Developing Effective Mineral Resource Policy for Sustainable Livelihoods through Geoscience

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- Governance and Regulation
- Community and Environmental Sustainability
- Operational Effectiveness

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Research aims:
The aim of this Action Research was to identify practical solutions (i.e. tools and skill requirements) which will enhance the capability and useability of public geoscience data by the government and primary clients, the exploration industry, recognising that resource governance is a key pillar in helping Zambia reach its development goals.

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Zambia is the focus of this study, recognising the historic importance of copper mining in Zambia, the current resurgence of interest in the copper belt and issues associated with foreign investment. There are deep misgivings in the community that the nation’s mineral wealth is not benefiting Zambia and an overall sense that the country does not get a fair deal with mining and tax policies “over-generous” to companies and tilted towards investors. The industry has also expressed concerns regarding privatisation, changing corporate tax regimes with recent increases in royalties from 3-6%, transparency, labour laws/costs and securing affordable and reliable power with electricity currently comprising 15% of operational costs for mining companies. The balance between resource development, foreign investment, regulatory regimes as they apply to all investors and community expectations clearly remains a major issue in Zambia.

This report targeted a more comprehensive understanding of the gaps in knowledge and skills in the area of regional resource analysis, industry activity and trends in Zambia. A key question was how to more fully realise the resource sectors role in Zambia’s future, both by invigorating brownfields regions as well as frontier regions and recognising government’s geoscience role in regional planning and infrastructure development, development of regional exploration frameworks and marketing prospectivity. This approach reflects the experiences of resource-rich countries like Australia and Canada that actively support the provision of public geoscience data and information.

With this as context, this study concentrated on the obstacles to operational effectiveness of the Geological Survey of Zambia in its role of providing reliable information to support:

1. Marketing the mineral resource potential of the country
2. The provision of geoscience understanding for wider socio-economic planning

Key knowledge and skill gaps identified were:

- Data governance frameworks (documented policies, procedures and processes) and data standards (e.g. database models and data definitions; reporting requirements) are required to enable the effective capture of data in forms that can be integrated and confidently interrogated with minimum effort by industry and government users
- Data stewardship and custodianship roles are essential to realise greater integrity and confidence in the administration and delivery of information. Custodians ensure information datasets and products are of a consistently high standard and ‘fit for purpose’ as well as oversight quality control and quality assurance procedures before dissemination of information
- Data integrity and security, recognising that large investment decisions are made using public geoscience so data integrity is critical and that data security is essential, recognising that information submitted on exploration activity forms a vital part of government geoscience databases
- Storage and access technologies
Action Research Report

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The International Mining for Development Centre was established to promote the more sustainable use of minerals and energy resources in developing nations by assisting governments and civil society organisations through education and training, fellowships, research and advice. Our focus is three core themes—governance and regulation, community and environmental sustainability, and operational effectiveness.

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The W.H. Bryan Mining and Geology Research Centre (BRC) conducts world-class research to reduce geological and mining risk, and to optimise mining procedures to meet the complex challenges that face the global mining sector. The BRC delivers strategic technologies and engineering solutions, in pursuit of effective and sustainable industry practice.
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1 Introduction

African nations are resource-rich with huge potential for undiscovered mineral resources but they often remain poor, unstable and therefore suffer from the so-called ‘resource-curse’ disease. Institutional development has been identified as affecting the extent to which the relationship between natural resources and growth differs between Sub-Sahara Africa and the rest of the world. The ‘resource curse’ phenomena in Africa exist where low levels of institutional development exist, and as institutions improve, resources turn from a ‘curse’ into an advantage.

To address this issue requires development of institutional governance capabilities to support informed planning and decision-making aimed at realising the full benefit of the natural mineral endowment and delivering resource development that can deal with what are often competing needs. The economic value of mineral and energy resources, energy requirements, environmental values, and employment are examples of some of these.

To establish real partnerships to advance sustainable resource management between exploration and mining companies and African governments depends, amongst other things, on adequate technical knowledge being held by the countries involved. Effective self-regulation and policy development is required to engender confidence within societies-communities that they are gaining appropriate value from the productive and sustainable use of their land and its mineral resources. Industry also seeks an operational environment in which it can confidently and effectively operate.

Zambia is the focus of this study recognising both the historic importance of copper mining in Zambia, the current resurgence of interest in the copper belt (copper production is expected to reach 1200000 tons by 2015 compared to 700000 tons in 2012), and issues associated with foreign investment.

Copper has long been the country’s primary export and the health of the Zambian economy as a whole is considered to rest largely on the state of the copper market. Yet, the fortunes of the copper mining industry has not necessarily correlated with the prosperity of Zambians and even the surge in the copper price seen during the mid-2000s, and its relatively fast recovery after the global financial crisis of 2008, have not seen a decline in poverty levels, which remain extremely high. About 85% of people in rural areas and 34% in urban districts live below the poverty line and about 64% of the total population (approx. 13.5 million) live on less than the equivalent of one dollar a day.

Zambia is also one of Africa’s biggest recipients of Chinese investment with billions of dollars invested in reinvigorating Zambia’s mines, but the money has also brought new problems, with increasing tension within the local population. There are deep misgivings in the community that the nation’s mineral wealth is not benefiting Zambia and an overall sense that the state of the copper market.

