Reliable Geological and Minerals Management Systems – A Precondition for Mining Sector Development

Case Studies from Selected African Geological Surveys

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AfricaGIS 2017

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Data is Money ?

- **Billions of Dollars** were spent for mineral resources and geological exploration
- **Data** is stored as paper files & different data formats
- **Data** is the key issue for:
  - mining investment attraction
  - national development
  - land use and infrastructure planning
  - environmental protection
  - geo-hazard prevention
  - forestry, water management

Data is money !

Investor's Expectations Regarding Data

Minerals ?

Geological framework ?

Political framework ?

Decision making processes, licensing procedures ?

Taxation?

Infrastructure ?

Working forces ?

Opportunities / prospects ?

- What data is available ?
- How to get it ?
- How much does it cost ?
- How long does it take ?
- What format is it ?

Data availability is the key factor

How to Make Data Available ?

- Have data „on stock“
- Centralise data management
- Standardize data structures and coding
- Have instruments for data distribution
- Regulations for data release/ usage
- Guarantee data security
- Prevent loss of data

Information management systems (IMS)
are the key instrument
to make data available

Case Study Locations

Ghana:

2005 – 2007
EU funded

Namibia:

2001 – 2017
national MDF funded

Uganda:

2007 – 2012
WB funded

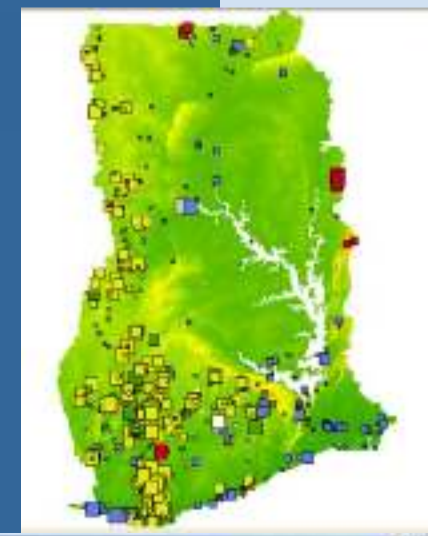
Tanzania:

2013 – 2016
WB funded

Case History 1: IMS Ghana - Facts

- **Task:**
  - Interconnect five Mining Sector institutions
  - Implement central database and GIS: deposits, mining reports, mining cadastre, geophysical, geochemical data, reports, documents, maps,...
  - Provide training and support
- **Starting point 2005:**
  - separated ACCESS databases and ArcView 3.2 applications
- **Situation in 2012:**
  - IMS is running at GSD and MC
  - Maintenance of hard and software required

    (the level of the system is 2006)



Case History 1: IMS Ghana – Benefits & Lessons

- **Mining sector data centralised**
  - all mineral licenses
  - 900 mineral occurrences
  - 4200 documents (incl. bulletins, reports,…)
  - 1000 samples
  - Airborne geophysical data
  - All 126 geological maps
- **User friendly interfaces implemented**
- **Bad infrastructure damages the system**
  - power shortages, climate (hot, humid)
  - no reliable Internet (in 2006-2009)
  - low quality communication masts
- **Very high expectations**
  - interconnect all branches... to a centralised system...
  - create a unified system for five institutions:
    - geo-scientific data, mining data, cadastral data, mineral trade data

