

## **A web GIS Application for Project Tracking and Production Monitoring**

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### **Abstract**

Using ESRI ArcIMS, ArcSDE, and Geodatabase technologies, EarthData developed a web-based project tracking application. This paper describes the functionalities and operational use of this tool within EarthData, with which project managers monitor production and delivery status of map products based on their tiling index, production technicians report workflow status, and customers track the progress of their project and provide on-line quality control feedback on individual products. This application has provided the following benefits: an improved production process with greater first-time-right delivery rates, improved production organization resulting in reduced management time. The use of this application has also resulted in a greater customer satisfaction by increasing their visibility on project progress, and improving interaction through the ability to review deliverables and provide feedback at any time.

### **1. BACKGROUND**

A web-based project tracking and production monitoring application is a particularly important management tool for GIS/mapping companies such as EarthData International. EarthData provides the airborne imaging, photogrammetric mapping, and GIS products and services to clients world-wide. With its fleet of aircraft, EarthData collects information — data — about the earth's surface using aerial photography and a variety of other airborne sensors. The company transforms that data into customized mapping, GIS products and services. Most of EarthData's production is based on geospatial elements such as lift boundaries, flight lines, standard map sheet boundaries or stereoscopic models.

EarthData project managers need to be able to track the project progress, hours spent, performance metrics and status of all subcontractor activities online. In addition, team leads and analysts need to communicate with each other to ensure work is not duplicated and vital production processing steps are not inadvertently omitted. Finally, EarthData needs to communicate on a regular basis with its clients in order to inform them of a project's status. As a result, EarthData developed a project tracking and production-monitoring tool, PROJECTTRACKER, using ESRI ArcSDE 8.3, Oracle 9i, and ESRI ArcIMS4.01 with ASP, JavaScript, HTML viewer and Java viewer. PROJECTTRACKER - the current version of the tool has been tracking and monitoring both client and production level management for over 40 projects in the past 7 months.

There are three user status levels within PROJECTTRACKER:

- **Administration:** This level permits an administrator to manage the system users or projects. Common tasks include defining production processing steps and assigning user read/write access privileges for projects.
- **Production:** This level account allows analysts to report his/her production workflow and progress, including hours spent per production step.
- **Client:** EarthData clients can view the status of their projects, review GIS products and other deliverables online, and send feedback and comments to EarthData project managers.

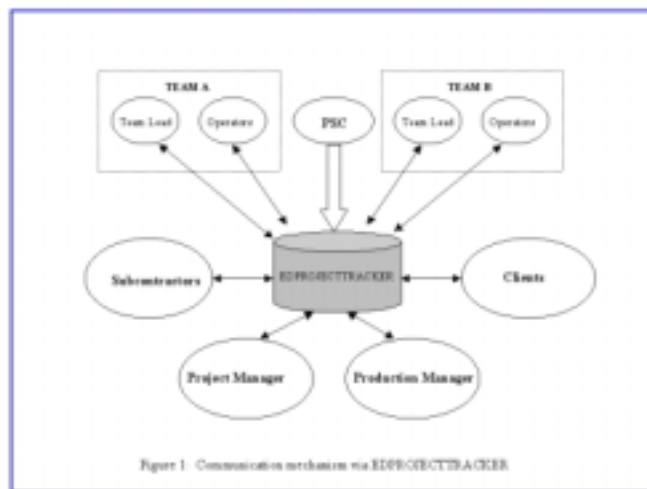
PROJECTTRACKER also allows EarthData management to generate Microsoft Excel spreadsheet reports detailing performance metrics and hours consumed for all projects.

PROJECTTRACKER has been developed to track and monitor production for all of EarthData's core services – GeoSAR processing, lidar processing, ISTAR processing, stereocompilation, orthophotography development, cartographic editing and GIS services. Since each service possesses its own set of unique production processing steps and is based on different geospatial elements – flight lines, map tiles, stereo models, etc. - the challenge is to present all this information as one seamless package to the all the users.

The objective of this paper is to describe the development structure, procedure and implementation. We first introduce the application's overall design concept, followed by a discussion of the system architecture. Finally, application implementation is demonstrated through several examples, including the Florida statewide mapping project, the Tennessee statewide mapping project, and the Sangamon County (IL) GIS mapping project.

