In his article in the Nov/Dec edition of PositionIT, David Ives [1] opened his exposition with "Right now, there are a number of technology mega trends that are reshaping the future of business and society." He continued, "This is having profound implications for the way we live and work."

The heading of the very next article [2], "Paradigm shift in navigation industry", also points to a changing landscape driven by technology. Against this background, mine surveyors face a continuous challenge of adapting and applying changing technologies to the mining environment. Ives' observations are, therefore, particularly appropriate.

In addition to technological innovations, the legal framework within which mine surveyors operate today is fundamentally different to that of ten years ago. The law affects the way in which mine surveyors collect, process, present, and report survey results. The objective of this article is to explain the impact of the new legal framework for mining on the role of the South African mine surveyors today.

The legal implications on mine surveying were already established in the medieval times. Agricola [3] discussed the role of the mine surveyor in great detail in 1556 and he listed lease surveys, position surveys, and the provision of evidence for the settling of boundary disputes as key activities of mine surveyors.

Today, accurate mine plans are still essential for the health and safety of mine workers and those members of the public living in close proximity to mines. For multiple-level underground mines, surveying involves the correlation, duplication and linkage of the surface survey and mapping system with each underground level to a high degree of accuracy. Although the role of the mine surveyor has not fundamentally changed over time, technology and the laws that govern the profession have changed and will continue to change.

A recent publication [4] on the role of the coal mine surveyor highlights the rules and principles governing the mine surveying profession today.

The legal impact is substantial and this article explains the most important pieces of legislation to mine surveyors, namely the Mine Health and Safety Act and the Mineral and Petroleum Resources Development Act, together with the relevant secondary legislation.

**The Mine Health and Safety Act (MHSA) 29 of 1996**

The MHSA became effective on 15 January 1997 and replaced the long-standing Mines and Works Regulations 27 of 1956. Although relatively new, the Act had undergone substantial amendment. All the chapters of the Regulations to the MHSA have not yet been promulgated, which means that the effective sections of the MHSA have not yet been promulgated, which means that the effective sections of the Mines and Works Regulations that were incorporated into the Regulations of the already repealed Minerals Act 50 of 1991 were again reincorporated as an interim measure into the Regulations of the MHSA.

Whereas the historic legislation was of a highly prescriptive nature to prevent past mistakes and accidents from recurring, the MHSA has a forward-looking approach, and it aims to promote a culture of health and safety among employers and employees through the implementation of health and safety measures.

**Fig. 1: Mine surveyors taking stope measurements.**

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systems, institutions, training and monitoring (also the management thereof) of risks.

Responsibility generally lies with the employer, who is defined as the owner of the mine and by implication, the holder of the mining right. To ensure compliance with the legislative framework, the employer has to staff a mine and entrust functions to a manager and other persons, which employees include those meeting the definition of competent, such as the mine surveyor. Once the mine is staffed with due regard to health and safety, the employer, who will normally delegate the health and safety function to the mine health and safety manager, must establish a health and safety policy, codes of practice (COP) for high-risk activities and training programmes and systems to assess and respond to risk.

Despite the fact that the employer has overall responsibility in terms of the Act, Section 22 states that employees must take reasonable care of their own health and safety and others affected by their actions. This responsibility includes the right to leave a dangerous working place.

Enforcement is through the empowerment of an inspectorate of mine health and safety to conduct inspections, investigations, inquiries and give instructions to employers and mine staff. Section 86 of the MHSA states that, “Any person who, by a negligent act or by a negligent omission, causes serious injury or serious illness to a person at a mine, commits an offence…”

Contravention or non-compliance with the MHSA may result in fines imposed on employers by the regional Principal Inspectors of Mines. Serious cases may be referred to the Attorney-General in addition to the authority of the Principal Inspectors of Mines. The minister may declare health and safety hazards, prohibit or restrict work for any reason relating to health, safety and the environment. This provision for closing a mine for health and safety reasons was exercised on several occasions in 2007 when mine accidents resulted in the death of employees.

In terms of the MHSA mine surveyors, as employees, must assist employers with general health and safety matters required for ensuring safe operations. The relevance for the competent mine surveyor becomes more evident from the Regulations.

