

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

## Case Studies from Selected African Geological Surveys

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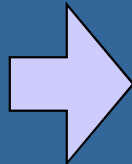
4 Geological Survey of Namibia, Windhoek/Namibia

5 Geological Survey of Tanzania, Dodoma/Tanzania



# 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 !**

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# Investor's Expectations Regarding Data

Minerals ?

Geological framework ?

Political framework ?

Decision making processes,  
licensing procedures ?

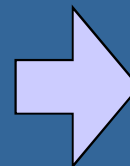
Taxation?

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**



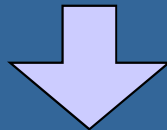
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# How to Make Data Available ?

- 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**

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# 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:

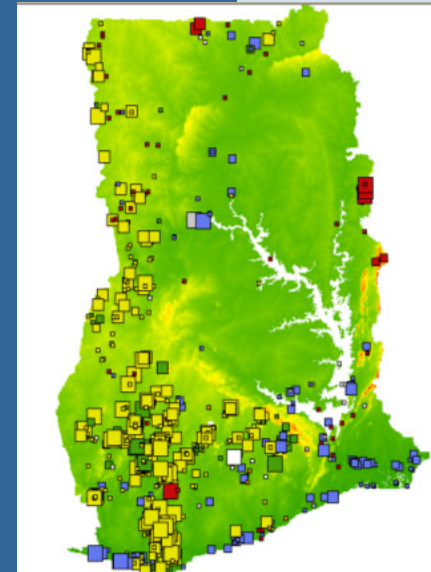
- Interconnect five Mining Sector institutions
- Implement central database and GIS: deposits, mining reports, mining cadastre, geophysical, geochemical data, reports, documents, maps,...
- Provide training and support

## • 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

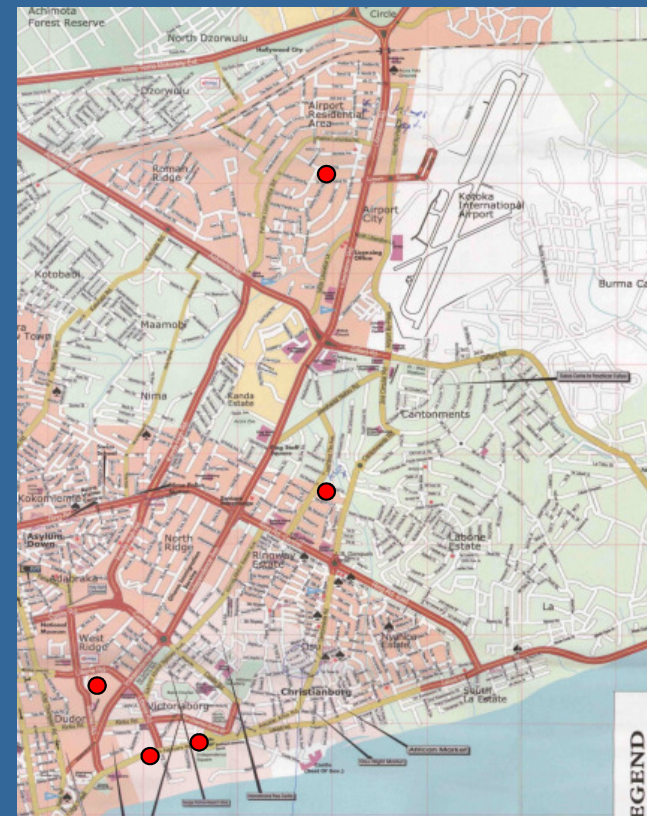
- **User friendly interfaces implemented**

- **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



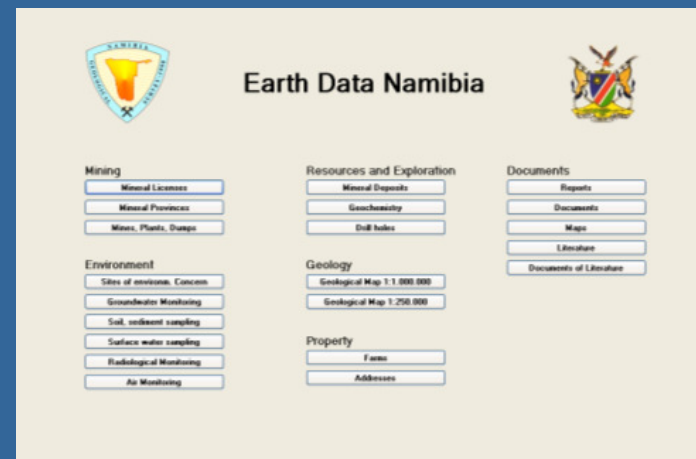
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# Case History 2: Earth Data Namibia – Facts