## 2. SYSTEM CONCEPT MODEL

Prior to the implementation of PROJECTTRACKER, communications between technicians, team



leads, project managers, subcontractors, clients and production managers was achieved by written reports, emails, phone calls or meetings. However, these mediums cannot adequately describe progress status nor can it describe geospatial information and elements. This resulted in inefficient communication and a greater likelihood for production errors and mismanagement. As a result, it was deemed necessary for EarthData clients, project managers and production departments to consolidate their requirements into one comprehensive system to track project progress status, monitor production, and to communicate more efficiently between the various people involved in a given project. EarthData decided to use ESRI technology to accomplish this goal.

The PROJECTTRACKER is aimed at improving project communication among all parties involved using ESRI ArcGIS technologies. With the tracking system, clients, managers, operators and subcontractors have better communication (figure 1). Technicians and subcontractors can identify sheets and steps they need to work on and report the workflow and time spent to the system. Team leads can obtain the step status per spatial unit via a friendly interface, review the map products, and send the review comments to the operators.

Communication among several different production teams is also greatly facilitated. As Team A progresses through a project, Team B can identify the sheets and steps available for the next stage of processing and report any issues that need to be fixed in any of the previous steps. The client can visit the tracking system to generate the project progress status reports or map plots, review the project deliverables and send feedback to EarthData managers. The project manager and production manager can generate project status reports, and time spent and performance metrics reports. The PROJECTTRACKER system has resulted in a more efficient communication between clients, managers, and production teams, as well as greater visibility for the clients. The use of this application also has resulted in significant reductions of time spent on project management, coordination and communication.

The EarthData production department is composed of several production teams that are each responsible for specific steps in the production as a project progresses from start to final completion:

The Production Staging and Control Department begins the production process by generating a flight plan and the associated sheet layout. The sheet layout is the fundamental underlying data structure in the tracking application and is basis for all project management and tracking. Depending on the type of project – GeoSAR, ISTAR, etc.- a certain production team will begin to develop the project deliverables. Using ISTAR as an example, the ISTAR team starts the first set of production steps processing per flight line or lift. As each production step is qualified in terms of started, in progress, or completed, an analyst will input into the system his/her name and any associated times for completion. As the ISTAR production stage progresses, a second production team will carry out its tasks focusing on mapsheet tiles attributed as “COMPLETE” by the status reports from the first team. If the second team finds any pressing issues, it will send feedback to team 1 for fixing.

As a project progresses toward completion, the team lead will keep track of step status and time-spent metrics in addition to generating weekly project progress reports for project managers. Project managers will evaluate the report against budget plan/schedule and send feedback to the team lead. Project managers correspond with EarthData clients with the weekly interactive status updates. The project manager may also need to include EarthData subcontractors into the project. Finally, the production manager conducts the budget control analysis.

### **3. SYSTEM ARCHITECTURE**

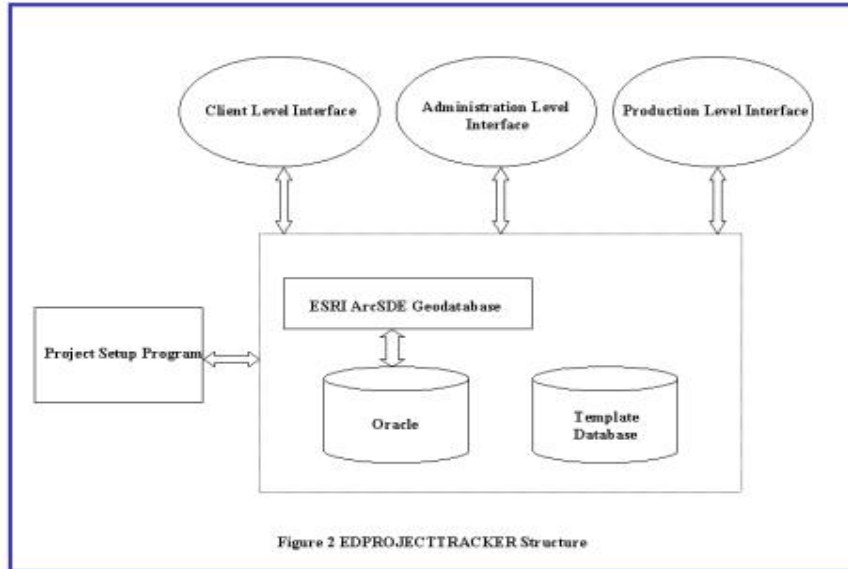
PROJECTTRACKER has six components (figure 2):

