

DIGITAL IMAGE MANAGEMNET (DIM) PROGRAM: AN INTEROPERABLE WEB-BASED IMAGE MANAGEMENT SYSTEM

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ABSTRACT:

The use of digital imagery is ever increasing for resource applications due to enabling technology to integrate digital imagery with other land related digital data in a digital mapping environment or in a Geographic Information System (GIS). To support increasing demand for digital imagery, the Base Mapping and Geomatic Services Branch (BMGS) of the British Columbia Ministry of Sustainable Resource Management (MSRM), Canada initiated the Digital Image Management (DIM) program. The purpose of this program is to establish and maintain a semi-automated interoperable computer-based system to support the acquisition, management, discovery and web-based distribution of geographic digital imagery for the province of British Columbia, Canada. DIM will address the data management issues related to the capture and operations of a very large volume of geo-referenced raster based imagery and digital mapping products including but not limited to scanned aerial photos, orthophotos, satellite imagery, canned stereo models and DEM. DIM will establish a corporate, universal data access facility, commonly known as the "image discovery system", allowing all BC Government offices in Victoria, Regions and public users across Canada to access the orthophotos and land related digital products through Internet. The DIM design objective is to operate on the Internet using standard browser technology, is interoperable, utilizes standard computing hardware, is extensible, distributed, open and OGC and ISO compliant. The system provides access to the BC Government geo-referenced digital image data holdings from air-borne to space-borne data. All software components of DIM is Open GIS Consortium (OGC) compliant and in compliant with Land Resource Data Warehouse (LRDW) of MSRM. DIM will provide capability to download lossy compressed and or lossless data in a reasonable time without special software. The scope of this paper is to describe the system requirements and architecture for DIM. It will describe the process to evaluate a number of Standard Commercial Off-the-Shelf (SCOT) software components for both DIM system requirements and OGC/ISO compliance. The approach and technology used in this evaluation will be discussed in the paper. The study will concentrate on an interoperable and operational system to provide Internet access for digital images in British Columbia, Canada.

1. INTRODUCTION

The Ministry of Sustainable Resource Management (MSRM) was created in 2001 through the merging of resource management business areas from several different ministries. Multiple cultures, infrastructure, images as resource management tools and applications have come to the ministry to support integration of natural resources and business data. One of the key goals of MSRM is to integrate resource based information from multiple resource business data. Easy access to digital imagery is essential to delivery of this goal.

For this purpose, the Base Mapping and Geomatic Services (BMGS) of the Ministry of Sustainable Resource Management initiated the Digital Image Management (DIM) program in year 2001. The purpose of this program is to establish and maintain a semi-automated, computer-based system to support the acquisition, discovery, management, and distribution of geographic digital imagery for the Province of British Columbia, Canada. This corporate service is particularly important to MSRM, the Ministry of Forests, the Ministry of Water, Land and Air Protection, many external clients and the public. The goal of this program is to determine the technical and business requirements for management of a variety of digital image products; scanned photos, orthophotos, satellite imagery, DEM, etc. available at Base Mapping and Geomatic

Services, and to implement a Digital Image Management System to meet these requirements. The DIM program will:

- Address the data management issues related to the capture, management and operations of a very large data volume of geo-referenced, raster based imagery including scanned aerial photography, canned stereo models, orthophotos, and satellite imageries.
- Support the Terrain resource Information Management (TRIM) digital base mapping and forest inventory program by providing the efficient delivery and archiving of image data.
- Support the production, management and access of digital aerial photos.
- Establish a corporate, universal data access facility, commonly known as the " image discovery system " in industry, allowing British Columbia Governmnet including MSRM and WLAP in Victoria, Regions, and public users to access the digital orthophotos and imagery by providing on-line digital indexes of the available data.
- Enable integration of the digital imagery data into the corporate Land Resource Data Warehouse (LRDW).