The industry has also expressed concerns regarding privatisation, changing corporate tax regimes with recent increases in royalties from 3-6%, transparency, labour laws/costs, and securing affordable and reliable power with electricity currently comprising 15% of operational costs for mining companies. The balance between resource development, foreign investment, regulatory regimes as they apply to all investors, and community expectations, clearly remains a major issue in Zambia.

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This report provides a synopsis of the action research project which targeted developing a more comprehensive understanding of the gaps in knowledge and skills in the area of regional resource analysis, industry activity, and trends in Zambia. This understanding is essential to inform long-term sustainable growth of regions.

1.1 Approach to the Study

This project focussed on identifying practical solutions (i.e., tools and skill requirements) which will enhance the capability and useability of public geoscience data by the government and primary clients, the exploration industry, recognising that resource governance is a key pillar in helping Zambia reach its development goals.

A key question was how to more fully realise the resource sectors role in Zambia’s future both by invigorating brownfields regions as well as frontier regions, and recognising government’s geoscience role in regional planning and infrastructure development, development of regional exploration frameworks, and marketing prospectivity.

This approach reflects the experiences of resource-rich countries like Australia and Canada that actively support the provision of public geoscience data and information to:

- Encourage exploration in high risk, potentially high return frontier regions;
- Enable the application of geological knowledge of known deposits to increase the chances of finding more deposits;
- Reduce risk and uncertainty right across the resources exploration industry, by enabling the use and re-use of geoscience data held in public archives;
- Encourage the participation of a larger number of small private investors than would otherwise be the case;
- Prevent exploration activity falling to ineffectively low levels;
- Reduce expensive re-acquisition of data, thus focussing expenditure on acquiring new data;
- Maintain a competitive edge to attract international exploration and resource investment;
- Increase competition through processes for granting or renewal of licenses, tenements and concessions that are informed by the available geoscientific data; and
- Harmonise data at provincial and continental scales to underpin policy-making and regional development decisions.

Fundamental to the rational for the provision of public geoscience data is the reduction of exploration costs and risks with the ultimate objective being successful discovery. Countries such as Australia, as sovereign owners of resources and recipients of tax revenues from resource development, use public geoscience data/information to maximise their interests by attracting the largest competitive field of potential investors. In this context, public geoscience information is seen as analogous to a prospectus intending to maximise the selling price of community-owned assets. Importantly, public geoscience data is used to underpin successful partnerships between private investment, government and the community not only by increasing royalties and taxes to governments but also stimulating other sector development through infrastructure provision catalyzed by mining sector investment.

With this as context, this study concentrated on the obstacles to operational effectiveness of the Geological Survey of Zambia in its role of providing reliable information to support:

1. marketing the mineral resource potential of the country, and
2. the provision of geoscience understanding for wider socio-economic planning initiatives.

A sketch of the Zambia situation was generated by interviewing senior staff in the Geological Survey of Zambia, Ministry of Mines, Energy and Water Development, and representatives of key client groups and stakeholders including: The Chamber of Mines, Association of Zambian Mineral Exploration Companies (AZMEC), Zambia Consolidated Copper Mines Investment Holdings (ZCCM-

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5Commonwealth of Australia, Department of Finance and Deregulation, Strategic Review of Geoscience Australia, 2011.
IH), the Zambian Environmental Management Agency (ZEMA), World Bank, and the University of Zambia (UNZA).

Discussions considered:

- Institutional jurisdictions and relationships;
- Geoscientific data/information requirements by various Departments/Agencies;
- Approaches to geoscientific data acquisition;
- Interpretation and dissemination;
- Regional resource understanding and impact on development and regional planning; and
- Building capacity for tertiary education in mining.

2 The Study

2.1 Government Goals and Strategies

Zambia’s long term development strategy is articulated in its “Vision 2030: A prosperous middle-income nation by 2030”\(^6\). To reach this objective, the Government of the Republic of Zambia has put into place a series of national development plans. The current Sixth National Development Plan (SNDP) encompasses 2011 through 2015\(^7\).

The SNDP has three overarching objectives: infrastructure development, rural development, and human development. Underlying these is a theme to bring about an environment in which the Zambian government provides quality services in a transparent manner, and Zambian citizens can expect high standards of government performance.

Natural resources figure prominently in Zambia’s development planning. Mining remains Zambia’s greatest source of earnings accounting for over 80% of the country’s exports and contributing 10% of Gross Domestic Product (GDP). In 2012 mining accounted for 74,000 jobs, an increase from 27,000 in 2000. Copper mining and the diversification of extractable resources remains a key pillar of the Zambian government’s economic growth strategy. This strategy aims to encourage continued private sector investment and exploitation of the spill-over effects from associated infrastructure expansion to benefit other sectors of the economy.

The Ministry of Mines, Energy and Water Development (MMEWD) has four Departments: Geological Survey, Mines Development, Mines Safety, Water and Energy. Strategic Planning documentation that is available refers to the period 2008-2012 and was developed for the then Ministry of Mines and Mineral Development (MMMD). As such it does not reflect the recent amalgamation of MMMD with the Ministry of Energy and Water Development. The 2008-2012 Strategic Plan outlines the Ministry’s mission, goal, objectives and strategies:

- Mission – ‘To facilitate the development of efficient, safe, viable and sustainable mineral and petroleum industries for the maximum benefit of the people of Zambia’.
- The Goal Statement – ‘To have an efficient and computerised information and licensing system and improved compliance in the mining and petroleum industries’.