- EDRI ArcSDE Geodatabase and Oracle database
- project setup system
- frame database for EarthData different types of projects
- web-based administration level interface
- web-based client level interface
- web-based production level interface

The PROJECTTRACKER database currently accommodates nine different mapping activities within the EarthData organization, and stores the each application as a separate mapservice template for use in ArcIMS:

- ISTAR true orthophotography
- ISTAR ground orthophotography
- Traditional orthophotography

- LIDAR mapping
- Stereoscopic compilation
- GeoSAR mapping
- GIS base mapping
- GIS conflation



- GIS feature collection and feature extraction

Each template consists of three types of information – Geodatabase schema, ArcIMS Map service information and AXL template, and ASP template in supporting the project setup system. The project setup program provides a friendly interface that allows non-GIS users to insert a project into the PROJECTTRACKER. The operator just needs to input the project type(s), processing spatial unit(s), mapping extents, projection information and the graphic information of spatial unit(s), then the setup program will generate the project geodatabase, the ArcIMS AXL for map service, and ASP for web-based interface based on the frame database. The setup program will also insert project related information, including schedule, time budget, steps, and extents into the tracker database.

PROJECTTRACKER accommodates three different levels of read/write access. The administration level interface allows an administrator to manage the users and projects. The user can assign or remove projects to a user, and update/add/delete a user or a project. A user is also assigned one of three privilege levels to access a project. The first level user is only permitted to view the project status. Clients are normally granted a level 1 access. The second level user is allowed to view and update the project status. EarthData production staffs usually have this access level. The third level user, granted primarily to managers, is privileged to generate the project progress, step status and time spent reports.

PROJECTTRACKER is designed with two slightly different graphical user interfaces. EarthData employees use a production-oriented interface as tools are customized for easily reporting workflow status and time spent. The client level interface is customized to meet the information needs of EarthData clients, including tools for reviewing project products, sending client feedback, and tracking project progression and status.

## 4. SYSTEM IMPLEMENTATION

### 4.1 Project Frameworks

- Geodatabase Model

We designed the geodatabase schema for each of EarthData 9 major project types. The geodatabase schemas are stored in XML format. The core of the geodatabase is a standard relational database schema that includes a series of standard RDBMS tables, column types, indexes and attribute relationship. The attribute domain, topological rules and relationship rules are also defined in the schema.

- Mapservice Design

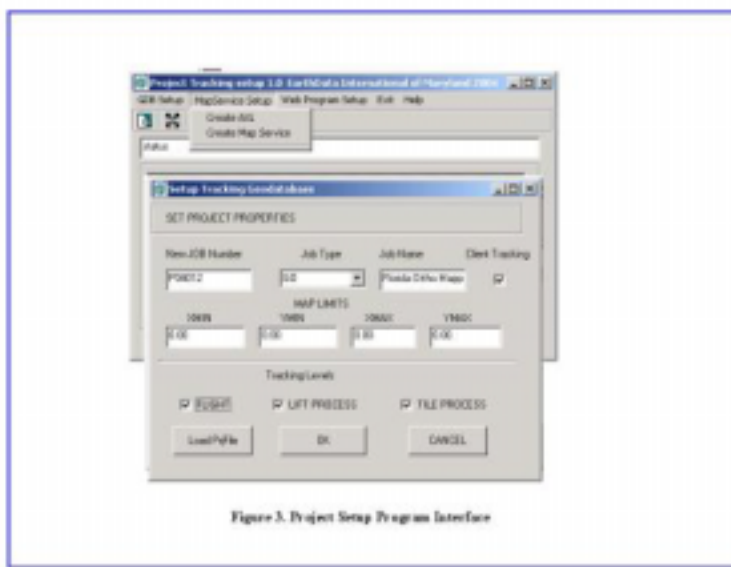
We designed mapservice frames to accommodate nine project types. A project type is comprised of several mapservice files in ArcIMS AXL format. The ArcIMS AXLs are stored in Oracle tables. When a user defines a project type and other required information, the setup program will create the mapservice file based on the corresponding AXL frame.