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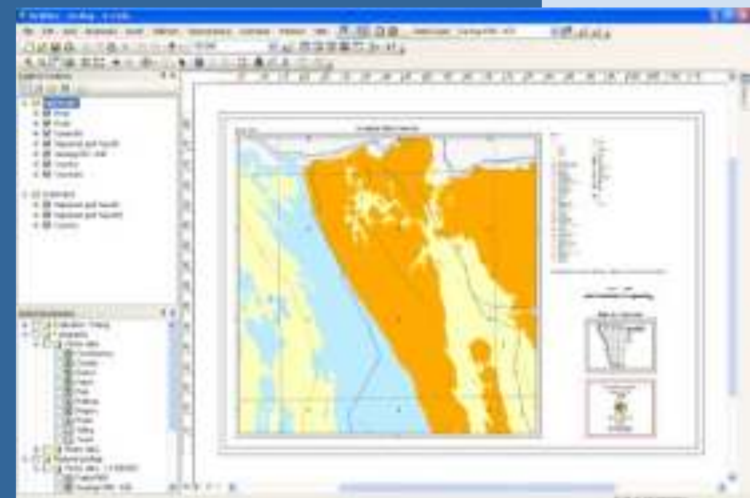
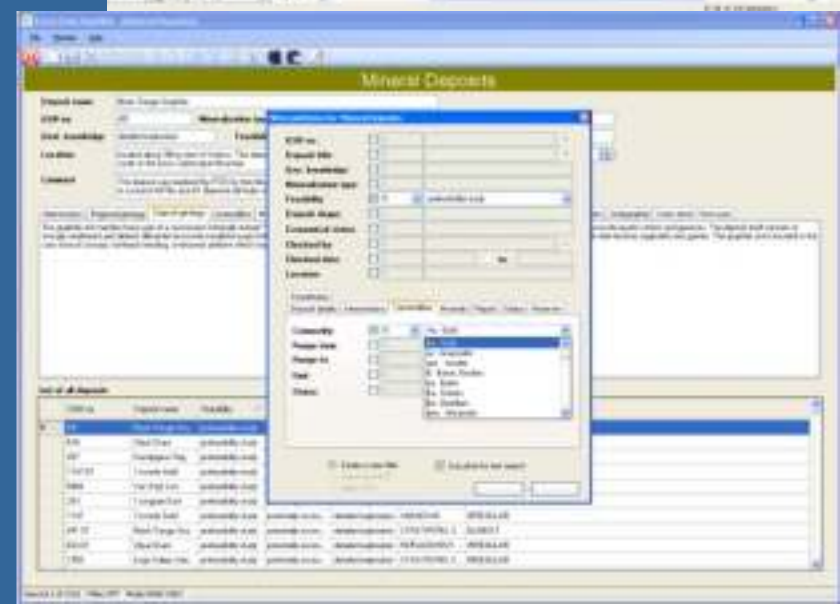
Case History 2: Earth Data Namibia – Facts

- **Starting point in 2000:**
  - separated ACCESS and GIS applications (ArcView 3.2)
- **2003:**
  - centralised system implemented (ORACLE, ArcView 3.3)
- **2012:**
  - Database and GIS upgraded (SQL 2010, ArcMap 10.0)
  - System is maintained continuously
  - Interactive web site implemented
  - Data capture is ongoing
- **2016- 2017:**
  - Field data capture module implemented

Case History 2: Earth Data Namibia – Benefits & Lessons

- **Geological sector data centralised, cadastral data taken from the mining cadastre**
- **User friendly database & GIS**
- **Stakeholder involvement from the beginning → broad support**
- **Continuous maintenance very helpful**
  - Infrastructure: server & workstations
  - system software, application software
  - ongoing data capture
- **Problems**
  - qualified IT staff
  - personnel for data capture



