WEBGIS FOR EMERGENCY AT AIRPORTS

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ABSTRACT:

Emergency management at airports is highly regulated by the international and national regulations and by technical standards. International Civil Aviation Organization (ICAO) has standardized airport operations throughout the implementation of Airport Service Manuals among which is Airport Emergency Plan (AEP). An AEP is meant to be implemented for any emergency situation and to encompass all possibilities for disaster. It describes the actors involved in emergencies, their responsibilities and functions, operations centre, contact information, medical services, communications, etc. Two analogue maps visualize the geographic locations of the important objects. Till now, GIS has not been included in standardization or recommendations for the emergency management at airports. We present WEBGIS airport emergency planning application developed by Geodata d.o.o. and implemented at The Split Airport. In addition to standard GIS functions of displaying geographic and alphanumeric data including the AEP itself in pdf format, it enhances the emergency response by function of finding the most appropriate path for selected emergency vehicle. The user interface is simple, has large buttons and includes only task-required GIS functions. Special attention is given to cartographic visualization, so the recommended cartographic symbols for analogue maps were adopted. The advantages of having an AEP as WEBGIS application are from data updating and ensuring that all participants have the latest version of AEP, till GIS spatial analyze function of finding paths. Our current research is towards geosemantic web application for airport emergency planning which should enable easy access, search and integration of dynamic data for all participants in emergency activities.

1. INTRODUCTION

Air traffic is a human activity that is coordinated at the world level. A large number of participants and resources are involved in interrelated tasks and share the same data. Airport services are an important component of air traffic, and therefore are highly standardized at the international level. The 1st International GIS for Airport Management was recently held at Paris Orly airport to discuss the wide and varied use for GIS within airport management and operations (see Thurston, 2011).

Airport emergency management is a complex activity characterized by participants not only from the airport but also from surrounding communities. Dynamic data from various sources, geoinformation and temporal information are needed. Therefore, there are many challenges associated with integrating GIS in airport emergency management. Findings of (Abdalla, 2004) have clearly demonstrated that the application of WEB GIS for airport emergency provides unique capability in terms of providing distributed interoperable services that allow for collective decision making process.

In the paper, Section 2, we present a brief overview of standards and specifications for the airport emergency management with focus on geoinformation. Section 3 gives a description of WEBGIS airport emergency planning application developed by Geodata d.o.o. and implemented at The Split Airport, Croatia. Finally, we conclude with the next steps and further research in Section 4.

2. EMERGENCY MANAGEMENT AT AIRPORTS

One of the airport emergency services is emergency services preparedness or airport emergency planning. As airport operations are highly regulated by the international and national regulations and by technical standards, this chapter focuses on the main standards for airport emergency planning and geoinformation.

2.1 Standards for airport emergency planning

The International Civil Aviation Organization (ICAO) is a specialized agency of the United Nations. ICAO develops international air transport standards and regulations and serves as the medium for cooperation in all fields of civil aviation among its 190 Member States (ICAO, 2009a). ICAO has standardized airport operations throughout implementation of the ICAO Standards and Recommended Practices (SARPS). The main references for the airport emergency planning are Annex 14 to the Convention on ICAO, Volume I (ICAO, 2009b) and Airport Service Manual (doc. 9137), Part 7, Airport Emergency Plan (ICA0, 1991).

Annex 14, Volume I, Chapter 9.1 defines airport emergency planning as process of preparing an airport to cope with an emergency occurring at the airport or in its vicinity. The objective of airport emergency planning is to minimize the effects of an emergency, particularly in respect of saving lives and maintaining aircraft operations. The Airport Emergency Plan (AEP) sets forth the procedures for coordinating the response of different airport agencies (or services) and of those agencies in the surrounding community that could be of assistance in responding to the emergency (ICAO, 2009b). Examples of emergencies are: aircraft emergencies, sabotage including bomb threats, unlawfully seized aircraft, dangerous goods occurrences, building fires, natural disaster and public health emergencies. Examples of agencies on the airport are: traffic control units, rescue and fire fighting services, airport

administration, medical and ambulance services, aircraft operators, security services and police. Examples of agencies off the airport are: fire departments, police, health authorities, military, and harbour patrol or coast guard.