- Web-based interface Design

We also designed a web-based interface template with ASP, JavaScript and ArcIMS ASP connector. The ASP code is stored in Oracle tables. The ASP program will be created when the user runs the setup program and defining project type and other related required information. Such design guarantees the user to easily update the framework and create new project template or framework.

- Database Design

PROJECTTRACKER database is comprised of two main components – an ArcSDE Geodatabase and Oracle tables. The ArcSDE Geodatabase is used to maintain project geodatasets including project tracking spatial units, e.g. flight lines, lift, model or sheet layout, and project products and deliverables. User information, project metadata and framework data is stored in Oracle tables.



## 4.2 System Functions

### 4.2.1 Project Setup Program

Project setup program provides the 5 functions (figure 3):

- Set Geodatabase for a new project by typing the project type and project metadata information
- Update or insert the featureclass graphic
- Create ArcIMS mapservice AXL file for a new project
- Insert a new project into PROJECTTRACKER
- Provide the interface to update the ASP template

### 4.2.2. User / Project management

PROJECTTRACKER provides an interface to allow an administrator to manage the users and projects (figure 4).

### 4.2.3. Production Level

- Standard GIS functions

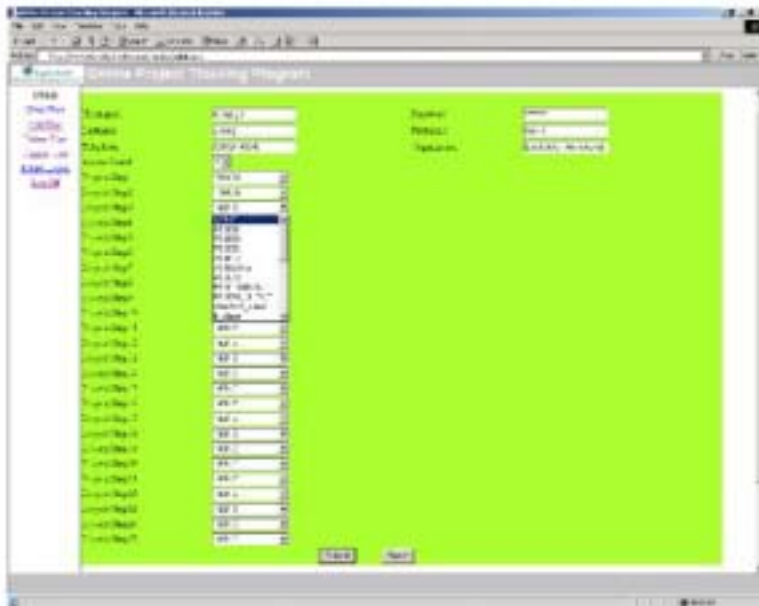


Figure 4 User Management Interface

PROJECTTRACKER offers many different standard GIS-specific functions to manipulate GIS data and project deliverables. This includes the option to zoom in and out, identify feature attributes, query data, perform analysis, and print maps.

- Production status and time spent updating

PROJECTTRACKER provides three flexible functions to update the production step status per spatial unit. A technician can use the first function to update an individual spatial unit, e.g. map sheet, lift, model or flight (figure 5). The second option is to update a group of geo-spatial elements by a

select box (figure 6). The third option allows an operator to update the status by locating a folder

