THE NATIONAL PROJECT AND THE APPLICATIONS IN THE FIELD OF DIGITAL PHOTOGRAMMETRY DURING THE FIRST YEAR OF ROMANIA'S INTEGRATION TO THE EUROPEAN UNION

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ABSTRACT:

The process of Romania's integration in EU went along with the obligation of aligning to the community legislation and standards, including the spatial data infrastructure. Thus, the 2005 Working Project INSPIRE contributed to the introduction of new concepts and methodologies uniting the Member States at the infrastructures level, including Romania. The Institutional Cadastral Reform was prepared by 7/1996 Law with it's afterwards changes. The management is assured, at a Governmental level, by The National Agency of Cadastre and Real Estate Advertising (NACREA), and at regional levels there are Offices of Cadastre and Estate Advertising. According to the long term strategy, NACREA as a unique state authority, decided to cover the entire country with orthophoto images, frame work of the National Project. There were presented the workflow of the management in producing the orthophoto: the flight, the approval, aerial triangulation, Digital Terrain Model and the obtaining of the orthophoto itself. Thus, it can be said that in the transition - post transition period the project and its applications in digital photogrammetry met the national interest and the integration demands: economic development, social stability and environment management. Indeed, according to the long term strategy, the orthophoto represents the informational background for producing the cadastral index map and also for thematic GIS, especially LPIS (Land Parcel Information System).

1. INTRODUCTION: THE OLD AND NEW PARADIGM OF CHANGES

1.1 The performances of photogrammetry: criteria and evolution

The first criterion (technological) which stood at the base of primary photogrammetric data processing system configuration was the changing of the opto-mechanical sensors for the medium and large format digital aerial cameras. The second criterion (methodological) aimed at the processing system of the data which allowed, in the end – as a corollary of the "calculus device's" performances and of the afferent functioning programs – the affirmation of a new paradigm, moving the applications from plans and maps to the creation and actualization of GIS systems.

The superiority of digital aerial cameras over the classic photo cameras was proved on several levels: economicity, image quality, image quantity, geometrical precision and a new photogrammetric technological flux. The photographic coverage increased considerably, and by eliminating film, the digital images obtained directly have a radiometry unaffected by developing errors. There was also an increase in the volume of data and information, fact which is especially valuable to the 3D modeling concepts. Amongst the great opportunities of affirmation of the new evolution also stood the high quality software that accompanied the data collection and processing technology, permanently removing the conventional frontiers between photogrammetry, remote sensing, cartography and GIS. By combining efficiency and high precision with the simplicity of automatic processing, the evolution of modeling based on reality won the battle of operationality. This constitutes one of the last victories of the 20th century.

In the present, the GIS technology has the possibility of directly using the data collected not only from remote sensing captures, rather precise according to the recent sensorial capabilities of the satellite platforms, but more expensive, especially for our current needs, but also from the data collected, with perfectible methodologies, from the captures of digital aerial cameras, with a precision comparable with photo-aerial cameras. Of course, the competition is only at the beginning. Not between the old paradigm of change (traditional photogrammetry) and the new one (digital photogrammetry), where the verdict was set: "The film is dead!" The battle that has begun now is between remote sensing and integrated digital photogrammetry. Because the first decade of the 21st century seems to be reserved to the problematic of aero-carried sensors, related to the image quality and the automation of processes. We know that the most significant investments were made within the "emergence of digital sensors" and that we can anticipate, in this time of major changes, the appearance of aerial platforms with multiple purposes in photogrammetry, the fundaments based on the concepts of "sensor fusion" or "geo-sensor network".

It is important to underline that, without the management of sensors with the aid of GPS technology, the controlled functioning and automated monitoring would have been impossible to imagine. Of the same priceless support will further beneficiate, also within the inertial measurement unit, the interferometric radar or light and space detection sensors.

1.2 The infrastructure of spatial data: between the tendencies of globalization and the European integration

1.2.1 European directives: The process of Romania's integration to the European Union implies the obligation to align to the legislation and standards of the community, including in what regards the "spatial data infrastructure" (SDI). The INSPIRE frame directive (Infrastructure for Spatial Information in Europe), initiated by the European Commission, was adopted in 2005 under the name of "INSPIRE work program". The rules of application foresee the technical orientations for the achievement and operationalization of the program, considering the environmental spatial information, but also from other activity sectors (agriculture, transport, energy, etc.). The purpose of the work program is realizing a European SDI through the introduction of new unifier concepts and methodologies at the level of national infrastructures, whose finality would be the easy and total access to the spatial data of the Member States. For the support of the INSPIRE Directive, there are other projects that have to be considered, amongst which we remind RISE (Reference Information Specifications), whose main purpose is creating a Rough Guide for the creation and application of spatial data specifications, in correlation with the international standards.

