

MGMI

News Journal



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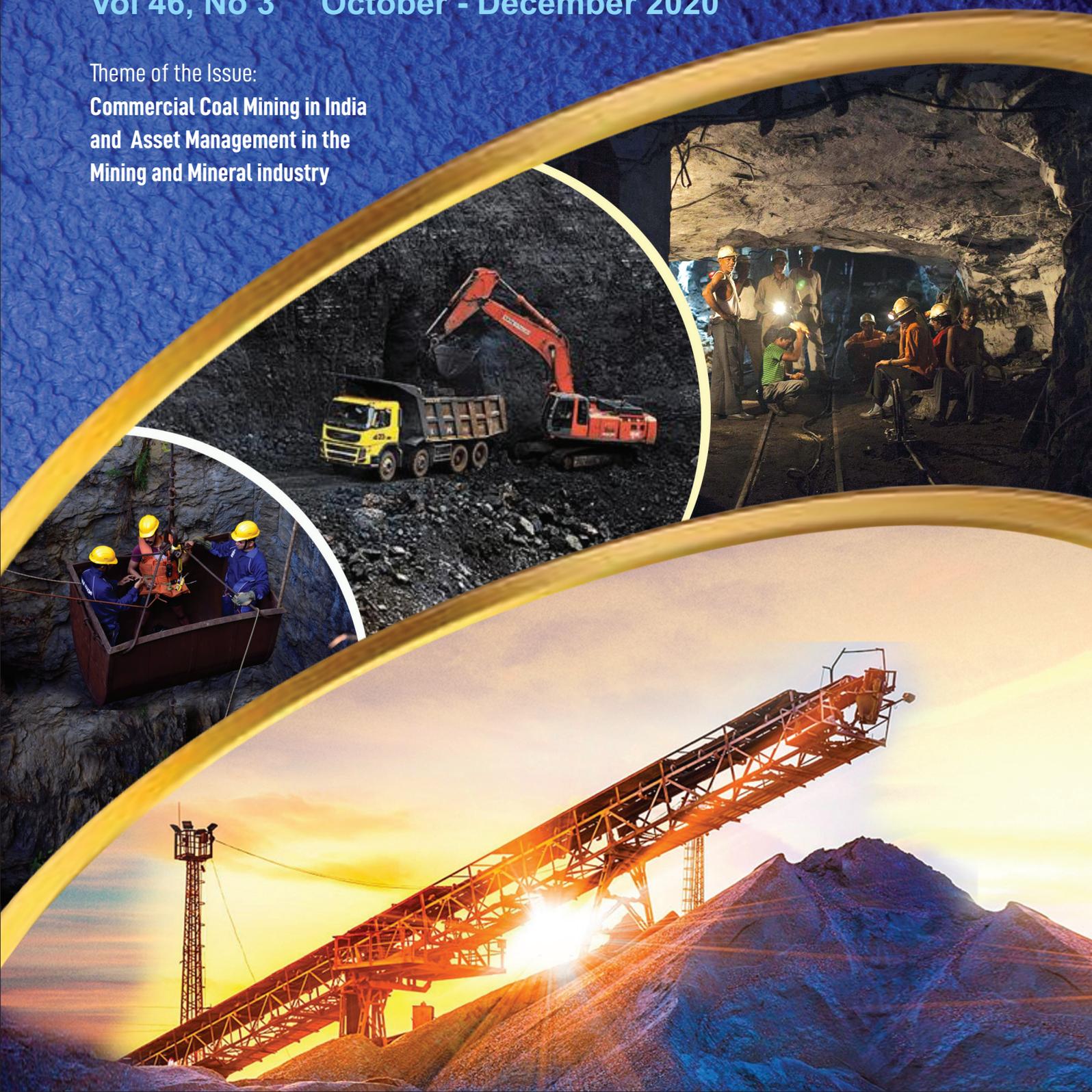
A Quarterly Publication

THE MINING, GEOLOGICAL AND METALLURGICAL INSTITUTE OF INDIA

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Theme of the Issue:

**Commercial Coal Mining in India
and Asset Management in the
Mining and Mineral industry**



MGMI Council 2020-21



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The Advertisement Tariff for Insertion in MGMI News Journal

Mechanical Data		Advertisement tariff per issue	
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Number of copies:	Above 3000	Cover II (Coloured):	Rs. 25,000/-
Periodicity	Quarterly	Cover III (Coloured):	Rs. 20,000/-
		Special Colour Full page:	Rs. 18,000/-

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President's Message

British Standards define asset management as a set of systematic and coordinated actions and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance risks and expenditures over their life cycles for achieving its organizational strategic plan. Asset management system is designed to support the delivery of an organizational strategic plan in order to meet the expectations of a variety of stakeholders. The organizational strategic plan is the starting point for development of the asset management policy.

Asset management is very important in the mining industry. Assets are developed as a result of capital expenditure. Some assets contribute directly to production while others contribute indirectly. The most important asset for mining in India is land. A critical scrutiny of the amount of land being used out of the total available land is the need of the hour. Surplus land could be used for creation of community assets like eco parks, community halls etc. Post mining reclaimed land, after restoring its fertility, could be transferred to its rightful future custodians. This will increase the trust between mine operators and project affected persons. Other important assets of the company include HEMM and financial assets.

Commercial coal mining will lead to the induction of state-of-the-art technology and a sharp ramp up in coal production. However, commercial coal mining will present new challenges for Coal India. The capacity utilisation of Coal India in FY 20 was 73 %. The dumper and shovel utilization was 69 % and 68 % as per the CMPDI norms of assessment. The delay in physical possession of land, statutory clearances,

rehabilitation and gamut of other factors have undoubtedly, played a role in poor utilisation of assets in mining companies. With the new changes brought recently, there are some improvements now and expeditious physical possession of land, statutory clearances and rehabilitation are being visible. Commercial coal mining is going to introduce new business competition in the industry; and to remain competitive the asset utilisation has to increase dramatically. The mining companies will need to produce more at lower cost today while facing a highly complex business and operational environment, which includes intrinsic uncertainties related to business, natural, technological, organizational, regulatory, legal, financial and market environment. Asset management can play a key role in this environment.

International Standard Organization (ISO) published in January 2014 the International Standard on asset management – ISO55000. This has been implemented in Australia and is reaping its benefits. Time has come to adopt this standard in mining companies.

However, India needs to assess its own assets and under its socio-economic and cultural backdrop, new Indian standards of industrial and public asset management system must evolve. A declared asset management policy by various organizations under an Indianised international standard would lead India towards its goal of development and march towards prosperity, to emerge as Samridha Bharat.

I appreciate that MGMI has chosen a theme of immense contemporary importance for its News Journal. I expect many new activities in these areas would follow in the coming years.

Kolkata
31st December 2020

P. M. Prasad
President, MGMI



From the Desk of Editor-in-Chief

Commercial Coal Mining is expected to expedite the scientific Asset Management in the Mining and Mineral industry in India.

Indian coal mining operations has large number of aging infrastructure that are not replaced or demolished yet. The hidden costs in many assets get seldom evaluated through detailed data acquisitions. The holding lands and deposits are often does not get properly monetized and many assets become liabilities that eat out profits. The values of mineral deposits keep gradually decreasing based on the way it is developed and exploited. Some of the utility reserves like water sources and township spaces get increasing demands. There is also an increasing demand today for introducing sophistication and advanced technology. However, there are many complicacies in deployment of advanced technologies as a large number of employees in mining and mineral industry are digital half-literate. With the retirement and new recruitment, the digital literacy is being introduced fast, however, controlling the product and environmental quality has many issues yet to be adequately addressed in Indian coal mining. Deep seated coal seams are yet to be accessed. Economic underground coal mining capabilities are yet to be established

Asset management in mining industry involves managing the land on lease, machinery and plants, infrastructure and facilities, and human resources which determines the nature and characteristics of mining operations carried out on a particular deposits in a specific environment. The quality and values achieved in such operations depend on performance and profit realized through the uses of the assets. For that purpose a scientific asset management applies information and communication technology to integrate different engineering

applications and operations and maintain them. The financial management is tuned with the operation and maintenance of production machinery.

Thus, it is essential that the advanced technology application in mining provide dependable models of subsurface conditions, environmental impacts and return on investment in manpower and machines. The financial management of mines, environment and mine closure management or production management all involve proper interactions and uses different assets deployed in the mines.

India is now going commercial coal mining that will introduce private companies to coal mining sector. As India does not have indigenous mining machinery manufacturers, the industry depends on imported machinery. The life of such imported machine and their spares must be extended as much as possible with high utilization factor, less mean time to repair and high mean time between failure. This is a challenge and proper asset management principle can help in meeting these challenges. As modern asset management is basically data driven decision making, therefore a transformation of mining industry is envisaged. Sooner the industry realizes and acts on digitalization and adopt advanced asset management, better will be the chances of surviving through timely capital and asset management and diversification, if required.

Let us hope 2021 will bring a healthy new normal in the mining and mineral industry also. With best wishes for a happy any prosperous new years to all the members of the MGMI, I expect in this year to receive more letters to the editor and more technical communications for publication.

Khanindra Pathak

Editor-in-Chief, MGMI

Kharagpur

31st December 2020



Associate Editor's Column

Looking at the Future of Mining Operations in India and that of MGMI News Journal

At the outset, I would like to wish fellow members of MGMI a very Happy New Year. The last year gave an important lesson to the planet at large on the criticality of building resilient societies, communities and industries. It is in this spirit that this issue of MGMI News is being brought out on commercial coal mining and strategic asset management across industries.

This past summer, the Government of India took the decision of opening up the coal mining market by inviting investments from the private sector. The coal blocks for which bids have been invited represent coal capacity in excess of 225 Mt. In doing so, the government anticipates revenue generation of Rs. 33,000 Crore (US\$ 4.5 billion) over the next 5-7 years. The move comes with opportunities of increasing the country's energy security and diversification of end uses. That said, there will be a set of challenges with the members of this august body should deliberate on. These questions pertain to the changes in investment structure in the coal sector, the implementation of key regulations, employment, environmental implications and so on.

In the media, several prospective merits and risks of this move have been pointed

out. Commercial coal mining builds resilience in two important ways. First, it has the potential to reduce India's coal imports which would otherwise rise in the backdrop of sustained economic growth. Second, a diverse economic portfolio is inherently more resilient, as it offers some buffers to system shocks. Such a process also has the potential to increase foreign direct investments, helping induce some positive reverberations to the economy. That said, concerns have been raised about the environmental challenges that coal sector growth could bring in.

Leveraging on the diverse end uses of coal is the key to the future success of this initiative. In the past issues of MGMI Transactions, members of this institute have discussed the complexity of extraction as well as utilization. In some deposits in western India, for example, there are very high prospects for underground coal gasification (UCG). Both the Government of India and CIL have, in the recent years, talked about the need for increased thrust towards UCG. Similarly, on the utilization front, sustainable pathways need to be developed for low-carbon, efficient conversion of coal to hydrogen to open up novel setups such as the methanol economy (as proposed by the NITI Aayog). Of course, such

diversification of sectors is easier said than done and they involve changing a lot of the induced path dependencies over decades. For example, last year Saudi Aramco – the world's top oil producing company – reportedly slowed down its plans toward diversification into the petrochemicals sector due to price signals. Thus, fossil fuel industries across the world are seeking to change their way of operating and delving into new areas. Concurrently, they are very aware of the risks in an abnormally risky market, generated due to reasons well outside their realm of control.

Another critical interplay involved here is that with environmental and societal sustainability objectives. Some voices have pointed to the potential risks of unabated increase in coal use jeopardizing global climate targets. It is difficult to predict whether an increase in commercial mining will de facto increase coal demand as well. At the same time, efficient mining practices, especially in the underground mining domain, could improve air quality somewhat and accelerate coal mine methane capture and utilization. In terms of how equitable these would be, some unions have expressed concerns over privatization. Indeed, employment and equity objectives are a key part of the Sustainable Development Goals, and it remains to be seen on how they will be incorporated in light of these new developments.

My personal sense is that there is no better venue for discussion of potential ways to reduce some of the aforementioned externality than this publication. Having now been involved in the preparation of five issues of this journal, I can safely say that there is an appetite in our MGMI community for high-quality articles from the academia and the industry. There are, in my view, few organizations that are capable of developing this interconnectedness between theory and practice better. Already, we have seen an increased turnout from authors, thoughtful feedback from readers and addition of new features such as interviews from learned experts. By continuing on this path, we are confident of carving out a niche for this publication in a way that directly addresses the concerns of the mining industry in India, and its stakeholders.

