Analysis and Visualization of Geospatial Data in Enterprise Application

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Abstract

Airports GIS is a cluster of geospatial enterprise applications. It allows authorized users of FAA (Federal Aviation Administration) to submit changes to airport data. One of these applications, electronic Airport Layout Plan (eALP), automates the data assembly process and provides a workflow to replace the paper copy version of ALP by digital copy. The analysis and visualization of geospatial data at enterprise level pose a lot of challenges. Spatiotemporal nature of data brings added complexity.
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1 Introduction

Airports GIS can be accessed from internet at airports-gis.faa.gov by authorized users. It currently consists of half a dozen of mainly geospatial applications. One of these applications is electronic Airport Layout Plan (eALP). The main purpose of creating eALP is to move from paper copy to digital version. The data that go into eALP are both spatial and temporal in nature. The visualization of spatial data needs specific software. The software sometimes imposes certain constraints and challenges. Despite all these issues, the accuracy of data displayed on eALP is not compromised.

2 electronic Airport Layout Plan

The eALP helps support Next Generation (NextGen) of air transportation which is an FAA wide highly visible initiative spanned over next few years. The design of eALP should be such that it can generate a digital version for small, medium, or large airport. This brings the biggest challenge. In other words, the eALP should be developed keeping enterprise level workflow in mind. Also, unlike signature on the paper, a digital version of signature should be developed and used by respective authorities. The concept of digital signature is nothing new. What is important is to convince the users that they should see eALP in a different setting.

2.1 Highlights of eALP

There are approximately over 13,ooo airports and 5800 heliports in USA. They come under the classification of large hub, small hub, and towered airports. Some are designated as NPIAS (National Plan of Integrated Airport Systems) airports funded by FAA, and others are non NPIAS. The former gets grants from FAA for different activities like construction of runways, taxiways, or modifying them, installing lights or navigational equipment on the airport. Airports use some of these grants to produce a paper copy version of ALP regularly. They are required to change this ALP when data changes on the airport. For example, if a runway extension project is undertaken, that requires a change in ALP. Any small change in data like installing a hangar also requires modification of ALP. Airports have noticed in last few decades that it is almost impossible to make these changes on the paper regularly. Also, making these changes on the paper needs lot of funding. The ALPs are typically stored at different locations. That means when data changes, all these locations need to have a current copy as well. Maintaining these paper copies are extremely difficult. That is the reason we have undertaken this task of digitalising the paper ALP. The data on eALP is visualized using ESRI software [1]. Some data are needed to be displayed with great accuracy up to under a foot. This requires good visualization techniques and tools.

2.2 Workflow of eALP

The dataflow or workflow of any enterprise level application is completely different from that of a standalone application. Even though the data are assembled at airport level by airport sponsor, the data have to be coordinated among Airport District Office (ADO), Regions, and finally Headquarters. It also has to be coordinated through different Lines of Business (LOB) because other LOBs use the same data for flight standards and flight procedures. This requires a new approach, not typically followed for any standalone application development. Also, some data can be ingested at different locations. Some data are interrelated due to their inherent nature. This needs special attention. The workflow is also such that it moves from Airport sponsor to headquarters and back to airport sponsor.

2.3 How data is analyzed

The Airport data undergoes various steps before it can be **used** for eALP. For example, the data for constructing a taxiway on a specific airport, is entered into Airports GIS by Airport sponsor or their consultants. They use another module called Survey module to create a project and upload a Statement of Work (SOW). This module is also available in Airports GIS. The SOW is verified by ADO. It is little bit difficult as we have not yet developed a standard template for

creating such SOW. The data provider also submits geo-referenced imagery which could be aerial, satellite, or LIDAR [2] along with a plan for imagery. The data submitted has to be consistent with current Advisory Circulars. The data submitted could be safety critical or non-safety critical data according to the Advisory Circular specifications. Once the data is entered through Airports GIS, the system itself does a first check of available data and flags the errors if any. This needs to be corrected before the data is verified by National Geodetic Survey (NGS). This process takes several months. NGS validates and verifies the critical data. Once the data is verified, it is stored at NASR (National Airspace System Resources) database which is used by all Lines of Business. This verified data is assembled for the purpose of initiating eALP process.

2.4 Enterprise data review process

The coordination, review, and delegation process associated with the development of this application is very important. The data is reviewed and analyzed first by Airport sponsor or its consultants. Once it is determined that the data is correct, it is sent to ADO for review. We plan to implement a modified notification process in eALP such that the ADO would get an automatic email, once the Airport sponsor submits the data to ADO. The ADO verifies the data and sends it to FAA regional office. This needs to be sent securely. The eALP process has an industry standard digital signature process that allows the data to be transmitted from one location to other electronically without having any or minimal chance of data being hacked on its way to its destination. Sometimes the data is entered with comments or attached files. The coordination process plays a significant role as there may be total disagreement of the data along different Lines of Business. The application provides necessary graphical user interface to analyze and visualize the data on the airport. The delegation process is specially important in a big organization like FAA where people move in and out regularly.

2.5 Teechnical Challenges and Temporality

Technical challenges are plenty when one implements the requirements and deploys them in time. In a big organization like FAA, development work may be performed by one Line of Business whereas another Line of Business may be responsible to deploy the application. Occasionally this requires change in strategy which has different technological implications. Also, versioning of eALP plays a significant role in properly depicting pen and ink changes which are typically carried out on ALPs. Sometimes these pen and ink changes are very minor and implementing them correctly requires an automation process like eALP. Temporality also plays great role in the development of eALP. Data is changing continuously on Airports. Temporality basically stamps a data piece when it is initiated and follows through its evolution. This can hardly be done through manual process without compromising accuracy. The evolution of these data also includes the deletion of the data at some stage if the data is not required. Hence, policy makes across the world, specially in USA and Europe, have realized the importance of temporality. This is being pushed through several globally accepted models like AIXM (Aeronautical Information Exchange Model). To accomplish this, a lot of architectural and design changes to the eALP application are required. We have been using ESRI ArcGIS viewer [1] to visualize the data on the Airport. Each software has its own limitation. The integration of visualization tool with the application brings enormous challenges. Dimensioning and labeling should be specially improved customizing the ArcGIS to bring about a real look and feel of eALP printout.

3. Conclusion

The eALP development mainly consists of developing a few mandatory sheets and a few optional sheets. We recently conducted a gap analysis to see the deficiency between the existing eALP and the available national check list which needs to be completely implemented. We have learnt a lot from pilot program activities. We know that producing a high quality pdf file from eALP module is as important as automating the whole process of creation of eALP. In other words, the visualization of eALP on the paper is as important as it is on the computer. However, increasing the look and feel of eALP printout is not easy. It is like finding a solution which will fit airports of different sizes. We will continue to approve the spatiotemporal portion of eALP in next few months. A lot of work has to be done to customize ArcGIS viewer to enhance the visualization part of eALP. Three dimensional capability of viewing a taxiway or runway or a building is still not available in the existing eALP.

References

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