Objectives, strategies and output indicators in the document include:

**Objective: To promote investment in the mining and petroleum sector in order to increase their contribution to the national economy**

- **Strategies**
  - Identify, document, package and disseminate information on investment opportunities in the mining and petroleum sectors locally and abroad;
  - Streamline the processing of mining and non-mining rights and other related documents;
  - Procure appropriate field equipment and rehabilitate and equip the laboratories;
  - Participate in local and international mining and petroleum investment forums;
  - Strengthen existing five mining regional bureaux and extend to every other provincial centre;
  - Increase geological mapping coverage of the country;
  - Undertake reconnaissance surveys and exploration of oil, gas and other minerals; and
  - Establish and maintain core sheds.

**Objective: To establish and maintain an integrated information system in order to enhance the processing, storage, retrieval of and accessibility to comprehensive geological, petroleum and mining information**

- **Strategies**
  - Upgrade, update and acquire modern hardware and software;
  - Establish Wide Area Network (WAN) links through satellite;
  - Establish and maintain a robust website;
  - Develop capacity to manage the integrated information system;
  - Monitor and evaluate the performance of the integrated information system; and
  - Digitise existing data and information.

**Objective: To provide appropriate policy and legal framework in order to guide the operations of the mining and petroleum sectors**

- **Strategies**
  - Facilitate the amendment/and repeal of legislation and regulations;
  - Finalise the review of the Mineral Resources Development Policy;
  - Develop and disseminate the Safety, Health and Environment Policy;
  - Monitor and evaluate the impact of the policy and legislation on the operations of the mining and petroleum sectors; and
  - Constitute a policy and legislative review committee.

**Objective: To encourage research and development in mining and petroleum industries in order to increase productivity, value addition and environment protection**

- **Strategies**
  - Identify and collaborate with academic/research institutions and industry to undertake research and development (R&D);
  - Commission research and development activities;
  - Disseminate research findings and development of appropriate technologies and products;
  - Encourage mining and petroleum industries to establish a research Fund; and
  - Promote R&D on value addition and environmental protection.
Objective: To effectively monitor seismic activities in order to facilitate development and implementation of appropriate interventions

- Strategies
  - Construct and rehabilitate existing seismic stations;
  - Network with other seismic institutions/organisations in the region and beyond;
  - Document and disseminate seismic data; and
  - Monitor and evaluate the performance of seismic network.

Government geoscience data including reports on exploration activity, reporting on production licenses, and the development of value-added information packages to market the resource potential of Zambia feature prominently in MMEWD Strategic Planning.

2.2 Institutional Jurisdictions and Arrangements

The Government of Zambia gained control of the copper mines in 1973 and created the state-owned Zambia Consolidated Copper Mines (ZCCM) in 1982. As a result of deteriorating copper prices, reinvestments in Zambia’s copper industry dwindled, productivity declined, compromising ZCCM’s financial sustainability. With a view to increasing productivity through foreign investment and private sector development between 1995 and 2000, the Government proceeded to sell ZCCM assets to private investors.

This change of policy required a ‘strategic repositioning’ of the legal framework and governance arrangements around developing a self-sustaining and effective partnership between government and the private sector. The country’s Mines and Minerals Development Act of 2008 was established to enable a private-sector-driven mining sector and provide more certainty in terms of the legislative regime and policy framework.

In June 2013 the Zambian Government announced that it had started drafting a revision of the current mining policy - reviewing the viability of the existing industry policy and legislative framework which would, amongst other things, ‘seek to promote investment in the development of a more diverse range of commodities: metalliferous deposits, industrial minerals, gemstones, and energy resources’.

This policy is promoted by the MMEWD through the technical support available from its three constituent departments – the Geological Survey, Mines Development, and Mines Safety.

The Geological Survey’s stated focus is: “the promotion and development of both large and small-scale mines in order to increase the sector’s contribution to economic development and poverty reduction”. In the current mining legislation the Office of Director of the Geological Survey is responsible for granting prospecting and mineral processing licenses.

The Mines Development Department is responsible for the issuing of mining licenses and the monitoring of mining operations to ensure development is in line with approved programmes of operation and the Mines and Minerals Act. It has five regional offices in mining regions: Mkushi, Kitwe, Chipata, Solwezi and Livingstone. The Department does undertake inspection visits to large scale mines but the compliance among small-scale mines is low. This Department is currently implementing a new computerised mining cadastre for the administration of mining rights in an effort to streamline the issuing of rights at a “one-stop centre”.

The Geological Survey and the Mines Development Department have joint responsibilities with regard to prospecting/exploration tenures license granting and management. Currently, applications for licenses are made to the Mining Cadaster Unit in the Mines Development Department and the ‘vetting’ process involves assessment by the Geological Survey before submission to the Mining Advisory Committee (MAC), which comprised individuals nominated from key government

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9 As per the Mines and Minerals Development Act No7 of 2008.
departments and stakeholder organisations. The MAC is charged with scrutinising and recommending the granting of mineral rights\textsuperscript{10}.