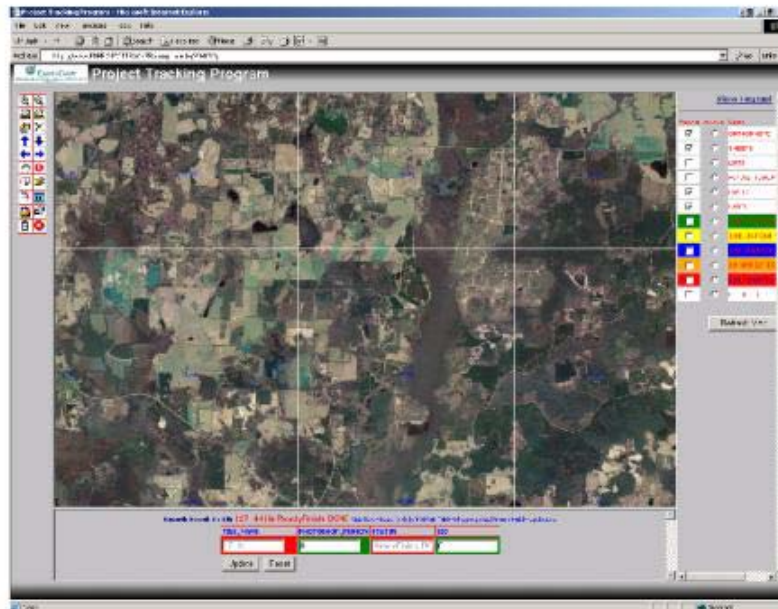


Figure 5 Individual Mapsheet Updating

storing map files. Because tiling index ID is a part of the map filenames, the system extracts the tile ID from the filenames and then automatically updates the step status for the map unit. This function

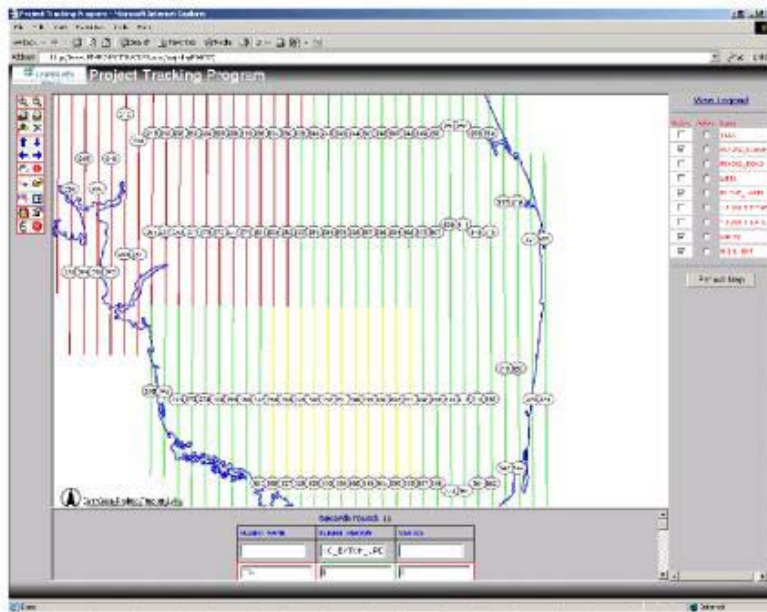


Figure 6 Updating a Group of Flight Lines

is very efficient for updating project status in batch mode (figure 7a, 7b).