- **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



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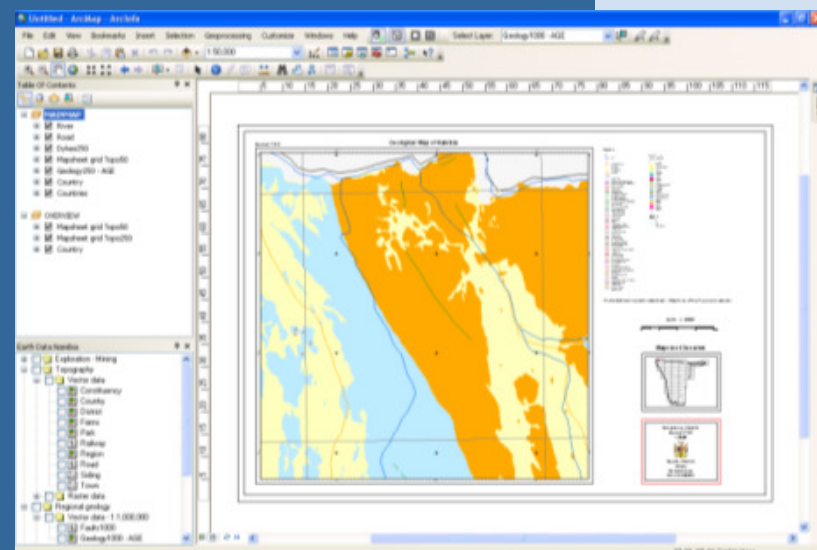


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# Case History 2: Earth Data Namibia – Benefits & Lessons

- 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



ID	Deposit name	Feasibility
481	Black Range Gra.	potentially study
534	Oliva Silan	potentially study
487	Wondjara Peg.	potentially study
1747 B1	Tevende Gold	potentially study
1804	Van-Step Iron	potentially study
243	Toungat East	potentially study
1747	Tevende Gold	potentially study
481 B2	Black Range Gra.	potentially study
534 B2	Oliva Silan	potentially study
1750	Ergo Valley Iron	potentially study

# 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**

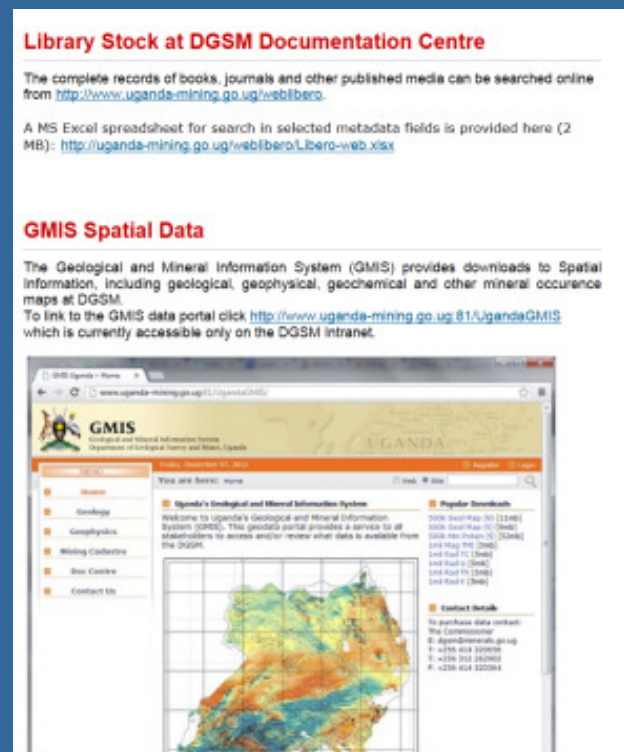
- **Data available: LAN, Internet**

- **System at a high technical level**

- **Problems:**

- Too long implementation time

- Fluctuation of personnel



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# Case History 4: Tanzania - Background