The Mines Safety Department is responsible for all aspects of safety, health and environment in mineral exploration, mining and mineral processing operations. The Department is located in Kitwe and has four sections: mining, explosives, machinery and environment. The sections enforce relevant legislation, issue permits and provide technical advice.

A number of other Agencies and Ministries are involved with mining related matters and would benefit from access to geoscientific data and information (refer Section 3).

2.3 Geological Survey Aims, Objectives and Structure

The Geological Survey of Zambia (GSZ) is located in Lusaka and is responsible for ‘undertaking preliminary exploration works, issuance of prospecting permits and licenses and mineral processing licenses. It also provides geological, geophysical and geochemical data on a countrywide basis, acts as the repository for all such data on Zambia, and provides support and advisory services to the public.'\textsuperscript{11}

The GSZ organisational structure reflects its specialised services: regional mapping, economic geology, geophysics and laboratories (geochemistry and mineral processing).

Key objectives and strategies of the Geological Survey are listed in the Ministry’s Strategic Plan as:

- Identify, document, package and disseminate information on investment opportunities in the mining and petroleum sectors locally and abroad;
- Streamlining the processing of mining rights and other related documents (e.g. exploration reports);
- Increasing geological mapping coverage of the country from 58% to 61% by 2012;
- Core shed built and fully functional by 2012;
- Establish and maintain an integrated information system to enhance processing, storage, retrieval of and accessibility to comprehensive geological, petroleum and mining information.
A key strategy involved developing capacity in information management.

These strategies are discussed in terms of identifying and marketing the mineral wealth potential of the country.

2.3.1 Geological Survey Operational Environment

High copper prices between 2002 and 2012 (refer tables 1 and 2), coupled with the privatisation of the Zambian mining industry, resulted in increases in exploration, mining and production leading to increased production and contribution to GDP and employment creation. Capital investments in the mining sector amounting to US$8billion since 2000, have led to an increase in copper production currently standing at around 700,000 metric tonnes up from 260,000 metric tonnes a few years ago. Current projects such as the Kalumbila and Kansanshi smelter, both costing over US$2.6billion, are projected to increase copper production to about 1.5million tonnes per annum when completed by 2016.

In 2013 there has been a downturn in copper prices with world copper consumption in the first quarter of 2013 estimated to have declined by around 5.3% compared with that in the same period of 2012, according to International Copper Study Group (ICSG)\textsuperscript{12}. ICSG projections for 2013, is that the global copper market is expected to have a production surplus relative to demand. For 2014, although a recovery in usage is anticipated, a higher surplus is expected with increased output from new and existing mines.

\textsuperscript{10} This arrangement may change with the new Mining and Minerals Act.
\textsuperscript{12} Source:www.icsg.org
The unprecedented growth of the mining sector in the period 2002-2012 led to the inability of the GSZ to recruit and retain professional staff. The Strategic Planning document for MMMD outlines the consequences: ‘the few remaining staff are overworked leading to reduced efficiency and poor service delivery’. In practice this has meant that specialist activities other than geophysics are not supported in the GSZ as all staff are required to respond to emerging priorities, such as progressing backlogs of company report approvals. The implications of a copper price downturn for the operations of the GSZ most obviously are to reinforce GSZ’s role in diversifying the countries resource base.

### 2.3.2 Public Geoscience Data and Value-added Information

GSZ is a repository of geological maps, publications, reports, and data generated by the survey staff including:

- Memoirs and Bulletins of the GSZ that provide descriptions and evaluations of specific geological terranes. Geological maps at 1:100 000 scale, both hardcopy and scanned, are available on demand for a nominal fee.
- Economic Reports that provide descriptions of specific mineral deposits or occurrences of potential economic interest.
- Occasional Publications in national and international journals relating to the geology and mineral resources of Zambia.
- Minex Reports that were produced by the exploration arm of Zimco Ltd., a parastatal mining and exploration group.
- Geochemical Data: stream-sediment, soil, and rock samples analysed for selective suites of trace elements and resulting from three major initiatives - the Regional Geochemical Mapping Project, the Metallogenic Province Mapping Project, and the Granitoid Geochemistry Project.
- Geophysical Data: a reconnaissance-scale Bouguer anomaly map of the whole of Zambia published at a scale of 1:1 500 000 with contour intervals of 5 milligals; complete airborne magnetic coverage of Zambia and 70% radiometric coverage at line spacings of between 800 m and 2000 m and mean terrain clearance of 150 m.
- Mineral Inventory Database: the GSZ has an ongoing commitment to the preparation of a computerized database comprising the approximately 350 mineral deposits and occurrences listed in a major compilation prepared by Watts, Griffis and McOuat (1991). A search-service is available to the public or the database can be purchased on disk.
- The primary source of external geo and spatial data/information are the quarterly hardcopy exploration reports submitted by industry.

The GSZ’s data and information packages strongly reflect its core discipline strengths: regional mapping, economic geology and geophysics.

**Regional mapping:** field recording standardly involves Global Positioning System (GPS) location and transcribing this on a topographic map as well as recording rock descriptions (e.g., lithology, structure) in note books. There is no regional mapping database and data are not captured in a structured format nor are standard observational data codes and vocabulary used. Whilst a number
of staff have access to 2D GIS software packages and have trained in their use, in some cases, to advanced levels the benefit of these skills is constrained by the availability of digital data.