Surveying duties directly linked to the MHSA are measurements required for accident scenes; monitoring surveys for fluid concentrations, slope stability, subsidence and pillar over- or undermining; high-risk and hazard plans; boundary verification; mine plan updates; and correlating the surface topography with the underground surveys for each level of the mine. The following requirements of Chapters 14 and 17 of the Regulations [5] necessitate specific mine survey input:

Chapter 14 is concerned with protection of the surface and the workings, ingress of water or other fluid material into workings and risks, such as rock falls, subsidence, cavities and collapse of surface structures at mines. The role of the mine surveyor includes the surveying, monitoring and reporting of these risks to management;

Chapter 17 of the Regulations deals with the statutory duties of mine surveyors with respect to the appointment of the competent surveyor; general practice relating to accuracy and standards for field surveys, map projection and survey systems, processing of survey data and mapping at mines; safety precautions, procedures and reporting of risks requiring survey input; detailed requirements for the compilation, updating and submission of statutory mine plans and departmental copies; and the survey issues relating to mine closure.

All physical survey measurements that are taken or observed in the workplace need to be processed in one way or another. Most of the measurements required for the survey function on a mine require error propagation and calculation of accurate coordinates and heights in relation to the survey datum. Health and safety survey measurements, such as monitoring pillar over- or undermining, require additional calculations, such as safety factors, extraction factors and width-to-height ratios. Coordinates and elevations are also the base data for further processing of areas, volumes and mineral reserve reconciliations.

As is the case with data processing, mapping is normally done electronically using specialised mapping software. The mapping duties include the updating of statutory maps, other plans and sections as required by the MHSA (e.g. mine rescue and ventilation plans), the compilation of reticulation plans, rehabilitation design plans, infrastructure plans and check survey plans.

Mine surveyors must also give input to the compilation and implementation of COP. In this regard, they are involved with the installation and management of monitoring systems designed to combat rock falls. Another COP which requires survey input is that for the ingress of water into mine workings. It is also standard practice to have a stand-alone survey COP with detailed operating procedures to guide all survey duties on a particular mine.

Another important duty is to observe the mine plans for the identification of risks, such as subsidence, collapse of surface buildings and structures resulting from the removal of support, and risks related to mining in the proximity of other underground workings. To ensure that the surveyor knows which parts of the mine to monitor, the MHSA requires the employer to notify the surveyor appointed as competent person of all working mining faces, surface structures affected by mining, workings being abandoned and safety pillars that are being or have been removed.

Once aware of these events, it is the mine surveyor’s responsibility to implement effective compliance systems and report hazards, risks and any non-compliance to management.
In addition to on-mine reporting protocols, the Regulations (Chapter 23) include a guideline document on the reporting of accidents and dangerous occurrences. Other statutes of relevance to mine surveyors include separate guideline documents on the compilation of COP.

A further duty is the observation and management of the mine boundary lines and pillars. The mine surveyor must indicate boundary pillars on the mine plan, follow instructions from the mine manager and communicate events on both sides of the boundary line. When working faces approach the boundary pillar, the surveyor must give adequate warning and continuously monitor the situation.

The mine surveyor also gives input to the rehabilitation plan and has to investigate community complaints registered at the mine. Examples of such input and investigation would include the survey of ground movement in the form of cracks, subsidence and sinkholes by establishing the distance from the mine, correlating the incident with the surface and underground mine workings and establishing the scale of the problem.

The Mineral and Petroleum Resources Development Act (MPRDA) 50 of 2002

The role of the mine surveyor in terms of the MPRDA varies from company to company and the qualifications of the surveyor. The MPRDA is a new Act and can be considered a paradigm shift from its predecessor, i.e. the Minerals Act 50 of 1991. The MPRDA was promulgated on 30 April 2004, and it affects all historic rights issued over the past 100 years, with the associated plans and diagrams compiled on many different survey datums and units of length. Its impact is significant and is reflected in first, the many different Acts it repealed or caused to be amended and second, the allowance of a five-year transition phase (Schedule II of MPRDA) to fully implement all the new provisions.