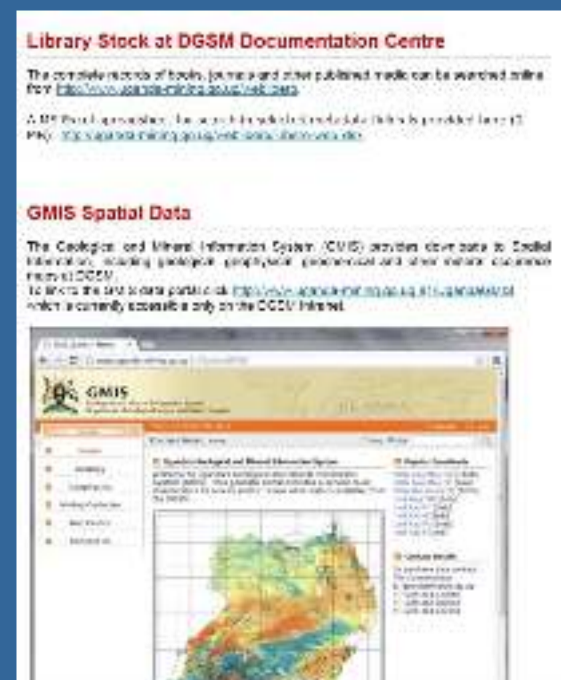


Case History 3: DGSM Uganda - Facts

- **Starting point:** no database, paper files, AUTOCAD data
- **Task:**
  - create local IT infrastructure
  - create the documents IMS
  - implement the GIS
  - implement the Mining Cadastre
- **Final situation in 2012:**
  - Archive upgraded
  - IT infrastructure upgraded
  - Several databases and GIS created
  - Hardware, infrastructure, training provided

Case History 3: IMS Uganda – Benefits and Lessons

- **Geological archive/ maps digitised completely**
  - **Metadata of books/Journals: 24,000 (MARC Standard)**
  - **Scanned documents: 8,700**
  - **Geological maps data**
  - **Geophysical data**
