

Geomatica GeoCapacity Information Systems



A PCI Geomatics White Paper

October 2006

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1. Introduction

Traditional methods for generating geo-information products from large quantities of remote sensing images are too often limited by production inefficiencies and long to-market cycles. PCI Geomatics' enterprise solution to these challenges is a customizable, cost-effective **GeoCapacity Information System (GCIS)** powered by automation technology aimed at large-scale, production-oriented geo-information creation – helping users make intelligent business decisions.

A GCIS is a complete geospatial solution combining users, data, and technology. Built on PCI's open and proven Geomatica® platform and enterprise database technology (Oracle 10g Spatial), componentized geospatial tasks can be chained together along with interface, delivery, and job-control processes.

Leveraging existing expertise, a GCIS can exploit all of your applications' geospatial data types, including satellite, GIS, photogrammetry, vector, tabular, and cadastre data. Beyond the task of integrating or fusing multiple data types, a GCIS automates many image and data processing tasks, improving interoperability, data management, and cost of ownership.

A standards-based web-services delivery model is one of a number of options to spatially enable your existing applications or create new geo-information product lines.

PCI Geomatics, a world leader in the development of geospatial software specializing in remote sensing, digital photogrammetry, spatial analysis, cartographic production, and fully automated production systems, is an innovative developer of image-centric geospatial solutions that provide answers to real-world questions using satellite images, aerial images, and other geospatial data. In short, we turn geospatial data into information.

"We're proud to have supported PCI Geomatics in the development of their first GeoCapacity Information System – the Mapping Centre. PCI's leading image-centric geomatics solutions combined with the Oracle 10g Spatial GeoRaster data management platform provide robust, scalable, secure geospatial solutions that truly empower the enterprise. We look forward to our future together, and are pleased that PCI has selected Oracle as their exclusive partner of choice."

Jack Pellicci
Brigadier General, US Army (Ret.)
Group VP, Business Development
Oracle North American Public Sector

2. How a GCIS reduces the cost of creating geo-information products

With more imagery available than ever before, there is rising global demand for accurate, up to date, and standards-based digital maps for use in governance, industrial development, and commercial services. Moreover, many organizations are demanding extremely high volumes of data and near real-time delivery.

To meet these geo-spatial market pressures, PCI Geomatics has developed a turnkey GCIS capable of providing a large production-oriented solution comprised of hardware and integrated software tools that manipulate digital geographic information. The system streams manual and automated processes that can deliver a variety of information products to help users make intelligent decisions in a specific geomatics field. Examples of application areas include mapping, disaster management, and environmental monitoring.

PCI Geomatics can customize and assemble a cost effective GCIS with integrated standards-based software supplied by a single vendor to meet a customer's specific spatial information production needs. A GCIS so designed can add significant value to your organization's existing infrastructure and provide increased production capacity.

A customized, image-centric GCIS can improve the efficiency of creating geo-information products by

- Taking advantage of rapidly changing technologies to deliver just-in-time mapping and the associated cost savings
- Reducing administrative overhead and increasing the production rate of geospatial information by automating repetitive processes through a fully integrated job control system
- Processing large volumes (terabytes) of geospatial data assisted by highly automated fusion of multiple data types
- Fully integrating open, standards-based, and automated imagery analysis with existing geo-spatial data infrastructure and business processes
- Leveraging existing investments in software and imagery by integrating a variety of software
- Facilitating horizontal and vertical information dissemination by delivering custom images and topographic maps through the Web or e-mail.
- Incorporating easily extendable solution workflows and processes to deliver new products

A GCIS lets you connect your business to an important new information ideology, keep current with new technologies, and add spatial knowledge to your areas of expertise.

3. Characteristics of a GCIS

A cost-effective GCIS, customized to meet specific information production needs, takes advantage of standards-based PCI Geomatics and third party technology that delivers your critical application and geospatial information reliably from a secure portal to anywhere in the world. It lets you add geospatial relevance to your current applications and expand the functionality of your existing information delivery system. A wide variety of functions for GIS, remote sensing, image processing, photogrammetry, and cartography can be incorporated into a GCIS (Figure 1).