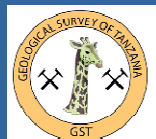
## Provision of Consulting Services for Preparation of Geoscientific Data Information Management System

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

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### Project Team



**ibes**  
SYSTEMHAUS



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# Case History 4: Tanzania – Previous Existing Situation



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



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# Case History 4: Tanzania – Database Interface

Geological and Mineral Information System

File Module Help

 **Geological and Mineral Information System** 

**System administration**

- Look up tables
- User Management

**Economic Geology**

- Deposits & Min. Occ.
- Mines
- Drill holes
- Geochemistry

**Mineral Licenses**

- Licenses

**Business data**

- Companies

**Geology**

- Map 1:2.000k
- Map 1:500k
- Map 1:100k
- Map 1:100k (Capture)
- Field Work Data

**Remote sensing Data**

- Geophysics

**Library and Archive**

- Library
- Archive
- Spatial Data / Maps

**Museum / Core Depot**

- Museum collection
- Drill Core Depot
- GIS

**Minerogenic Map 1:1Mio**

- Minerals
- Geology
- Tectonics

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## 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

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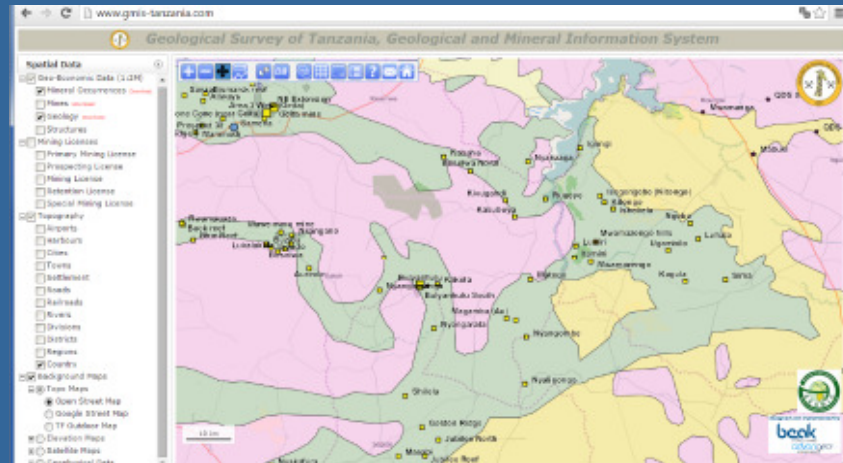


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# Case History 4: Tanzania – Public Web Site

- 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



Name	Region	Commodity	Genetic Type	Morphology	Mineralization	Size	Mining / Exploration	Socioeconomic Status	Feasibility	Cost Knowledge
Bulwerhulu	Shironga	Gold, Copper, Manganese	4 - Hydrothermal	1 - Vsh, hole, reef	1 - Archean Epoch	> 250 t	1 - Mining active	1: economic	1: feasibility study and mining report	1: detailed exploration
Bulwerhulu South	Shironga	Gold	4 - Hydrothermal	1 - Vsh, hole, reef	1 - Archean Epoch	unknown	0: undetermined	0: undetermined	0: undetermined	0: undetermined
Bulwerhulu North	Mwanza	Gold	4 - Hydrothermal	1 - Vsh, hole, reef	1 - Archean Epoch	unknown	0: undetermined	0: undetermined	0: undetermined	0: undetermined
Spring	Mwanza	Gold	11 - Unknown genesis	8 - Undescribed	5 - Unknown Epoch	unknown	0: undetermined	0: undetermined	0: undetermined	0: undetermined

[www.gmis-tanzania.com](http://www.gmis-tanzania.com)

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# Case History 4: Tanzania – Web GIS & Database



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## GEOLOGICAL SURVEY OF TANZANIA

About GST | Research | Mapping | Resources | Geo Information | Exploration | Services | Media Center | Map Products | Geo Hazards | Projects

### WELCOME TO GEOLOGICAL SURVEY OF TANZANIA

The Geological Survey of Tanzania (GST) is the government agency responsible for the acquisition and storage of geoscientific data and information used in the mineral resources sector and other sectors of the economy. GST is active in promoting mineral exploration and mining in Tanzania. GST core activities range from geological mapping, mineral exploration, evaluation, and processing, and research work on geological processes and mineral systems and geohazards. GST'S vision is to evolve as a centre of excellence providing national geoscientific data and information for use in the evaluation and sustainable utilization of natural resources. GST manages mineral resources between its primary responsibility of geological mapping, geodata management, conceptual research and development of geoscientific services to both public and private sector.