  - **Cadastral data**
- **System centralised**
- **Data available: LAN, Internet**
- **System at a high technical level**
- **Problems:**
  - Too long implementation time
  - Fluctuation of personnel



Case History 4: Tanzania - Background

Provision of Consulting Services for Preparation of Geoscientific Data Information Management System

Beneficiary:

Ministry of Energy and Minerals

Geological Survey of Tanzania

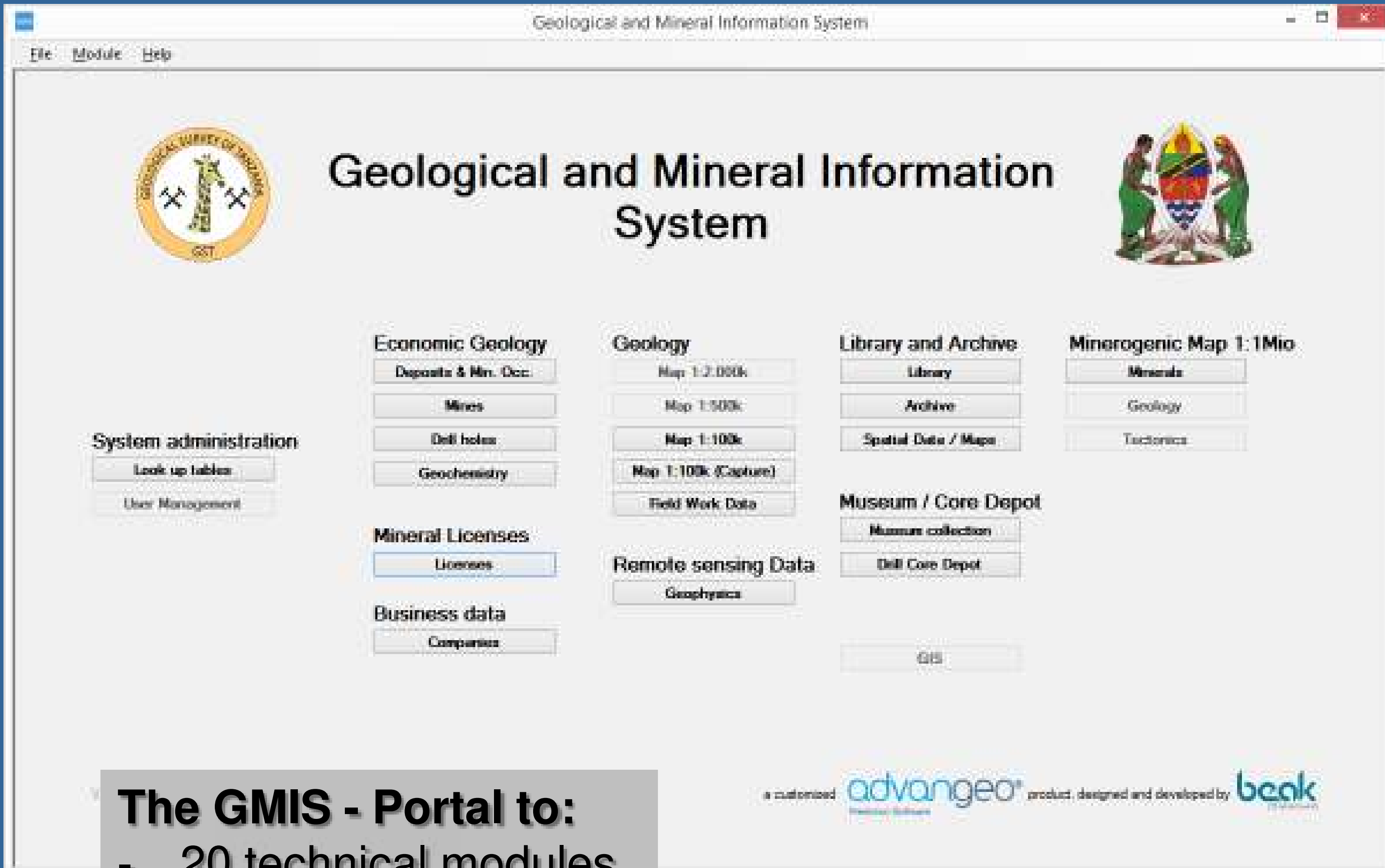
- IT Infrastructure
- **GMIS Design and Implementation**
- 60 QDS Map Sheets
- Minerogenic Map
- Data Dissemination Policy
- Library and Archive
- Museum, Rock Store and Core Depot
- Investment Promotion
- Remote Sensing Unit
- Training