1.2.2 The international-regional context: If at a world level, the United Nations Convention upon climatic changes, come into effect in 1998, or the Kyoto Protocol in 1992 claim, among other things, that the geographic information and the data in the environment must be used in monitoring the development of world states, in this sense an important role being played by the "spatial data infrastructure" (SDI) in Europe, EGII (European Geographic Information Infrastructure) defines a complementary infrastructure at a regional level. The coordination of this last organism is ensured by the EUROGI (European Umbrella Organization for Geographic Information).

On the other hand, if in "horizontal plan" the SDI agenda (at a global and European level) fusions and can be found in the international-regional context, in "vertical plan" we notice that, in the purpose of "global observation", IGOS (Integrated Global Observing Strategy) represents a unification factor between the "spatial observation" systems and the "terrestrial observation" systems.

1.3 The national experience and the new technological approach

Within the integration, Romania comes with a personal, recognized experience in what regards the professional preparation of generations of photogrammetrists – the turning point being represented by the university medium – but also in what regards the practical achievement of wide scope works, begun half a century ago, in 1958, through the creation of the Photogrammetry Center in Bucharest – a true standard unit in the field.

1.3.1 Romania's dower:
The national experience finds its principle in the first plans of systematization for the cities of Bacău and Curtea de Argeş, executed through aero-photography in 1924 by the Aerial Cadastre Division next to the Civil Aviation. From this reference point, gradually, large surface works were achieved, started by the Photogrammetry Center in 1958 and continued by its successors until the current National Center of Geodesy, Cartography, Photogrammetry and Remote Sensing (NCGCPRS).

The beginnings of applications in the field of remote sensing are found sometime around the '70s, within the Photogrammetry and Remote Sensing Laboratory (Lab. P&RS) from within the Technical University of Civil Engineering of Bucharest (TUCEB). If the first ***Course in Photogrammetry*** was taught in 1949 by Professor Nicolau Bârlad at the Faculty of Geodesy from within the Military Technical Academy (MTA), the first ***Course in Remote Sensing*** was taught in 1970 by Professor Nicolaie Oprescu at the Faculty of Geodesy from within the TUCEB. In this context, we underline the role played by Lab. P&RS in collaboration with NASA (National Aeronautics and Space Administration) and with RCSA (Romanian Committee for Spatial Activities). In synthesis, we note: (1) the collaboration, at an international level, with NASA (1970-1975) regarding the use of ERTS-LANDSAT data for the investigation of natural resources; (2) the collaboration, on an internal level, with RCSA (1970-1988), which materialized, among numerous studies, as well under a documentary report, in the editing of 35 issues of the **Remote Sensing Bulletin**.

In what regards the beginnings of governmental cooperation at a regional level, from them we can keep in mind two participations that are more important: (a) at the permanent remote sensing "work group" Counsels from within the INTERCOSMOS (1972-1989); (b) at the CORINE LAND COVER program (1994-1995), both benefiting from the collaboration of a large number of specialists from various profile institutions in Romania.

In preparation for our country's integration to the EU, a recent page in the European collaboration, in the spatial field, is constituted by the signing by the ESA (European Spatial Agency) and ROSA (Romanian Spatial Agency) of an Agreement through which Romania becomes the third of the former countries participant to INTERCOSMOS that obtains the status of European state Cooperator with ESA (after the Czech Republic and Hungary); the signing of the Agreement ensures a new communitarian frame important in the application of the EU program aiming at agriculture, forester culture, telecommunications, disasters, etc.

Going back to the recent history (after the revolution in December 1989) in the field of photogrammetry, we will mention the gradual transition to digital technology use, effectuating works within the national projects which, according to the strategy adopted, will cover the whole territory; they are realized by both state organizations and private firms, under the coordination of the National Agency of Cadastre and Real Estate Advertising (NACREA). It is important to notice, in this sense, the first aero-photogrammetric flights made in the years preceding the integration (2004-2007), using medium and large format digital cameras or other detection techniques (SAR, LIDAR), mounted on various aerial platforms (planes, helicopters).

