Section: Technologies of Geodesy and Cadastre

Geodetic database for aeronautical purpose

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Abstract

Geodetic data and information is used for many applications: land cadastre, topography, civil engineering, scientifically, but lately aeronautical community start to used not only geodetic data (coordinates, height, magnetic variation, distance, bearing), but also information about them – metadata and evidence of integrity. Geodetic data and information in aero navigation is used for further calculation and design of movement for aircraft and safety areas in space, and on the ground.

A specialized agency of the United Nations, the International Civil Aviation Organization (ICAO) was created in 1944 to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection. ICAO set down minimum geodetic data what is needed for aviation to design flight management in sky and on the ground. All data must satisfy quality requirements in accuracy, resolution and integrity. European Union (EU) adopted regulation No 73/2010 of 26 January 2010 laying down requirements on the quality of aeronautical data and aeronautical information for the single European sky. To support EU EUROCONTROL developed specifications to clarified metadata needed. Research focus on development a management system for full life cycle of the geodetic data, specially requirements to geodetic data base and evidence of integrity.

Keywords: aeronautical data and information; geodetic data base; data quality requirements.

1. Introduction

Nowadays geodetic data and information is used for many applications with difference requirements not only to accuracy but also to plausibility of data/information. Traditionally area of geodetic data application is land cadaster, topography, civil engineering, scientifically, cartography, GIS, but lately aero navigation community start to used not only geodetic data (coordinates, height, magnetic variation, distance, bearing), but also information about them – metadata and evidence of integrity. Geodetic data and information in aero navigation is used for further calculation and design of movement for aircraft and safety areas in space, and on the ground. In Latvia this process is done by only one organization Latvian Air Traffic.

A specialized agency of the United Nations, the International Civil Aviation Organization (ICAO) was created in 1944 to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection. [1] ICAO set down minimum geodetic data what is needed for aviation to design flight management in sky and on the ground. All data must satisfy quality requirements in accuracy, resolution and integrity.

European Union (EU) adopted regulation No 73/2010 of 26 January 2010 laying down requirements on the quality of aeronautical data and aeronautical information for the single European sky [2]. Main focus of relation 73/2010 is to develop such management system in country which can provide not only quality requirements but also evidence of them and each data item has traceability to the moment of origination. In Latvia three main aeronautical data generator are Latvian Air Traffic, Riga International airport and Latvian Geospatial information agency.

To support EU EUROCONTROL developed specifications to clarified metadata needed, but not management system itself and specially geodetic data/information part.

EUROCONTROL developed five specifications:

– EUROCONTROL Specification for Data Quality Requirements (DQR);

– EUROCONTROL Specification for Data Assurance Levels (DAL);
– Terrain and Obstacle Data Manual (eTOD);
– EUROCONTROL Specification for the Origination of Aeronautical Data Volume 1: Compliance Material for Commission Regulation (EU) 73/2010 (DO vol1);
– EUROCONTROL Specification for the Origination of Aeronautical Data Volume 2: Guidance Material (DO vol2).

Each of EUROCONTROL Specification have accent on difference aspect data quality requirements of aeronautical data and information in general. Geodetic data and information is input values in aeronautical process and suppose to be at the best quality. After admission in aeronautical process there is no geodetic data check, that way it is very important to produce geodetic data/information according to data quality requirements.

Data Quality Requirements specification set down process have state should manage data quality requirements for every data item and can apply requirements for specific state situation. State can change data quality requirements, add or withdraw data item from harmonize list. Harmonize list enumerate data items which have data quality requirements and will be published in aeronautical information publication. Regulation 73/2010 relates only to data items in harmonize list and information about those items.

Data Assurance Level specification set down data and information quality, safety, security management systems requirements for origination of data items from harmonize list. One of the way how prove management systems certificate of ISO standards for data originator, other one is description of all process and systems according with Data Assurance Level specification. In data origination point of view starting point is not actual measurement in the field but request of survey as data product specification.

Terrain and Obstacle Data Manual is guidance material for providing data massive of state (could also area 1 in aviation) terrain and obstacle larger than 100 m from ground. Data massive must be produce from geographic information systems our data bases in common exchange format with clear specification.

