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LATEST TECHNOLOGICAL UPGRADATION IN THE MINING INDUSTRY

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ABSTRACT
Mining progresses through a series of stages that begin with exploration continue through production and conclude with mine closure. We encounter numerous risks, as well as hazards to the environment and mankind, at every stage of the mining process. As a result, technological advances in the mining industry are being developed to reduce the job's risks. The increase of mineral demands with respect to communities and the environment drives the renewal of innovations. The mining process becomes more productive and dependable by incorporating technical breakthroughs such as geophysical methods for mineral discovery, global positioning systems, geographic information systems, 3-D models employing software, and so on. As a result, technological upgradations shape the future.

Keywords: Mining, Technical Breakthroughs, Geophysical Methods, Geographic Information Systems

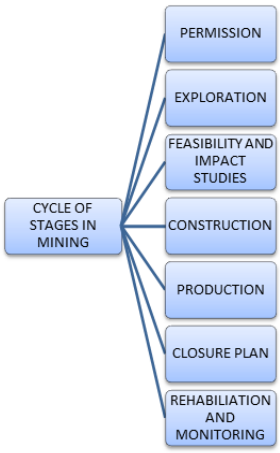
INTRODUCTION
Mining is a historic business that is considered the backbone of any economy. As a result, being an ancient industry does not imply that you must use old methods. In general, the mining business appears to be less technologically advanced than other industries such as biotechnology, communication and so on. However, the truth is rather different. In any bad condition, mining has the potential for innovation, resulting in increased efficiency, safety, environmental and social integration. Because we mined nonrenewable minerals that are present beneath the surface, where unknown and unreceptive circumstances obstruct exploration and extraction, mining innovations are complex and challenging.

Technological advancements in the mining business enable smarter mineral discovery, more efficient mining, safer working conditions, and a more ecologically conscious industry. Smarter exploration methods aid in the identification of minerals, chemical and physical features of minerals in the field, as well as the detection of mineral deposit depth and modelling of mineral deposits. Mining technologies based on data that are better suitable for mineral extraction. The technical advancements increase the underground communication system while also allowing for advanced mineral transportation and emergency response. It also has a lower environmental impact.

Innovation in the mining industry refers to changes in the continual process of drawing information from many fields. Innovation isn't limited to the realm of technology; it can also be founded on social and environmental considerations. Social and environmental factors are extremely important in the mining industry. As a result, while renewing technology, technical improvements take these factors into account.

MINERAL DEVELOPMENT CYCLE
PERMISSION
It is the primary stage before starting mining processes. In this stage we acquire the government approval for the further proceedings.

EXPLORATION



It means searching the minerals which present below the surface. It is the preliminary stage of the mining operations which guides us for choosing the mining method, machinery selection, adaptation of new technologies etc.

Fig. 1 – Exploration of mineral

In this stage the technological advancements like global positioning system, geographical information system, geophysical methods, spectrometer etc set a remarkable achievements in mining industry.

GLOBAL POSITIONING SYSTEM

It is a satellite based radio navigation system which allows the user for determining the fast and accurate location information by utilizing the satellite signals. It allows the user to pinpoint the location quickly and accurately. Each GPS receiver uses these signals which are transmitted by GPS satellite from the space to calculate its three-dimensional location (latitude, longitude, and altitude) and the current time. It is handy and light weight. So you can carry anywhere easily. In mining industry that is used for finding location and searching mineral in remote areas [1].

Fig. 2- Global Positioning System

GEOGRAPHICAL INFORMATION SYSTEM

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The key word to this technology is **Geography** – this means that some portion of the data is spatial. In other words, data that is in some way referenced to locations on the earth [2].