1.3.2 The new technological approach in Romania:
The transition of the photogrammetry bases from classic geometry to modern information technology has known, in Romania, an adjusting period developed in two phases, as follows: the first, by using the **hybrid** procedure (film plus scanning), using latest generation photo cameras; the second, by using the **complete** procedure (directly digital), using medium and large format digital aerial cameras. In both situations, the

processing of data was made in the same work stations. In both cases, the primary product was presented by the digital aero-photogram.

In what regards the approach of the first digital system, the most compliant photo-aerial cameras used in our country were Leica RC 20 (or 30), Zeiss RMK 1000 or TOP RMK 15, generally having a linear resolution of approximately 60 pairs of lines/mm (amounting to a pixel size of 5,8 μm), and one of the devices used for scanning the film was DVS 600 from Leica Geosystems.

In what regards the approach of the second digital system, the most offering aerial cameras were ADS-40, DMC and UltraCam-D, and the first thing that could be noticed was the huge volume of processed primary data, apparently redundant.
In the next period, we propose to approach the so-called "projection phase" referring to the two image collection processes in digital photogrammetry, the institutional frame and the special legislative foresights, the concepts of orthophotoplan and index cadastral plan, the strategy and revamping in the field.

2. THE PROJECT IN THE FIELD OF DIGITAL PHOTOGRAMMETRY, THE STRATEGY AND REVAMPING PROCESS

2.1 The project in transition (the hybrid procedure): using the classic aerial camera

It is certain that, in terms of efficiency, the cadastral works on large surfaces of the country can only be realized with the help of digital photogrammetry, even in the conditions of the hybrid procedure. In the first year of integration (2007), the Romanian firms continued to realize data processing through aero-photography, using compliant photo cameras in collaboration with the specialized firms abroad; the collection of primary data was conditioned by the digitalization of aerial images with the help of the scanning station, keeping into account the classified information protection standards established by the national law, after which the final products, the DTM and the orthophotoplan, were realized by Romanian specialists in the digital work stations.

2.2 The post-transition project (the complete procedure): using digital aerial cameras

This procedure refers to the first component of the digital photogrammetric system which uses opto-electronic cameras, based on devices interlinked by charge, Change Coupled Device (CCD) and realizes the direct digital data collection, with a high geometric and radiometric resolution, with a longitudinal overlapping of up to 95%, panchromatic, RGB color (multispectral) and NIR. The second component is represented by the digital work station which, by using compliant computers and adequate software, achieves the collection of digital photogrammetric images up to the obtaining of final photogrammetric products.

The main medium and large format digital aerial cameras, offered by the world leaders in geomatics are: Z/I Imaging DMC (Digital Mapping Camera) of the Intergraph company (USA), ADS-40 (Airborne Digital Sensor) of the Leica Geosystems company (Switzerland), UltraCam-D, offered by the Vexcel company (Canada). For the general cadastre on large surfaces, in Romania, the DMC digital aerial camera was used, and for the general and specialized cadastre (urbanistic real estate), the ADS-40 digital aerial camera was used.

There is a proposal launched within the RSPRS Conference in 2005 and retaken during the RSPRS Symposium in 2007 regarding the creation of a aero-photography unit equipped with large format digital cameras, as a result of the main Romanian profile firms' in the country cooperation.

2.3 The governmental institutional framework

The institutional framework is ensured, according to the law, by the National Agency of Cadastre and Real Estate Advertising (NACREA), having under operation the National Center of Geodesy, Cartography, Photogrammetry and Remote Sensing (NCGCPRS), and at a county (regional) level, the Offices of Cadastre and Real Estate Advertising (OCREA). The Geodes Order in Romania issues, under the conditions of the law, authorizations for the execution of works in the field for private firms or entitled individuals who participate to the organization of auctions.

In order to achieve its objectives, the NACREA – as a unique state authority in the public sector – fulfills a series of important functions (strategy, readjustment, guidance, representation, etc.), and for their realization it has a series of corresponding attributions; mainly, it coordinates, executes and controls, through the means of the NCGCPRS, the works in its field of activity, including the processing of digital photogrammetric images and the verification of the orthophotoplan's production flux.