Project Team

Case History 4: Tanzania – Previous Existing Situation

- Information on paper: reports, books, maps,…
- Stand alone databases: minerals, library metadata
- Start of Geological Map digitisation

Case History 4: Tanzania – Database Interface



The GMIS - Portal to:

- 20 technical modules
- System administration
- GIS module

Case History 4: Tanzania – Data Access Policy

Data freely accessible for the public:

- All metadata (library, archive, spatial data)
- Low resolution data, i.e. maps and data 1:1M (deposits/occurrences, geology, geophysics)

Data accessible for the public for a fee:

- High resolution data (geology, geophysics)

Confidential data:

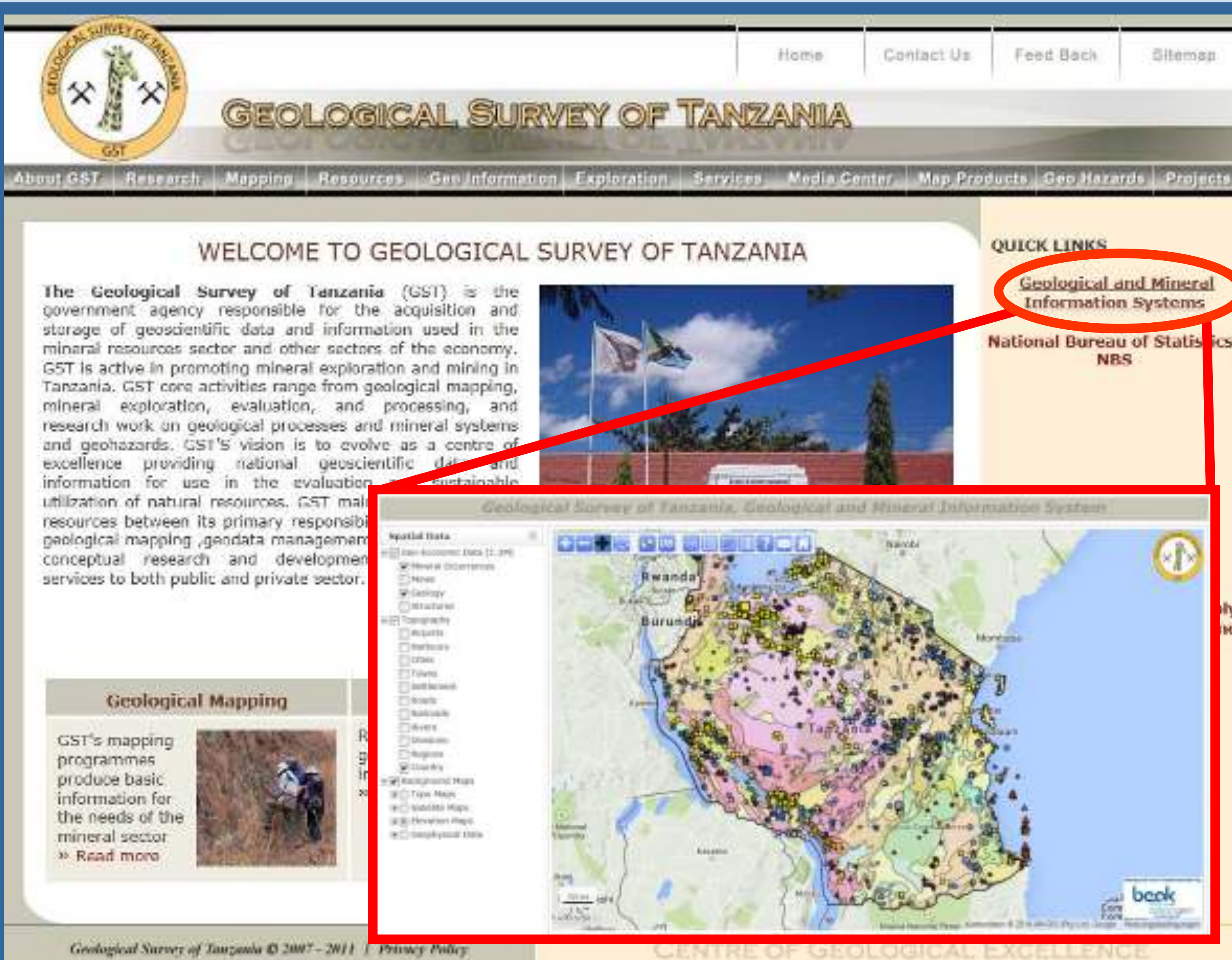
- Ongoing private projects

Case History 4: Tanzania – Public Web Site

- Developed with open source (no license costs)
- Hosted by Beak
- Including topographic background information, e.g.
  - Topographic map 1:1 M
  - Open source background images (Google Earth, OpenStreetMap…)
  - Vector data from Ministry of Lands
- Low-resolution thematic data:
  - Geology
  - Geophysics
  - Minerals