2. DESIGN OBJECTIVES

The primary design objectives of the DIM system are such that:

- The entire system must operate on the Internet using standard browser technology.
- The system must provide access to the government digital image data holdings.
- Users should be able to download “original data “in a reasonable time without training or special software. (Note: large file sizes will be addressed through data compression and improved bandwidth.).
- The system must require minimal maintenance by network and system staff.
- The system must utilize standard computing hardware that can be easily integrated with existing services, equipment, and personnel.
- The system design must be extensible and based on Standard Off-the Shelf Software (SCOTS) when feasible.
- The system must work with the hardware and software that B.C. government currently uses to manage other geo-referenced data.
- The system must be able to deliver raster image data to a vast array of different client infrastructure and application environments.

3. SCOPE

The scope of the DIM program has not changed following the initiation of the program in year 2001. The re-structuring and amalgamation of BC resource ministries has had an effect on the alignment of the stakeholders and the potential for changes in the coordination of the delivery of the DIM program. The DIM program has been reconfigured into three phases to accommodate the broader corporate IT infrastructure of the BC Ministry of Sustainable Resource Management (MSRM) and to realize some short-term delivery successes. It should be noted that there would be many projects that are undertaken within each of the three phases. The three Phases are:

Phase I

Phase I included various activities, including a review and assessment of the data management and technical architecture requirements for digital imagery as well as recommendations for future development. There are a number of reports produced for this phase. They are:

- Data Management Architecture and Recommendations.
- Transition Strategy and Migration Plan.
- Current Assessment and Future Direction.
- Software Evaluation and Selection Criteria.
- Migration Strategy.

Each of these documents is available on the DIM program website at:

- <http://www.gov.bc.ca>

These reports are the primary references to the design objectives and the implementation of the DIM program for Base Mapping and Geomatic Services in

British Columbia. The content and direction outlined in these reports lays the foundation for the long-term structure of the DIM program. The design proposal was constrained by the Data Management Review documents for BMGS. Changes to BC government organization and IT architecture compelled a review and acceptance of the recommendations made in this report. The vetting of these reports has been rolled into Phase II to ensure consistency with the current re-architecture of the MSRM corporate IT infrastructure.

Phase II

The scope of Phase II includes:

- A governance model for the program.
- Prove of concept by the delivery of orthophotos to internal government desk top applications as short-term solutions to image access.
- Program plan for Phase III.

Phase III

The scope of Phase III includes:

- Long-term digital image delivery through Internet and integration into MSRM data warehousing.
- DIM program architecture consisting of image cataloguing, database management including imagery and metadata, software and hardware selection and acquisition, and access.
- Service delivery model.
- Ongoing program management and policy review issues.

Data Sources

The basic image data contained within the scope of the program will be from these sources:

- Digital raw imagery scanned from the aerial photography diapositives or predominantly the negatives.
- Orthophotography which are created from digital raw images that have undergone significant photogrammetric processing to create an “image map “.
- Satellite digital imagery, which are orthorectified, and raw satellite imagery such as, Landsat, IRS, IKONOS, SPOT, and Quick Bird.
- Digital Elevation Models (DEM).
- Stereo Models for Photogrammetric map productions.

4. DIM SOFTWARE COMPONENTS

The seven primary software components of the DIM program are as:

- Raster (Image) Management Applications.
- Raster (Image) File Access Server.
- Raster (Image) Discovery Application.
- Raster (Image) Order Placement and Fulfilment Application.
- OGC Compliant Web Feature service (WFS) Server.
- OGC Compliant Web Map service (WMS) Server.

- Raster (Image) Compression and decompression Software Tools.

Raster Product Management

The raster product management component will provide the functionality to manage the raster files (TIFF, GeoTIFF, ECW, MrSID, etc.), the metadata about the online (digital) and offline (negatives, etc.), metadata about collections (Air Photos, Satellite Imagery) of raster and other metadata (Flight Lines). The management applications should manage both the metadata and the files as a single asset within the management system. Additionally, this component must publish raster and metadata to the Land Resource Data Warehouse (LRDW).

This functionality shall be implemented as a custom extension of the existing BMGS Air Photo System to support the raster files and other types of raster metadata.

