3D PLATFORM FOR INTEGRATION OF CARTOGRAPHIC PRODUCTION PROCESSES AND INFORMATION IN A CORPORATE INFORMATION SYSTEM

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Summary:
The experience obtained through the development of technological products and use and integration of diverse commercial software systems, has allowed Trabajos Catastrales, S.A. (Tracasa) to implement the development of a new platform for the exploitation and management of 3D information. With this development, it hopes to facilitate the integration of cartographic production processes and the loading of data into Corporate Information Systems. It is directed to companies dedicated to producing information –in Spain they mainly use Digi 3D, the market leader digital photogrammetry software- as well as administrations that contract these companies, so that this way they can control the complete cycle of information, from production specification to the GIS loading.
The implementation of this concept starts from the premise of using an architecture and platform of advanced .NET technology that is not format dependent. The result is production technology, a base for the integration of production cartographic processes and software components for the integration of the cartographic and geographic information in Corporate Information Systems.

The technology mentioned, is used in the development of all the components of the platform that are mentioned next and that will be described in a later section:

- Catalogue with data production model object-oriented.
- 3D GIS Engine.
- Quality control tools.

Finally, this article presents the applications of this technology, insisting on the start-up of a platform oriented towards the integration of all 3D cartographic information production processes.

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1. Introduction

The experience obtained through the development of technological products -SITNA, Visor, etc.- and use and integration of diverse systems of commercial software (Intergraph, ESRI, Smallworld, etc.), has allowed Trabajos Catastrales, S.A. (Tracasa) to implement the development of a new 3D platform. This development hopes to facilitate the integration of cartographic production processes in Corporate Information Systems, and pursues the following objectives:

- Automate and integrate the cartographic production processes according to a catalogue with data model specifications (graphic as well as alphanumeric).
- Facilitate and promote quality control processes.
- Provide multi-platform 3D edition tools.
- Insure the integration of cartographic information in any Corporate Geographic Information System.

This article presents the technological foundations and potential applications of this technology, insisting on the start-up of a platform oriented towards the integration of all 3D cartographic information production processes.

2. Foundations for the development

The implementation of this concept starts from the premise of using an architecture and platform of advanced .NET technology that must not be format dependent. The results are production technology, a base for the integration of cartographic production processes, and software components for the integration of the cartographic and geographic information in Corporate Information Systems.

2.1. Architecture and platform for advanced technology

The platform presents an advanced architecture that is founded in the employment of the following technologies:

- Integral development in.NET environment, that implies multi-platform capacity and easy installation not achieved with the previous technology.
- SOA Architecture (Service Oriented Arquitecture), oriented to services that allows the access of any application to corporate information, understanding these services as the transfer of data and the communication between services that coordinate different activities.
- Programmable SDK components (Software Development Kit), that allow the end user to program applications that satisfy their specific needs.

2.2. Not format dependent

The system does not use any data proprietary format, but rather guarantees the access to different commercial software with the possibility of allowing direct reading and writing of the following native formats: BIN and MDT of Digi21, DGN and DGN v8 of Microstation, DXF and DWG of AutoCAD, Shapefiles and personal Geodatabases and ArcSDE of ESRI, Oracle SDO of Oracle and FICC of the Cadastral Management Center.

2.3. Production technology, base for integration of cartographic production processes

Based on the knowledge acquired in the last 15 years of all the cartographic production processes, a base technology has been implemented that is oriented to the integration of processes. As a result of the implementation of said technology, once can, for example, simplify edition processes by integrating part of them into the photogrammetric digitalization process with a Digital Photogrammetric Workstation (DPW), such as Digi3D.

2.4. Integration of cartographic and geographic information in Corporate Information Systems

The platform offers components for the integration of the geographic and cartographic information in Corporate Information Systems, allowing the data to be exploited just like any other data.
3. Platform components

In its application as a production tool, the platform has these three components (Figure 1):

- Catalogue with data production model, object-oriented.
- 3D Engine.
- Quality control tools.

3.1. Catalogue with data production model object-oriented

The Catalogue of Cartographic Entities is an advanced application that picks up the data model with the contents of information, the method of acquisition, the codification and the graphic and assignment structure to use in the production processes within the DPW. The data model previously mentioned is object-oriented, understood as graphic objects with their corresponding attributes -stored in the same object as well as linked to external databases-.

The Catalogue includes specifications of the production model, which defines the criteria of digitalization and edition for each of the cartographic objects according to an integrated and complete model, capable of harmonizing the efficiency of the methodology of the data capture with the required structure for its loading into a Corporate Information System.

Associated with the Catalogue is the catalogue generator, a key tool that allows creation and adaptation of production specifications for use in a specific project.

3.2. 3D Engine

This component constitutes the nucleus of the platform and allows 3D visualization and editing of the objects created in a Digital Photogrammetric Workstation such as Digi3D, according to the Catalogue, using quality control tools. For its development, OpenGL graphic technology has been used, which allows 3D visualization and naviga-
tion of vectorial and raster information (Image 1) stored in a great variety of formats. It also has import and export tools, definition of user themetics, entities tagging, spatial selection, alphanumeric search of elements of associated databases and geoprocessing.