Specific expertise in structural and petroleum geoscientific were identified as significant skill sets missing in GSZ.

**Geophysics:** there is a strong earthquake seismology focus in this section supported over the years by international aid/training and at times direct collaboration (e.g. Sweden, Finland, USGS, Norway).

Regional magnetic and radiometric surveys were undertaken in the 1970's. This data continues to be the basis for preliminary regional geological assessments by industry and by the GSZ. These data are stored as contoured transparency maps. Geophysical data in company reports are not readily available for use by GSZ staff nor is there an ‘open file’ report system that would make such data publicly available upon tenure relinquishment. Ground gravity data is not acquired due to lack of equipment and training, similarly EM and IP are not acquired.

The operating platform for geophysics section is Geosoft Oasis montage. This software platform provides a 3D data integration and analysis environment enabling, importing, viewing, processing and modelling of large volume geophysical, geochemical and geological data.

**Economic geology:** mineral occurrence data (e.g. statistical data on operating and abandoned mines and prospects; deposit models and mineralisation; locations; grades/tonnages) is available for 350 mineral deposits and occurrences listed in a major compilation prepared by Watts, Griffis and McCuatin 1991.

Geochemical data, gathered in a number of regional collection programs that cover approximately 30% of Zambia, have been digitally captured, together with some data incorporated from company exploration reports, and these are available on disk.

Limited funding has restricted data acquisition activities of all sections of GSZ. Special mention is made of this in the MMMD Strategic Plan 2008-2012: ‘despite the importance of this information in promoting investment in the mining sector, the Ministry did not produce a single map during the period under review. The last geological maps were produced in 2000’. Considering the operations of the GSZ in terms of supporting mineral resource policy particularly striking was:

- Whilst technologies such as GIS are available for use, their impact in terms of value-adding is limited due to data management issues. This fundamental hurdle has major ramifications in terms of:
  - developing information packages to market and ultimately facilitate diversification of Zambia’s resource base
  - GSZ’s ability to facilitate the broad use of geoscience data/information across a range of disciplines and sectors as this requires development of standards and a ‘common language’.

- GSZ projects are disciple specific rather than having a multidisciplinary team approach. The latter is needed to support effective resource assessment.

- That industry - government linkages are not effective, an example of which is that GSZ is not represented in council meetings of peak bodies such as AZMEC. These relationships are essential to ensure GSZ can impact/establish effective partnerships between government and industry in a private sector driven mining sector.

2.3.3 Data Access

A significant proportion of the data held by GSZ is in hardcopy. Most GSZ reports and all company reports are in hard copy form and stored in a technical records office/information section. Currently there is no librarian/archivist and no mechanism to effectively catalogue these data nor a mechanism to facilitate access/distribution (e.g. scanning). The new core library that is currently being built will have similar problems in terms of guidelines and procedures to store, catalogue and support
examination and sampling of physical samples/core by industry and researchers. ZCCM’s Technical Services Department had an extensive archive of company reports and also a large drill-core repository that is not under the control/management of the GSZ and the condition of both these archives is not clear.

Whilst a number of databases exist: mineral occurrence, geochemistry and geophysics, these can be considered either ‘legacies’ that have not been maintained and/or fail to meet client needs fundamentally due to a lack data management protocols and procedures. For example:

**Standards for data acquisition**, for both company reporting and government field surveys. Reporting requirements for exploration companies are outlined in The Mines and Minerals Development Act, 2008. These do not specify data standards/formats to ensure that the GSZ and other government agencies, as well as subsequent explorers, can readily use the data and information contained in submitted reports.

In contrast Australian company reporting requirements require digital exploration data to be supplied to Geological Surveys to contain: comprehensive metadata (e.g. what type of data it is, where it was collected, when and how); conform to file formats and be supplied in non-proprietary formats (e.g. drilling and geochemical tabular data), and include exploration reports that must meet compliance standards.

The detailed requirements for company reporting in Australia ensure compatibility between different datasets, greatly assisting search ability when data needs to be retrieved and delivered. These standards create an environment where data can not only be readily accessed but also easily used and integrated with data from a range of sources, thus maximising the return on public data and avoiding unnecessary expenditure in repeating previous investigations.

**Geological Survey of Zambia Company reporting requirements – mineral exploration:**

A holder of a prospecting licence shall keep full and accurate records at the holder’s office of the prospecting operations which shall indicate-

- the boreholes drilled;
- the strata penetrated, with detailed logs of such strata;
- the minerals discovered;
- the results of any seismic survey or geo-chemical, geo-physical and remote sensing data analysis;
- the result of any analysis or identification of minerals removed under section twenty-two;
- the geological interpretation of the records maintained under paragraphs (a) to (e) inclusive;
- the number of persons employed;
- any other prospecting work;
- the costs incurred; and
- such other matters as may be prescribed by the Minister by statutory instrument;

and shall furnish, at least once in every three months, digital and hard copies of the records to the Director, Director of Geological Survey and Director of Mines Safety.