Raster File Access

The raster file access component of the DIM system will provide the functionality for clients to access the raster in the DIM system over the Internet. The file access server should provide functionality to access the entire original raster, a portion of the raster or a resized portion of the raster. It must also support and/or integrate the security functionality from the Raster Order Placement and Fulfilment component.

Raster Discovery

The raster discovery component will provide the facilities to enable users to search for raster products using a spatial and metadata filter. Image metadata will be developed according to ISO/TC211 standards. The result should be displayed as a list and an option to display the photo centres and footprints on the index map. The discovery application should also include an index map that displays the base map of BC and should also support connection to an OGC Map service to get the layers for display.

Raster Order Placement and Fulfilment

The raster order placement and fulfilment component will provide shopping cart functionality for the raster discovery application in order to add products to a user's order. The component should also provide a pricing service for the products and online/offline order fulfilment and workflow.

Requirements

The DIM system and its components have the following common requirements:

- Meets all system requirements as detailed in the DIM System requirements document available on the DIM web site.
- Meets all applicable MSRM standards. MSRM standards are available at: <http://srmwww.gov.bc.ca/imb/3star/index.html>.
- Performance, functional, and system requirements are proven through adequate system, integration, and regression testing.

5. CONCLUDING REMARKS

The Digital image Management program will provide a managed environment for storing and accessing raster data on an ongoing basis. Data types of principal interest include aerial photographs, satellite imagery, digital elevation models, and a variety of derived products from these fundamental data sources. In addition to these diverse raster data sets, DIM will handle the corresponding ISO/TC211 standard metadata. Many users will benefit from a simplification of business processes that make use of such raster data now, or potentially could in the future.

British Columbia has been a leader internationally in the use of aerial photography beginning in the 1940s. Since the early 1980s the same has been true of its use of satellite imagery. More recently with the Terrain Resource Information Management (TRIM) program, British Columbia has emerged in the forefront of digital aerial photography. The overall justification for this sixty year endeavour has been the tremendous benefit that such data provides to a large variety of resource and socioeconomic applications. Because BC is so large (95 million hectares) and so varied, because the land is owned predominantly by the Crown, and because the population is so small relative to the land base, digital mapping and digital imagery have played a particularly significant role in managing the Province.

A number of reasons exist for pursuing the DIM program at this time. These include the following:

- Duplication of specific image files and of image stores in general will be eliminated.
- The online orthophoto mosaic (built as part of the initial work on DIM) will be extended to accommodate all current orthophotography, thereby increasing its relevance to many users interested in the new data.
- Increased number of data types will be supported, with new types to include satellite imagery and stereo pairs.
- Metadata will be put into place to facilitate exploration and access by managers and users alike.
- An update process will be built that will allow for new raster data, and its corresponding metadata, to be added readily to the DIM system.
- Dynamic generation of derived imagery will support resampling and reprojection, thus eliminating the need to store multiple versions of the same data at different resolutions and in different projections.
- The access time to raster data will decrease measurably because of higher performance software, thus improving the user experience.
- Off-loading raster data from the ArcIMS application will lead to better performance with the vector data that ArcIMS serves.

All of the above will lead to an effective management process, able to handle ongoing maintenance, while improving accessibility to a variety of users both within and outside of government. The DIM system will also help ensure that the huge investment that the Province has made in raster data will be managed appropriately on an ongoing basis. Finally, a number of capabilities that could only be handled clumsily, if at all, will be realistic to carry out for DIM users.

By following through with the full construction of DIM, the Ministry will be able to meet its mandate to manage raster data on behalf of all provincial agencies. Right now BMGS has produced specifications for DIM data and continues to receive data from other Ministries. However, its ability to manage such data needs to be greatly improved to meet the ongoing business needs of government associated with fire protection, emergency response, forest management, regional and local planning, treaty negotiation, cross-border interaction, and the like. The DIM program will provide us with the necessary mechanism to meet these needs.

6. REFERENCES

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