi' of Colombia (IGAC),created in 1935, is the commissioned governmental organization to produce cartographic, soil, geographical and cadastral information that is required by public and private organizations involved in the processes of planning and territorial ordering of the country.

The Institute is conforming of four technical departments that redeems the following duties:

* **Cartography:** Produces the topographic maps in scales 1:100.000 , 1:25.000, 1:10.000 for the rural areas and 1: 2.000 for the urban sectors, which are the base for elaboration of soils and geographical studies and cadastral work. This area also has to elaborate the official governmental map and the establishment and densification of the National Geodetic Net.

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[3] Authorative Topographic Cartographic Information System

* **Agrology**: Establishes and inventory and study of soils of the national territory and produces specific information for cadastre and geography.
* **Cadastre**: Carries out the inventory of the properties of the country and generates the regulations in cadastral subjects.
* **Geography:** Elaborate the geographical studies of the country and produces basic information and methodologies for planning and territorial ordering.

The information produced by each technical department is converted in base data for other users , generating a permanent interactive flow (See figure 1). Actually the Geographic Institute is developing a Modernization Program. Which main objective is endowing to whole technical areas of equipment, programs and knowledge that allow to improve the quality and opportunity of the produced information. In order to achieve this objective the integrated Geographic Information System (GIS) has been designed, which permits capture, manipulation, storage and analysis of useful information for taking decisions in different levels (See figure No. 2).

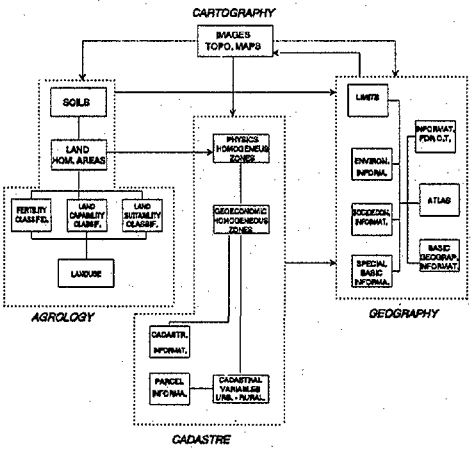


Figure No. 1: Data Flow within IGAC

2. DATA MODEL "SIGAC"

In the frame of the Modernization Program which principal task is the design and implementation of a GIS, an important aspect is the standardization for capture, storage and exchange of data between different users of the system. As first step toward this standardization was defined and implemented the data model of IGAC "SIGAC", which allows to classify, store, handle and represent the geographical information in a easy way.

3. BASIC CONCEPT

The data model of the Institute "SIGAC" had as initial reference the german model ATKIS, that was adapted according to the necessities of information and specific requirements of each technical area .

In this model, the real world is represented by a Digital Landscape Model (DLM) (primary model) , where the different element are classified, code and transformed through cartographic work into a secondary model, Digital Cartographic Model. The elements are categorised into Themes, Groups and Objects classes. The content of the DLM is fixed in object Catalogues.

The Digital Cartographic Model (DCM) contains the thematic and topographic information being transferred to its cartographic representation according to scale, geometry and specific rules for cartographic representation. The content of the DCM is outlined in symbol catalogues.

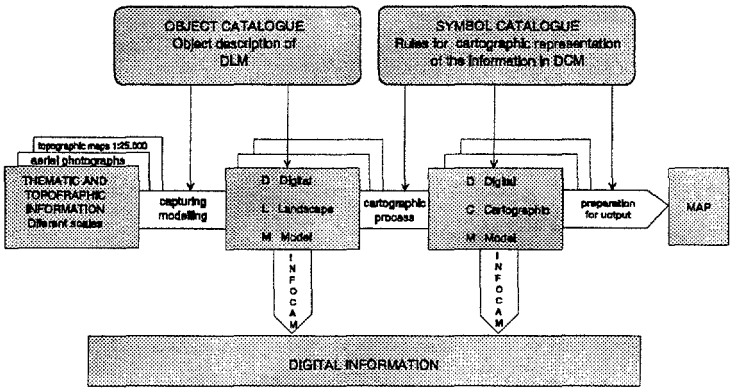


Figura No. 2: Data Flow within SIGAC

3.1. DIGITAL LANDSCAPE MODEL (DLM)

The Digital Landscape Model describes the elements of the real world with their position and shape, as well the characteristics and names.