We welcome your ideas for representation of earth science sub-disciplines less represented so far and article categories that could help improve the outreach of our publications. Your input will help us markedly in reaching the editorial standards that we aspire to.

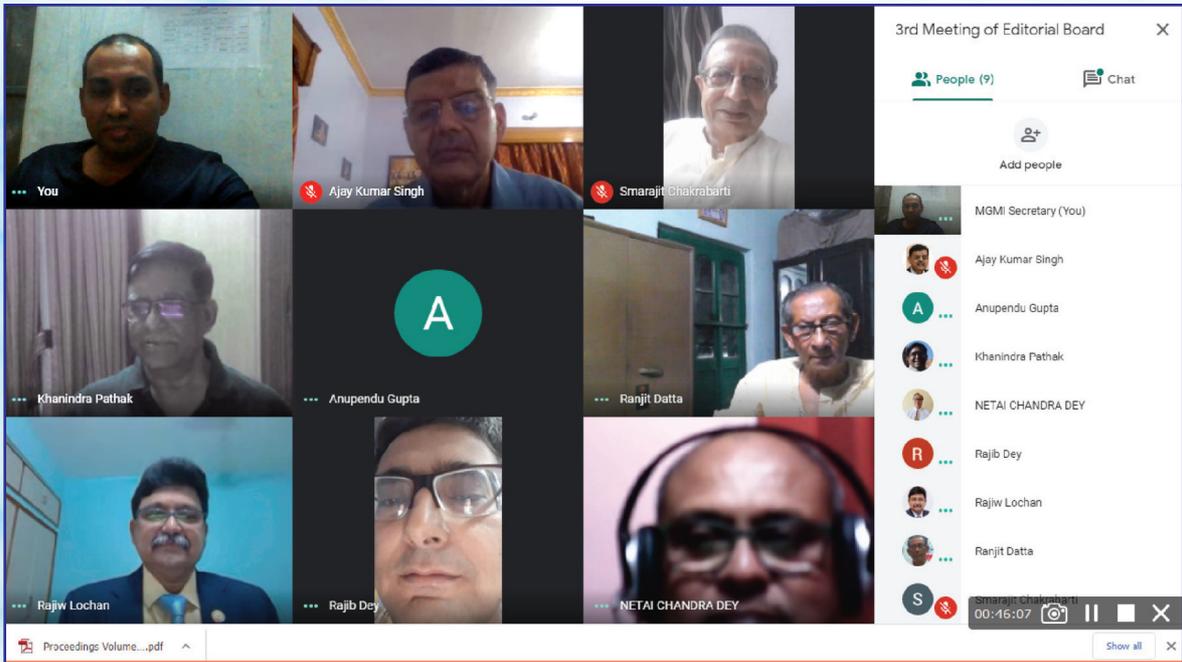
Ajay K. Singh

Former Scientist and Head,
Methane Emission and Degasification
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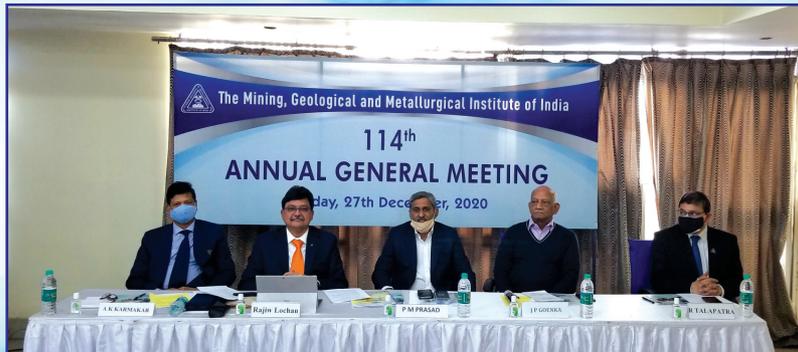


Snapshot of 886th Council Meeting of MGMI held on August 16, 2020



Snapshot of 3rd Meeting of Editorial Board held on November 8, 2020

PHOTO GALLERY



Dignitaries on dais in the 114th Annual General Meeting
Shri Anil Kumar Karmakar, Shri Rajiw Lochan, Shri P M Prasad, Shri J P Goenka & Shri Ranajit Talapatra
(L to R)



Shri Anil Kumar Jha, President, MGMI, delivering the Presidential address virtually in the 114th AGM of MGMI.



President Elect Shri P M Prasad addressing at the 114th AGM.



Group photograph of dignitaries present physically in the 114th Annual General Meeting held at MGMI Headquarters (others present through virtual mode)

Headquarters Activities

Minutes of 886th Council Meeting

(Held through Google Meet Virtual Platform VC)
Date & Time: 16th August, 2020 at 11.00 am

The report of the 886th Council Meeting of MGMI held at MGMI Bldg., GN-38/4, Sector - V, Salt Lake, Kolkata – 700091 on 16th August, 2020 at 11.00 a.m. (Duly approved in the 887th Council Meeting held on 16th December 2020).

PRESENT: Shri Anil Kumar Jha, President in the Chair. The meeting was attended by Prof Banerjee S P, Prof Dhar B B, Dr Nanda N K, S/Shri Sharma R N, Jha N C, , Saha R K, Ritolia R P, Goenka J P, Mandal P R, Lochan Rajiw, Talapatra Ranajit, Karmakar Anil Kumar, Roy Prasanta, Arora V K, Barnwal J P, Bose L K, Biswas Anup, Chakrabarti Smarajit, Prof Bhattacharya Ashish, Prof Dey N C, Prof Karmakar G P, Dr Pathak Khanindra, Dr Moitra A K, Nag T K, Prof Sarkar Bhabesh Ch, Dr Sen Kalyan, Dr Singh P K, Shri Singh Anil Kumar, Dr Sinha Amalendu, Shri Khuntia G S and Shri Kundu D K.

ITEM No. 0 Opening of the Meeting

0.1 President extended welcome to all Past Presidents, Council Members present in the meeting and informed that the world is now going through tough times because of the pandemic situation i.e.; COVID19. There might be more virtual meetings. Thereafter, he requested Hony Secretary to take up the Agenda items.

0.1.1 Leave of absence was granted to those who could not attend the meeting.

Condolence

- 1) Late Manoranjan Das (MMGI, LM-6296, 1992-93): He passed away on 2nd May 2020.
- 2) Late Dr Dilip Kumar Ray (MMGI, LM- 7766, 1997-98): He passed away on 24th May 2020.
- 3) Late Kalyan Kumar Sen (MMGI, LM-8653, 2003-04): He passed away on 31st May, 2020.
- 4) Late Chandra Shekhar Jha (MMGI, LM-1647, 1962-63): He passed away on 20th June, 2020.

Members expressed their condolences to the departed souls that was followed by observing one minute silence as a mark of respect to the late members.

886.1.0 To confirm the Minutes of the 885th meeting of the Council held at MGMI Bldg., GN-

38/4, Sector- V, Salt Lake on 28th December, 2019 at 11:30 a.m.

The draft Minutes were circulated by mail to all the Council Members. So far, no comments were received. The Council then resolved that:

Resolution: The Minutes of the 885th(1st meeting of the 114th Session) Meeting of the Council held on 28th December, 2019 at MGMI (H.Q). Kolkata be confirmed.

886.1.1 To consider matters arising out of the Minutes.

The Council considered the Action Taken Report in respect of the Minutes of the 885th Meeting of the Council held on 28th December, 2019 at MGMI (H.Q), Kolkata.

Membership Drive – Hony Secretary took pleasure in informing that M/s Central Mine Planning & Design Institute Limited (CMPDI) has become Life Corporate member of MGMI.

In last Council Meeting, a Committee was formed for Membership Drive and the members were intimated about their nominations. There has been no significant effect perhaps due to this pandemic situation, however, the Committee members are pursuing it on regular basis.

Short Term Course: Honorary Secretary, requested Dr AK Moitra to speak about Short Term Course on Exploration Techniques, its ways and means etc. In this connection, Prof Bhabesh Ch Sarkar wanted to know who would be the target audience and organizations to be approached who may be interested in sponsoring the course.

While discussing for organising the next Short Term Course on “Sustainability Development in Mining considering Environmental Issues” and “New Legislation – CMR 2017” here again almost same queries were raised about the targeted audience and the Industries to whom we can approach for financial help.

In this connection, Prof SP Banerjee, Prof BB Dhar, Dr Amalendu Sinha and Prof Bhabesh Ch Sarkar raised the similar queries regarding suitable subject for the Short Term Course and date schedule. On the subject, Dr Khanindra Pathak proposed that in each Short Term Course there may be 6-8 Sessions. He further added that

Headquarters Activities

courses “Exploration Techniques” and “Sustainability Development in Mining considering Environmental Issues” and “New Legislation – CMR 2017” may be clubbed together and a combined Short Term Course may be organized with virtual training classes for which propagation would be required with the scope and objective of the Programme through a valued informative brochure which would be circulated amongst the relevant organizations because individual participants may not be interested.

A Committee has been constituted with Prof S P Banerjee, Chairman, Prof B B Dhar, Co-Chairman, Dr Amalendu Sinha, Member, Dr Khanindra Pathak, Member and Prof Bhabesh Ch Sarkar, Member. Prof Banerjee proposed that a Kolkata based Council Member should be included in this Committee, preferably from Coal India Ltd. for better co-ordination.

Hony Secretary assured the Council that now MGMI will also organise Short Term Training Courses on Virtual platform and requested members to provide their input through email so that MGMI can prepare courses theme, topic, curriculum, and training format to prepare suitable circular /brochure for sponsorship. This assignment has been given to Dr Khanindra Pathak, Hony Editor and editorial committee members.

The Council also noted that 2nd Short Term Course cum Workshop “GEM 2020” was jointly organised by MGMI and CSIR-CIMFR , Dhanbad during 20th to 25th January 2020, in Kolkata and Dhanbad.

886.2.0 To Discuss on the 114th Annual General Meeting.

In view of the prevailing current pandemic situation i.e. COVID 19, the Council discussed the matter at length and felt that under the situation it will be difficult to hold the 114th AGM in person in September 2020. Further, to organize AGM through Virtual platform 75% of total membership must have their Email IDs functional. It was also observed that most of members are elderly citizen and are not comfortable to attend the meeting through virtual link platform. Considering the unavoidable circumstances and unexpected situation due to COVID 19, the Council unanimously decided and resolved that the 114th AGM will be held on 20th December, 2020. This may be intimated to Registrar of Companies (ROC) immediately.

While discussing on the forthcoming events of MGMI, it has been unanimously agreed by the Council that in view of pandemic, proposed Holland Memorial Lecture, MGMI President's Cup Golf Tournament, National Seminar and other events supposed to be held in 2020 where physical participation is required will now be deferred to the next year i.e.; 2021.

886.3.0 To consider Report & Recommendations of Award Criteria Committee on MGMI AWARDS

The Report & Recommendations of the Award Criteria Committee were circulated to all members. The Council accepted the report and recommendations of the Committee which will take effect from the year 2021-22.

Shri G S Khuntia proposed that MGMI Award amount may be increased from Rs 50, 000 to 1 lakh for each Award and for this, different organizations may be approached for sponsorship of MGMI Awards. The Council agreed to give a thought to the proposal.

Best Technical Paper Award published in MGMI Transactions: It was approved by the Council that the “MGMI Editorial Board” will prepare the norms, criteria and selection procedure and finalise it in consultation with Prof SP Banerjee for consideration and approval of the Council.

886.4.0 To consider and constitute a Board of Scrutineers to conduct the Election of Council Members for the year 2020-23.

Due to the effect of Covid -19 all over the country, the Council deliberated the issue at length and felt that it would not be possible to follow and conduct the Election process for the retiring Council Members (3nos) completing their terms of 2017-20 within stipulated time before the forthcoming AGM, i.e. in September 2020. Accordingly, it was unanimously approved by the Council that these three vacancies will be merged with vacancies going to arise on completion of term of 2018-21. So, Board of Scrutineers, to conduct the Election of Council Members for the Year 2021-24 for nine vacancies, will be constituted accordingly.