Although a stand-alone Act with its own Regulations, the Mining Titles Registration Act (MTRA) 24 of 2003, which is an amendment of the Mining Titles Registration Act 16 of 1967, provides for security of tenure during mining and prospecting and is classified as secondary legislation to the MPRDA.

The mine surveyor is responsible for the preparation of tenure and other legal plans, which include regional plans, locality plans, mining rights plans, plotting land survey diagram (farm information) on mine plans, surface right plans indicating agricultural lease areas on plans and keeping the necessary records on their status, rezoning and servitudes, and finally, plans and information required for the relocation of graves.

The primary role is the preparation and signature of maps, plans and diagrams when applying for mining rights and the registration of such rights and permissions. There are many different rights that could be applied for, all of which require plans, diagrams and areas for both application and registration purposes. In addition to the plans and diagrams, the mine surveyor must give input to work programmes and mine rehabilitation plans, which include the determination of areas and volumes to determine the financial provision for the remediation of environmental damage (Section 41).

In terms of Section 48 of the MPRDA, mining and prospecting is prohibited on land comprising a public cemetery. However, for surface mines wishing to mine in areas where there are family or traditional burial sites and cemeteries, it is possible to mine such areas under strict rules governing the relocation of the graves. Such relocations have implications for the mine surveyor, who has specific surveying and mapping duties to ensure compliance.

A particular problem for mine surveyors during the transitional period, when all the rights granted over a period extending back to more than 100 years, is the conversion of coordinates to the current map projection and survey system. The original systems range from being localised in Cape roods, Cape feet, English feet or metres to the current Hartebeesthoek land survey datum. The mineral royalties stipulated in the original contracts will remain effective during the transition phase. Where these royalties were based on units, the mine surveyor remains responsible for the measurement and calculation of the royalty amount.

The MTRA deals with the registration of mining and prospecting rights that are granted in terms of the MPRDA as limited real (property) rights in the Mineral and Petroleum Titles Registration Office (MPRTO). Regulation 3 [6] defines a surveyor as a person registered at PLATO [7] in the category of either Professional Land Surveyor or Professional Mine Surveyor [8]. Chapter IV of the Regulations deals with the requirements for diagrams and plans, which must accompany applications for rights, permissions, permits and reservations. All plans must be signed and certified by a qualified (registered in the professional category) surveyor. There are specific requirements (Regulation 42 of MTRA) for the information and details that must appear on plans for this purpose. Additional requirements for the plans that must accompany the original application appear in Regulation 2 of the MPRDA.

International influence

In addition to legal compliance issues, national and international standards are increasingly playing an important role in what is expected from mine surveyors today. The mining industry in South Africa has undergone dramatic changes in the past two decades. Where local mining companies only had national assets before the 1990s, today these are international with assets around the globe.

International standards are applicable to South African surveyors working for multinational mining companies, e.g. BHP Billiton, the Anglo group of companies and Goldfields. These multinationals have operations in different parts of the world and have or are in the process of standardising mine survey practices across the group through guideline documents.
A final international influence is the requirement for additional reports and recordkeeping when the mine has ISO 9000 accreditation. ISO compliance makes it easier to comply with the legal framework because of the overlaps in the requirements and the fact that ISO currently describes international leading practice.

**Conclusion**

This article demonstrates that, as in the past and now in the present, the future role of the mine surveyor will be principally driven by legal requirements. Along with society, the legal framework is still evolving. It is, therefore, essential for mine surveyors to know the legal framework that affects them.

The mine surveyor has a particular challenge to keep current with qualifications and applied technologies. A measure of their contribution is the extent to which they adapt to the changing landscape and implement new systems and measures to continue to add value to their employing or client companies.

The role of the mine surveyor is not only of a technical nature. Both the MHSA and the MPRDA require reporting measurements far in excess of their predecessors. These requirements leave the profession and providers of education with a specific challenge: First, to deepen the understanding of the application and impact of the new legal framework on the role of the mine surveyor; second, to anticipate future business risks to their employing companies or clients and thereby add value to the greater business; and third, to improve reporting skills so that survey communications effectively demonstrate compliance with the law.

**References**


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