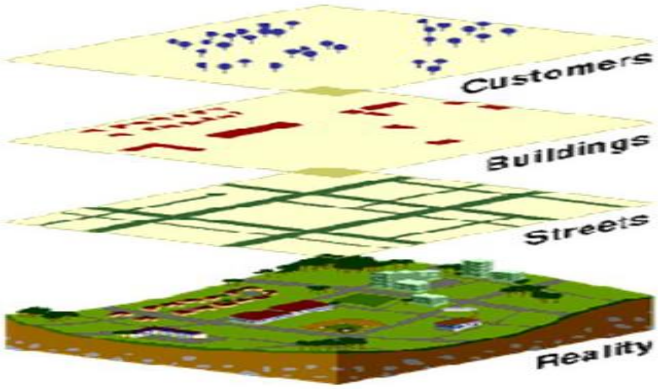
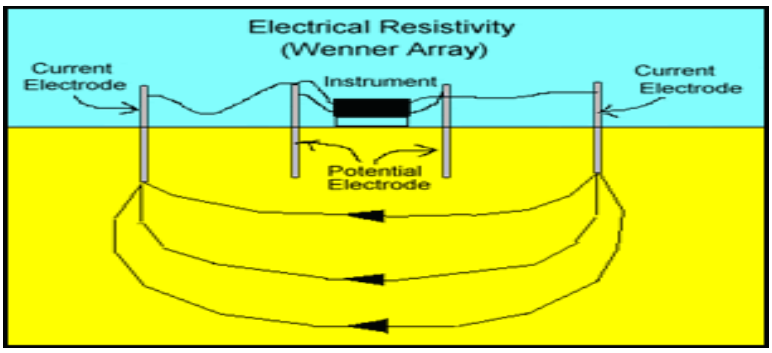


Fig. 3- Geographical Information System

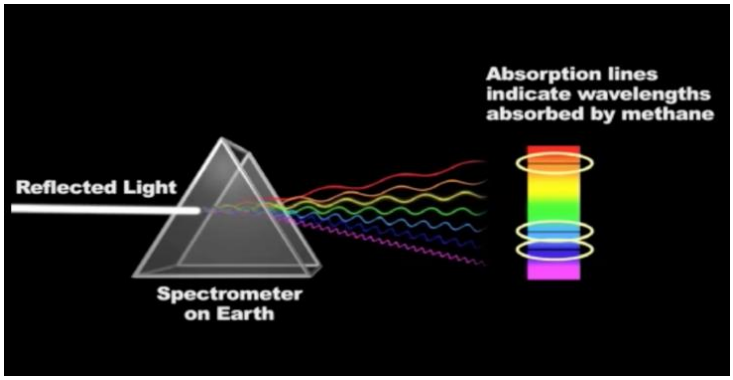
GEOPHYSICAL METHODS

Geophysical methods which is used for mine exploration is a combination of geophysics and economic geology, which uses physical methods, such as seismic, gravitational, magnetic, electrical and electromagnetic at the surface of the Earth to measure the physical properties of the subsurface, along with the differences in those properties. Now days these methods are the most preferable methods for exploration of minerals [3].



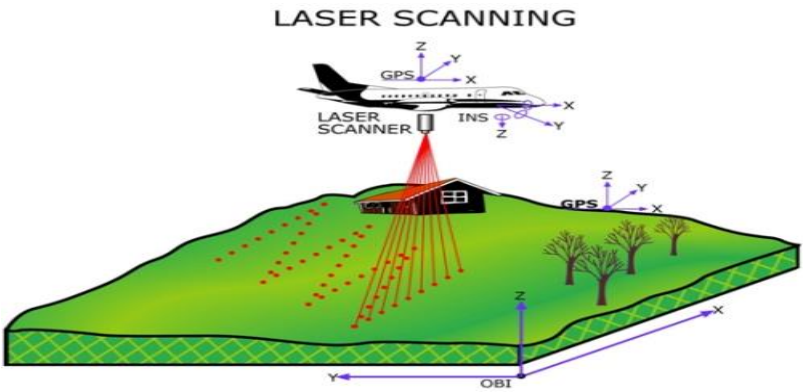
PORTABLE SPECTROMETRY

Spectrometer is a measuring device which is used for analyzing any substances using different wavelengths. The device allows the user to recognize the collections of different minerals and has the greater sensitivity than human eyes.



LIDAR

LIDAR stands for light detection and ranging. This device is used to map the topography fast and accurately in comparison to traditional methods. It uses the laser light for mapping [4].



ORE DEPOSITS

After exploration of mineral the next step is the calculation of ore reserve. For calculation there are many technologies implemented.

GEOMETTALLURGY

Geometallurgy is the combination of geological, mining, metallurgical, environmental and economic information to increase the Net Present Value (NPV) of an ore body while lessening technical and operational risk [5].