Originations of Aeronautical Data are two specifications with request to evidence and metadata which must be fulfill in process of data origination.Volume 1 is mandatory, but volume 2 permissive, but for achieving the best results with same payment in origination of geodetic data and information there is no hindrance use both volumes. On one hand Data origination specification set down request for evidence and metadata, on other hand it is state responsibility how to realize it. For geodetic data and information,this only after applying special aeronautical procedure become an aeronautical data and information, shall be established data base.

Nowadays there is no working example for state organizedprocess has to originate geodetic data and information to comply data quality requirements set in regulation 73/2010

1.1. Data origination process

Data origination process is state appointed process between geodetic and aviation communities for geodetic data and information origination. In scope of regulation of 73/2010 data origination starts with request to originate data. Request for origination shall be producing only for data items in Data Quality Requirement Specification annex E – Harmonize List for publication in aeronautical information publication by means of data product specification or task for surveyor. In data product specification must be reference too clearly identify the report format to be used (together with validate survey method), include the data quality requirements and exchange way and format. Requesting person produce data farther do aeronautical community. Meanwhile, state must do geodetic data and information audit and validation to ensure that data quality requirements are accomplished.

From process point of view to get aeronautical data and information according data quality requirements additionally to geodetic data and information shall be add extra information. Extra information can be add by data generator or aviation authority.

Traceability to data origin is one of the main keystones for data quality requirements using electronic instruments for data origination, storage, treatment and production all obtain data must be in electronic depository. One depository with difference access rules is electronic solution have to meet data quality requirements. Depository principle must me data could be add but not withdraw.

1.2. Geodetic data and information origination process in state

Geodetic data and information serve for creation of aeronautical data and information. In current research origination of geodetic data and information starts when there is need for requesting person or generator for aeronautical data and information which must be in state aeronautical information publication. Data has guideline data quality requirements for publication from Harmonize List. Usually generator is aerodrome, heliport, state (if digital relief model and/or potential obstacles higher than 100 m is prepare by state) and other persons like telecommunication tower or wind generator builders or owners. Acting persons in geodetic data and information origination and interaction with depository see Table 1.

Table 1. Acting person and interaction with depository in geodetic data and information origination

Sequence in origination of geodetic data and information	Acting person	Interaction with depository
Comprehension of need for aeronautical data and information	Generator	Register data item and receive standard data product specification for surveyor
Data origination on field	Originator (surveyor)	Upload to depository field files, scan notes and photography
Data control and adjustment	Originator (surveyor)	Download data from depository
Final results and geodetic information	Originator (surveyor)	Upload to depository files and fill mandatory fields in depository
Produce data to aviation community	Generator	Do remark in depository
State established auditor perform validation according validate audit method	Auditor	Download and upload data and information from depository. Put remark pass/fall for each data item
Using of geodetic data and information	Aviation community	Download data from depository our directly use in procedures

1.3. Measurement coding system

Each data items traceability to origin starts from registration of request in depository. Next step is physical measurements on field with electronic instruments. Measurements coding system on the field must be evenly useful for geodesists and aeronautical data and information processors.

Using total station our other digital geodetic instrument with coding system exact coding of object can be done and each data item separate for further saving in depository. Coding system is easily perceptible for specialists in geodesy and aviation, and uncial for each data item.

Unique coding consists of:
- Aeronautical area where is data item. Two Symbols in the code;
- Data item specified place in data base or on the field description. Four symbols un the code;
- Data item group. Two symbols in the code;
- Measurement number to this data item. Three symbols in the code.

Unique coding allows identifying not only measurement number, but data item and area. That is critical for traceability to origin and data integrity.

To determine in which aeronautical area is data item ICAO country and aerodrome code shall be used. ICAO produces every state with unique two letters code. Where first show region over the world but second one is produce for state in that region. Latvia ICAO code is EV, where E is North Europe region and V denotes Latvia. Adding two more unique letters civil aviation agencies gives codes for international aerodromes in each state. For example: Riga aerodrome has code EVRA, where EV is Latvia and RA Riga aerodrome, but Ventspils aerodrome EVVA, where EV is Latvia and VA Ventspils aerodrome.Those data items (physical objects on the field) which belong to some aerodrome area second part of four letters is used unique coding, but for area 1 (all state territory) first part.

Data item specified place in data base description or on the field use:
- Sequence in data base or other registers (obstacle number one 0001 or wind generator near Ventspils number 2- VE02);
- In aerodromesspecific aeronautical abbreviation (taxiway- ALFA, BETA, threshold number- 0018) ;
- Other four symbols.