#### QUICK LINKS

[Geological and Mineral Information Systems](#)

[National Bureau of Statistics - NBS](#)

#### Geological Mapping

GST's mapping programmes produce basic information for the needs of the mineral sector  
[» Read more](#)



**Geological Survey of Tanzania, Geological and Mineral Information System**

**Spatial Data**

- Geo-Economic Data (1:2M)
  - Mineral Occurrences
    - Mines
    - Geology
    - Structures
  - Topography
    - Airports
    - Harbours
    - Cities
    - Towns
    - Settlement
    - Roads
    - Railroads
    - Rivers
    - Divisions
    - Regions
    - Country
  - Background Maps
    - Topo Maps
    - Satellite Maps
    - Elevation Maps
    - Geophysical Data

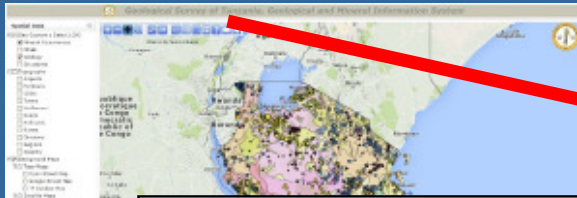
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# Case History 4: Tanzania – Web Store


www.gst-datashop.com







WELCOME TO OUR STORE!

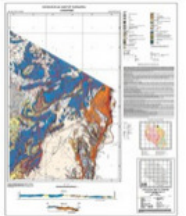
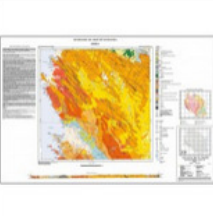
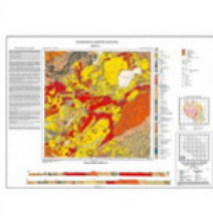
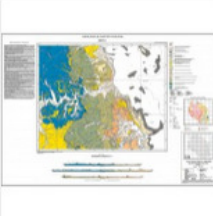
 **Geological Survey of Tanzania**  
Geoscientific Data Web Market

ACCOUNT  CART

Search entire store here... 

HOME GEOLOGICAL MAPS GEOPHYSICAL MAPS MINERALS OCCURRENCE DATA

SORT BY: Position    4 Item(s) SHOW: 12 

QDS LOLIONDO	QDS KIPILI	QDS IRINGA	QDS KILWA
			
120,00 \$	130,00 \$	99,00 \$	125,00 \$
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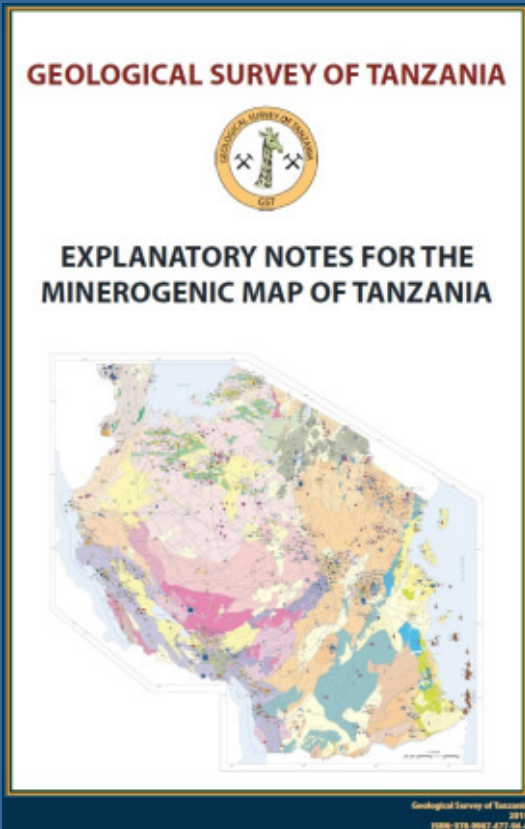
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# Case History 4: Tanzania – Publication & Advertisement