Australian Geological Survey Company reporting requirements - mineral exploration:

- Tenure information
- Location map at 1:100 000 or larger scale, showing Map Grid of Australia (MGA) standard map sheet reference,
- Exploration rationale, the program undertaken, and the exploration methods used, and
- Results of literature searches.

**Body of report contains:**

- **Geological Data** - regional setting and results of geological mapping must be described. Geological maps 'fact' and/or 'interpretative' maps are required and the datum must be specified. All maps must have a legend. Appendices include information such as petrological descriptions. Sample locations need to be shown on appropriate plans (or listed in drilling logs) or indicated by local grid co-ordinates and MGA or latitudes and longitudes. The datum must be specified.

- **Geophysical Data** (airborne surveys, ground-based surveys, down-hole surveys) consists of: raw and processed located data (digital data); gridded data and images, and interpreted results. Reports include results and interpretations of all geophysical surveys and include data details such as: date of submission, an A4 or A3 plan showing the location of the survey, flight lines, traverse lines and stations presented on maps with MGA (datum specified) and significant cultural features which may affect the results (e.g. power lines). Specifications of the survey are required (i.e. type and date of survey and survey parameters, and any data recorded on terrain conditions, nature of ground, quality of electrical contacts, extent of drifts. A data acquisition report is required detailing the operations carried out and any processing, text descriptions defining what constitutes an anomaly over background, and relating anomalies to geochemistry, geology and the results of drilling; plans or sections showing processed data and interpretation at the same scales as the geological and geochemical plans. For ground geophysical surveys, located (or reduced basic) data, with adequate ties to MGA coordinates tabulated in appendices. The datum must be specified. Gravity data must include the station number, MGA co-ordinates, AHD elevation, absolute observed gravity, terrain correction, and must specify the methods and parameters used to calculate the Bouguer anomalies.

- **Specifications are similarly set for:** Geochemical Data, Drilling Data, Remote Sensing Data.

- **Statements of any resources and reserves identified must be included** and must be in accordance with the Australian Code for Reporting Identified Mineral Resources and Reserves and the Australasian Code for Reporting Identified Coal Resources and Ore Reserves prepared by the Joint Committee of the Australasian Institute of Mining and Metallurgy, the Australian Institute of Geoscientists and Australian Mining Industry Council.

- All reports should include a bibliography of other work, earlier reports cited etc. and appendices (data) as appropriate.


Similarly GSZ’s internal mapping programs\textsuperscript{13} do not have ‘data models’, standards or procedural guides. Consequently, there are inefficiencies and obstacles to widespread useability of the data captured by GSZ mapping programs.

**Maintenance and integrity testing**, to protect against deletion, over-writing and issues around multiple versions of data and quality control. This can involve testing that focuses on completeness and correctness of data (including technical assessment before acceptance); or systems such as logging of database modifications so that changes can be ‘rolled-back’ if errors are detected.

**Access constraints and security**, for confidential company data/information. There needs to be a sophisticated system in place that prevents unauthorised access. Industry clients raised concerns regarding security of data/information provided to GSZ through the current reporting system.

Data delivery is another hurdle for the GSZ. Static website content is available and this provides limited information about the GSZ, its projects and services (e.g. mining legislation, tax regime, exploration potential, document ordering details). Templates for reporting requirements of exploration activities and results are not available on the web. Public geoscientific data cannot be displayed, selected, previewed or downloaded on the GSZ website nor can company reports be submitted online.

### 2.3.4 Monitoring Company Activity and Trends

Company activity is recorded through the Mining Cadaster Unit’s application system. As mentioned earlier, other mechanisms to monitor industry activity and issues, such as representation at exploration and mining peak body council meeting/assemblages, are not in place.

\textsuperscript{13} GIS platform - MapInfo and Encom discover
3 Stakeholder Data Usage and Needs Analysis

3.1 Mining Industry

Peak bodies for exploration (The Association of Zambian Mineral Exploration Companies - AZMEC) and mining (The Chamber of Mines of Zambia - CMZ) were interviewed to establish their perceptions of public geoscience data and the issues associated with information provision and access.

AZMEC is a lobby group for mineral explorers as well as government representatives, service providers, academic institutions and other parties interested in contributing to the growth, promotion, and sustainable development of the sector in this country. AZMEC has a total membership of 37 composed of: Large Scale Members (African Energy Resources, Anglo Exploration, Ausdrill Zambia, Blackthorn Resources, Caledonia Nama, Denison Mines, First Quantum Minerals, Katanga Resources, Luiri Gold, Barrick Lumwana Zambia, MMG Zambia, Northcore, Phelps Dodge/FMI, Rio Tinto, Serlinga Mining, Vale Zambia Ltd, Zambezi Resources, ZCCM – IH and Chibuluma Mines PLC.); Associate Members (Atlas Copco, Capital Drilling, Caracle Creek, GeoQuest, Infracra, Alfred H Knight, Intertek Genalysis, Kellogg Brown, Inkazteca Drilling and Ox Drilling Limited); Individual Members and Affiliate Members (The Chamber of Mines of Zambia, the Federation of Small Scale Miners Associations of Zambia - FSSMAZ, UNZA-School of Mines and Geological Society of Zambia).