- Workflow reporting control



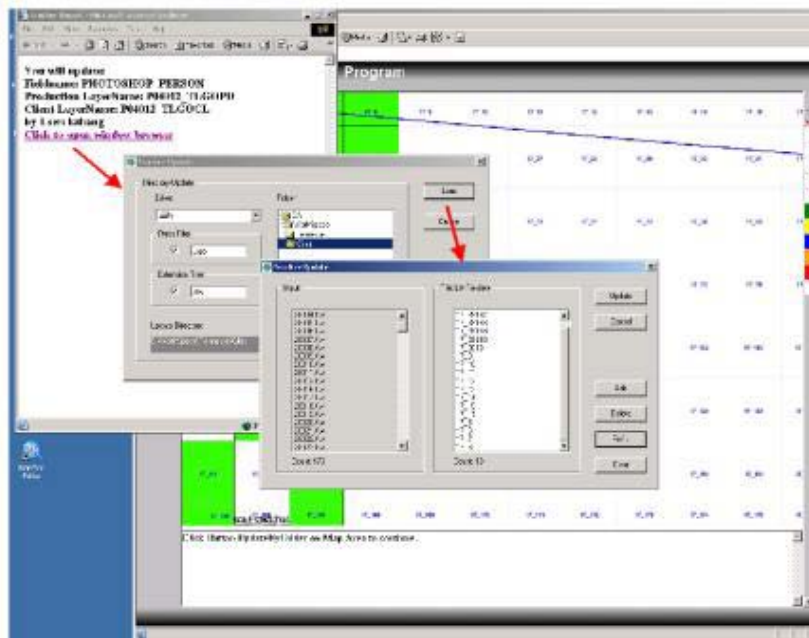


Figure 7a Updating Tiles by Locating a Folder

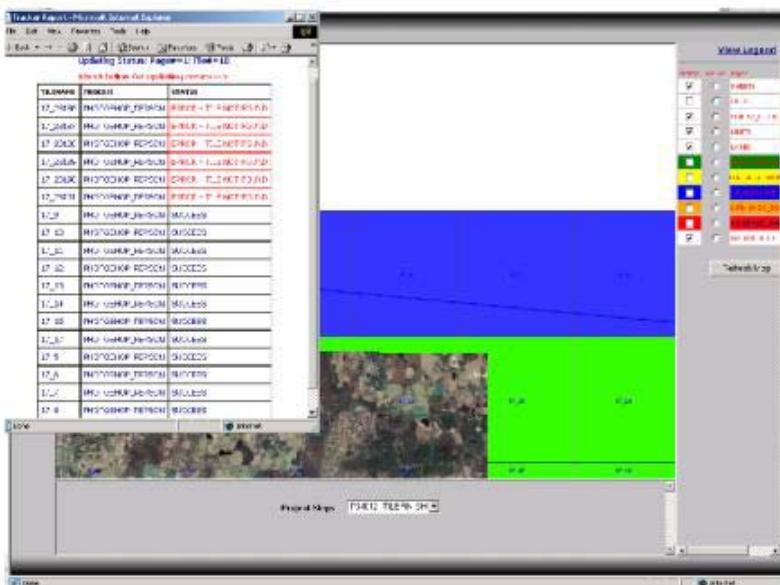


Figure 7b Updating Status Reporting

For interactive processing, the technician must first login to the PROJECTTRACKER system. He/she may then reserve the sheet(s) or lift(s) that are ready for the processing step(s) that he/she is responsible for. After a production step is completed, the operator triggers the system to flag the processing step as “DONE” for the associated map units (figure 8). The hours spent will be automatically attributed.

For updating, the following rules are set in order to minimize user errors:



- (1). Once a production step for a certain map unit has been reserved by an operator, all other operators are restricted access from the step and map unit. This ensures operators do not duplicate work efforts by working on the same dataset.
- (2). Once a processing step has been reserved by a user, only this user can complete the map unit and label it as “DONE”. This ensures data integrity.
- (3). Production processing steps are ordered in sequence. As a result, operators are not to work on a production step if a previous step has been completed. This ensures a production process will not be inadvertently overlooked.
- (4). Operators can not rewrite the hours spent once entered into the system. This ensures data integrity.