886.5.0 To consider applications for Membership and the Membership position of the Institute.

- a. The Council approved 19 Life Membership Applications, 01 Associate Membership Application and 01 Life Corporate Member.
- b. The Council noted the present position of Membership as follows:

Headquarters Activities

	Membership Position				16.08.2020
	28.12.2019	Add	Trans	Loss	
Member	265	-	-	-	265
Life Member	2543	19	-	-	2562
Associate	40	1	-	-	41
Student Associate	06	-	-	-	06
Life Subscriber	32	-	-	-	32
Subscriber	01	-	-	-	01
Donor	03	-	-	-	03
Patron	04	-	-	-	04
Corporate	08	-	-	-	08
Life Corporate	01	01	-	-	02
	2903	21			2924

886.6.0 Any other matter with the permission of the Chair.

MGMI News Journal: Dr Khanindra Pathak, Honorary Editor, MGMI informed to the Council that the April – June 2020 issue of MGMI News Journal was in final stage and was waiting for printing & supply. It was delayed in printing due to prolonged lockdown. He proposed to combine the forthcoming issue i.e. July – Sept 2020 along with April – June 2020 issue and get it printed for distribution to the members which will save printing cost as well as postage. Council appreciated and agreed to this proposal.

Regarding MGMI Transactions: Dr Pathak said as such there were no standard technical papers for printing in the MGMI Transactions. So, we should arrange to get more standard technical papers and conduct another Paper Meet, if possible.

Regarding CRIRSCO: Dr NK Nanda, Immediate Past President informed the Council that recently India through NACRI has become member of CRIRSCO (Committee for Mineral Reserves International Reporting Standards). Accordingly, formulation of Indian Mineral Industry Code (IMIC) is underway. Ministry of Mines (MoM), GoI has constituted a group for evolving a Government structure of mineral reporting standards and guidelines considering two international systems namely UNFC and CRIRSCO.

In this connection, Past President, Shri NC Jha, referred to the decision of the 112th AGM in 2018

on the Recommendations of the Special Committee formed to report on CRIRSCO wherein the Committee had recommended that MGMI should not opt for being a Registered Professional Organisation (RPO) under CRIRSCO, due to the various reasons stated in the Committee Report. The General Body had accepted the Recommendations of the said Committee and the matter was considered closed.

However, he expressed that since the matter was now under consideration of Ministry of Mines, Secretary, Ministry of Mines may be informed by the President, MGMI about the views of MGMI on CRIRSCO as early as possible. He further suggested that since Ministry of Coal does not appear to be involved in the matter as per the Office Order of Ministry of Mines, copy of the letter should also be sent to the Secretary, Ministry of Coal. Council agreed to the proposal and requested Shri NC Jha to help in drafting a suitable letter.

On the query from Shri JP Goenka regarding the payment status of M/s Tafcon on 8th AMC Exhibition account due, Hony Secretary informed that Rs. 20 Lakhs has been received by MGMI. Reminders have been given for releasing the balance payment as early as possible. M/s Tafcon conveyed that they will clear amount as early as possible as they are also effected due to current pandemic situation.

The meeting ended at 12.15 noon with Vote of thanks to the Chair.

Headquarters Activities

Report of 114th Annual General Meeting

The 114th Annual General Meeting of MGMI was held on 27th December 2020 at 11.30 hrs at MGMI (HQ) Office, Salt Lake, Kolkata 700 091 in hybrid (physical and virtual) mode. The meeting was chaired by Shri Anil Kumar Jha, President, MGMI, who attended the meeting online. The office bearers and members, on and off the dais, who were physically present were – S/Shri P M Prasad, R P Ritolia, R K Saha, J P Goenka, Rajiw Lochan, Anil K Karmakar, Ranajit Talapatra, Prasanta Roy, T K Nag, V K Arora, Prof (Dr) Khanindra Pathak. Members who joined the meeting online were S/Shri Prof S P Banerjee, Nirmal Chandra Jha, Dr N K Nanda, N N Gautam, Dr Amalendu Sinha, Smarajit Chakrabarti, J P Barnwal, Anup Biswas, Prof Bhabesh Chandra Sarkar, Prof G P Karmakar and Ranjit Datta.

At the beginning 2 (two) minute silence was observed to mourn for the departed souls of members who left us during last one year.

President Shri Anil Kumar Jha, President, MGMI called the meeting to order on confirmation of establishment of quorum at 11.35 am. President, MGMI welcomed all the members present in the meeting, mentioning that with the advancement of technology and prevailing pandemic situation the Annual General Meeting of MGMI could be organized in hybrid mode in association with Central Depository Services (India) Limited, (CDSL).

The notice convening the 114th Annual General Meeting was read by the Hony. Secretary, Shri Rajiw Lochan. Minutes of the 113th Annual General Meeting was circulated to the members. In addition CDSL also sent the (114th AGM Notice and (ii) Annual Report 2019-20 to the members through email for compliance.

Hony Secretary presented the Actions taken on the 113th AGM Minutes. The minutes were confirmed by the house which was proposed by Shri V K Arora and seconded by Shri R P Ritolia.

Report on last year (2019-20) Audited Balance sheet was also sent to the members through email, post from by MGMI office, and by CDSL through email, and uploaded on the Institute's website. Salient points of the audit report were read out by the Treasurer and clarified by the Auditor. Hony. Secretary also informed about 8th AMC accomplishments fund status. The audited report was adopted by the house unanimously and confirmed and accepted by the house as proposed by Shri Prasanta Roy and seconded by Shri R K Saha.

Appointment of Auditor M/s. Jha & Jha Chartered Accountants Company for the FY 2020-21 was proposed by Prof (Dr) Khanindra Pathak and seconded by Shri Prasanta Roy which was approved and adopted by the house unanimously.

Hony Secretary placed on record that in the 887th Council Meeting held on December 16, 2020 at MGMI (H.Q), Kolkata in hybrid mode, the Life Member of the MGMI Shri P M Prasad presently CMD, Central Coalfields Limited (a subsidiary of Coal India Ltd) has been elected unanimously as President for the year 2020-21 which was proposed by Past President Shri R K Saha, Dr Amlendu Sinha and seconded by Vice President Shri P R Mandal, and Past President Shri N C Jha and Anil Kr Karmakar. House was informed that Shri Rajiw Lochan will continue as Hony Secretary as he has been elected Secretary in 113th AGM for the (2) two-year term.

Shri Anil Kumar Jha, President, MGMI then

Headquarters Activities

addressed the members on virtual platform for which link was provided by CDSL to all members through CISCO Webex.

President expressed that he is proud to serve the esteemed organization for two-year term. He thanked all members who helped him in smooth running of the organization. He said that in the first term he was extremely busy in his duties at Coal India Limited which was facing difficult situation to meet nation's demand at that time. However, the 8th Asian Mining Congress could be organized in a grand manner due to untiring efforts of organizing committee members. The second term impacted due to the current pandemic situation and he could not do much for MGMI, however, as Past President he will extend all support to new President to bring more laurels to MGMI and bring it to new height with flying colours.

Shri Jha felt that 2021 is also going to be tough and requested members to give their best so that MGMI should prosper further and MGMI should become a self-dependent organization. It should be able to generate funds, through training programmes, workshops, seminars etc. as we are having experienced knowledgeable resource persons from all fields as knowledge bank. He expressed his confidence on our new President, Shri P M Prasad who is very dynamic and energetic person and under his leadership MGMI will prosper leaps and bounds.

He expressed that there are gaps between industry and academia and appealed to office-bearers and council members to bridge the gap. He suggested that all efforts to be made to contribute towards development of mining, geology and metallurgy. In 9th Asian Mining Congress, all organizations and industries connected to these disciplines should be encouraged to participate actively.

He stressed that though exploration and

mining in Coal sector are of good standard, these are not so in cases of others mineral and metal ore mining. Here MGMI may contribute much towards their sustainable development to make us self-reliant. He also suggested efforts to be made to reduce the import of raw material, especially coal.

He expressed his special thanks to Prof S P Banerjee, Shri Rajiw Lochan for guidance and help in performing his duties as President, MGMI during his two years tenure. He thanked the Editorial Board, especially Prof (Dr.) Khanindra Pathak, for timely bringing out the MGMI publications even during the pandemic time. He again thanked each and every member who helped him in running MGMI activities and wished MGMI a bright future.

New President Shri P M Prasad, was installed, welcomed and felicitated by the former Presidents and greeted by members present.

Shri P M Prasad addressed the members, thanked each one of them for electing him the President of this 114 years prestigious organization. He spoke on overall mining scenario of the country. He expressed his best wishes to MGMI fraternity and assured help in development of MGMI.

Hony Secretary further informed the house details regarding the MGMI Excellence Awards which will be effective from 2021-22.

The Council at its 886th Meeting approved that the existing Awards to be consolidated to four coveted MGMI Excellence Awards as follows:

- 1) **MGMI Award of Excellence for Coal Mining** – for outstanding contribution in Coal Mining Industry;
- 2) **MGMI Award of Excellence for Non-Coal Mining** – for outstanding contribution in Non-Coal Mining Industry;
- 3) **MGMI Award of Excellence for Earth**

Headquarters Activities

Sciences – for outstanding contribution in any branch of Earth Science and Mineral Engineering, and

- 4) **Best Technical Paper** published in MGMI Transactions for every Calendar year.

He also appraised the house that the existing vacancies of Council members at present has been clubbed with coming year vacancies as approved by the Council considering constraints due to prevailing pandemic situation. Election of the Council members against the vacancies will be conducted accordingly.

In the open session, S/Shri V. K. Arora, R. P. Ritolia, J. P. Goenka, Prof K. Pathak were physically present and Prof S P Banerjee, N. C. Jha, Dr N. K. Nanda expressed their views on virtual platform in the meeting, thanked the Outgoing President and welcomed the President Elect and thanked the Hony Secretary for smooth running of the organization.

Council Member **Shri V K Arora** thanked Imm. Past President Shri A K Jha, President Elect, Shri P M Prasad, Members on the dais and the members attending virtually. He said that the year 2020 was very tough year due to pandemic situation. Shri Anil Kumar Jha steered Coal Production of Coal India Ltd to higher level and at the same time managed to attend all the meetings of MGMI to ensure smooth functioning and complemented Shri Jha for his extraordinary managerial capability. He also complimented Shri Rajiw Lochan, Honorary Secretary for his hard work and dedication and to keep the members updated time to time through e-mail, and WhatsApp which is highly creditable and reflects his efficiency and traits of a master administrator. Other office bearers also did justice to their role. He congratulated Shri P M Prasad for his new role as President of MGMI and

highlighted that the Year 2021 would be very active year and under his leadership MGMI will have to think of new ideas to generate revenue and improve the image MGMI.

Past President **Shri R P Ritolia** extended his heartfelt thanks to Shri Anil Kumar Jha and said that during his two years tenure in the first year he was serving as Chairman of Coal India Ltd and in spite of his busy schedule he managed to steer the MGMI to new heights and in his second year he along with the very active MGMI team worked so efficiently that everybody felt that the pandemic had no effect in the workings of MGMI. He also thanked Prof (Dr) Khanindra Pathak on improving and bringing about a sea change in the publication of MGMI News Journal and Transactions and in bringing it at par with other International Journals.

He welcomed President elect, Shri P M Prasad and wished that all look forward for brighter days for MGMI under his leadership. He also complimented Shri Rajiw Lochan, Hony Secretary on bringing about the drastic improvement in communication to MGMI Members.

Vice President Shri J P Goenka thanked Shri Anil Kumar Jha for all his endeavors during the tenure of Presidentship of the MGMI and welcomed Shri P M Prasad and congratulated him for his new role as President of MGMI. He suggested that the election of Council Members should also be planned and conducted through electronic voting system because very few members participate when done through ballot by post.

Honorary Editor Prof (Dr) Khanindra Pathak expressed his sincere thanks to Shri Anil Kumar Jha for his fabulous work as President of MGMI. He took pride in mentioning that MGMI successfully ran 114th year and welcomed the new President Shri P

Headquarters Activities

M Prasad and said that he has got very dynamic team members to assist him in his journey. He acknowledged and complemented the efforts and contributions of Associate Editor, Dr Ajay Kumar Singh along with Mr Joy Chakraborty and Mr G Ghatak and all other members of the Editorial Board in giving a new shape to MGMI News Journal and Transactions.