**Minerogenic Map of Tanzania**  
**1 : 1,500,000**

*Prepared under the Program*  
**"Sustainable Management of Mineral Resources"**  
 2013-2014  
 Project ID: P096302

Contract No. ME/008/SMMRP/C/35  
 Provision of Consulting Services for Preparation of Geoscientific Data Information Management System

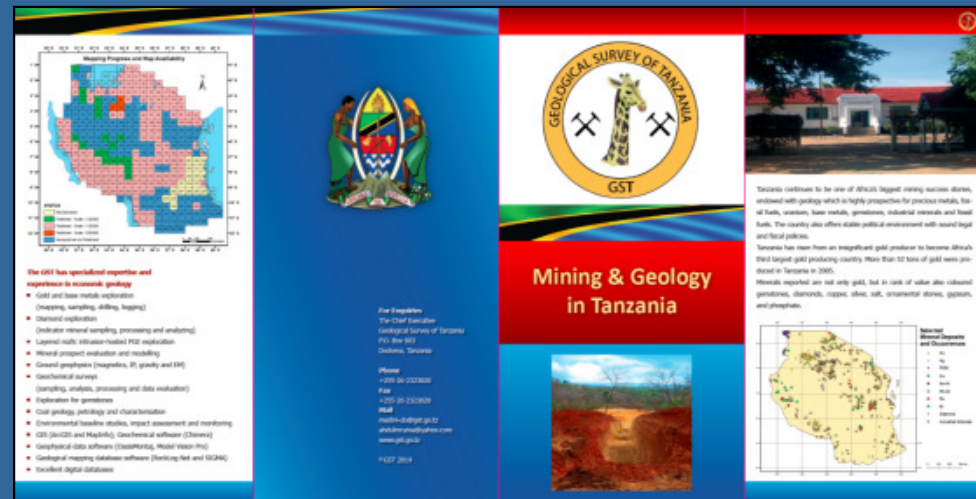
*Contractor*  
**Beak Consultants GmbH**

in co-operation with

**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



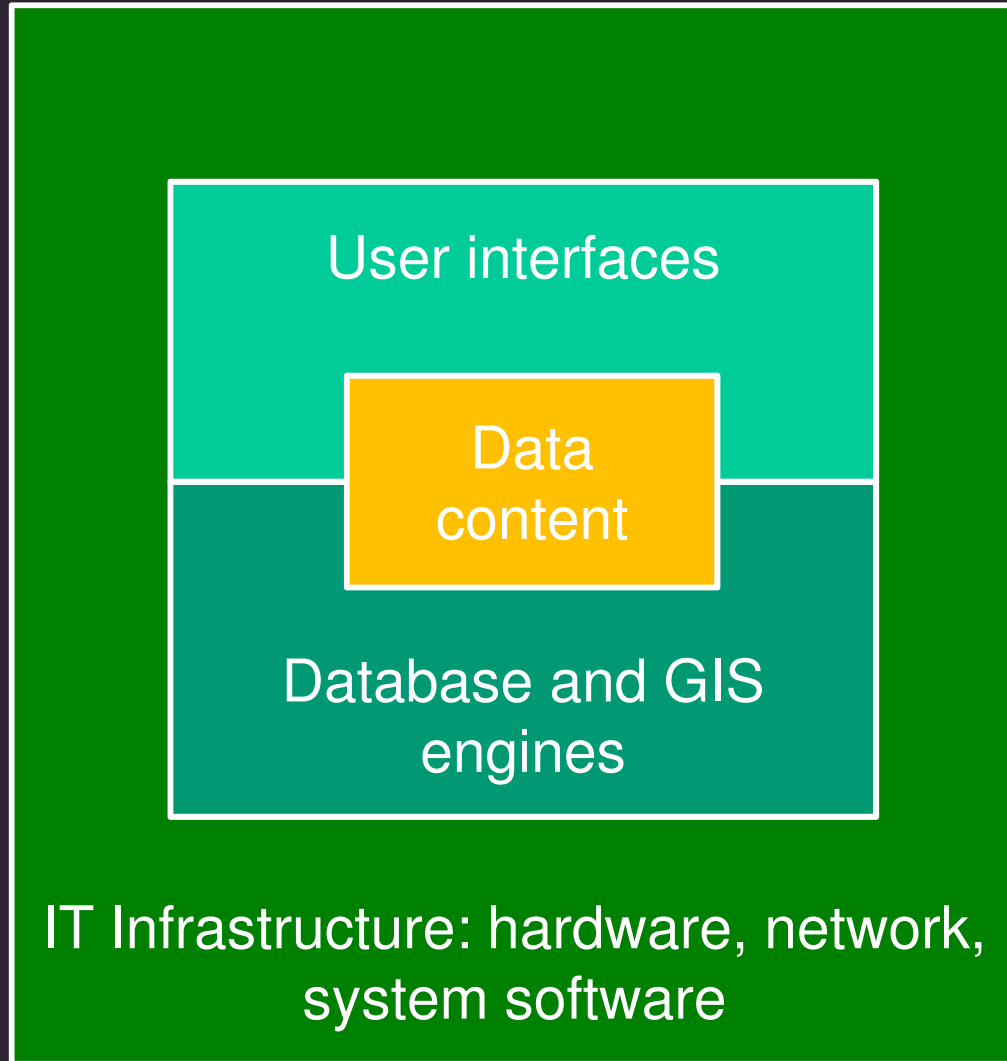
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# Summary: Main IMS Components