Data item group title is abbreviation of data item inEnglish from Harmonize List, for example- threshold TH, obstacle OB.

Measurement sequence in the row automatically attach to the end.

In total unique code consists of eleven symbols and for fifth measurement to threshold of aerodrome Riga is:

RA0018TH005

Where RA is Riga aerodrome, 0018 threshold in North direction, TH data item group threshold and 005 fifth measurement threshold.

Unique code in depository is as personal code for each data item with data quality requirements.

1.4. Principle scheme of depository

Depository principle is data base and subject interacting administration possibilities. Difference access possibilities for in geodetic and aeronautical data and information origination and generation involved subjects. Data and information is possible to upload/download, put remarks and add extra information. No possibility to withdraw data and information.

Interaction with data base is only by means of direct connection to depository. Depository usage principle with interacting subjects scheme see Figure 1.
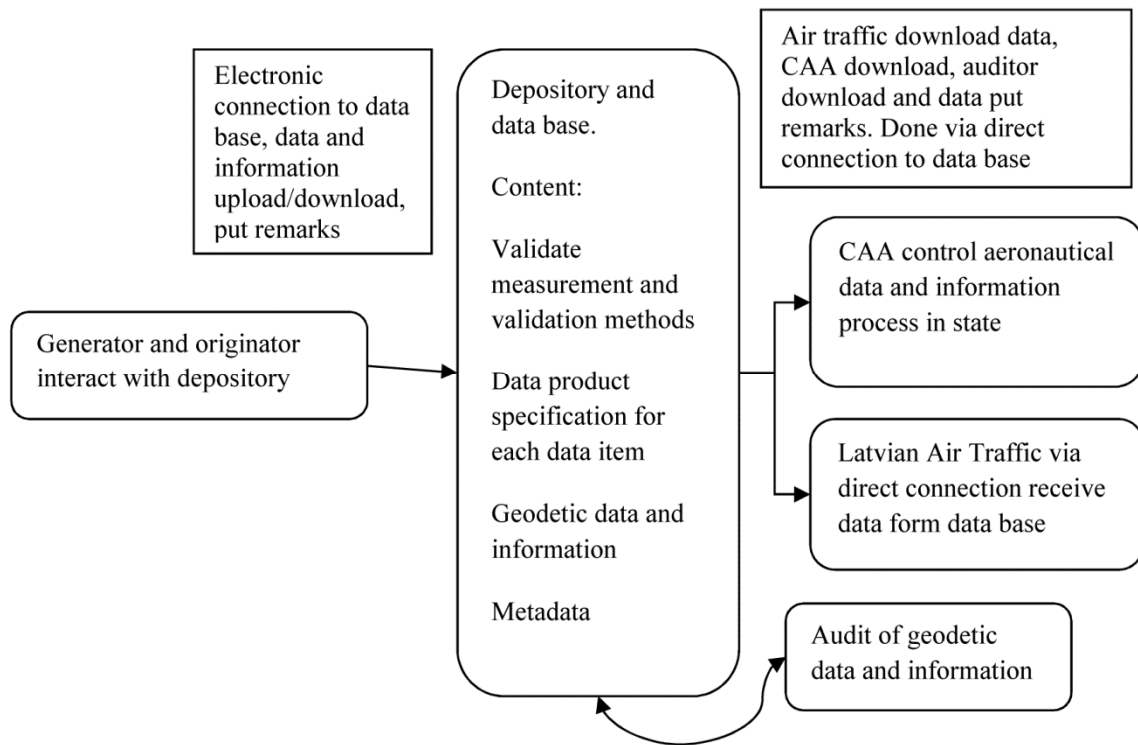
Fig. 1. Depository usage principle scheme in state with interacting subjects

1.5. Geodetic data base principle

Geodetic data base principle is data base with difference access possibilities for in geodetic data/ information origination and generation involved subjects. Data and information is possible to upload/download, put remarks and add extra information. No possibility to withdraw data and information. Interaction with data base is only by means of direct connection to depository. As data item reference in data base unique code is used. Starting with moment when data generator makes request for data product specification for surveyor. In data base is standard form for data product specification request for each data item. Generator selectinggeodetic attribute (height, coordinates etc.), area, data item group and write data item specified place in data base or on the field description. Creation of unique code for data item is done. After that standard data product specification is produce for surveyor with unique code of data item which must be originate.