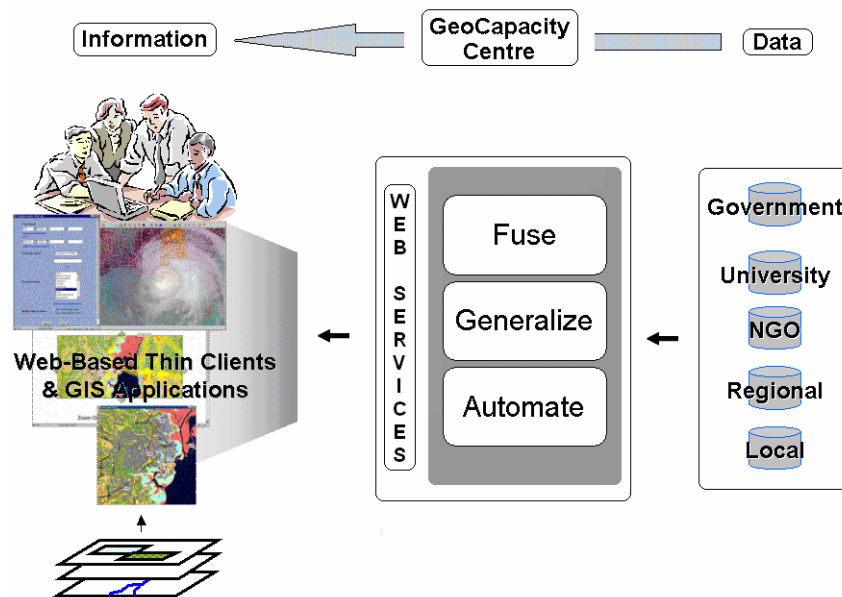


Figure 1 – Functions of a generic GCIS

Key Features

- **Componentized** – Independent building blocks that can be configured in a variety of ways to constitute a flexible architecture; lets you add components as workflow and processing requirements change.
- **Scalable with high level of performance** – Allows for a variety of hardware and software configurations to increase capability by easily adding or replacing hardware and software.
- **Compatible with multiple operating systems and industry standard hardware** – A GCIS allows for a mix of hardware and operating systems. Built using common operating systems, workstations, multiple CPU servers, raid disk subsystems, gigabit networks, and raid disk storage. All components are standard off-the-shelf systems.
- **Enterprise database** – For data storage of all or part of the data and data products. The enterprise database supports SQL, spatial data (both vector and raster), and XML archiving, backup, versioning, and concurrent access.
- **Security** – Supplied by the operating system, features in the Enterprise Database, firewalls, third party products, and the custom structures for each GCIS. Three levels of

data access, full access (all data), limited access (a subset of data), and no access, are enforced by OGC Web access.

- **Metadata capabilities** – Handles metadata in a flexible, extensible, and open manner. Metadata is stored in an SQL database with reliance on XML. The standardization of digital geographic information is supported through ISO 19115 and ISO 19139. To ensure that geographic information and services are supported across any network, application, and platform, a GCIS supports the OGC standard OWS, which includes WMS, WFS, WVS, and WPS.
- **Integration with clients' existing IT infrastructure** – Ability to interact with third party software, such as ESRI. Some third party systems, such as Oracle®, are tightly integrated, but the system is flexible enough to incorporate new software in a loosely coupled manner (e.g. data exchange through common file formats or binding using a scripting language).

On the infrastructure level, a GCIS is able to run on the Microsoft® Windows®, Linux®, and UNIX® operating systems. It provides Oracle GeoRaster and GeoVector storage based on the J2EE™ platform. PCI Geomatics GCIS is also compatible with .NET-based software.

On the application level, a GCIS is compatible with ISO 19115/19139-powered products and OGC-standard web services such as Web Map Service, Web Feature Service, Web Coverage Service, Web Processing Service, and OGC Catalog Service.

- **Web enabled** – Data and data products can be accessed or distributed over the web through OGC-compliant web services suite and third-party partner solution eSpatial iSMART.
- **Highly customizable** – Rapidly link modules and components together to create new configurations, workflows, and production lines.
- **Extensible** – PCI and other third parties can integrate new GCIS-standard compatible features and extensions.
- **High levels of automation** – Incorporates cross-level automation, including a Job Control System (JCS), which accepts, runs, and manages jobs, and is based on industry standard enterprise tools that are the scripts and programs processing data and creating products. It also includes automated workflows for image-centric processing, such as an image correction system for satellite and airborne images.
- **Multi-user capabilities** – Depending on clients needs, a system can range from fully automatic to hundreds of interactive users.
- **Standards and interoperability** – These are key aspects to integrating GCIS into existing environments and interacting with other spatial and non-spatial infrastructures, such as CubeWerx web services, Ionics web services, and Syntell 4i.