He suggested that MGMI need to be nominated as a permanent member in some of the Government National Decision making Committees, become an authentic organization and engage in industries oriented activities, create a separate cell for consultancy and planning. He expressed his desire to get a book published by MGMI which will be a chronicle of century old past experiences and memories of past times. MGMI should also think of meeting to discuss and provide with feedback and cater to the problems the Mining and Mineral Industry in the country by using the expertise of our members who are most experienced knowledge bank.

Past President **Shri N C Jha** extended his thanks to Shri Anil Kumar Jha for excellently managing MGMI as President in the same time also served being the Chairman of Coal India Ltd. He expressed his desire that MGMI should think of keeping separate fund for MGMI Excellence Awards. MGMI should also plan how to form different committees to take care of different aspects of functioning of MGMI and how we can involve the younger generation to take the institute to new heights in future also. He wished all the success to

MGMI under the leadership of Shri P M Prasad and firmly believed that he will steer MGMI to new dimensions in a befitting manner.

Past President **Dr N K Nanda** congratulated Shri Anil Kumar Jha for his exemplary accomplishment and congratulated incoming team under leadership of Shri P M Prasad on inviting more members to the organization and make all efforts for presence of institute at all corners.

Past President **Prof S P Baneerjee** congratulated Shri Anil Kumar Jha for his sterling performance during his tenure as President of MGMI and especially during the tough time of COVID-19 pandemic. He mentioned that Shri P M Prasad is a rare fit for today and welcomed him and wished him all the best for his new role as President of MGMI. He said Shri P M Prasad is very intelligent, humble and hard working person.

He suggested that MGMI should diverse from Coal to other areas also which need more attention in the Mining and Mineral sectors. MGMI should activate its Branches and work on the membership drive, work more actively to get good quality and standard papers for MGMI News Journal and Transactions. MGMI should also take the steps to get the required accreditations of National bodies. Shri Prasad and his dynamic team should take the necessary steps to organize the 9th Asian Mining Congress (AMC) where more Asian countries must participate in befitting manner and wished all the best to new team.

The meeting concluded at 13.30 Hrs with Vote of Thanks by Hony Secretary, Rajiw Lochan.

News About Members

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Asset Management in the capital-intensive mines of today need:

1. A structured Asset strategy to ensure your gain through controlled and effectively managed assets, operating at their full potential.
2. Assessed total cost of ownership i.e the capital purchase price plus the ongoing operating cost of your asset less residual value at time of asset disposal shows what value that asset delivers on a return on investment.
3. Plant and machinery acquisition and disposal policy to evaluate the capital invested in each asset to maximise your return on investment.
4. Fleet production and cost estimation by determining tonnes per hour, cubic meters per hour) and cost (Rs per tonne, Rs per cubic meter) to ensure the fleet selected will meet your job requirements at the lowest cost.
5. Fleet health management and monitoring critical equipment information and data and planning preventative maintenance servicing and defect repairs.
6. Supplier management to ensure they deliver a cost-effective service with appropriate warranties and service levels in managing the cost and risk for machine downtime.

New Members

(As approved in 887th Council Meeting on 16. 12. 2020)

As Life Member

10850 – LM, **Shri Nilay Ghosh**, B E (Min), M Tech (Opencast Mining), DGM – Mining, JMS Mining Private Limited, 4 A 4 Green, Greenfield Residency, City Centre, Durgapur, Burdwan, – 713216, WB, Ph: 033-40833760 (O) 0343-2542130 (R), Mobile: 7603088814 / 735825512 Email: nilay.ghosh@jmsmining.com, ghoshnilay@gmail.com

10851 –LM, **Ms Riya Ghosh**, M Sc (Appl. Geol), Manager (Geology), JMS Mining Private Limited, Siddha Pines, Gardenia – 507,AS/185, Rajarhat Main Road, Kolkata – 700136, WB Ph: 033-40833731 (O), Mobile: 9830123417 /9836812976 Email: riyageol@gmail.com, riya.ghosh@jmsmining.com

10853 –LM, **Shri Subrata Panigrahi**, B.E. ETC & MBA, Chief Operating Officer, Institute of Quality & Environment Management Services, Flat No. 208, Jagannath Avenue, Canal Road, Jagannath Nagar, Lane -1, Opp. Bank of Baroda, Bhubaneswar - 751006 Email: panigrahisubrata@gmail.com

As Student Associate

10852 –SA, **Shri Abhijit Roy** , M Tech (Student), Tripura University (A Central University) Bhattapukur, Near Suktara Club Chowmuhani, P.O. &PS : AD Nagar, Agartala, West Tripura – 799003 (M): 8794150689, Email: abhijitroy9619@gmail.com

Health tips

Sugar - the latest culprit

How to find out how much sugar you can eat?

It's not possible to add up how much sugar you are eating in your diet every day in every meal. But it is possible to acquaint with the recommendations for healthy eating, such as minimizing eating of processed foods, and eating more whole fruits and vegetables and whole grain products.

The sugar in the whole apple results in a slow increase in our sugar levels. But apple juice causes a sudden spike in our sugar levels putting a strain on our insulin system. From metabolic point of view, it's much easier for our body to process the sugar when it is in the form of an apple rather than apple juice. When sugar is released slowly, our body is able to metabolize it and does not store it as fat.

INTERNATIONAL MINING NEWS

Philippines turns to idle mining assets to raise extra revenue

Reuters reported in the October 2020 that the Philippine government is seeking to raise additional revenue by pushing for the resumption of operations at idle state-owned mining projects, including through the sale of its Nonoc nickel assets. The Nonoc mine has been idle since the environment ministry in 2011 stopped the project



The Privatization and Management Office, an agency under Dominguez, has reviewed state mining assets that could be sold, as the government scrambles for funds to meet increased spending aimed at resuscitating a pandemic-hit economy.

Dominguez said he was working closely with the Mines and Geosciences Bureau and the environment ministry to revive the sale of the Nonoc nickel project in Surigao del Norte province, the Basay copper mine in central Negros Oriental province, and all other state mining assets.

The Philippines, home to more than two dozen nickel mines, is a major supplier to China. Its mostly low-grade ores are used to produce nickel pig iron, a raw material for stainless steel.

Though the Gold and Copper producing Phillipine was concerned with environmental conservation and wanted to stop mining

activities, the post COVID19 economic scenario is forcing to rethink on the mining sector revival. The World Bank warned the Philippine economy may contract this year by as much as 6.9%.

If Asset Management is not done for sustainable development mining towns are bound to end as ghost towns

A 19th century gold mine site Bodie is now a ghost town in California. Mining sites must undertake appropriate asset management approach to avoid creating ghost towns of future.



The U.S. coal industry has been struggling for years. Availability of much cheaper and cleaner-burning natural gas, proliferated by fracking technology; growth in the solar and wind energy production; and tougher environmental regulations contributed to closure of coal mining in the USA.

In Appalachia coal production fell by nearly 45 percent overall between 2005 and 2015, according to a recent analysis by the Appalachian Regional Commission, an economic development agency established by Congress in 1965. As a result, since 2011 the entire region has lost about 33,500 mining jobs.



In 2016, when Kentucky's coal industry slumped to its lowest point in 118 years. The number of jobs state-wide dropped by nearly 1,500 during just the first three months of that year, or 17.9 percent, leaving an estimated 6,900 employees in the industry. Eastern Kentucky lost 21.6 percent of its coal jobs during the quarter, while the drop in the state's western coalfield was 12.2 percent.

Hazard, a coal mining town in Kentucky, The USA becoming ghost town

Global Mining Review reports: Startup licences sustainability technology for mining-inventions at University of Arizona serving the mining cause

While mining generates much-needed resources to power the world economy, the industry is seeking ways to reduce its environmental footprint. To address challenges in mining, such as soil and water pollution and water usage, inventors from the University of Arizona College of Engineering have joined forces with an experienced mining industry entrepreneur to launch the startup Auxilium Technology Group. The Tucson-based company has licensed University of Arizona inventions that offer sustainable and holistic solutions that address growing concerns about mining's impact on the environment and climate change.

Under the leadership of Auxilium CEO, Abraham Jalbout, the company will develop

the inventions, which make ore leaching processes more efficient and less toxic, contribute to water conservation, and reduce energy consumption.

This initiative for waste to wealth transformation applied to tailing management will lead to resource maximization.

This type of entrepreneurial collaboration offers a pathway for university researchers looking to increase the impact of their research and advance the industry, even as they remain committed to educating the next generation of mining professionals.

Such attempts would make existing mines cleaner to operate

Jaeheon Lee, an Associate Professor of Mining and Geological Engineering, contributed one of the licensed technologies – a leaching process that uses the organosulfur compound thiourea rather than the more toxic element cyanide to extract gold from ore. The process he developed can reach up to 98% efficiency of extraction, resulting in higher profitability and lower toxicity.

Associate Professor, Moe Momayez, Interim Head of the Department of Mining and Geological Engineering and David and Edith Lowell, Chair in Mining and Geological Engineering, contributed two other licensed technologies.

Storing mine tailings – a common industry practice – requires pumping waterborne refuse material into human-made ponds where it is kept and separated. Momayez invented a system of floating, interlocking panels that cover tailings ponds to reduce evaporation and increase the amount of water available for reuse. The system also can be outfitted with solar panels to generate electricity.

He also invented a spray-on thermal insulating geof foam made with mine tailings. When sprayed on the walls in hot underground mines, the geof foam provides a layer of insulation that prevents heat from

radiating from the rock into the working areas, significantly reducing the cost of cooling the air. The team also foresees an opportunity to leverage this technology to benefit the construction industry.

The Auxilium Technology Group leadership team also includes Dominic Gervasio, Associate Professor of Chemical and Environmental Engineering at University of Arizona, who brings expertise in applying chemistry to the processing of ore.

Auxilium's growing technology portfolio reflects its goal of creating sustainable solutions for issues affecting today's mining industry. Building on a long-standing relationship with the College of Engineering, entrepreneurs continues to work closely with



University of Arizona inventors and Tech Launch Arizona to identify new technologies that will be beneficial for the company and contribute to greater sustainability for the industry.

The members are requested to send contributions for the columns of the MGMI News Journal, like "Technical Articles" related to the mineral industry on topics dear to the members, Articles as Case History on various mine practices in the field, interesting write-ups for "Down Memory Lane", "Opinion" on burning issues of the mining industry, "Safety & Health" issues, research findings for "Technology Updates", etc.

**Theme for the next issue
of MGMI News Journal**

**Metal Extraction vis-a-vis Mineral Resources :
Indian Perspective**

NATIONAL MINING NEWS

India produces high capacity truck

Technical specs	- BH150E Beml	Engine manuf.	: Cummins
Weight	: 104 t	Engine type	: QSK50C
Standard tyres	: 33.00 R51	Engine power	: 1398 kW
Dump capacity	: 82 m ³	Engine power	: 1875 HP
Net load	: 136 t	Displacement	: 50.3l
Transport length	: 12.155 m	Revolutions at max torque	: 1500 rpm
Transport width	: 7.707 m	Max. torque	: 7871 Nm
Transport height	: 6.526 m	No. of cylinders	: 16 Cylinder
Travel speed	: 64 km/h	bore x stroke	: 159x159 mm
Turning radius outside	: 13.35 m	Emission level	: Tier II
Loading height	: 5.4 m		

Epiroc to supply BEV to Hindustan Zinc

Vedanta Group Company Hindustan Zinc has signed a memorandum of understanding (MoU) with Epiroc Rock Drills, advancing a push for zero-emission and sustainable mining with the introduction of battery electric vehicles (BEVs) in underground mining.

Hindustan Zinc will become the first mining company in India to unveil electric vehicles in underground mines.

By introducing BEVs in mines, the company will be able to reduce carbon emissions and enable environmentally friendly mine operations.

Hindustan Zinc CEO Arun Misra said: “At Hindustan Zinc, we are committed to smart, safe and sustainable operations and we believe that as a leader it is incumbent on us to be catalysts for transformation towards adopting sustainability driven business solutions.

“This partnership with Epiroc fortifies our commitment to green and responsible mining and takes us further in the right direction to achieve carbon neutrality, in line with our emission reduction Sustainability Development Goal for 2025.”