By taking data from the Military Topographical Direction, the NACREA mainly ensures the execution and maintenance of the national geodesic network, but also various phases within the digital photogrammetric works.

At a regional level, the OCREA organizes the auction for general cadastre works (which will be realized with the help of digital photogrammetry, by using both procedures – hybrid or complete) and ensures the registration of terrains and buildings in the cadastral evidences and the real estate advertising.

Through ordinances of the resort minister, methodological norms have been established regarding the introduction of the general and specialized cadastre, and also rules of notice, reception and verification of the works in the fields of activity.

2.4 Special legislative foresights regarding the exploitation of photogrammetric works

Through Governmental Decision no. 585/2002, with the ulterior modifications and completions, protection standards are established, at a national level, for classified information and the conditions of aero-photography activities upon certain objects, areas or places of special importance, aiming for the protection of state secret information. For taking aerial images with analogical and digital cameras at a flight scale larger than 1:20,000, the issue by the NROSSI (National Registry Office of State Secret Information) of a special authorization is considered.

Both the operations of aerial film developing, within the hybrid procedure, and the operations of general declassification of aerial images (scanned or digital) are realized in collaboration with the Military Topographic Direction (MTD) from within

the Ministry of Defense. Finally, the classified information is eliminated through the masking of special importance objectives, areas or places, in order to protect secret information.

2.5 The orthophotoplan and the index cadastral plan

Because of the characteristics and quality of the orthophotoplan, the cadastral works are approached according to the concept of "index cadastral plan", the purpose being to provide efficient cost solutions, based on the long-term use of the existent cadastral data. The index cadastral plan contains the graphical representation in digital format of the following elements:

(a) The limits of the property bodies;
(b) The permanent constructions;
(c) Elements of infrastructure (railroads, roads, waters, canals and the afferent toponymy elements);
(d) Geo-reference identifiers.

The index cadastral plan is obtains by vectorizing the limits on digital orthophotoplan and it needs, on the one hand, a terrain identification of them, and on the other hand, an evaluation of their significance.

Going over the details, we will essentially show that, for the realization of the Textual Database (TDB) the information extracted from the following sources will be used:

(i) The technical documentations created for the attribution of provisory cadastral numbers;
(ii) The property titles issued according to Government Decision no. 835/1991, with the ulterior modifications and completions;
(iii) The data collected from the field and registered in the property body index card.

In its own time, the Graphical Database (GDB) is realized in digital format, with the incumbency to register all the entities defined in "the technical norms for general cadastre introduction". The attributes which are attached to the graphical entities will be loaded in a database that must ensure the content of cadastral registries. The connection between the GDB and the TDB is established through the means of unique cadastral identifiers on an administrative-territorial unit.

2.6 The national strategy and the reform in the field of cadastre

The long-term strategy in the field of cadastre in Romania has two components: primo, the evaluation of the existent cadastral system in report to the national requests and world tendencies (in our case, especially the European ones regarding digital technology introduction), by also considering the context of our preparation for EU integration; secundo, the manner in which the cadastre supports the development and maintenance of a national SDI in the perspective of collaboration with the SDI of each EU Member State.

Next we will approach the main measures which must be implemented in the development of the strategy, but also the strategic management, at a communitarian and national level, regarding the application of the national project in the field of digital photogrammetry.

(1). On the background of the reform in the field of cadastre, the measures of implementation for the long-term strategy have aimed for the following issues:

(a) The economic development, the social stability and environment protection;
(b) The protection of the legal interests and support the terrain marked;
(c) The coordination of the general cadastre by the governmental organism, etc.

Generally, the institutional reforms in the field of cadastre and real estate advertising were implemented successively, in the years 1996 and 2004, through the adoption and later the modification of the Law of Cadastre in Romania, managing to shape, in this sense, for the realization of the two components of the long-term strategy, a true branch of the legislation in the field. Our options for the reform and strategic management in Romania took into consideration, as they should have, the Declaration in Copenhagen (UN, 1995) and the Declaration in Bogor (UN/FIG, 1996).

(2). Within the long-term strategy, the NACREA responded, firstly, at the communitarian level, to the essential question **What must be done?**, in conformity with the requests of the INSPIRE frame, the NACREA responded at a national level to the question **How must it be done?**, related to the problems left at the election of our country.