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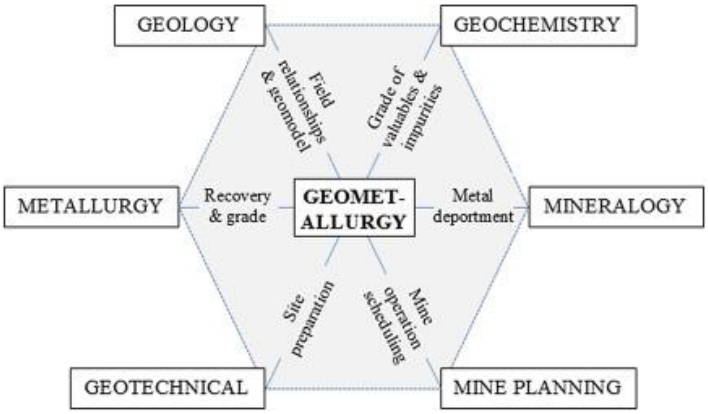
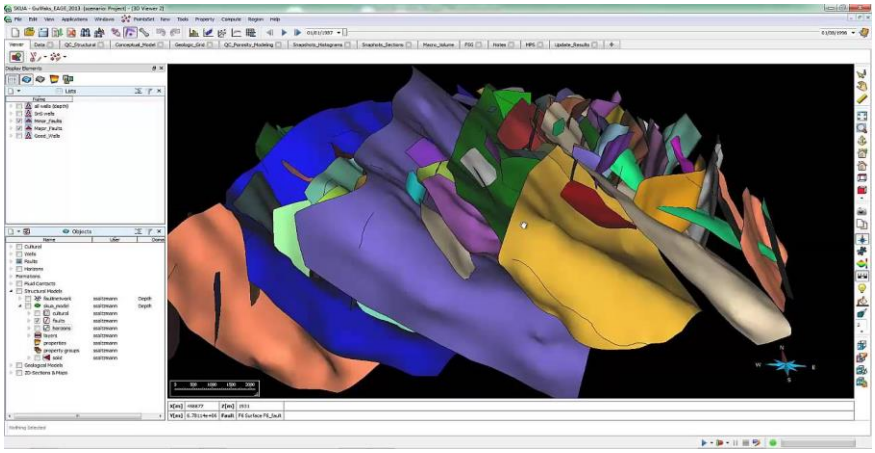


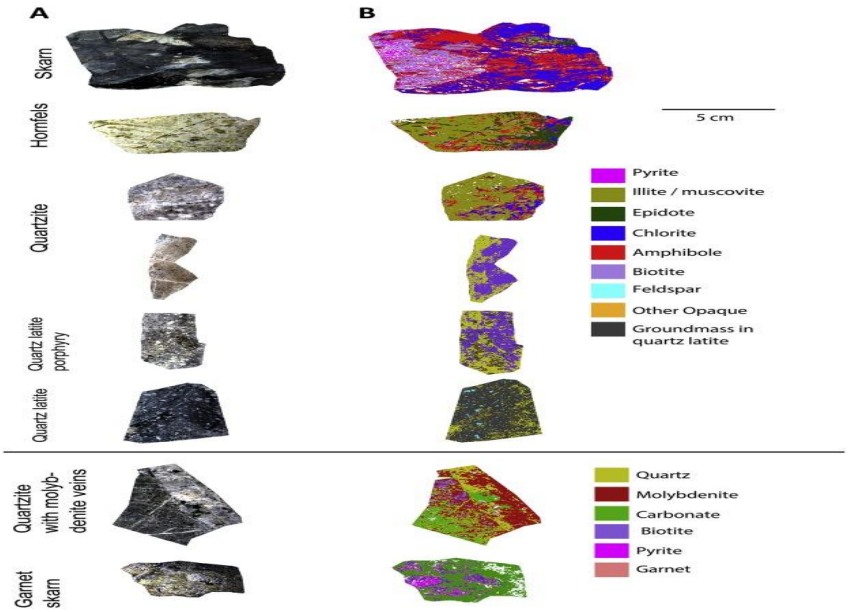
3 D GEOLOGICAL MODELS

There is much software available in the market which transforms the drilling and mining data into 3D images and data integration platforms that helps in data management. The 3D presentation of the ore body make easier for mine planning and designing [6].