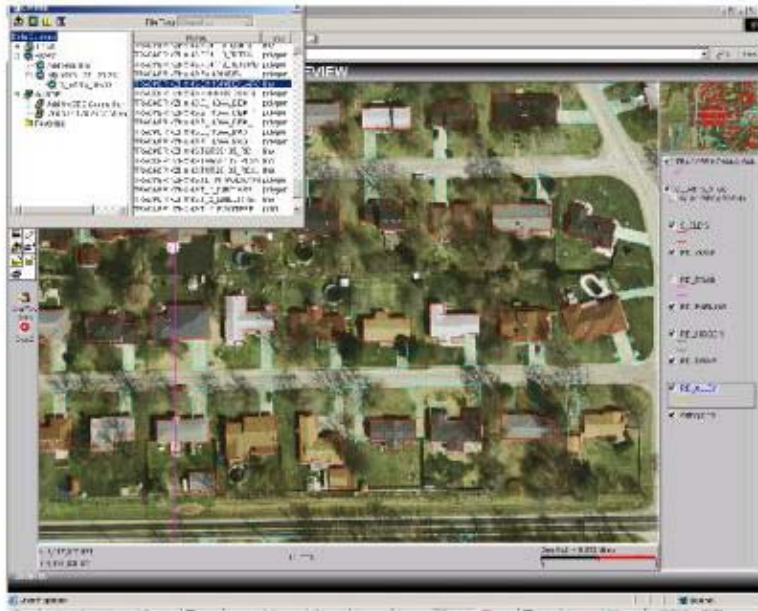


Figure 9 Products Online Review

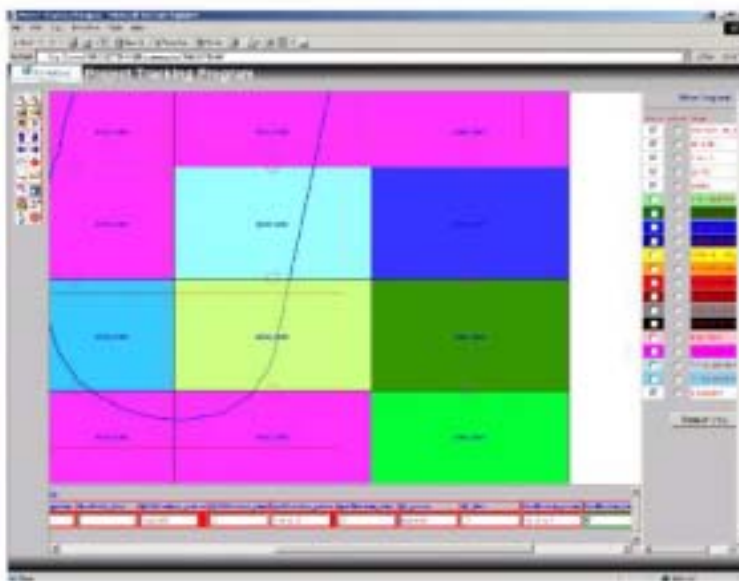


Figure 8 Workflow Reporting Control User Management Interface

- Client status updating

At the production level, the PROJECTTRACKER system provides a detailed set of processing steps required in the tracking process. EarthData clients, on the other hand, do not require the same level of detail and a more generic production status approach is adopted. As a result, for each type of project, it was necessary to design two tracking templates – one for production tracking and the other for client tracking. For instance, the production tracking status per lift for ISTAR ground orthos includes 16 steps – including ControlReady, AO, RO, Generate DSM, Edit DSM, etc. Client tracking for ISTAR projects includes only three main steps – AT, DSM and RECTIFY. It is important to note, client status is updated automatically when production-tracking status is updated. For example, when the technician updates a lift as “EditDSM\_DONE”, the client status for the tile will be automatically updated as “DSM\_DONE” for the client application.

- On-line quality control feedback

Since EarthData has centralized GIS project processing in an ArcSDE geodatabase, project leads can use a web browser to view and QC intermediary products of any processing step and send comments or notes to certain operators (figure 9).

- Project status overview

A function was designed to allow a project manager or production team lead to review project progress and status in a table.

- Project status and time-spent reporting

A function was developed to enable a manager to generate the Microsoft spreadsheet report of project status and time spent (figure 10).

- Collection and monitoring of performance metrics

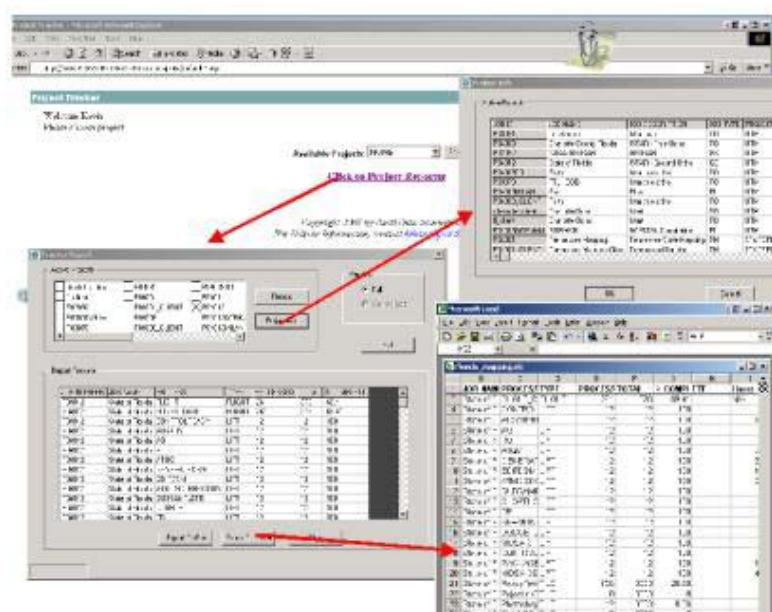


Figure 10 Project Status and Time-spent Reporting

#### 4.2.4. Client Level

In addition to the standard GIS view functions (figure 11, Figure 12), ESRI ArcIMS java viewer was applied to allow EarthData client(s) to review the products, e.g. orthophoto imagery or GIS vector data, and send the comments or editing note to EarthData (figure 9).