(3). The NACREA predecessor took the decision to realize a number of national projects starting with the "Cadastre and real estate advertising project", financed by the World Bank and the Government of Romania. Thus, in 2004, the aero-photography in four national projects was achieved (AERO 01, 03, 05 and 06) at various scales (1:5,000; 1:2,000; 1:1,000), summing up a surface of 100,855 km².

The year 2005 represents the year when the decision was made regarding the complete coverage of the country's territory with photo-aerial images (for the realization of orthophotoplan), with personal funds (budgetary) of the NACREA. Next, the AERO 07 national program was started, for the realization of orthophotoplan at a scale of 1:5,000 on a surface of 136,510 km². In 2007, the year of Romania's integration to the EU, the work moved on to the realization of photogrammetric projects at the level of municipalities as well (at scales 1:1,000; 1:500).

Between the types of photo cameras used in our country, we mention, taking as example the flights made in 2005, Leica RC30 (the EUROSENSE firm), for the AERO 05 national project, or Zeiss RMK Top15 (the OFEK firm), for the AERO 07 national project. In this state of national coverage with aerial images, the precision of the orthophotoplan is related to the scale: ± 1.5 m (at a scale of 1:5,000), ± 1.6 m (at a scale of 1:2,000) and ± 0.5 m (at a scale of 1:1,000).

2.7 Revamping in order to achieve orthofoto products

In this subchapter we will approach, under the title of example, the peak technology and the achievements in the main governmental institutions, either in the digital photogrammetry – GIS binomial (the case of the NCGCPRS, in obtaining the orthophotoplan), or in the digital photogrammetry – GIS – remote sensing triad (the case of the MTD, in obtaining the orthophotoplan).

(1) NCGCPRS: the technology and management in producing the orthophotoplan:
In collaboration with the MATRA (later the EADS) from France, the NCGCPRS initiated and equipped the technological line for the digital photogrammetric system, the latter being mainly formed by the DSW 600 digital scanner, two work stations for aero-triangulation, two work stations for DTM generation, eight work stations for 3D stereo-restitution, two high resolution color plotters, to which we add 13 GIS work stations. At the same time, for the realization of automatic digital aero-triangulation, the NCGCPRS is equipped with two compliant management systems: the PHODIS system, from Carl Zeiss in Jena (acquired in 1997) and the ORIMA system – SocetSet, from Leica Geosystems (acquired recently).

A few national interest objectives of the Center must be mentioned, such as: the actualization of topographic plans at a scale of 1:5,000 (information source for the cadastral plans); the realization of infrastructure projects for agriculture, industry, transport and tourism; the inventorying and management of natural resources; studies regarding the setup of the territory, the protection of the environment and the establishment of measures for fighting natural disasters.

Among the major achievements of the NCGCPRS in the field of digital photogrammetry using both procedures, registered just before the year 2007, we remember: the aero-triangulates for cities; the scanning of urban negatives, but also the start of film archive scanning from the National Geodesic Fund (to compose the database of the digital archive); the participation to the creation of orthophotoplans on a scale of 1:2,000, for urban areas and a scale of 1:1,000, for country and municipality residences; the verification of orthophotoplans realized as a result of aero-photographs taken; the participation to the **Euroregional Map Program** for the integration of digital topographic information in Romania at a scale of 1:250,000 and the juggling of the national SDI with the community SDI.

Referring to the specialized (thematic) cadastres, they are realized in the purpose of collecting data specific to various fields (specialized GISs), like in the case of the real estate-urbanistic cadastre (for example, in Craiova Municipality) in order to integrate them in geographic informational systems of the general cadastre (for example, in Galați Municipality).

(2) MTD: the technology and management in producing the orthophotomap:
From the beginning, we will mention that the products and studies realized by the Military Topographic Direction are not only solicited by military users, but also by civilian ones. For the first user category, along with Romania's adherence to NATO, started the actualization process of military topographic maps at a scale of 1:50,000 in a new standard format, so that, up to 2012, this map will be realized in a vector format, having as source the existent topographic map, completed, for the actualization with new aero-photographs. In the process of realization, the FACC Catalogue from the DIGEST standard is implemented by VMAP 2, and the vectorizing is made with the program ArcGIS 8.3 and PLTS 3.1.

In order to obtain current aerial images, the MTD uses the RC30 photo camera, modernized with the ASCOT system. After the scanning of the aerial film, with the DSW600 digital work station, for the image processing Leica Photogrammetry Suite software is used (the dimension of the pixel on the ground is of 50-60 cm). Next comes the obtaining of the orthoimage, then the ortho-rectification, using DTM and, finally, after the actualization, the orthophotoplan.