3.3. Quality control tools

The integration of cartographic information in a Corporate Information System has quality demands in the codification and structure of the data, that prevents its loading if not fulfilled. The quality control specifies the different processes to carry out on each entity –conceived as geoprocessing operations– to allow the integration and insure its quality as far as:

- Contents: refers to the verification that the photogrammetric digitalization process has collected all the specific cartographic details and contents.
- Planimetric accuracy: the accuracy in the geometric positioning of different digitized elements should be within admitted tolerance.
- Altimetric accuracy: should check the accuracy of the coordinate Z for three-dimensional elements.
- Codification: refers to checking the codes assigned to each element or cartographic entity.
- Graphic quality: understood as the transitions of a straight line to an arch, angular inflections, straight sections and the perfection of graphic sketching; as well as the quality related to double points, duplicated lines, etc.
- Analytical and structural continuity: when a cartographic entity is made up of diverse geometric contiguous elements -sections-, it must be guaranteed that there is analytical (position) and structural (same code) continuity between them.
- Structures: should check that the complex structures required have been generated, verifying the coherency of the codification and the analytical continuity of the simple elements that form them.
To guarantee flexibility and adaptability to different projects, there is a module called QC Project that allows the link of different quality control processes (Image 2). This module presents the information of errors to project managers using reports and thematic representations.

Image 2: Quality control through geoprocessing

4. Technology applications

Once the architecture and the basic components of the platform have been presented, a comparison of cartographic production using this technology in respect to earlier methodologies, the potential users and the competitive advantages derived from its use are then showed.

4.1. Comparison of methodologies

In traditional cartographic production, there are two well differentiated processes, one of data production, and another of data structuring and loading into the information system.

In the process of data production –for instance using the Digi3D Digital Photogrammetric Workstation-, the digitalization operator is limited to interpreting and sketching, in its right position, exclusively what is being seen in the stereoscopic pair. In the edition –the Digi3D edition module is called DigiNG-, once the task of field revision is carried out, the following processes are implemented:

- correction of possible digitalization errors.
- inclusion of digitalization omissions.
- incorporation of additional information that is not possible to obtain in the digitalization (portal number, place names, lettering texts, etc.).
- graphic purification and correction.
- generation of the structure of specified data.
- assignment of alphanumeric attributes.
- formation of the “lay-out” as a product for its delivery on paper.
Finally, the structuring and loading is done in the Corporate Information System using specific tools for each project, according to that established in the exploitation model.

With the implementation of this technology, however, the quality control in a Digital Photogrammetric Workstation such as Digi 3D, becomes incorporated in the diverse production phases for the producing companies, like in internal reception processes, loading into the geographic database and posterior maintenance and update by the public administrations and other companies that contract cartography. Next, is a summary of the more significant differences:

- It gives the detailed production specifications for each object.
- For the process of digitalization, it defines the contents to collect and it gives the criteria and interpretation of the existing geographic entities in reality.
- For the edition process, it specifies the data structure and the criteria for its generation.
- It specifies the requirements of graphic quality.
- The integration in the Corporate Information System is immediate.

4.2. Potential users

Directed to companies dedicated to producing information as well as administrations that contract these companies, so this way it can control the complete information cycle, from the production specification to the GIS loading. The following competitive advantages are highlighted:

- Production companies
  - There is a unique tool for the specification of all the conditions of production and quality control.
  - All the restitution and edition tools use this data specification model.
  - There is a complete quality control package that uses the same specification that is used at the same time in the QC Project module.
  - The 3D Engine is a 3D visualization and edition tool.
  - It is designed as a programmable component that is flexible enough to satisfy all specific user needs.
- Public administrations
  - Allows availability of complete and exhaustive technical specifications for all formalized elements.
  - All production specification is deliverable to the production companies to define the production methodology and avoid rejection for non-compliance observed in posterior quality controls.
  - Allows the configuration of reception and quality control processes according to production specification, to insure the integration in the exploitation model.
  - Allows immediate integration in the Corporate Information System.

5. Conclusions

The high value of cartographic information and, in general, of geographic information, is being highly promoted through its integration in Corporate Information Systems that allow consultation, analysis and maintenance in a coordinated manner. The accessibility that these systems offer, as well as the capacity of integrated access into distinct information “layers”, justifies the adjustment of the available information. Therefore, previous to the use of the data, it will be necessary to carry out quality controls and, in its case, correction of the information with the goal of guaranteeing its integration in consultation systems. The following advantages of this new platform are observed:

- Adequate structure for its loading in object-oriented databases.
- Data model that allows the use of the delivered information by the production contractors, directly to the end user without the need for additional processes or special tools.
- Specific digitalization and edition instructions with the objective of there being unique and homogeneous criteria for the interpretation of the varied casuistry.
- Exhaustive quality control.

To end this article, it is important to highlight the importance that the use of a unique catalogue has, which achieves that all the visualization, digitalization and edition processes use the same model of data.
References