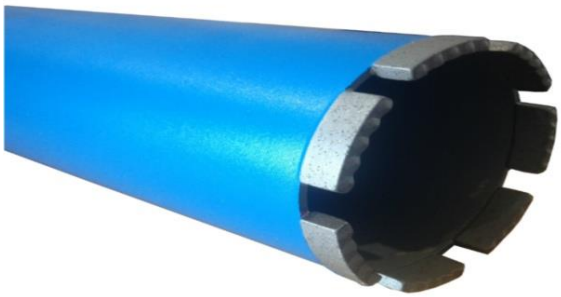
HYPERSPECTRAL IMAGER

Hyper spectral imaging is the ability to characterize the color of the user items. So every mineral has characterized by its color or images. This technology is used for mineralogical mapping and exploration in which characterized the minerals in the borehole.



CORE BITS

For exploration of minerals and finding the quality of ore now days core drilling is mostly used. In core drilling there is used core bits which help in collecting the core.



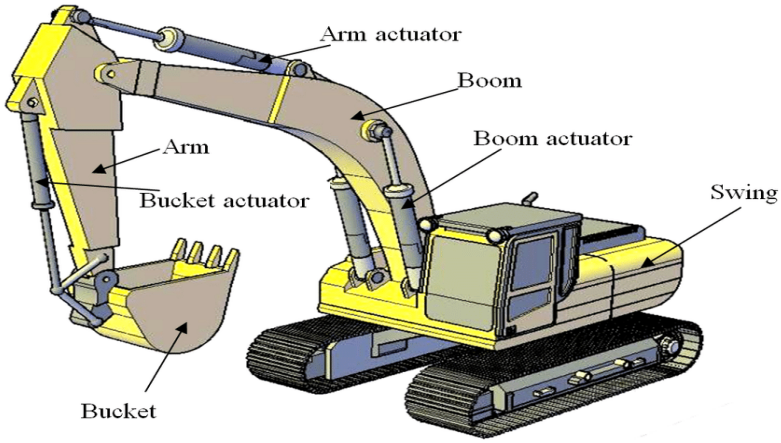
PRODUCTION

In this stage of mining we extract the ore which is most important phase for generating the money for running the mine.

EXPLODER- It is a device which is used for igniting the explosives in the blast hole.

HYDRAULIC EXCAVATORS

These are used for excavation operation i.e. cutting the ore or waste, loading of the blasted materials. It is more flexible, productive in comparison to traditional excavators.



MOBILE DRILLS

Mobile drills are used for drilling production holes as well as exploration holes.

MINING SIMULATOR

This technology is used for the virtual training of different mining operations to the personel in a safe environment. So the personel will be well acquinted with the operations in mining.

TRANSPORTATION AND COMMUNICATION

RADAR SENSOR

Mining vehicles are bigger in size so poor visibility for the operator. These vehicles are equipped with radar sensor which senses the obstacle and alert the operator. These radars are high frequency waves and more effective than optical devices which could be obstructed by mud or dust or magnetic devices.

TRUCK TRACKING

Road Analysis Control (RAC) is a combination of number of sensors that informs the manager about the condition of haul road and improves large mining truck performance, productivity and safety while sinking repair, maintenance costs and downtime. By observing this data, manager will be able to identify and attend to haul road sections affecting cycle times and component life. As result of which we maintain the haul road properly and safer working conditions which implies the less breakdowns and accidents.

UNDERGROUND COMMUNICATION

Communication is the process in which exchange of the data with each other. Communication in underground is difficult. Before for communicating in underground mine whistles are used. The arrival of wireless communication system revolutionized the communication in mines.

HEALTH AND SAFETY

GAS DETECTION DEVICES

Underground mining operations produce the noxious and toxic gases. These gases are monitored by sensor used gas detecting devices. It will assist for ventilation management.

LED MINING HEADLAMPS

The technology for the mining headlamps has progressed significantly. This provides better illumination and also longer operating duration, light weight.

CONCLUSION

The mining industry should pay the more attention to improve the productivity by upgrading the technology. Without changing technology the allied industry has lagged behind the productivity to be achieved as per demand. Realizing a breakthrough on productivity performance demands to change how mining works. The potential to accomplish such a breakthrough is now coming within the industry's reach through digital and technology innovations that could transform key aspects of mining. As we discussed a number of digital technologies that have long been in the works and are now available and affordable enough to become operational at scale across the mining industry. Their applications include building a more comprehensive understanding of the resource base, optimizing material and equipment flow, improving anticipation of failures, increasing mechanization through automation, and monitoring performance in real time.

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