Source: <https://www.mining-technology.com/news>



NALCO planning massing CAPEX in smelter and captive power plant (CPP) expansions

The Alumina Refinery is located at Damanjodi, Odisha, approximately 14 KM from the bauxite mine at Panchpatmali. The mined-out bauxite is transported from captive mine to refinery by a 14.6 KM long single-light multi-curve 1800 tonnes per hour (TPH) capacity cable belt conveyor. The alumina produced is transported to aluminium smelter at Angul (Odisha) and to Vizag (Andhra Pradesh) port by rail.

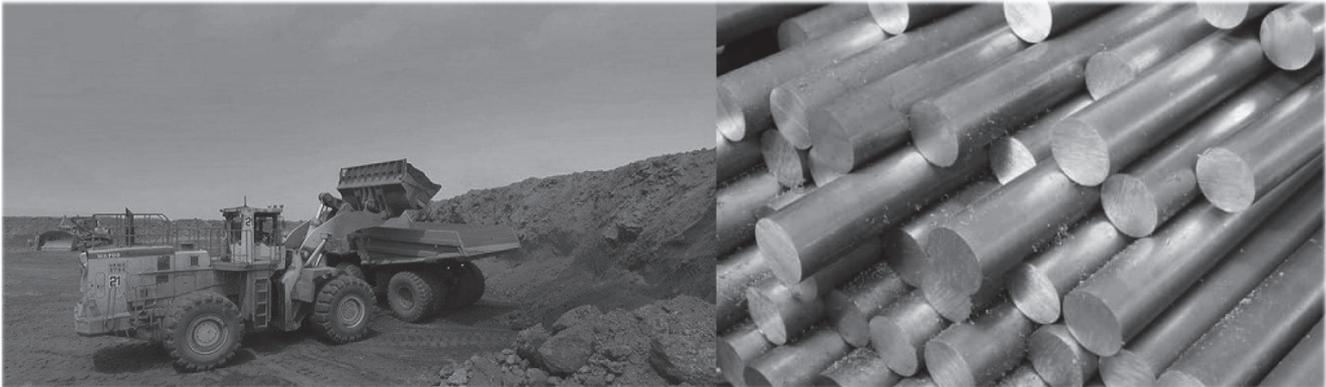
National Aluminium Company has the largest integrated alumina-aluminium complex of Asia. Its integrated operations cover the entire aluminium production value chain from mining bauxite, refining alumina, smelting aluminium and captive power generation to a strong logistic network in terms of rail & port facilities, coal mining and handling plant to support its operations and also, to become one of the most cost-efficient aluminium companies across the globe.

NALCO, in association with the Government of

Odisha is setting up a world class Aluminium Park in Angul, in close proximity to its smelter plant to encourage development of downstream and ancillary industries in the state of Odisha. This will enhance employment in the area and give boost to local entrepreneurship.

Nalco wants to commence the operations of its second bauxite mining lease of Pottangi in 2023, which will feed its fifth stream of alumina refinery at Damanjodi currently under expansion. The Pottangi mining lease and the Panchpatmali mines have balance deposits of around 160 million tonnes together and are expected to offer ample bauxite to ensure the refinery operations for the next 25 to 30 years.

The present capacity of Alumina Refinery is 22.75 lakh TPA. Alumina produced is used to meet Company's requirements for production of primary aluminium at smelter. The surplus alumina is sold to third parties in the export markets.



Chowgule and Company, a part of the Goa-based Chowgule Group of Goa going for commercial coal mining

In November 2020 Chowgule and Company has appointed Rajeev Bora as the Chief Executive Officer of its mining division following the firm recently winning the bid for commercial mining of coal from Sahapur (East) mine in Madhya Pradesh. A veteran of the mining industry, Bora will be responsible for leading the group's renewed focus on mining and creating a large national footprint for the business.

The group currently has mining operations in Goa and Karnataka, and three sophisticated plants with capacity to produce and export over five million tons of finest iron ore and pellets every year

Source: <https://economictimes.indiatimes.co>



UPCOMING EVENTS

Modern Electric Furnace Steelmaking — A Practical Training Seminar

01 Feb 2021 - 05 Feb 2021

Tennessee, United States

Organizer: Association for Iron & Steel
Technology (AIST) Electric Steelmaking
Technology Committee

Topics: Covers safety, the basics of electrical
and mechanical features of electric arc furnaces,
refractories, and the role of raw materials.

Website: <https://www.aist.org/conference-expositions/technology-training/modern-electric-furnace-steelmaking>

ONLINE WEBINAR - Essential rules of adopting AI in Mining and Metals

23 February 2021 - 23 February 2021

United Kingdom

Join OSISOFT for a webinar on the essential rules of adopting AI in mining and metals. In this webinar, you will learn more about AI and the benefits of adopting it into your operations. The webinar will also cover the anatomy of a successful AI project, an AI maturity model, and real-world examples and success stories.

Mining and metals companies contend with an unpredictable market and volatile commodities pricing. In response, these companies must increase tonnage while reducing cost, and they are often pressed with making important decisions in uncertain circumstances. They seek out artificial intelligence (AI)-driven technologies in pursuit of more stable results in their operations to improve quality, increase tonnage throughput and even achieve autonomous operations. But first, they must lay down the proper data foundation to take advantage of the many benefits that AI can offer.

Increasing output while reducing production costs is every company's dream. However, achieving that dream requires optimised assets, processes, and optimising strategies without compromising team member safety. Now, many companies are looking for new ways to improve efficiency and overall production by embarking on a digital transformation journey. Digital transformation enables key stakeholders to turn operational data into quantifiable business results.

Unfortunately, many companies are struggling getting value out of such initiatives. They are not taking a structured approach on new deployments, focusing on implementing new AI

technologies without first having the right operational data foundation in place and making sure their people are properly empowered.

Watch this webinar to learn:

- ◆ A simple definition of AI and the benefits of adopting it into your operations.
- ◆ AI maturity model.
- ◆ The anatomy of a successful AI project.
- ◆ Real-world examples and success stories.

Website: <https://www.osisoft.com/>

MINEXCHANGE 2021 SME Annual Conference & Expo

01 March 2021 - 05 March 2021, United States

Connect to a vibrant exchange of information, ideas and products. Collaborate with colleagues and thought leaders from across the industry and get the insights, information and tools you need to excel in an era of innovation and economic change.

Website: <https://www.smeannualconference.com>

Geo Connect Asia 2021

24 March 2021 - 25 March 2021, Singapore

Global solutions for Asia's geospatial and location intelligence markets. Comprising a 2-day exhibition and conference, the show will bring together over 2500 corporates, regulators, tech start-ups and more to discuss global geospatial information development and collaborate on tackling today's key global challenges.

Comminution '21 — 12th International Comminution Symposium

19 Apr 2021 - 22 Apr 2021 Cape Town,
South Africa

Organizer: Minerals Engineering International (MEI)

Abstract : MEI's Comminution conferences are established as the main events for profiling cutting edge research and innovation in all aspects of crushing, grinding and ultrafine grinding in the minerals industry. We strongly encourage a good balance between industrially based and academic research papers showing the benefits of basing practical application on scientific rigour, such as the industrial validation of models and control techniques.

Contact: Phone: 07980627075;

Email: bwills@min-eng.com

Event website: <http://www.min-eng.com/comminution21/>

Role of Enhancing Diversity in The Earth Sciences and Engineering Community

- Udayan Singh^{1,2}, Catherine Owsik¹, Samarth Singh¹

“Diversity benefits all” in STEM

The role of diversity, equity and inclusion in STEM (science, technology, engineering and medicine) fields has been studied in detail by numerous researchers over the past decades (Botella et al. 2019). Research has shown that diversity and equity lead to positive outcomes in schools, workplaces, and society at large (Crosby et al. 2006). At the broadest levels, the United Nations Sustainable Development Goals point to reducing inequality as one of their key 17 thrust areas. In terms of institutional objectives, diverse student populations have the potential to create a more inclusive STEM workforce which improve the quality of decision-making (Allen-Ramdiel and Campbell 2014). At the classroom level, diversity improves the quality of learning and exposes the students to diverse points of views. At the individual level, inclusion and equity can empower students and employees that are traditionally marginalized (Bauman et al. 2014).

In the summer of 2020, the United States witnessed a unique resurgence to revisit some of these works as issues about systemic racism became clearer once again. Educationists and researchers from different

STEM disciplines pointed out the need for improving equity in such fields. Researchers from the US, and across the world, participated within the calls for #ShutDownSTEM and #ShutDownAcademia,

where they devoted one particular day looking at the issues inhibiting diversity for under-represented populations (particularly, African-American communities). This movement was joined by leading organizations, including the world’s leading scientific publishing group, Nature, whose editorial page committed to looking at different ways to eradicate racism and other forms of discrimination plaguing STEM fields (Subbaraman 2020). The problem of race and racism in geosciences was pointed out as being even more acute as it was found that earth science related fields are among the least diverse in the US and globally. Thus, even as chemistry and biosciences fields have indicated strong outcomes towards

eroding some of the historic inequities, earth sciences have largely lagged behind over the past four decades (Eiler 2020). The reasons for this lack of diversity in the geosciences are myriad and not only limited to recruitment inequities. Evidence indicates that women and people of color are less represented across key factors that affect career progression as well, e.g. named professorships, invited papers, editorships and referee roles in journals, and scientific awards and fellowships (Marin-Spiotta et al. 2020). An editorial in Nature Geoscience articulated that “A lack of diversity and inclusion is the single largest cultural problem facing the geosciences today, and this is probably not just limited to the United States” (Dutt 2020).

Geosciences lack, but urgently need, diversity in their functioning

In terms of achieving global societal goals, STEM fields and particularly, the geosciences have an oversized role to play. Consider the case of climate change mitigation – that has emerged as a key societal challenge, which the MGMI has also taken note of (Banerjee 2019). The geosciences and aligned fields

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would need to develop the technological tools that would be needed to transform the energy sector towards a path of reduced carbon emissions. For instance, unsustainable mining can lead to reduced qualities of life for communities surrounding areas where these resources are extracted. These historical inequities (also considered to be within the realm of environmental justice) need to be systematically addressed so that these communities receive improved standards of living via better air and water quality. In our previous work, we demonstrated how a convergence of novel engineering tools such as desalination could be used, for instance, in delivering clean water while aiding just coal transitions (Singh and Colosi 2019). As different governments pledge to net-zero emissions and increased renewable penetration in their electricity grids, the role of mineral extraction would dramatically increase by the end of the century. It is estimated that mineral extraction in a renewable-rich society would increase ten-times from the present day (Luderer et al. 2019). Indeed, the Government of India also hinged its nationally determined contributions in the Paris Agreement to an aggressive increase in renewable energy capacity, one which would lead to unprecedented need for extraction of key materials from below ground. As such, it should be ensured that this new strand of resource extraction happens in a much more equitable way than the past has shown. A rapidly evolving area of climate change mitigation also happens to be carbon dioxide removal (CDR) which seeks to actively enhance so-called “negative emissions” by relying on a suite of technologies very dependent on geologic carbon sequestration. Recent works point out how the global CDR field would evolve if historically high emitters were to take responsibility so as not to stifle the economic growth in the Global South, as arising out of the high costs for such technologies (Poza et al. 2020; Fyson et al. 2020).

One cannot realistically believe that these massive large-scale environmental justice transformations can be sought without having adequate representation of under-represented communities in different levels of the geosciences. Accordingly, organizations such as the MGMI, which is the among the oldest societies devoted to earth sciences in the current developing world, have an important role to play in this cause. We present a blueprint here of how graduate student leadership at our department helped transform the Engineering Systems and Environment seminar series. We argue that this framework can be adopted in regionally-appropriate ways by professional societies that lead networking initiatives among scientists and the industry. This would also lead to aiding key governmental goals. For instance, the Government of India has also started a push for using Indian institutes as an educational hub for African students. The government has aimed to provide more than 15,000 scholarships to African students for pursuing STEM education in India, which is expected to push upward the diversity in such institutions. That said, such students have been subject to several unfortunate incidents and hate crimes, and have voiced concerns of alienation as pointed out in the media. These lead to stereotype threats i.e. the worry that a person will be seen through the lens of negative stereotypes. It can be distracting, at best, and seriously harm mental health, at worst. However, when a person feels like they belong, feelings of being valued, respected, and accepted mitigates this threat (Cohen and Garcia 2008). That is, people that feel like they belong do not have to worry about being stereotyped.