The AEP should include at least the following:
1. types of emergencies planned for;
2. agencies involved in the plan;
3. responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;
4. information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and
5. a grid map of the aerodrome and its immediate vicinity.

Annex 14 provides recommendations on emergency operations centre and command post, communication system, airport emergency exercise and emergencies in difficult environments.

Airport Service Manual (doc. 9137), Part 7 is a comprehensive guidance material to assist in the establishment of AEP. The purpose of the AEP is to set out in manual form the responsibilities and required actions/roles of the various personnel/agencies involved in dealing with emergencies affecting the airport.

To be operationally sound, a comprehensive AEP gives consideration to (ICAO, 1991):
1. preplanning before an emergency;
2. operations during the emergency; and
3. support and documentation after the emergency.

AEP is a complex project of a large magnitude in terms of technical and coordination issues, human resources and costs. The AEP is to be considered as a "living document" and must therefore be maintained current at all times, tested regularly and accessible to all emergency response personnel (ICAO, 2008).

2.2 Geoinformation for airport emergency planning

Airport Service Manual (doc. 9137), Part 7, Chapter 7 gives specifications and examples for two grid maps (ICAO, 1991):
1. grid map of the airport depicting the confines of airport access roads, location of water supplies, rendezvous points, staging areas, etc. (see Figure 1 for an example of analogue AEP grid map for The Split Airport, Croatia); and
2. grid map of the airport and surrounding community depicting appropriate medical facilities, access roads, rendezvous points, etc. within a distance of approximately 8 km from the centre of the airport.

Regarding geoinformation, Annex 14, Volume I defines common reference systems (horizontal, vertical and temporal reference system) and aeronautical data quality requirements. The Annex 14, Volume I and Airport Service Manual (doc. 9137) do not contain specifications for digital mapping or GIS.

U.S. Department of Transportation, Federal Aviation Administration (FAA) has developed the following geoinformation specifications (FAA, 2010):
1. AC 150/5300-16 "General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey";

2. AC 150/5300-17 "General Guidance and Specifications for Aeronautical Surveys: Airport Imagery Acquisition and Submission to the National Geodetic Survey"; and
3. AC 150/5300-18 "General Guidance and Specifications for Aeronautical Surveys: Airport Survey Data Collection and Geographic Information System Standards".
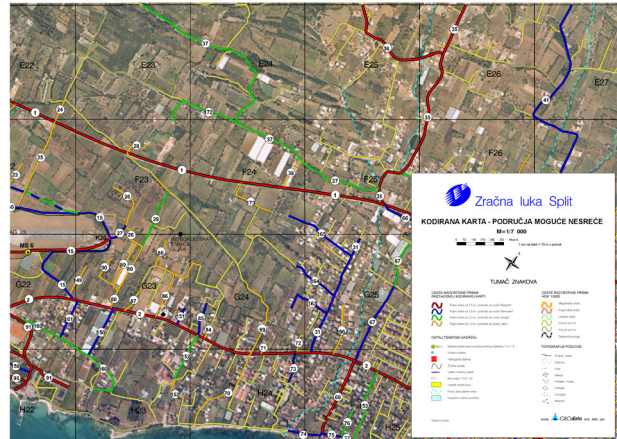

Figure 1: Analogue AEP grid map for The Split Airport, Croatia (© Geodata d.o.o. Croatia, 2010)

On the basis of the above standards, FAA is developing Airports Geographic Information System (AGIS) (FAA, 2009). AGIS defines the process for the collection and maintenance of airport and aeronautical data. Through a single internet based web application the airport can access its data along with the ability to submit changes as required. FAA is working to integrate other aeronautical applications into a single internet portal for submission and delivery of airport and related aeronautical data to the FAA. The Airports GIS currently supports open data standards, has enhanced workflow and tracking capabilities, automatic validation on all submitted data, and GIS viewer capability for airport data. FAA is in the process of developing electronic Airport Obstruction Charts and electronic Airport Layout Plans (Phase II). Still, there is no support particularly for airport emergency planning.