4. GCIS technology

The specific technologies used to build a GCIS depend on the client's workflows and process requirements. A GCIS can include base platform PCI technology, Oracle 10g relational database management system, GCIS reusable modules, third party software, and GCIS-specific custom scripting (Figure 2).

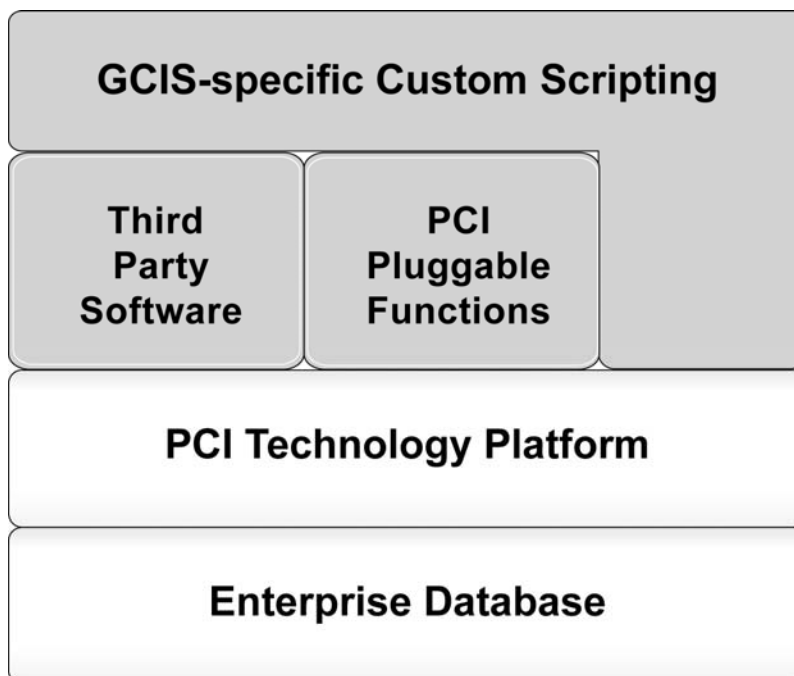


Figure 2 – Schematic of generic GCIS configuration

4.1 GCIS components

Tailored specifically to the customer's geo-information production needs, a GCIS can include any of the following components:

PCI technology – OGC web servers, OrthoEngine technology, Oracle support, GDB support, and Geomatica[®] 10 and its architecture are the basis of the PCI Technology Platform. Geomatica technology has been greatly enhanced and improved to meet GCIS needs.

Oracle 10g relational database – Oracle 10g is the world's leading enterprise database management system. It is scalable for easy addition of processing power, and contains extensions for geo-coded vector and raster data types and ensures simplified, repeatable management of extensive data sets. It supports versioning, archiving, backup, and data level security and includes useful features such as grid computing and development aids. Supported worldwide, Oracle is the industry standard database management system.

PCI Pluggable Functions – GCIS reusable modules are specifically designed to supply common processing capabilities within a GCIS. An example of a reusable module is an

automatic image correction subsystem. Choose from the dozens of PCI pluggable functions, or PCI can create customized functions for your specific needs.

Third-party software – Third party software can be incorporated as required to supply complementary functionality. Examples of supported third-party software include ESRI, for GIS functionality; eSpatial iSMART, for advanced web editing and delivery; Xi-Batch, for batch processing; and Socet Set, for 3D stereo photogrammetry.

GCIS custom scripting – Binds all third party software, specific user interface requirements, GCIS reusable modules, and the PCI pluggable functions components together to create process flows, automation and user interfaces specific to a particular GCIS.

Python scripting language – Python is a powerful, popular, cross-platform, open-source scripting language. GUI building tools and a variety of extensions are available.

OGC-compliant Web services – Access and distribution of data and products over the web is based on OGC compliant Web Server products.

Windows, Linux, and Solaris Operating Systems – Windows, Linux, and Solaris™ operating systems are supported – in fact, it is possible to use a combination of operating systems within a single GCIS. Several Linux versions are supported.