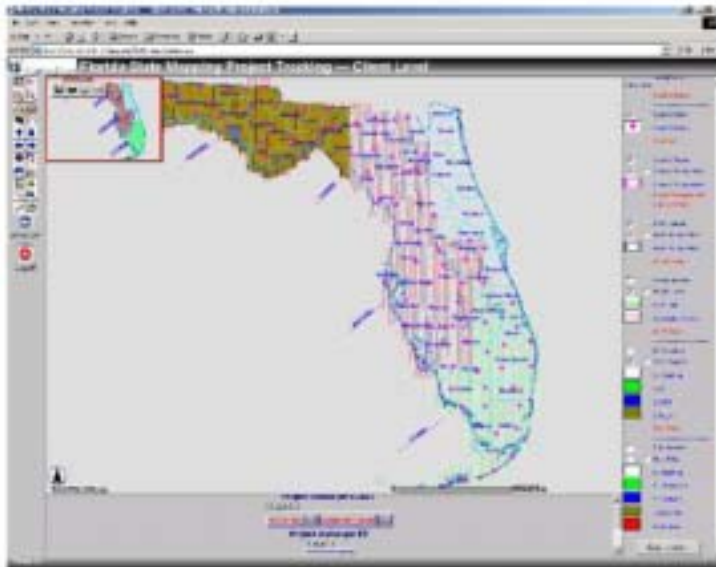


Figure 11 Florida Ortho Mapping Project Tracking

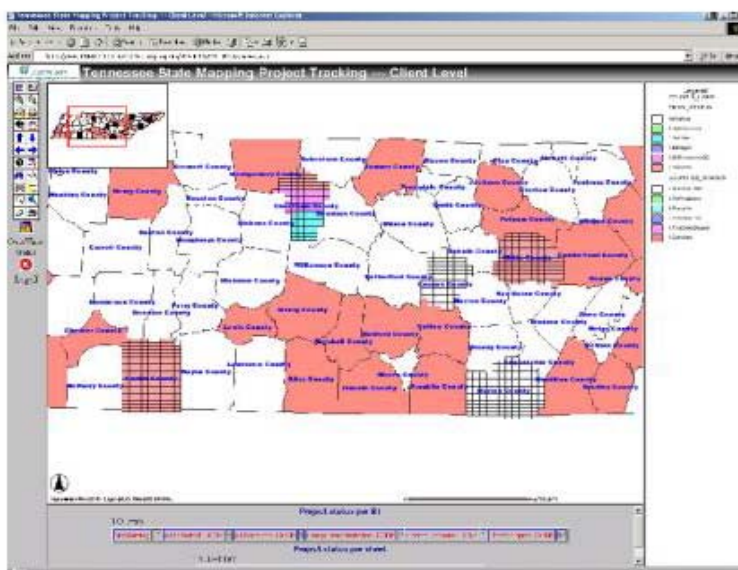


Figure 12 Tennessee State Mapping Project Tracking

## 5. FUTURE WORK

Additional enhancements are required to justify the implementation of EDPROJECTRACKER - Phase II using the ArcGIS server. More functions will be provided in the future, including:

- (1) Clients can monitor the entire production processing and all middle products when the image and GIS processing is centralized.

- (2) Clients can directly access GIS / image data via ArcGIS or ArcExplorer
- (3) Project status, performance metrics and workflow report will be automatically captured during the production processing when the entire processing is centralized.
- (4) As a project progresses from a tile environment to seamless environment, project tracking and production monitoring will become much more automatically.

## **6. CONCLUSION**

EarthData has successfully implemented a project tracking and production monitoring website for both EarthData clients and EarthData production team. This application has provided the following benefits, an improved production process with greater first-time-right delivery rates, improved production organization resulting in reduced management time. The use of this application has also resulted in a greater customer satisfaction by increasing their visibility on project progress, as well as better interaction through the ability to review deliverables and provide feedback at any time.

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