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

Personnel



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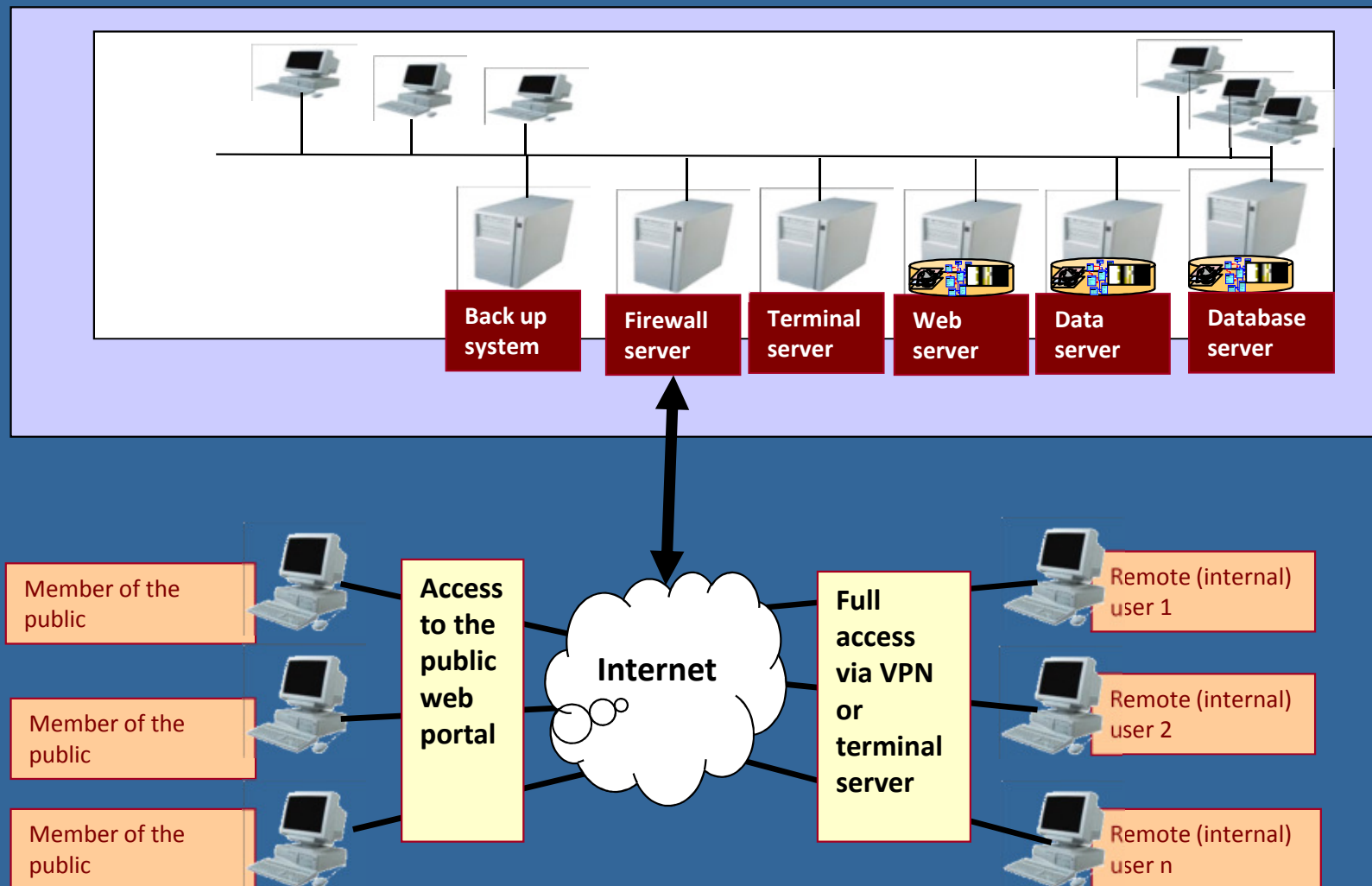
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# Recommendations: IT Infrastructure - Hardware & Network