In SIGAC the objects are classified in seven themes : 1000 Control Points, 2000 Cadastre, 3000 Transportation, 4000 Vegetation, 5000 Hydrography, 6000 Relief, 7000 Areas. Each one of these themes is divided in groups conformed by diverse objects that have the same characteristics. Figure No.3 gives an overview of these structure.

From the point of logical systematic viewing it can be possible to separate the two-dimensional themes (1,2,3,4,5 7) from the remaining three-dimensional theme (6 relief). The first six themes represent the Digital Situation Model (DSM) while the last one makes the Digital Terrain Model (DTM). In the DTM the relief is established by contour lines and geomorphologic information which describe the surface of the earth with the desired accuracy.

Theoretically all surface data could be created and stored digitally in one single DLM, however the technical realisation is too complex. Therefore SIGAC contains of four DLM that are scale related (1:100.000, 1:25.000, 1:10.000, 1:2.000), in respect to the accuracy of data capture and content. These models are called with short codes SIGAC-100, SIGAC-25, SIGAC- 10,SIGAC-2 showing their relationship with the basic maps.

The data model SIGAC is structured by attributes. That means, the landscape is divided generally in objects and more specifically by attributes.

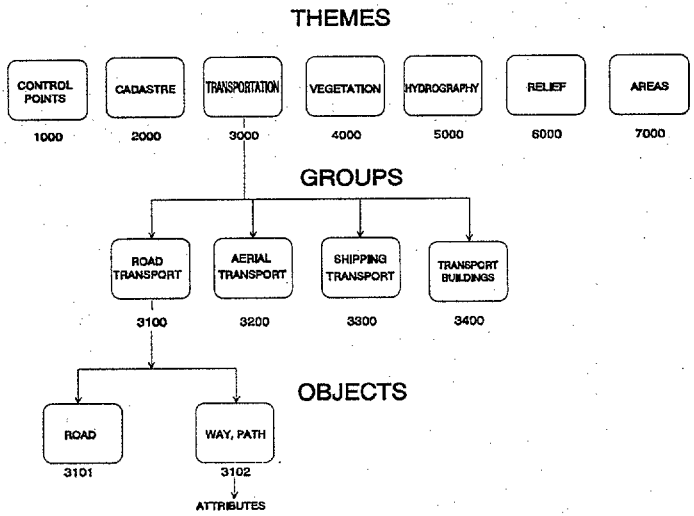


Figure No. 3: Themes, Groups and Object classes structure of SIGAC

3.2 OBJECT CATALOGUE

The object catalogue defines the elements contained in the DLM and how they have to be compiled. This Catalogue consists basically of three sections, object section (code, geometry, source), attribute section(list of attributes and possible attribute values), and definition section. In this catalogue the topographic and thematic objects are related.
In SIGAC the attributes are categorized according to their definition for each technical area as following:

* First category: Topographic attributes

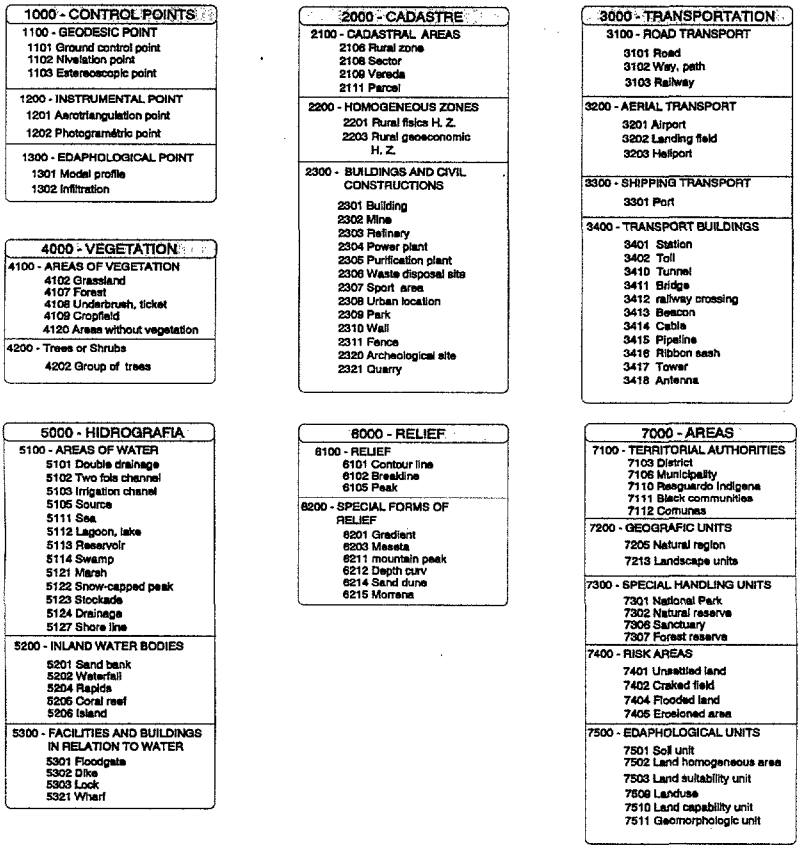


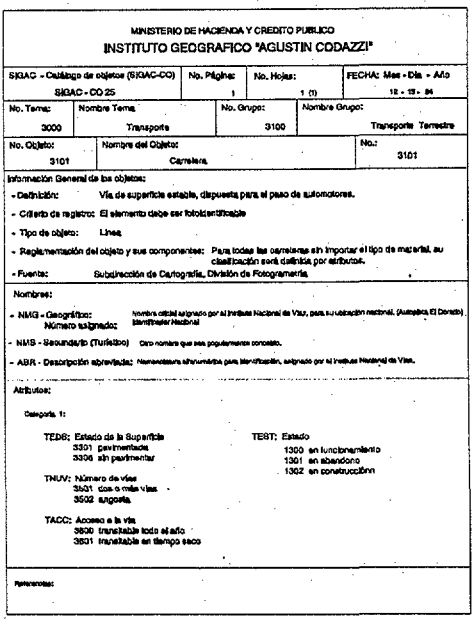
Figure No. 4: Content of the Digital Landscape Model (SIGAC-25)

*	Second category:	Soil attributes
*	Third category:	Cadastral attributes
*	Fourth category:	Geographical attributes

In this way an object could have the four category of attributes, depending only on the specific subject or study.

This structure by attributes allows a free selection of elements with specific object attributes and flexible creation of map objects for the graphical output (map).

Figure No. 5 gives an example of the object catalogue design in the Geographic Institute 'Agustin Codazzi'.



MINISTERIO DE HACIENDA Y CREDITO PUBLICO

INSTITUTO GEOGRAFICO "AGUSTIN CODAZZI"

SIGAC - Catálogo de objetos (SIGAC-CO)	No. Página:	No. Hojas:	FECHA: Mes - Día - Año
SIGAC - CO 25	1	1 (1)	12 - 13 - 94

No. Tema:	Nombre Tema:	No. Grupo:	Nombre Grupo:
3000	Transporte	3100	Transporte Terrestre

No. Objeto:	Nombre del Objeto:	No.:
3101	Carretera	3101

Información General de los objetos:

- Definición: Vía de superficie estable, dispuesta para el paso de automotores.
- Criterio de registro: El elemento debe ser foto-identificable
- Tipo de objeto: Línea
- Reglamentación del objeto y sus componentes: Para todas las carreteras sin importar el tipo de material, su clasificación será distinta por atributos.
- Fuente: Subdirección de Cartografía, División de Fotogrametría.

Nombres:

- NMG - Geográfico: Nombre oficial asignado por el Instituto Nacional de Vías, para su utilización nacional. (Ejemplo: El Dorado)
  Número asignado: Identificador Nacional
- NMS - Secundario (Turístico): Otro nombre que sea popularmente conocido.
- ABR - Descripción abreviada: Nomenclatura alfanumérica para identificación, asignado por el Instituto Nacional de Vías.

Atributos:

Categoría 1:

TEDS: Estado de la Superficie
- 3301 pavimentada
- 3306 sin pavimentar

TNUV: Número de vías
- 3501 dos o más vías
- 3502 angosta

TACC: Acceso a la vía
- 3500 transitable todo el año
- 3501 transitable en tiempo seco

TEST: Estado
- 1300 en funcionamiento
- 1301 en abandono
- 1302 en construcción

Referencias:

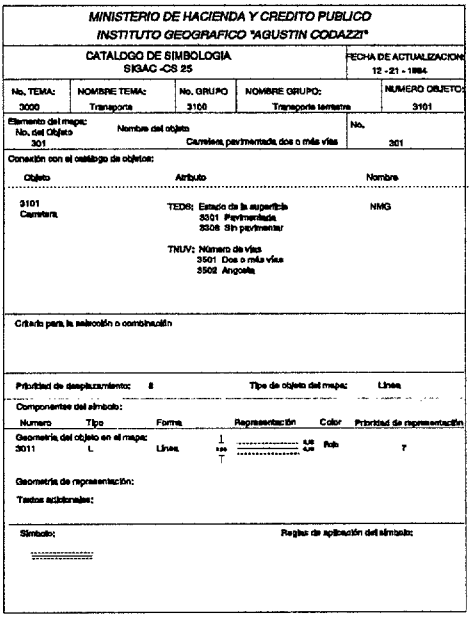
Figure No. 5 Object Catalogue (SIGAC-OC-25)