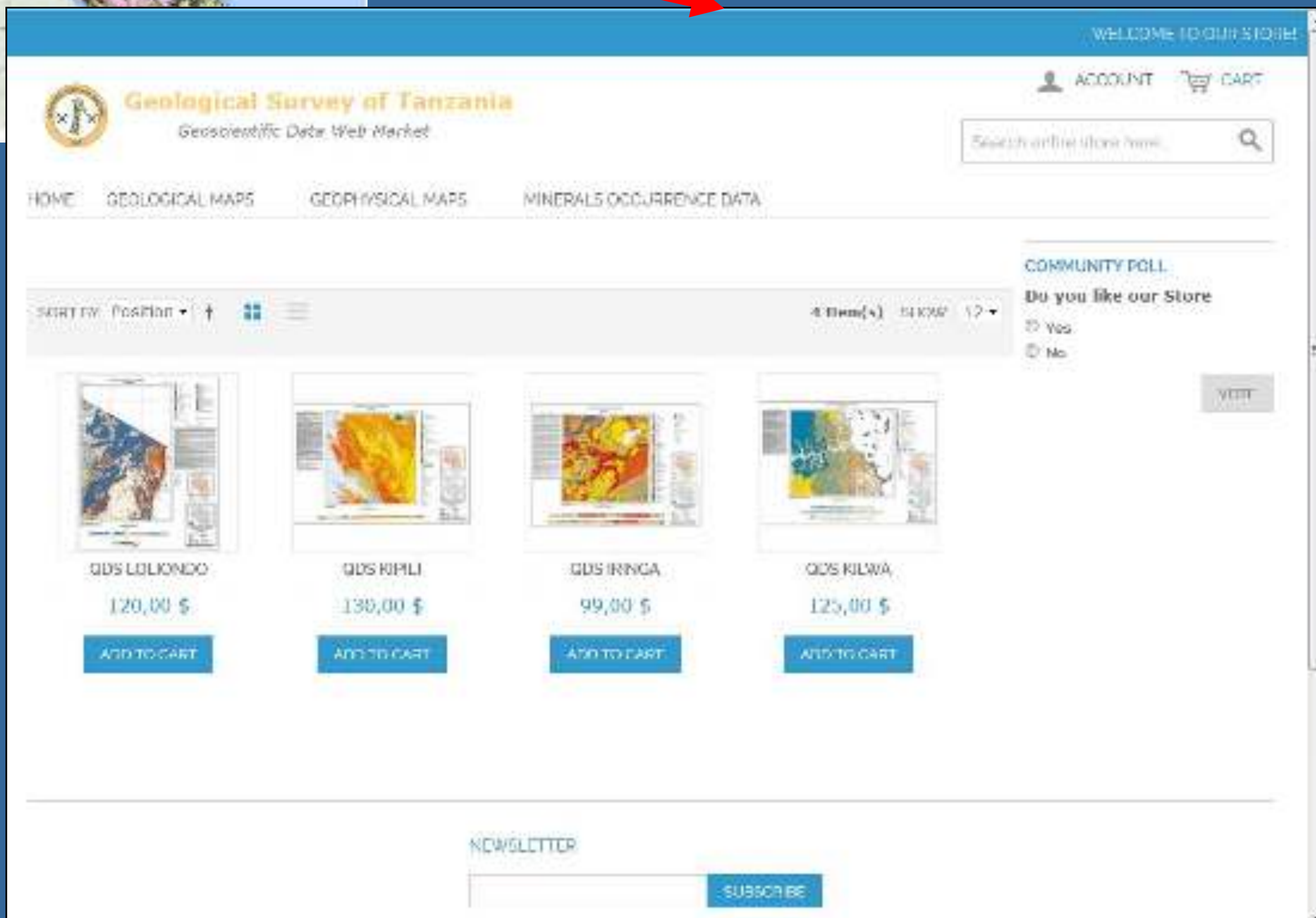
www.gmis-tanzania.com

Case History 4: Tanzania – Web GIS & Database

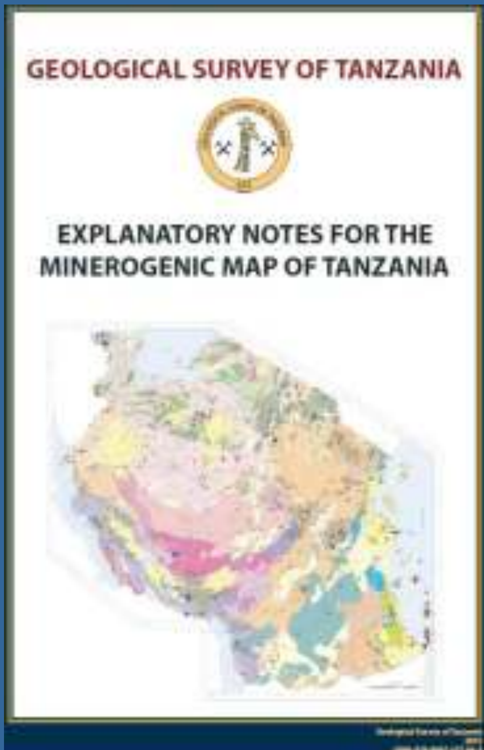


Case History 4: Tanzania – Web Store

www.gst-datashop.com



Case History 4: Tanzania – Publication & Advertisement



Minerogenic Map of Tanzania

1 : 1,500,000

Prepared under the Program

"Sustainable Management of Mineral Resources"