For the second user category, the MTD also responded to the requests of a number of public institutions and private agents. For example, in 2002, this Direction executed, in the benefit of the Ministry of External Affairs, the project regarding the evolution of Danube's shores on the border. After an aero-photograph executed on the border and the realization of Danube's course orthophotomap, the data resulted was compared to that already existent, noticing the clogging of the river on the studied sector, registering "territorial gains" for both countries. At the same time, in the benefit of the private Company "Deva Gold Corporation", the orthophotomap of the mine areas in Roşia Montană and Certej was realized. Next, we propose to approach the so-called "execution phase" referring to the case studies in the field of general cadastre and thematic cadastre and the verification of the technological flux for obtaining the orthophoto products.

3. APPLICATIONS IN THE FIELD OF DIGITAL PHOTOGRAMMETRY

3.1 General cadastre

3.1.1 Using the RMK Top 15 classic camera:

The technical data regarding the AERO 07 national project:
(1) Flight scale 1:25,000;
(2) 23x23 cm color photograms;
(3) Pixel dimensions on scanner 16 μm;
(4) Orthophotoplan scale 1:5,000;
(5) Pixel dimensions on orthophotoplan 0.5x0.5 m;
(6) DTM precision ± 1.0 m;
(7) Orthophotoplan precision ± 1.5m.

3.1.2 The management phases in producing the orthophotoplans (an example):

(a) Aero-photography at a county level, using the RMK Top15 camera to realize the AERO 07 national project;

(b) Notices: the Ministry of Internal Affairs and Administrative Reform, the Romanian Information Service, the Military Topographic Direction, the Aeronautic Authority;

(c) The discovery and masking of the areas with special destination;

(d) The aero-triangulation, which is effectuated at the digital photogrammetric station from the THEOTOP headquarters, using the Mach AT (Inpho GmbH, Germany) program and the GPS coordinates of the photogram projection centers in the national work systems (Stereo '70 and the Black Sea '75). Because of the method applied and the possibilities of automatic error detection, the bloc compensation precision was lower than 7 microns;

(e) The Digital Terrain Model (DTM), which was also determined at the work station, using the following software: Mach T, GVE SCOP ++, DT Master Stereo (Inpho GmbH) as follows: for the stereoscopic visualization from the first phase, GVE and SCOP ++ were used as software, and for the stereoscopic visualization of the DTM, DT Master Stereo was used as software. The DTM and precision verification were realized in accordance with the technical specifications;

(f) The digital orthophotoplan, which was realized with OrthoMaster software, mainly using: color aerial photograms, scanned at 16 microns, the aero-triangulation points in the Stereo '70 and the Black Sea '75 systems, and also DTM in ASCII XYZ format. The orthophoto-rectified photograms were transformed into mosaics with the help of the OrthoVista software, and the orthophoto mosaics eventually became TIFF World format. For its accordance with the technical specifications, the orthophotoplan constituted the object of a number of verifications regarding its precision, with the elimination of eventual radiometric or geometric errors.

3.2 The general cadastre and the thematic cadastres

3.2.1 The use of digital aerial cameras:

(1) The DiMAC digital aerial camera. The first photogrammetric flight in Romania was done in 2004 by the INTERGIS Company with a dual-motor plane (Beechcraft type) of the CICADE Company, equipped with a DiMAC (Digital Modular Aerial Camera) digital modular aerial camera. Making the terrain captures directly on CCD eliminates the information losses determined by their processing on film (by avoiding the developing and scanning stations). The superior radiometric resolution allows a better visibility in shadowed areas (the case of high buildings in urban centers).

(2) The DMC digital aerial camera. Based on a CCD sensor matrix, the Z/I Imaging DMC camera (Digital Mapping Camera) is the result of a "joint venture" between Intergraph (with the electronic part) and Zeiss (with the optical part), which ensures a better geometrical precision for the photogrammetric applications. It was used in 2005 by the THEOTOP firm in collaboration with the GEODIS firm in the AERO 07 national project.

(3) The ADS-40 digital aerial camera. The Leica Geosystems ADS-40 camera (Airborne Digital Sensor) was used in 2006 by the Geotop 2001 firm in collaboration with the GRUP FITT firm, in realizing the photogrammetric flight on the entire surface of Iaşi Municipality.