Surveyors after data origination make a data upload/download to data base only with connection to unique code. Principal scheme of unique code and connection to data base see Figure 2.
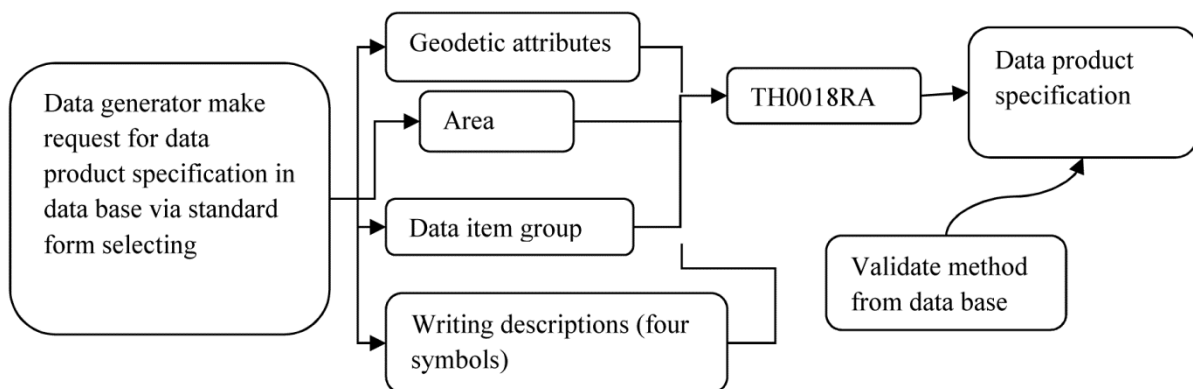
Fig. 2. Principal scheme of unique code and connection to data base

Process of data product specification formatting and assignation is fully traceable and transparent.

Data originator after field works uploads to the data base original measurement files, scan field notes and photography. For geodetic data adjustments and final results surveyor download data from the data base at the end of work upload all final files to the data base. In addition surveyor put remarks about persons who did job and upload all certificate to the data base. Principal scheme of surveyor interaction with data base see Figure 3.
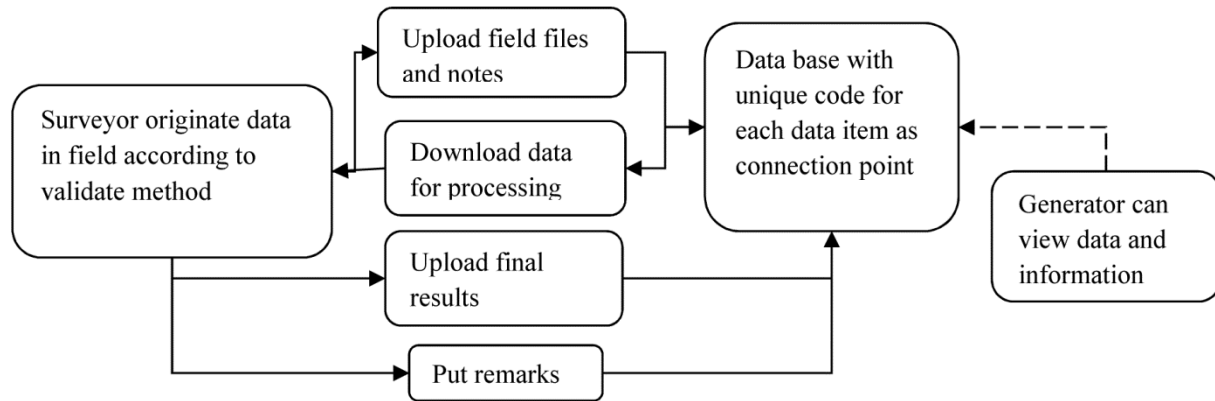

Fig. 3. Principal scheme of surveyor interaction with data base

2. Conclusion

Geodetic data have new application in aeronautical community with specific data quality requirements as part of aeronautical data and information creation. As input data and information it must be at the best level, because there is no further possibility to check geodetic data and information in aeronautical data and information origination process. As one of footstone for achieving data quality requirements is traceability to origin of data. Traceability starts with data product specification and measurement on the field.

Geodetic data and information is traceable if:
− Geodetic measurements on the field are with unique code;
− Unique code serve as keystone in relation data base;
− Origination of geodetic information starts and ends with data generator.

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