2013-2014

Project ID: P096302

Contractor

Beak Consultants GmbH

Geological Survey of Tanzania

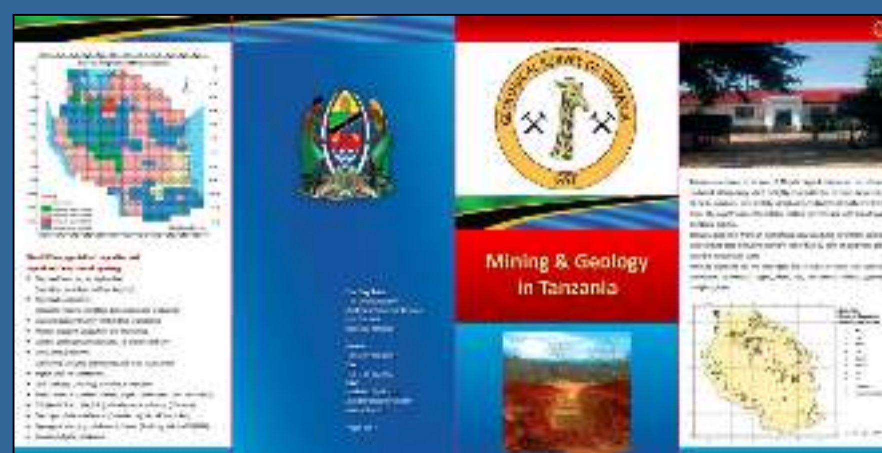
University of Dar-es-Salaam

Technical University Bergakademie Freiberg

Southern and Eastern African Mineral Centre

2015

Explanation Booklet Minerogenic Map



Brochures & Flyers

Summary: Main IMS Components

User interfaces

Data content

Database and GIS engines

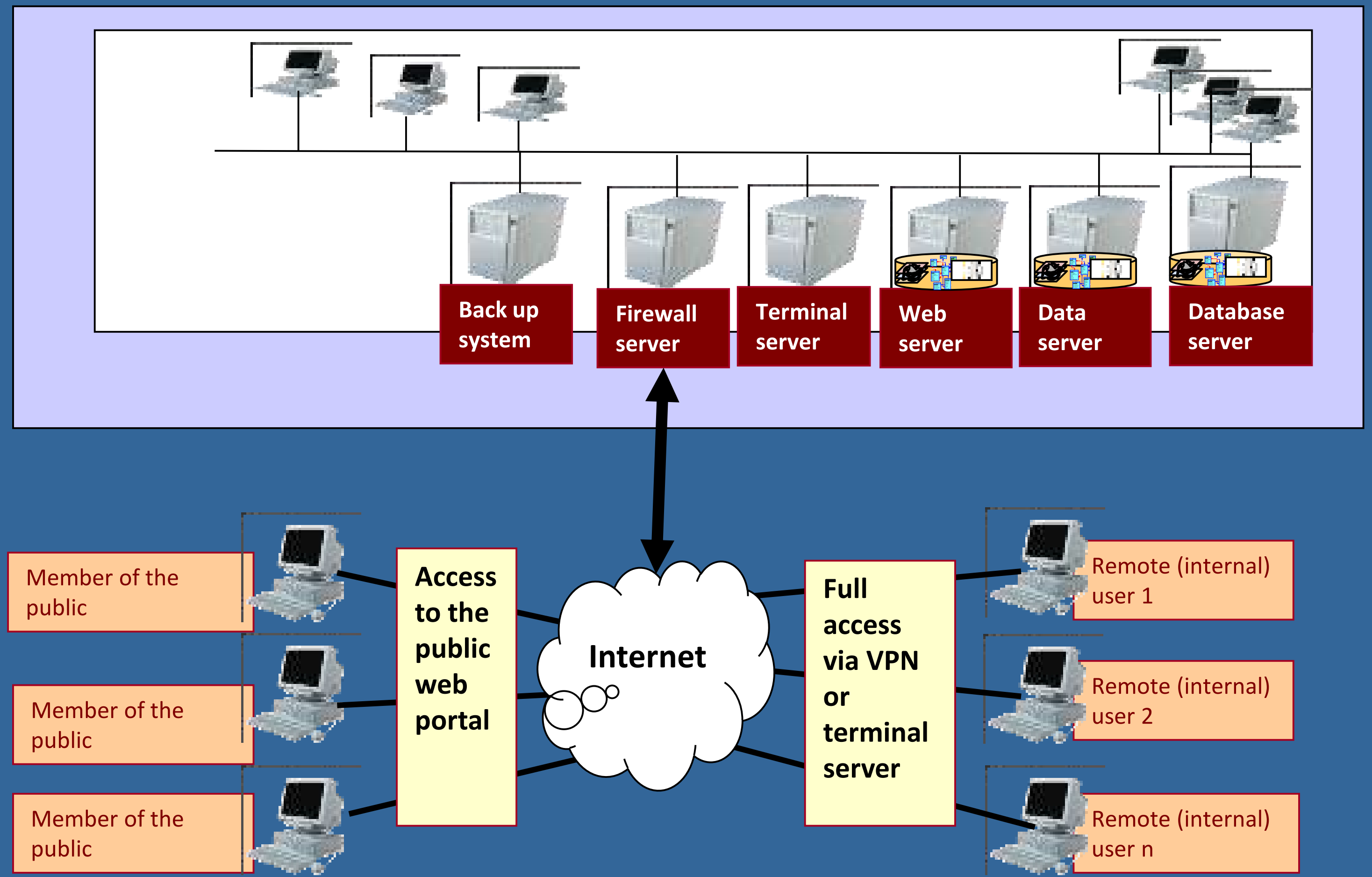
IT Infrastructure: hardware, network, system software