Incorporating diversity in STEM events

Scientific events (conferences, seminars, summer schools etc) hosted by departments and/or professional societies are a very common form of scientific research dissemination across STEM disciplines. However, as a recent opinion piece in *Science*

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noted, these seminars often do not represent the trainee diversity of such groups (Price 2019). Based on research conducted at the University of Michigan, it is evident that speakers from underrepresented groups – based on gender, age, nationality or ethnicity – are not proportionately invited in STEM and allied fields (Hagan et al. 2020). This presents two major issues: (1) opinions and research of such researchers receive less dissemination, and (2) invitations to prestigious seminars are an important part of academic profiles which could introduce bias to the way their CVs are perceived compared to their peers. Finally, apart from aforementioned forms of diversity, broader calls have also been made to make geoscience research more interdisciplinary. This means that topical diversity is also necessary, such that ideas from closely-aligned fields are better discussed in STEM seminars (to discuss cross-cutting challenges such as climate change and geoengineering).

As part of improving these metrics on the seminar front, the Graduate Student Council of the Engineering Systems and Environment (ESE) department at the University of Virginia initiated its seminar series in Fall 2019. As this interdisciplinary department's faculty have a significant role in the activities of geoscience societies (such as the American Geophysical Union), we believe that this model can be replicated by other academic groups as well. This department was particularly well-poised for such a project. For example, the representation of women in the undergraduate community is 42%, compared to the US-wide engineering average of 21%. Similarly, the department has 18% representation from underrepresented communities, which is the highest among the institutions of similar size surveyed by the American Association of Engineering Education. The department's faculty also have an extremely interdisciplinary character with a large number of them being involved in cross-school or pan-university initiatives on STEM collaboration.

ESE was formed in 2018 as the home of civil, systems and environmental engineering. While it is inherently difficult to launch a new department, ESE was successful, in part, because it purposefully and meaningfully engaged existing leadership in the diverse student body. For ESE, this meant supporting and creating space for the work of the Graduate Engineering Student Council (ESE-GSC).

The university is known for its student governance model, and ESE-GSC is a prime example of how we do it well. ESE-GSC is a diverse, effective group of students dedicated to improving the quality of the graduate engineering experience, giving back to the community, building collaborations, and more. Women, specifically, played a big role in leading this initiative. In the 2019-20 academic year, thanks to the generous funding from the Royal Society of Chemistry, we were able to find and bring in outstanding speakers for the tumultuous 2020-21 academic year. The timing of the events could not have been more important, given the salience of public conversations around systemic racism, health inequities, environmental justice, inclusion, and more.

Breadth and impact of activities

At the start of the semester, a Diversity in STEM Panel was organized with 75 participants to help inform the newly-formed Diversity, Equity and Inclusion Committee. This panel aimed to collect and synthesize the views of experts in engineering and equity to make concrete recommendations for inclusion and diversity. The lessons learnt from the panel will be used to inform decision-making at the department level, but more importantly used to create similar dialogue aiming much broader impact. This panel was organized at a time when a talented cohort of new students are joining. This event, thus, (1) showcased our commitment to incorporating diversity in engineering as a high priority and (2) create a meaningful exchange of ideas between expert

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panelists, faculty and students for this cause.

This panel was followed up with a series of specialized talks by scientists and engineers who were themselves champions on diversity in STEM. These lectures were all given by interdisciplinary group of speakers with some emphasis on geosciences, energy and systems-thinking. For instance, Professor Juan Horrillo of the Texas A&M University talked about his numerical model tools that could be helped in hazard mitigation forTsunamis. These tools could help emergency planners in times of disasters to create resilience. Similarly, Professor Destenie Nock from the Carnegie Mellon University discussed the implications of sustainability objectives in energy sector planning. She is also the creator of the PhDing

Blog site which posts articles about graduate and undergraduate advice, and research updates in energy and sustainability, thus blending in research and mentorship aspects of academia.

Initiatives such as these have the potential to

increase a sense of belonging for people with underrepresented identities. A person feels like they belong to a social environment when they believe they are valued, respected, and accepted by others in that environment (Walton and Cohen 2007; Good et al. 2012). This initiative signaled that the university values, respects, and accepts (and invites) not only discussion around the topic but BIPOC speakers and leaders in the field. This initiative launched a new, mutually beneficial relationship between the graduate student community (led by ESE-GSC) and the ESE department. By hosting this panel, ESE-GSC provided immediate value to the broader student body while also allowing leadership to step in and show support. The faculty leadership, in turn, expressed they want to continue working with professional societies, like ESE-GSC, to help graduate students champion diversity in STEM. This will help current and future graduate students maintain continuity even as existing cohorts graduate.

Table 1 shows some of the critical outcomes that this project created.

Table 1. Key outcomes associated with the project

	Positive signals from the leadership	A sense of belonging
Immediate outcome	"The ESE-GSC has created an outstanding seminar series that directly meets the needs and interests of our diverse graduate student body." - Professor Brian Smith, Department Chair, Engineering Systems and Environment, University of Virginia	This initiative has the potential to increase a sense of belonging for people with under-represented identities. Several students have reached out to us from these communities giving their enthusiastic endorsement.
Why it matters	People pay attention to what is said and resourced as a cue that it matters to the organization and authorities in the organization (Crosby et al. 2006).. People of color and people with other threatened identities pay particular attention to these signals.	An increased sense of belonging has been found to increase subjective well-being, performance, career aspirations, prosocial behavior, and. These are measurable outcomes that can last with individuals throughout their time at the university.

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Summing up

While the benefits of diversity and equity in STEM have been noted at different scales, some disciplines have largely lagged behind. Particularly, geoscience is a field which has an extremely important role in ensuring just and sustainable lives of communities, particularly in the Global South. Therefore, clear signals from the leadership levels are needed to help create new frameworks that take on the diversity challenges head-on. A key part of this is valuing and welcoming researchers from underrepresented communities. In this note, we present a blueprint of activities that helped in creating some positive reverberations towards a more diverse academic culture. We suggest that these initiatives may be replicated by different academic groups, with suitable modifications, and welcome feedback from the academic communities towards improving and enhancing such efforts.

Acknowledgements

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Interview

INSIGHTS INTO THE STATE OF THE MINING INDUSTRY

- Dr. T. N. Singh

The mining industry in India has significantly transformed since the inception of MGMI. Accordingly, there has been a transformation in the challenges in technology and economics of the industry. Our Associate Editor, Dr. Ajay Kumar Singh caught up on these trends with one of the key experts who has witnessed these changes over the past five decades, Dr. T.N. Singh, Former Director, Central Mining Research Institute. Dr. T. N. Singh has nearly 50 years of experience working with coal and non-coal mining industries in India and abroad. He has authored/edited several textbooks which are referred to in most mining engineering departments in India, e.g., *Underground Winning of Coal* (1992). He holds two PhD degrees in mining engineering – from ISM Dhanbad and BHU. He also served on the board of directors of CMPDI. Apart from carrying out several R&D projects, he has worked as consultant for mining solutions for thick and complex coal deposits, mine environmental pollution control, ground control, mitigation of water and fire hazards for CIL, IISCO, TISCO, SCCL and some non-coal mines. His work has been recognized with the National Mineral Award, National Coal Scientist Award, Indira Gandhi Rajbhasha Puraskar and CSIR Technology Award.

How did you choose mining engineering as your field of study? What led to your becoming one of the most established voices in this field?

Honestly, I had no idea about mining and was pursuing basic sciences for my career. I was tempted to join this stream by Professor R D Singh, who explained the challenges in mining and scope for career development. I was not impressed at the first instant when I joined as a Post Graduate Practical Trainee in Jharia coalfield. I saw no scope of any scientific creativity and looked for an opportunity where I could satisfy my inherent zeal. The projected activities of the upcoming Central Mining Research Station appeared fitted well to my vision and I joined the same despite humble remuneration.

Moving from deep underground workings, I found sinking houses on the surface and even a man getting lost with bed in potholes. This was a challenging problem for me. I started studying the earth to link underground mining to surface disturbance and made the earth science my subject of research.

With generation of knowledge from scrap and revealing the secret of strata otherwise invisible like Brahm, my focus grew intense. I ignored the attraction of better remuneration and prospect from industry to academia and continued my

research with intense desire to know more.

My penance was recognized by Professor E L J Pott (1915-1984; Past President of the Mining Institute) who invited me as a faculty of the University of New Castle upon Tyne, UK. I got an opportunity to pursue my mission in global perspective from there. I got my Master of Engineering degree from the university within six months and PhD from ISM Dhanbad and another one from the Banaras Hindu University, Varanasi. They worked as a booster to my concerted efforts and I conceived several concepts for winning difficult coal deposits.

My humble contribution was recognized by the mining fraternity and I received the National Mineral Award, National Coal Scientist Award, National R&D Council Award, CSIR Technology Award from different ministries of the Government of India. Each one encouraged me to do a bit more and I authored *Underground Winning of Coal* in English and *Koyla Khana Vigyan evam Takneek* in Hindi for the students and mining professionals. The latter was awarded Indira Gandhi Raj Bhasha Puraskar of the Ministry of Home Affairs, Government of India.

In the last decade of the millennium, global warming due to greenhouse gases became a subject of anxiety and the coal mining was alleged

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to be the main culprit. I concentrated on this subject and studied different aspects of nature of the coalfields and authored Geo-Environment of Indian Coalfields and initiated the stream of Ecofriendly Mining Alternatives. Jharia Trikaal Darshan was an effort for the awareness of people and the mining fraternity alike. Seeing the priority of surface mining, I authored Surface Mining to support the mining professionals for betterment of this alternative.

My humble contribution has been accorded recognition by different institutions like the Institution of the Engineers (India) by several gold medals and the “Mine Design Award”. MGMI has also encouraged me by the prestigious Deewan Bahadur D D Thakkar Gold Medal.

I am happy to record generous support of different agencies in seeking some of the secrets of the earth relevant to mining activities during 40+ years of my career.

What are couple of the key highlights of your career at CMRI in ways you could help the industry directly in achieving production objectives?

I was successful in understanding some of the secrets of the earth and used them to solve problems of the industry and was thankfully accepted as a “service to the industry”. While conducting some studies at Sudamdih mine, I saw Kazimierze and Yankowice methods of mining and started thinking where is CMRS method of mining? I focused on this aspect and developed new Wide Stall mining for working under surface features, Cable Bolted Mining for thick seams standing on pillars and mining of thick contiguous seams by Under Pinning technique etc. and completed successful trials in the fields with improved safety, conservation and economics.



Dr. T. N. Singh during interview with Dr. Ajay Kumar Singh (Photography: Dr. Rajendra Singh)

Interview

What are some of the differences you are seeing in the mining industry today when you compare it to five decades ago?

The underground mining stagnated in respect of production, productivity, conservation and economics. Surface mining has been preferred because of its flexibility to meet the rising demand of the nation with improved production and productivity. The option however is responsible for pollution problem- pollution of land, hydraulic regime, and environment. The mining has become a process of earth moving with the use of HEM and machine size has become the yardstick for mine economics.

How might the mining industry diversify itself under the current economic and environmental constraints?

Economics was the driving force for mining diversification from underground to surface as productivity with use of HEM improved and even the mining of the lowest grade coal became profitable. Environment is definitely a constraint because of extensive devastation of land, water, soil and environment pollution that needs change in mental attitude of the miners who always care to get gold and make the land waste. Gandhiji in his economic vision hated the word - waste and believed in value addition and use of all the byproducts. Coal Mining industry should integrate energy sector with mining – harvest coal bed methane, promote underground coal gasification under favorable conditions and land reclamation, forestation and use of the land for solar energy exploitation.

What do you observe as some key limitations to the Indian mining industry in driving innovation?

Innovation is possible by thinking, planning and advance preparation. The industry presently is engaged in mending its house because of different reasons and there is “just manage it” attitude in planning for mining beyond the cut off limit of the surface mining. This seems to be the key limitation of the day.

You were involved in the British Geological Survey project on CO2 sequestration in India. What impedes commercial scale deployment of such technologies in India despite readily available opportunities in eastern India?

Yes - I worked in the project CO2 sequestration in Indian coal mines and found fairly good scope for sequestration of CO2 in coal beds from Assam to Bikaner basin. The problem in taking the advantage of the opportunity is this economics - capture and compression, transport and storage cost etc. Realization of the economics of pollution control and energy penalty clause may make it successful in days to come.