Responses from these bodies highlighted a range of hurdles for the sector including:

- Lack of confidence in the current Mining Act;
- Lack of transparent and robust regulatory processes and consequent low confidence re: security and confidentiality of data held by government agencies;
- Inadequate funding of GSZ regional data acquisition programs and failure to market prospectivity of Zambia effectively;
- Inadequate training/skills development to meet governance/regulatory challenges facing government agencies (eg infrastructure provision – energy, water, transport; mining policy development and regulation) and productivity issues emerging in industry (eg advances for modern mining practice);
- Data management (physical and digital) and ICT skills in government was given particular mention and;
- Lack of regional Mining Registrar/Warden positions that had authority to investigate and resolve issues relating to the assessment of tenures within regions.

‘In-country’ training was raised as a major issue by both CMZ and AZMEC and that a more strategic approach was required. The CMZ highlighted the need to raise the skills level and the knowledge of best practice to ensure increased productivity in the face of rising labour costs and maintaining the operations of older mines.

The Federation for Small Scale Mining Association in Zambia (FESSMAZ), representing about 3,000 members, whilst not interviewed has been reported in the media as raising concerns about a lack of
transparency in government processes, highlighting the processes of the Mining Cadaster Unit. FESSMAZ listed challenges such as lack of financial resources, unreliable and incomplete geological data, and a lack of skills in mining (eg non-adherence to safe mining practices and mine planning).

### 3.2 Government Agencies and Ministries Involved with Mining Related Matters

The Zambia Environmental Management Agency (ZEMA) is the environmental regulator and coordinating agency for the government. The Environmental Management Act, 2011 requires mining companies to lodge an Environmental Impact Statement (EIS) and obtain approval for such EIS from ZEMA for all new mining projects as part of the mining approval process.

Currently there is limited interaction and awareness of potential benefits of engagement between ZEMA and the GSZ. Interaction is largely restricted to accessing GSZ’s laboratory facilities. Some geological information is provided for ZEMA’s 5 yearly report on ‘the state of the environment’.

The Ministry of Finance and National Planning is responsible for national infrastructure initiatives. The mining industry in Zambia has highlighted constraints to development in the areas of planning rail, road, electricity, water needs. Despite these concerns and the importance of understanding future resource potential for infrastructure planning, there is no direct engagement with GSZ in such strategic planning processes.

ZCCM Investments Holdings (ZCCM-IH) is the mechanism by which the Zambian government has retained a minority shareholding of between 10% and 20% equity in most of the large-scale mining companies following privatisation of ZCCM. The Company’s shareholders are the Government of the Republic of Zambia with 87.6% shareholding and private equity holders with 12.4%. ZCCM-IH holds tenure in Zambia and as such is required to undertake exploration. There is no direct engagement between ZCCM-IH and GSZ.

### 3.3 Tertiary Institutions

The University of Zambia’s (UNZA) main concern was not about interaction with GSZ but rather the lack of industry support and engagement with UNZA.

Options to strengthen such linkages were discussed including development of industry research thesis topics focusing on Zambian mining operations and co-tutelle arrangements for the joint supervision of doctoral candidates between Zambian Universities and The University of Queensland.

Key features of such co-tutelle arrangements include that the:

- Candidate has a principal advisor at both universities;
- Candidate complies with the admission and progression requirements of both universities;
- Degree is awarded by both universities following a thesis examination that complies with the rules and policies of both universities;
- Thesis examination includes an oral examination in the language of the university conducting the examination, with an oral summary provided in the other language.

Formal associations with Australian Universities with strong mining programs were seen as a mechanism to develop better engagement with industry.

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16 Source: [http://www.times.co.zm/?p=19942](http://www.times.co.zm/?p=19942) Times of Zambia 25 June 2013
17 Sources include presentations at the International Mining and Energy Conference, ZIMEC, June 2013.
4 Conclusions and Recommendations

Natural resources figure prominently in Zambia’s development planning. Mining remains Zambia’s greatest source of earnings, and attracts high levels of investment from China, Switzerland, the United Kingdom, Canada, Australia and other countries.

The Zambian Government is redesigning policies (e.g. the Mining Act) to encourage continued private sector investment and will look to exploit spill-over effects from associated infrastructure expansion to benefit other sectors of the economy.

Zambia’s Geological Survey should be a key instrument in the country’s development plan in terms of:

- Strengthening and diversifying mining, recognizing that there is risk due to market volatility associated with the dependence on a single commodity;
- Improving competitiveness and infrastructure for growth and employment by attracting the largest competitive field of exploration investors who will discover a new generation of large low-cost mineral deposits and deliver returns to the community as rents/tax revenues and improved infrastructure; and
- Improving governance and strengthening economic management by providing geoscience information for broader uses such as the planning and management (economic, social and environmental) that underpin regional development decisions.

Currently the GSZ cannot meet these expectations because of its inability to provide ready and equitable access to robust geo- data that is in forms that can be easily used by a broad range of clients.

By tackling the fundamental issue of data management, IM4DC has the opportunity to significantly improve sector governance and better position the MMMD to meet standards of service and satisfy citizen demand. Development of data management ethos will create an enabling environment for exploration and mining companies as well as facilitating natural resource planning and transparency of government.