"Earth Satellite customers demand high accuracy from our image products. We have consistently been able to deliver high-accuracy orthos and mosaics using PCI OrthoEngine technology. The PCI models support a wide variety of sensors, and save us considerable time and expense through automation. We're very happy with our investment in PCI Geomatics software."

Chris Peterson
VP of Information Technology and CTO,
MDA Federal Inc. (Formerly Earth Satellite)

4.2 GCIS compatible data classes

Geospatial Data – A GCIS can process a variety of geographical information, such as satellite imagery, GIS data, photogrammetric data, vector data, and cadastral data. PCI Geomatics' Generic Database (GDB) technology makes it possible to view and process a large variety of geospatial data and to accommodate the storage, retrieval, processing, archiving, and security of a number of data classes.

Metadata – Stores information about the identity, origin, and/or condition of the data that are the focus of the system.

- **Geospatial metadata** – Image metadata can include georeferencing information and the time of acquisition.
- **Production metadata** – GCIS systems are production systems that apply processing on geospatial data. As such, information about which process was run, the parameters used, and the user who requested it are crucial for adequate tracking of the production line. Production metadata answers the question, "What was the process that produced this data?"

System data – Data about the GCIS system.

- **Process Definition Data** – Data used by the system to implement a process flow. This information describes what services are required and how they interact with each other.

- **System Configuration** – Information used by the system to function adequately. This data can include the configuration, the computing resources available in the network, or the user name, password, and privileges of each person with access to the system.
- **Exploitation data** – Data produced during the exploitation phase of the system. Exploitation data includes information such as requests for work, history, logging, and error reporting.

5. Example applications of a GCIS

PCI Geomatics can assemble a customized GCIS for a variety of application areas benefiting from map product archiving and management, map product server for web portals, and decision support systems, among others. Examples of application areas include (but are not limited to):

- Automated map generation for governments
- Geospatial image management for the enterprise
- Water resources management
- Land use planning
- Natural hazards mitigation
- Climate change
- Coastal zone management
- Disaster management

“The Mapping Centre automates many important map-creation tasks, thereby improving interoperability, data management and cost of ownership. Integrated systems from PCI Geomatics, Oracle and third-party vendors make it possible to deliver critical map information quickly, efficiently, and securely.”

Dr. Robert Moses
President and CEO
PCI Geomatics

5.1 GCIS for automated map generation: The Mapping Centre

In response to requests from the Canadian government, PCI Geomatics has created GeoCapacity Information systems for Natural Resources Canada (NRCan) and Agriculture and Agri-Food Canada (AAFC). Both applications required the creation of an automated map generation system: the Mapping Centre.

The Mapping Centre reduces image-processing and map-generation time from days to minutes. Using PCI functions, an Oracle enterprise database, and complementary 3rd-party technologies, the GCIS approach allows the Mapping Centre to achieve such stunning efficiency.

After the data and its metadata are loaded into an Oracle 10g Spatial database, preprocessing tasks, such as orthorectification, are automatically performed by PCI Geomatics technology on the raw images and are stored in the same database.

When a request is submitted to the Mapping Centre for a certain type of map, such as a pan-sharpened image of a particular area, the Mapping Centre retrieves the preloaded image from the database. The image is automatically pan-sharpened by PCI Geomatics technology and is

then displayed to the client in minutes. The processed image can then be shared on the Web using eSpatial's iSMART technology or the Geomatica web coverage service (WCS).

For the analysts at NRCan, the Mapping Centre answers the need to update vast national coverages, quickly disseminate critical information, and meet the demands of dozens of applications without building and maintaining dozens of mapping systems.

For analysts at AAFC, the Mapping Centre is designed to monitor agricultural land use, in terms of acres in crop versus acres in fallow, and to determine methods to spend less money on fertilizer, maximize crop yield, and select the best fields in which to plant a particular crop. In addition, automatic image classification has allowed AAFC more time to analyze results, while automatic change detection reports allow quick comparisons of land cover changes over a series of years.