3.2.2 The management phases in producing the orthophotoplan:

3.2.3 In the case study effectuated by the GEOTOP 2001 firm, the flight was realized at a height of 480 m above the urban area, in order to ensure the orthophotoplan at a scale of 1:500. As shown at point 2, the general cadastre was approached according to the index cadastral plan concept and realized on the basis of the orthophotoplan; at the same time, the real estate-urbanistic cadastre was approached according to the GIS system. In our situation, the index cadastral plan contains the graphical representation, in digital format. In this purpose, the similar phases of the orthophotoplan production flux are the following:

(a) Aero-photography which, as we know, was realized with the ADS-40 large format camera;
(b) The notices and (c) The discovery and masking of the areas with special destination, were resolved by respecting the special legislation mentioned;
(c) The aero-triangulation, process realized in a manner similar to that used in conventional photogrammetry. The advantages of the current process are given by ORIMA software which facilitates the GPS and IMU (Inertial Measurement Unit) data processing referring to the position of the flying device, but also the use of other systematic partners' capacities.
(d) The DTM and (f) the Orthophotoplan, which have also used Leica specific software, such as LPS, SocetSet and respectively ORIMA and StereoAnalyst.

For the realization of textual databases, the necessary information is extracted from the existent technical documentations, and also from the data collected on the field.

3.3 The verification of the orthophotoplan production flux

The verification of the quality in orthophotogrammetric products for various projects keeps into account the creation of the following files and reports:

(1). Internal verification file (realized by the executant);
(2). External verification report, realized by an authorized expert (for ex. COWI or the Faculty of Geodesy, TUCEB);
(3). Verification report of the NACREA Commission.

Amongst those competent to verify the NACREA provisioned works, we remind NCGCPRS. The enframing in certain tolerances and the fulfillment of certain conditions are specified in the "technical norms" elaborated by the NACREA or in the "task books" created on the occasion of the auctions organized for the realization of national projects. Let us see which the main phases are referring to the verification of photogrammetric products:

The photogrammetric flight (100% verification). Obtained on the basis of a flight project and realized regardless of the aerial camera nature, the photogrammetric flight is assisted by the GPS system, in order to determine the coordinates of the projection center, by the GPS/IMU system, in order to determine the exterior elements and the LASER system, for the acquiring of DTM data. The verification starts with the analysis of the provisioning method for the images following the aero-photography, of the aero-photographed surfaces, of the quality of aerial images and of the photogrammetry checking points' documentation.

The aero-triangulation verification (100% verification). It is verified if the data obtained is in accordance with the values in the technical execution specifications, as follows: the medium square error, the maximum error of the connection points, the error of the ground control points, the distribution of connection and control points. The verification of the digital aero-triangulation project was made by importing data files in the software (LPS or SocetSet) and by using the analysis "tools" of the program to visualize results.

The DTM verification (10% verification). Both the standard deflections in the independent control points from the existent databases and the control points in the aero-triangulation process were verified.

The verification is made on the TIN created with the help of CAD type programs. The differences between the quotas read on the TIN and the ones known before must not surpass the tolerances foreseen in the technical norms of in the task books.
The orthophotoplan verification (10% verification). The orthophoto verification is made starting with the image files which must fulfill the following conditions:

For the verification of the orthophotoplan precision the sets of image coordinate are compared with the correspondent ones in the field. We close with a synthetic table referring to the precision requested in the DTM and orthophotoplan realization, according to the flight scale and the orthophoto scale:

Flight scale	Orthophoto scale	DTM precision	Orthophoto precision
1:25,000	1:5,000	± 1.00 m	± 1.50 m
1:12,000	1:2,000	± 0.50 m	± 0.60 m
1:6,000	1:1,000	± 0.25 m	± 0.50 m

4. CONCLUSIONS

During the transition/post-transition period, the National Project and the applications in the field of digital photogrammetry (in both hypostases – hybrid and complete) proved to be adequate to the national interest and to the requests of the European integration: economical development, social stability and environment management. In truth, according to Romania's long-term strategy, the orthophotoplan represents the informational fundament for the realization of the index cadastral plan, but also for the realization of thematic GISs, for the LPIS (Land Parcel Information Systems), which is stringently current for the subsidizing of Romanian agriculture by the European Union.