4.1 Gaps in Knowledge and Skills

The GSZ has identified data management as the priority area for capability development. Information management practices and ICT skills, as well as ‘the development of procedures and interfaces for data input, querying, and report generation’, was identified as a priority in the survey response by the Chief Government Geologist.18

Data management issues hugely impact on GSZs ability to support not only the exploration industry but to provide data to other agencies that can be used in a range of activities from infrastructure planning to environmental management. Put simply the benefits of public geoscientific data/information cannot be fully realised without establishing information systems/protocols that enable the equitable access to information and efficient data distribution for a broad range of purposes.

Key knowledge and skill gaps:

- Data governance frameworks (documented policies, procedures and processes)and data standards (e.g. database models and data definitions; reporting requirements) are required to enable the effective capture of data in forms that can be integrated and confidently interrogated with minimum effort by industry and government users.

18 Post graduate training in geosciences, especially petroleum geology, structural geology and geophysics was also identified as a priority
• Data stewardship and custodianship roles are essential to realise greater integrity and confidence in the administration and delivery of information. Custodians ensure information datasets and products are of a consistently high standard and 'fit for purpose' as well as oversight quality control and quality assurance procedures before dissemination of information.
• Data integrity and security recognising that large investment decisions are made using public geoscience, so data integrity is critical and that data security is essential recognising that information submitted on exploration activity form a vital part of government geoscience databases.
• Storage and access technologies.

Research is also required into the opportunities that new technologies are providing to economically extend the reach of geoscience archives.

With this capability in place other skill sets need to be developed to support the transformation of geodata into forms required by the decision-makers involved in broader regional development planning (e.g. economic, social and environmental management issues) as well as to market more effectively the resource potential of Zambia.

4.2 Developing Capability

The Chief Government Geologist highlighted that ‘sustaining activities beyond periods of technical assistance’ was a major hurdle for the GSZ. ‘Capability development efforts should be long-term – lasting a few years- rather than a one-off activity’.

With this in mind the following program is recommended:

• **Data Format and Integrity Training and Awareness:**

The objective of this training component is to support the Zambian Government’s objective to improve the enabling environment for mining sector development by training GSZ staff in practical data acquisition protocols that will improve useability, accessibility and reliability of government geoscientific data programs. These would draw on knowledge of governance frameworks and structured data management protocols currently used in Australian Geological Surveys that have been developed with the objectives of operational efficiency, and maximising the benefit of their archives.

The focus would be on:

• Data format/models for field recording.
• Australian requirements for company report submission – compliance standards and formats.
• Roles and responsibilities of data custodians.
• Metadata.
• Cataloguing of physical samples/records.

The emphasis would be on efficiency and transparency: focusing on strengthening institutional processes and capacity in modern data management practice.

• **Technology Assessment:**

Technology is a major part of public information management and dissemination and is important to the leverage value from existing data. Technology can also be used to increase transparency and eliminate waste and opportunity for rent-seeking. An assessment of minimal requirements to establish a platform for the GSZ to store and disseminate public geoscience is required, recognising that the ability to fund and maintain such technologies will be paramount in selection of approaches. This aspect of the work program requires involvement of key GSZ staff recognising that government ownership of process re-engineering is critical for sustainability of reforms.
The emphasis should be on assessing requirements to develop a basic geoscientific data management center to digitize, store and increase on-line access to geoscientific data. Supporting efforts of the Geological Survey to comply with the Extractive Industries Transparency Initiative19 as well as provide geoscience data to a broader client base.

- **Promoting the Mining Sector and Geoscience in Government Planning:**

The objective of this component is to support the Government to improve the enabling environment for mining sector growth by developing expertise in resource forecasting. The objective is to better support the policy environment for mining-related infrastructure development (with spill-over effects from infrastructure expansion to benefit other sectors of the economy) and to integrate more effectively with other Ministries (e.g. environmental).

The focus should include:

- Quantitative estimation of undiscovered mineral deposits – for industry and government clients.
- Statics for resource modelling: dealing with uncertainty and risk.
- Multidisciplinary approach to resource assessment.
- Regional resource assessment for policy making – methods and models for real decision making.

A series of tailored courses are proposed to ensure immediate impact on the operations of the GSZ in addition an evaluation and report outlining cost effective mechanisms to modernise the GSZ data management system. Training would also include UNZA staff and students.

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Appendix A – Potential program

The following outlines a potential training program which addresses the three themes identified, designed to be delivered over a two year period. Such a program would require a significant level of funding and benefit from the development of a partnership approach.

- **Data Format and Integrity Training and Awareness:**

This component would be conducted as Zambian based workshops over a 2 year period:

2014 – ‘Effective collection and management of field data’. A 10 day field based training workshop.
2014 – ‘Data custodianship’. A 5 day workshop.
2014 – ‘Cataloguing, standards and metadata’. A 5 day workshop.

- **Technology Assessment:**

To be conducted as a research and knowledge transfer project over a 2 year period.
2014 – 10 day evaluation of GSZ data and storage/archiving and retrieval systems.
2014 – Benchmark and research on cost effective mechanisms to transition GSZ to a modern data management system. Report and proposal.

- **Promoting the Mining Sector and Geoscience in Government Planning:**

This component will be conducted as Zambian based workshops over a 2 year period:
2014 – ‘Regional resource assessment for policy making – methods and models for real decision making’. A one week training course.
2014 – ‘Multidisciplinary approach to resource assessment’. A one week training course.