- **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

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# 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

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# 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

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# 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

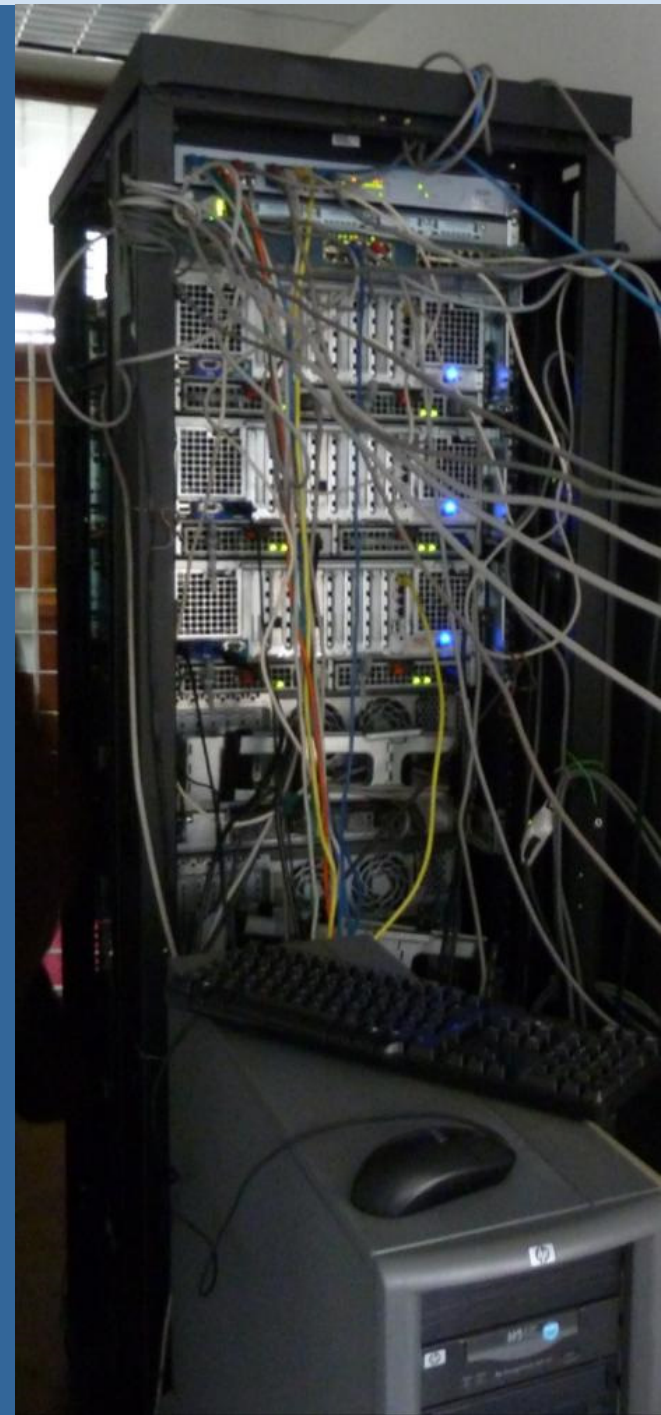
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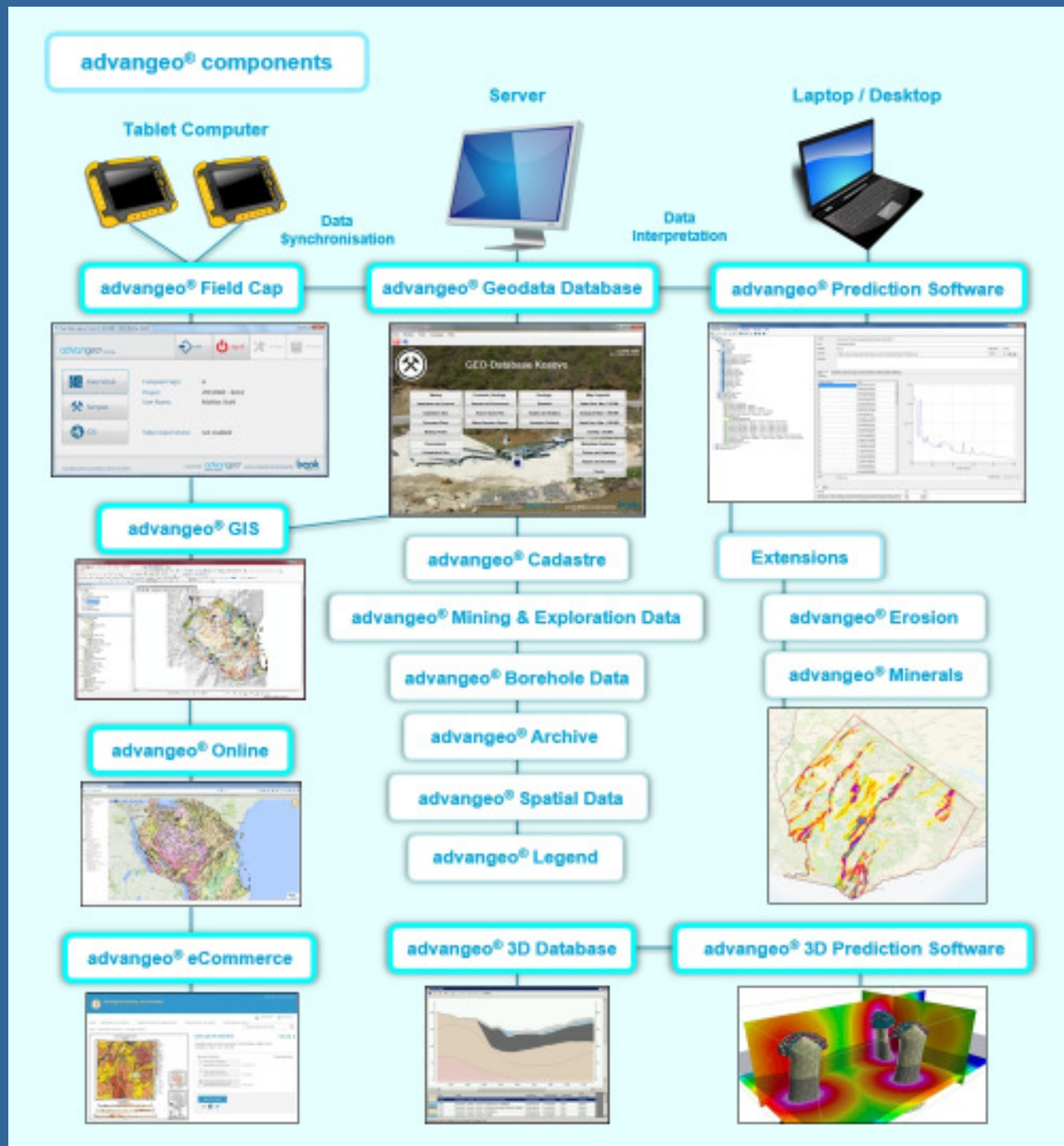
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# Lessons Learned

- 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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Resource Management and Investment Attraction !*