5.2 GCIS for enterprise image data management: GIMS

The increasing use of geospatial data in today's daily planning and decision-making workflows has brought about an influx of imagery to various industries. This influx has created the need for a better image management solution. The Geomatica Image Management System (GIMS) provides:

- Better storage methods for handling large amounts of data
- Rapid image processing capabilities
- Efficient and effective means of sharing and retrieving data
- Support for terabytes of geospatial data that can be accessed by users worldwide
- Access to the right software tools and application environments to view, manipulate, process, and analyze geospatial data

Traditional methods of image management have become costly and difficult to administer. These methods can no longer keep up with the size, abundance, and time-sensitive requirements of today's geospatial data. Instead of storing the data in one central location, these methods store data in multiple forms of media, such as hard copy, CD, DVD, laptops, multiple servers, and binary large objects (BLOBS). Consequently, the efficiency of an enterprise is limited, because images become difficult to manage, access, and store with other geospatial and non-geospatial data.

PCI Geomatics has overcome the challenges caused by the traditional raster image management methods with its enterprise solution: the Geomatica Image Management System (GIMS). With 25 years of experience in building image-centric geospatial solutions, PCI Geomatics can deliver a GIMS solution for any enterprise that manages and distributes geospatial imagery.

Thanks to its open architectural concept, GIMS allows specific components to be added as required. This modular framework allows you to implement GIMS efficiently, with minimal disruption to your existing internal systems.

5.3 GCIS for water resource management

The purpose of this GCIS is to provide information that can deliver more interactive feedback to farmers thus permitting more effective land management. The first step towards this goal is the creation of a riparian management system to monitor the environmental buffer zone between crop borders, cattle sheds, and nearby riverbanks.

A GCIS deployed in this example application area must be able to:

- Continually map remote areas using a scale range of 1:100,000 to 1:1,000,000 using satellite imagery and provide topographic and image mapping capabilities.
- Generate and maintain the latest satellite imagery, in geometrically corrected form, for remote areas while maintaining an on-line archive of historic imagery of the region.
- Provide special purpose products for government agencies upon request.
- Be the official government OGC standard web source for 1:100,000 to 1:1,000,000 scale topographic information including recent and historic geo-coded imagery for the region.

The above-listed tasks are accomplished by the following GCIS reusable modules

- **Image Correction System (ICS)** - Automates the processing and preparation of remote sensing imagery (orthorectification, pansharpening, and so on.)
- **Map Generation System (MGS)** - Automated map generation based on user requirements and national mapping standards.
- **Feature Extraction System (FES)** - Interactive feature extraction/updating of topographic features from satellite imagery.
- **Web Services System (WSS)** - Based on Open GeoSpatial Consortium (OGC) standards, enables the exchange of spatial data from anywhere, to anyone.
- **Job Control System (JCS)** - provides the tools to define, execute, and monitor jobs from the above four systems automatically.
- **Land Cover Extraction System (LCES)** – Automated land cover extraction of raster data.

6. GCIS enterprise services

PCI's Professional Services department can work with a client to produce an automated GCIS specifically tailored to your spatial information production. Designed for the client's specific requirements, these solutions are built upon a flexible and standards-based architecture.

With a commitment to open standards and interoperability, customized systems can incorporate PCI's Geomatica Webserver technology, imaging and mapping programs, and interface with third party software applications. PCI Geomatics value-added services extend GCIS technology through:

- Customized training
- Application consulting
- Implementation services
- Product customization
- Development of custom workflows
- Knowledge transfer
- Geomatics value-added consulting
- Project scoping and management

7. Summary

Increasingly, geo-information products based on large quantities of remote sensing images need to be generated cheaper, faster, and better. In response to this geo-spatial market demand, PCI Geomatics has developed a GeoCapacity Information System enterprise solution powered by open, standards-based, and easy-to-scale automation technology aimed at large-scale, production-oriented, geo-information creation – helping your organization make intelligent business decisions.

About PCI Geomatics

PCI Geomatics is a world-leading developer of geospatial software, specializing in remote sensing, digital photogrammetry, spatial analysis, cartographic production, and, more recently, automated production systems. Today, with our trusted Geomatica brand, PCI Geomatics provides all the image-centric solutions necessary to meet the expectations of a large and expanding industry. Since 1982, the company and its reputation have continued to grow as a result of innovative leadership, strong technology partnerships, active geomatics community involvement, and a dedication to earn the trust of customers who use PCI Geomatics technology.

For more information, visit www.pcigeomatics.com.



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