Frame conditions: communication, electricity, security, climate, ...

Personnel

Recommendations: IT Infrastructure - Hardware & Network

- **Hardware & network**
  - Server with n TB, work stations, backup system
  - Printers, plotters, scanner



Recommendations: GIS / Database Software / Engines

- **System software**
  - No real alternative to Microsoft Windows Server
  - LINUX as an option ...
- **Database and GIS software engine**
  - MS SQL Server (or ORACLE)
  - Esri ArcGIS Server
  - PostGre SQL, PostGIS, ...
  - Other options ...
- **Application software – always customised solutions**
  - Windows-based database and GIS interfaces
  - Web-based database and GIS interfaces

Recommendations: GIS / Database Software / Engines

- **Commercial software**
  - Service & support always available
  - Broad range of experts
  - Provides much functionality ready to use
  - Lower dependency from individual experts
  - Expensive

- **Free software products**
  - Service & support not always available
  - Limited amount of experts
  - Provide less ready to use functionality
  - High dependency from individual experts
  - Free or very cheap

Recommendations: Data Content

- **Structured data**
  - Licenses and related data
  - Mineral deposits & occurrences data
  - Mine data
  - Production data
  - Exploration data
  - Bore hole data
  - Geochemical data
  - Geophysical data
  - Hydrogeological data
  - Environmental data
  - Company data

- **Non-structured data**
  - Documents/ reports
  - Scanned maps
  - Images

- **Spatial background data**
  - Topographic maps
  - Images
  - Elevation model

Recommendations: Staff / Personnel

- **Most important component of the system**
- **Make them owners of the system**
- **Required are trained:**
  - IT system administrator
  - Database administrator
  - GIS administrator
  - Geo-scientists
  - GIS experts, cartographers

Challenges

- Environmental conditions
- IT infrastructure (internal & external)
- Missing / incorrect & incomplete data
- Data harmonization
- Costs
- Human resources
- Lack of support from above
- Working process integration

Lessons Learned

- IMS implementation is a **strategic issue**
- **Small but reliable system** is better than a big system with bad data, software bugs, slow infrastructure ...
- **Expectations and funds** must be adjusted to each other
- **System life time** is short : 5 – 8 years
- Correct & standardised data is a must: users expect **correct data**
- **Stakeholder involvement** from the beginning will support the system acceptance
- **Human resources** require much attention

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