Eurocontrol is a contributing member of the joint project which defines industry requirements and interchange specifications for Aerodrome Mapping Data Base (AMDB). The following standards describing the structure of AMDB (Eurocontrol 2010a):
1. RTCA DO-272A/EUROCAE ED-99A: User Requirements for Aerodrome Mapping Information; and
2. RTCA DO-291/EUROCAE ED-119: Interchange Standards for Terrain, Obstacle, and Aerodrome Mapping Data.

Aerodrome Mapping Exchange Schema (AMXS) is an exchange format for airport mapping data, developed by Eurocontrol and intended for use by the aeronautical community. It is an XML Schema implementation of the Airport Mapping Exchange Model (AMXM) (Eurocontrol 2010a).

Another Eurocontrol effort is directed towards the GeoAeroNet (Eurocontrol 2010b). It is geo-spatial standardization in the context of Aeronautical Information Management (AIM) and it

allows the fusion of various geo-spatial aeronautical information sources within a distributed and open interoperable data interchange environment. Still, there are no published specifications particularly to airport emergency planning.

In conclusion, the current status of standardization for AEP and geoinformation is as follows:
1. AEP itself is fully standardized including specifications for the two analogue grid maps visualizing geographic locations of important objects;
2. digital geoinformation for AEP is standardized mainly on the level of reference systems and data quality requirements; and
3. specifications for GIS support are under development and do not include processes of airport emergency planning.

The next section will describe an implemented WEBGIS airport emergency planning application developed by Geodata d.o.o. and implemented at The Split Airport, Croatia.

3. WEBGIS AIRPORT EMERGENCY PLANNING APPLICATION

WEBGIS airport emergency planning application was developed for The Split Airport by the Geodata d.o.o. company, Croatia. The objectives were: to enable wide access of AEP in its current version (the AEP is continuously updating) and to provide additional information concerning the shortest path for selected emergency vehicle. Emergency management planning is elaborated in the AEP which consists of a text document and the attached two grid maps, all in accordance with international ICAO standards.
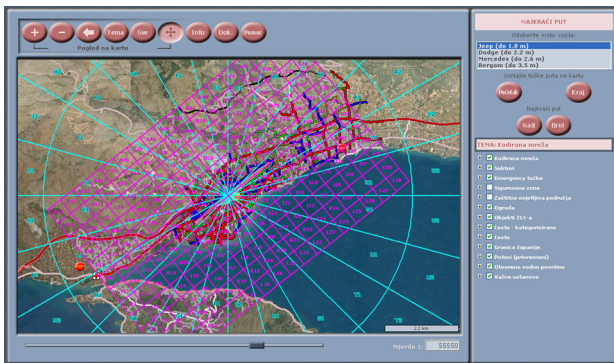

Figure 2: Main window of WEBGIS airport emergency planning application
(© Geodata d.o.o. Croatia, 2010)

WEBGIS main features are:
1. fast and easy access of AEP via web;
2. unlimited number of authorized users;
3. users need only standard internet browser and connection to server; and
4. data and application are maintained centrally (on server).

Geo database contains:
1. base maps (orthophoto, national base map);
2. airport objects;
3. sectors and coded grid;
4. security zones;
5. emergency points;

6. relevant facilities; and
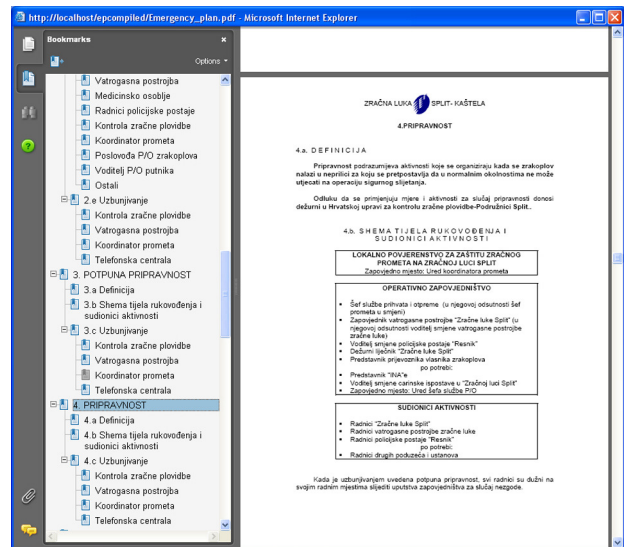7. classified access roads network.