3.3 SYMBOL CATALOGUE

The symbol catalogue allows to transform the objects of the landscape in objects of map depending directly on the scale. This catalogue describes the specifications for each symbol under the influence of cartographic generalization and describes graphically unique elements. The symbols described in this catalogue follow the rules of the Technical Topographic Manual

Specifications of the IPGH (Instituto Panamericano de Geografía e Historia) in relation to topographical information. For the thematic data was following the regulations described for the process of conceptual and geometric generalization.

An object in the Digital Cartographic Model is represented according to its geometry and attributes. For example the object ROAD will have different representation depending if it is paved or without pavement. Additionally it shows the link of attributes to object catalogue, attributes and names. (See figure No. 6)



MINISTERIO DE HACIENDA Y CREDITO PUBLICO
INSTITUTO GEOGRAFICO "AGUSTIN CODAZZI"

CATALOGO DE SIMBOLOGIA
SIGAC -CS 25

FECHA DE ACTUALIZACION
12 - 21 - 1994

No. TEMA:	NOMBRE TEMA:	No. GRUPO	NOMBRE GRUPO:	NUMERO OBJETO:
3000	Transporte	3100	Transporte terrestre	3101

Elemento del mapa:
No. del Objeto: 301 — Nombre del objeto: Carretera, pavimentada, dos o más vías — No. 301

Conexión con el catálogo de objetos:

Objeto	Atributo	Nombre
3101 Carretera	TEDS: Estado de la superficie 3301 Pavimentada 3308 Sin pavimentar	NMG
	TNUV: Número de vías 3501 Dos o más vías 3502 Angosta	

Criterio para la selección o combinación

Prioridad de desplazamiento: 8 — Tipo de objeto del mapa: Línea

Componentes del símbolo:

Número	Tipo	Forma	Representación	Color	Prioridad de representación
Geometría del objeto en el mapa: 3011	L	Línea	1	Rojo	7

Geometría de representación:

Textos adicionales:

Símbolo: — Reglas de aplicación del símbolo:

Figure No. 6: Symbol Catalogue (SIGAC-SC-25)

4.0 METHODOLOGY

The design of the data model SIGAC was developed in several stages. The creation of the Digital Landscape Model has priority to the Digital Cartographic Model.

The first stage beginning in the month of February of 1993 with the study of several models as the Canadian model, the Spanish model and the German model ATKIS, being the last one the nearest to the necessities of the Institute.

In August of 1993 the design of the DLM scale 1:25000 started, which only included the topographic elements. Subsequently at the end of the same year the thematic elements belong

to cadastre, agrology and geography areas were included .

In the second phase (1994) the pilot project in order to prove the ability of SIGAC-25 was carried out. After the positive result this data model had some improvements before beginning its implementation in the second semester of 1994.

In the following phase the data model for the scale 1:2000 (SIGAC-2) for urban areas was created. It will be proved in 1995 in the city of Santa Martha. In further stages the development of the data models SIGAC-10 and SIGAC-100 is planned .

5.0 CONCLUSIONS

The data model "SIGAC" implemented in the Institute is the result of a multi-stage research and development project carried out with the cooperation of the different technical areas of IGAC and represents the necessities of geographic information to different intern and external levels.

SIGAC is a flexible data model that allows to add, modify or eliminate Themes, Groups or Objects depending on the necessities of information of different users.

SIGAC composes the whole objects used in the Institute, which helps to avoid the redundancy of information and in consequence the duplication of efforts.

SIGAC is a data model which may be adopted of users which use information generated by IGAC. Thus IGAC is the organization that achieves the regulations related with cartography, photogrammetry, geodesy and cadastre.

The data model of the Institute will be the bases where different users could insert their own objects, additional object attributes used in their specific studies.

SIGAC is the first step in the process of standarization of geographical digital data in Colombia. Their utilization for the different public and private organizations will allow to share and transfer data independent of the hardware and software used, with the only condition following the regulations that are defining this data model.

In SIGAC the access to data is flexible and can be orientated according to the user's requirements. It can be distributed in digital or analogue form.