Your involvement with MGMI is well known over the years as recipient of DD Thacker Gold Medal, Editor of the proceedings of 4th Asian Mining Congress etc. What are the key directions, in your view, that you see MGMI pursuing over the next decade?

MGMI has been doing commendable service to the mining fraternity for the last 115 years and encouraging the mining and metallurgical engineers and the earth scientists in different ways. I am proud to be one of the DD Thakkar Gold Medal Awardees and was fortunate in the editing of the proceedings of 4th Asian Mining Congress. I recall my first active participation with MGMI nearly 50 years back when I was given a chance to present my scientific view on the problem of bump in coal mines and was awarded Silver Medal.

I am happy to say that it is actively involved in creativity in its own way and has access to the expert of all streams. In the present panorama of growth, I feel that MGMI should develop a wing of artificial intelligence and extend instant service to the members in general and the earth science fraternity at large.

What are some critical pieces of advice you would wish to give to a young professional graduating in mining engineering today?

I find the graduates of the time are getting good exposure of computer technology and taking the advantage of this are frequently tempted to move

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to IT field. I feel that they should use the potentials of these computational techniques to make mining safe and efficient. A mining engineer should return with computer technology to mining rather than running away to IT from mining for which they were prepared for 4 years.

Please tell the readers about some of your recent writing projects (e.g. books) and how you are keeping engaged in academic life after retirement.

I had some idea of the ancient culture of Bharat since childhood, but the impression world over was that it was all mythological gossip.

I started to seek historical truth of Bharat for self-satisfaction and for the awareness of fellow

Indians. For this mission, I have taken help of the comments of the ancient Roman, Chinese, and Persian visitors, references of different visitors, computer software modelling of celestial configuration given in Ramayan and Mahabharat to prove historicity of Ram and Krishna. I have used recent geological and archeological findings of Indian experts to establish subjectivity of the ancient texts to establish the dating of Vamana Avatar to oldest urbanization and the age of King Manu to date historicity of Bharat. I have successfully proved the subjectivity of the ancient sacred texts of Bharat well compatible to the modern science. The book Discovery of Bharat through Hindustan and British India is under publication after 12 years of research.

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Technical Note

DIGITAL TRANSFORMATION FOR IMPROVING PRODUCTIVITY OF MINING - AN APPROACH - Prof. Sheo Shankar Rai¹

Introduction

Mining process typically begins with finding the deposit and ends at closing the mines with due care to the environment and society. Figure 1 represents the sequence of mining processes and various activities involved with them.

Mining processes has been found to be highly variable in nature. Starting with uncertainty about the nature of the resource being mined, mining processes take place in an extremely dynamic and variable operating conditions often causing lack of control and certainty resulting into reduced productivity, increased cost, poor-quality control of ore being mined, and environmental challenges. Mine operating conditions of both

underground and surface mining are generally harsh and inhospitable that further hinders the control over the processes (Aggrey, 2018, OSIssoft, 2018).

Application of digital technologies across the mining processes from exploration and resource estimation through to mine design and engineering, mine operation, mine closure and environment management has the potential to enhance efficiency and sustainability of mining operation. This allows to have greater control and visibility over the mining plan, its implementation and pro-actively respond to operational and environmental challenges that are inevitable in mining operation (Albanese and McGagh, 2011).

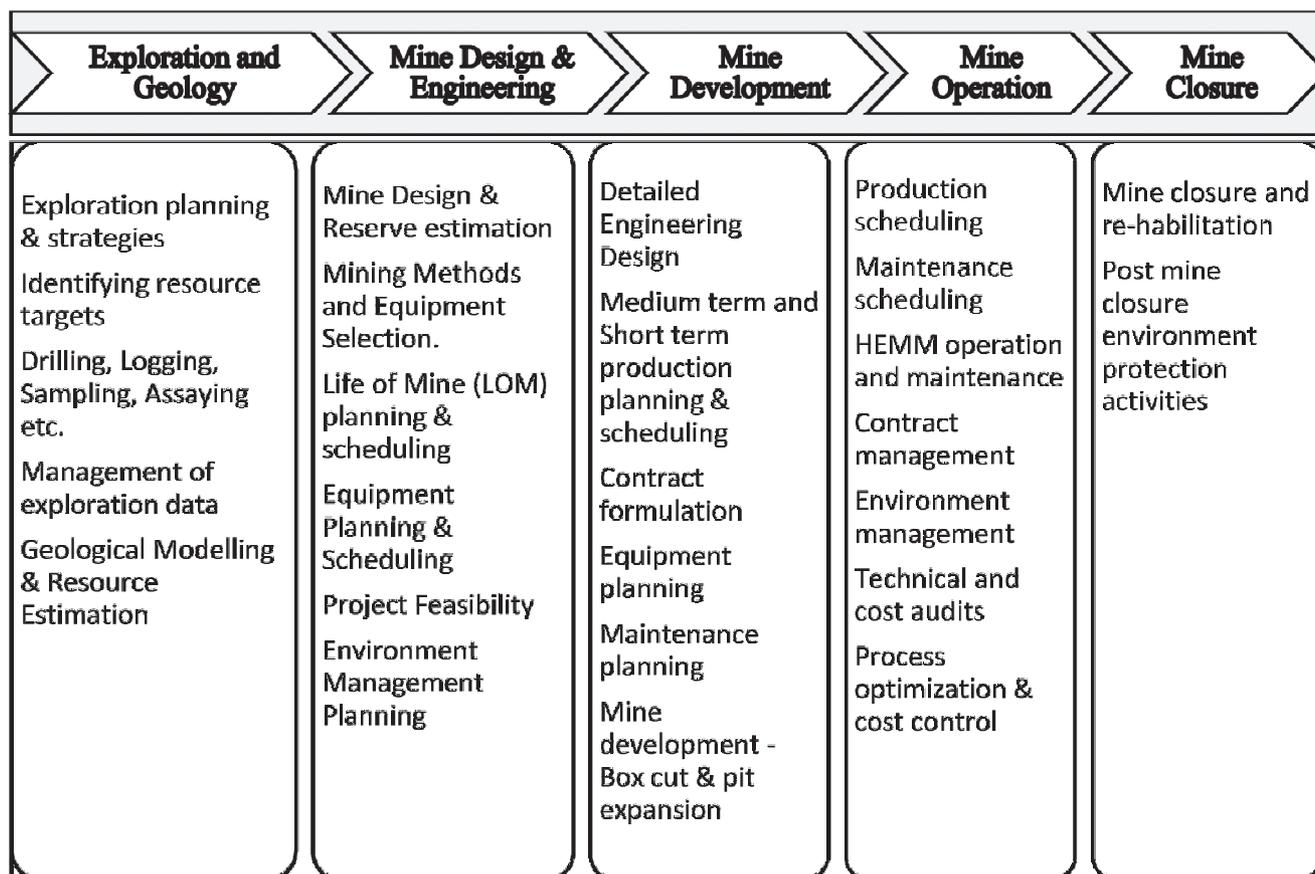


Figure 1: Sequence of mining processes

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Digital technologies for mining processes

Over the past few decades, the development and application of digital technologies for various mining processes such as Resource Estimation, Mine Design, Production and Operation Planning, and Monitoring of Mining Operation could

enhance efficiency, safety and sustainability of mining and allowed mining organizations to have some control over the mining plan, its implementation (Durrant-Whyte, et al. 2015). A typical technology platform on the various mining processes is presented in the Figure 2.

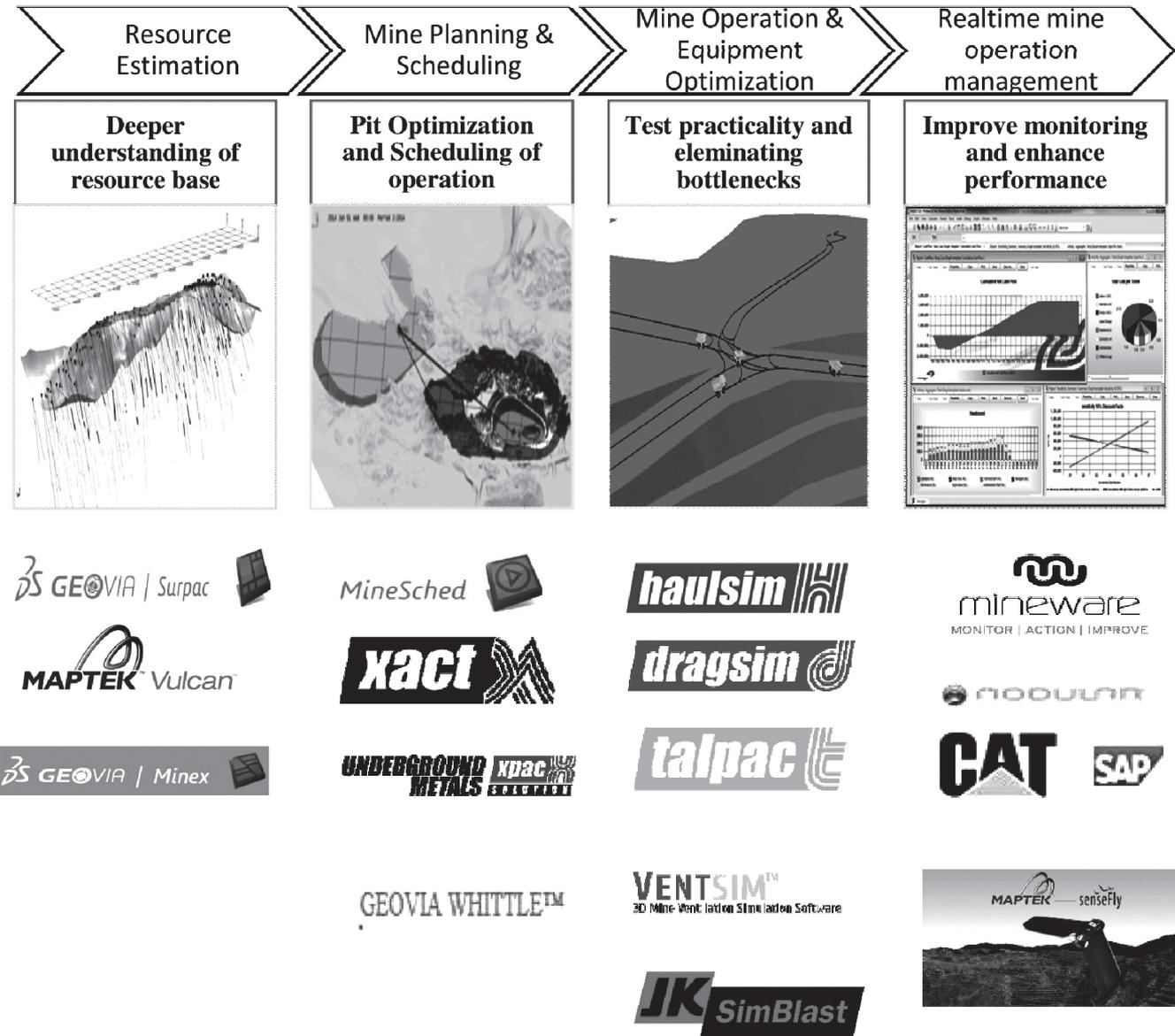


Figure 2: Digital technology platform on the mining processes

Complex mining tasks such as geological modelling, production planning, equipment maintenance and operation etc. generate large amount of data. Only a fraction of these data is

captured manually and processed with different software solutions. A data structure for collection and processing of mining data using existing technologies may look something like as presented in the Figure 3 below:

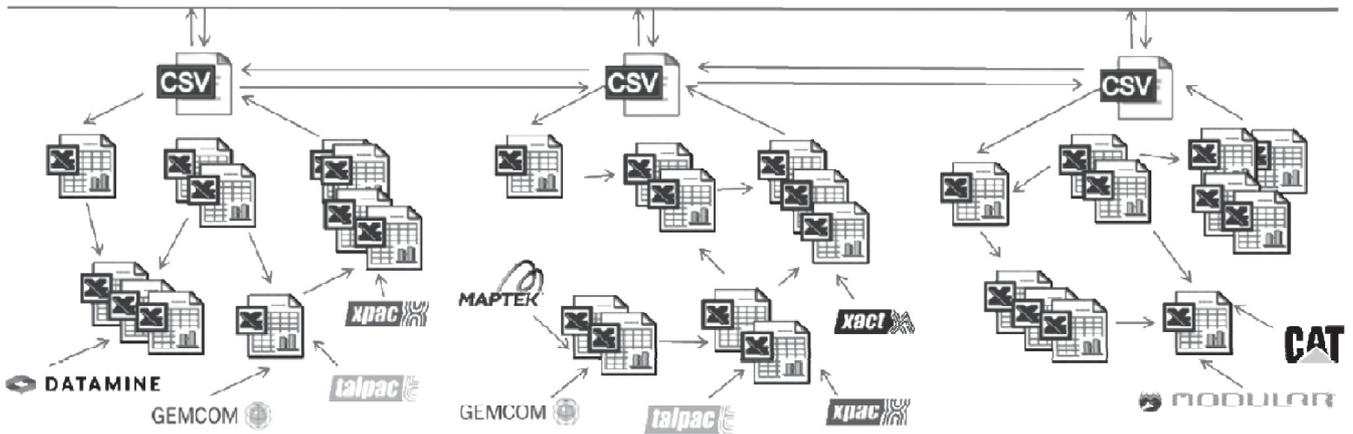


Figure 3: Typical data structure for collection and processing of data in mining

In this system, the data is generated from the multiple sources of mining operations such as production and maintenance process and uploaded manually. The process of data collection becomes cumbersome and time taking. Mining engineers have to spend more time on collecting the data very less time to analyse them before it is too late to take corrective measures for increasing productivity and controlling the cost during which time the mining conditions vary.