Figure 3. Display of AEP in pdf format

The main application window contains (Figure 2):
1. interactive map (visualization of the selected map content, map navigation, object information labeling);
2. tool buttons (zoom in-out, zoom previous, zoom extent, pan, info, AEP document (Figure 3), help);
3. map scale bar, graphic and numeric scale;
4. map legend (selection of the layers on the map); and
5. calculation of the most appropriate and shortest path for selected emergency vehicle (user selects the start and end by clicking on the map, and type of emergency vehicle) (Figure 4. and 5).

The user interface is simple, has large buttons and includes only task-required GIS functions (Figure 2). Special attention is given to cartographic visualization, so the recommended cartographic symbols for analogue maps were adopted.
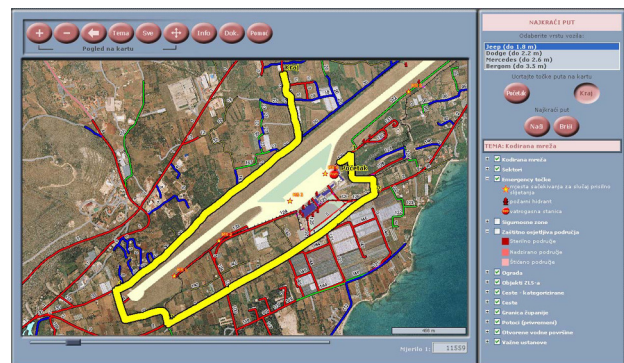

Figure 4. Visualization of the shortest path
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The advantages of having AEP as WEBGIS application are from data updating and ensuring that all participants have the latest version of the AEP, till the GIS spatial analyze function for finding paths.

Smjernice / Path Guidelines	Udaljenost Distance	Detaljne karte Detailed Maps
Početak kretanja na Sjeveroistok oznakom 129 prema 127	0,09	
1. Skrenuti DESNO na 127 (Jug)	0,37	
2. Skrenuti DESNO na 2 (Jugozapad)	1,5	
3. Skrenuti DESNO na 33 (Sjever)	0,52	
4. Skrenuti DESNO na 30 (Sjeveroistok)	1,45	
5. Oznaka ulice se mijenja u 14 (Sjeveroistok)	0,43	

Dolazak na 14

Ukupno predviđeno vrijeme (pri 40kmh) / **Estimated Time:** 6,6 minuta
Ukupna duljina / **Total Distance** : 4,35 kilometara

Figure 5. Print layout of the path guidelines
(© Geodata d.o.o. Croatia, 2010)

4. CONCLUSIONS AND FUTURE WORK

The specifications for GIS supporting airport emergency management are still under development. As airport emergency management is a complex human activity, there are various challenges associated with integrating GIS.

The presented WEBGIS application has ensured the following:
1. all the ICAO requirements are fulfilled (complete AEP document with two grid maps is included as a pdf document);
2. all the participants from the airport have access to the current AEP document via web;
3. AEP in pdf format can be used and searched more effectively then an analogue document;
4. the airport authority responsible for the updating of AEP has a central place to maintain the data;
5. visualization and search of geoinformation and related data is enhanced with a standard GIS functions;
6. cartographic visualization is enhanced by adoption of the recommended map symbols for GIS;
7. emergency response is enhanced with a function of finding the appropriate path for selected emergency vehicle; and
8. user interface is simple and made for non-specialist, the few large buttons only provide task-required GIS functions.

In the future, we plan to extend the geo database and add new functionalities to the WEBGIS for AEP. Also, we will continue to work on the following:

1. participation of agencies off the airport (getting their requirements regarding data and tasks);
2. integration of dynamic data (coming from the field crew); and
3. extending geo database with ontological scheme to support data search.

Our final aim is to develop a geosemantic web application for airport emergency planning which should enable easy access, search and integration of dynamic data for all participants in emergency activities.

ACKNOWLEDGEMENTS

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