Industry imperatives

Mineral deposits are getting deeper and complex with lowering of overall product quality and rising cost of production. Mining leader world over are concerned about the productivity of their operations and want to control it through innovations in mining methods and application of disruptive digital technologies. Achieving a breakthrough for enhanced performance and safety are the main imperatives of mining industry today. Minimizing uncertainties through the mining process, reducing the cost and adapting to the dynamic mining conditions on a real time basis, are some of the drivers causing mining companies to look at digital innovations.

Better performance and productivity are the paramount outcomes (Mundell, 2017). The mining industry has shifted the focus to improving productivity and reducing the cost of operation with application of disruptive and innovative digital technologies in mining (Durrant-Whyte, et al. 2015).

Amount of data generated from mining has increased exponentially over the last decade. It is a real challenge to analyze the huge amount of data and ideas generated during mining and take

remedial measures to reduce the variabilities and increase efficiencies of mining processes (Aggrey, 2018, Doran, 2018). Traditional statistical tools which could process no more than a handful of production and maintenance data and parameters are giving way to the machine learning algorithms such as process information integration system (PI) and Artificial Intelligence (AI) capable of crunching data from numerous events and considering the factors affecting the productivity and cost concurrently even when they lack linear relationship (Mori et al., 2018). Increase in computational power and the development of advance analytics for processing the operational data on a real time basis can enable mining companies to conduct highly sophisticated analysis.

In order to increase mine output rates with lower unit cost, efficiencies must be achieved in all operational areas from exploration to extraction. In addition, achieving operational excellence across the mining processes will mutually contribute toward sustainable mining (Whincup, 2018) because of reduction in the energy consumptions per unit quantity of material produced (Rai et al. 2020). The solution to efficiency improvement lies in the development and implementation of new and innovative technologies.

Investment in technology and innovation can provide a competitive advantage and provide new growth opportunities and resource base (Aggrey, 2018). IDC's FutureScape 'Worldwide Mining 2018 Predictions' report claims that "companies that prioritise digital transformation at the execution level by 2019 will deliver productivity, efficiency and / or revenue gains of up to 20%. However, the mining industry will need to invest

wisely in finding the most relevant technologies for application (Doran, 2018).

Benefits of digital transformation in mining

The mining industry of today is experiencing a dramatic change and presents an immeasurable opportunity to uncover hidden potential. Large amount of data generated across the mining processes must be captured and leveraged on a real-time basis to predict accurately about the variability of mining to allow consistent operation. Complex mining tasks such as geological modelling, production and maintenance planning, monitoring of mining operations etc. are now well in the domain of statistical and optimization algorithms of disruptive digital technologies such as machine learning and Artificial Intelligence (AI). Technology is rapidly changing the mining landscape as we harness information to make operations safer, smarter and more productive.

The progress of industrial internet and satellite navigation have determined the new industrial epoch – the fourth industrial revolution or Industry 4.0. Industry 4.0 is not only and not so much about the new technologies but it is more about the new approach to production and consumption. It is based on the collection of big data, their processing and use for the perfection and control without human interference. The base trend of the industry 4.0 development is the assignment of optimization functions to machines and customization of their operation in autonomous mode. A trend is emerging, according to which the objects of industrial internet (IoT) will independently perform the monitoring of their operations, adjust the parameters sending the data on one hand to the manufacturer for the elimination of machine design shortcomings and on the other hand predicting the failures and replacement of parts depending on the requirements of the production process. It means that one of the most significant aspect of the fourth industrial revolution in mining could be the complete alignment of production and maintenance process.

Mining sector of India must not be left behind in adopting these new innovations in technologies of Industry 4.0. As per a recent NITI Ayog document (May, 2019), AI has the potential to add USD

15.70 trillion to the global GDP. India could add an incremental USD 957 billion to its GDP by 2035. Realising the transformational potential of AI, Hon'ble Finance Minister, in his budget speech for 2018 – 19 has entrusted NITI Ayog with the responsibility of developing National Program on AI. NITI Ayog has proposed “#AIforAll” strategy for an inclusive leadership where the full potential of AI is realized in pursuance of the country's need and aspiration.

Indian mining sector is in the process of transitioning from being government controlled public sector companies to allowing private ownership. The government has initiated a series of new reforms in the mining sector desiring rapid development and growth (Ministry of Coal & Ministry of Mines, Govt. of India). To compete in the global markets, both government enterprises and private sector companies will have to establish “global standard” mining operations and recognize that they need to adopt systems, and technologies to exercise better control, enhance productivity, safety and sustainability in a cost-effective manner. Application of disruptive digital technologies such as machine learning and AI to control mining processes are much needed in today's context than ever before to unlock the hidden productivity opportunities of mining. Such systems and technologies would enable a paradigm shift in the way mining would happen in India – a shift marked both by harnessing the flow of information in decision making and by application of digital technologies enhance control and visibility in mine planning and execution process.

Challenges and methodologies to adapt digital transformation

Introducing process changes for disruptive technologies can be difficult because people are used to operate in a certain way. Organizations need to show them that a different way of doing could be better. In order to achieve a successful selection and adoption of technology, specific processes (production, maintenance, ventilation etc.) or asset (haul trucks, shovels, draglines etc.) may be chosen and then technologies can be introduced to capture (collect, connect and centralize), analyse, and visualize the data and

information to gain operational intelligence. Each step would lead to deeper understanding of what has been done and what is currently happening – enabling the organizations from reactive decision making to pro-active decision making to improve the performance and productivity. The process never stops and constantly uncovers opportunities to improve. The end goal is to create an environment where data can guide intervention at any stage to increase productivity, minimize losses and drive profits.

Increasing uptime, safety and efficiency through mining asset performance management can provide the type of quick wins with solid return on investment that may serve as a foundation for large scale digital transformation over time.

Asset Management : A smart area of digital focus

Having the appropriate assets available is critical for successful production process. Asset performance management could be a sound entry strategy to embark upon the path of digital transformation to ensure utilization and productivity of mining assets.

During the production process, maintenance analytics can ensure availability of sufficient equipment such as haulage trucks, excavators, conveyors etc. are available. Using advance pattern recognition and machine learning, these tools can identify normal, abnormal and failure signature agents for different machines and components. When an issue appears, the system

issues an alert describing the exact problem, root cause and time to failure which can guide production and maintenance process to fix them.

Production and maintenance process of mining

Production and maintenance are the major processes of a surface mining (Figure 4). The key features are as below:

- a) Production and maintenance process in mining generate large amount of data. Capturing and processing of these data on a real time basis are the key to the success of any mining operation.
- b) Production planning is generally performed in software applications configured to reflect specific geo-mining conditions. There occurs a lot of variability in the parameters affecting the production process as the mine changes over time.
- c) Maintenance process has more constant variables than production process – Easy to be planned in traditional technologies such as ERP which provide standard and repeatable application.
- d) Planning of production process is difficult in standard ERP tools as this system is not quite repetitive and evolve over time. Seamless integration of production and maintenance process is difficult – there is always a gap between what we plan and what we produce.

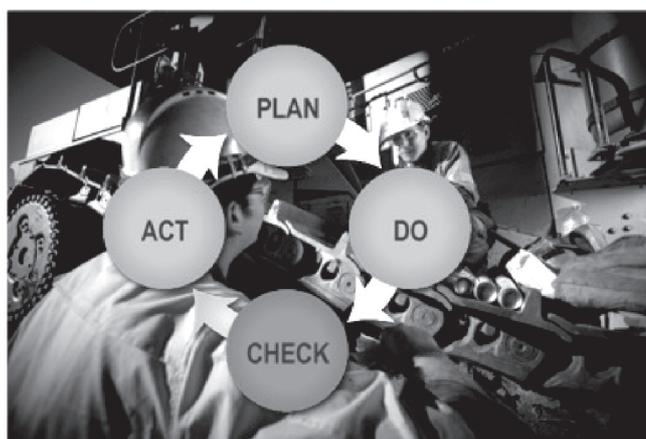


Figure 4: Production and maintenance process

Emerging big data analytics and machine learning algorithm has the ability to fill up this gap. The production and maintenance process can be

integrated based on the real time advance big data analytic tools to increase utilization of equipment and their productivities (Figure 5).

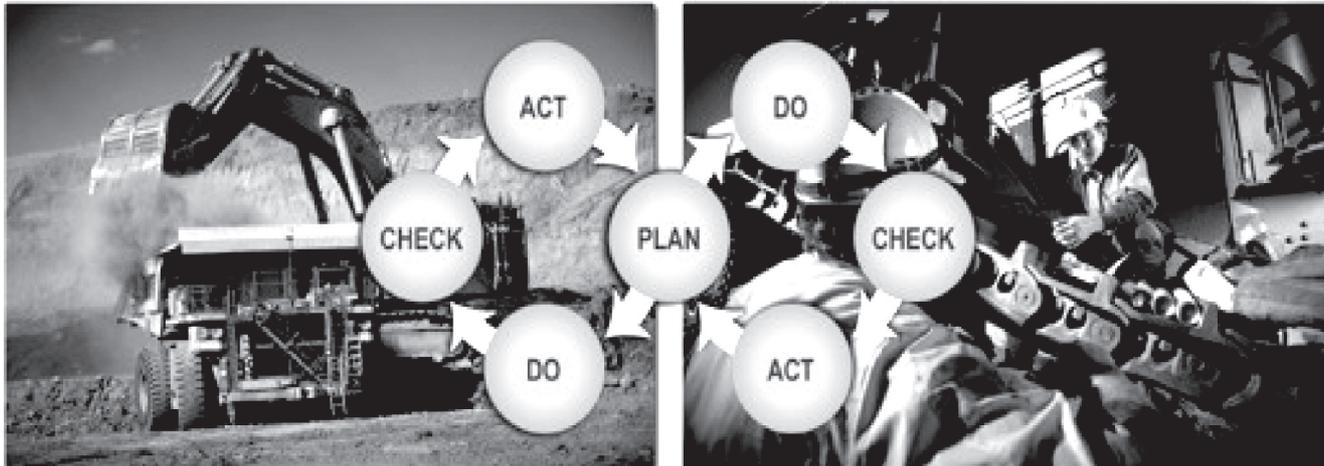


Figure 5: Integration of production and maintenance process

Shovel – Dumper mining operation

Shovel – Dumper mining is the most popular equipment system of surface mining. The main advantages of this system are its excellent flexibility which results into excellent ability to meet production and cost targets (Humphrey, 2013). Loading tools are generally shovels which operates at independent haulage system. The main advantage of shovel – dumper system is that it is not dimensionally constrained by operating method. The system can operate in constrained or irregular geology and

terrain, and can be added incrementally. This makes this equipment system virtually the only choice for use in complex open pit operations. Flexibility in the equipment system enables a mining operation to adapt quickly to changes in commodity prices, geology, and other influences that cause the original mine plan to change.

Cost of shovel-dumper mining is the most influenced by the dumpers. Dumpers account for nearly 50% of the total system cost while the loading tools about 10 – 15 % (Figure 6).

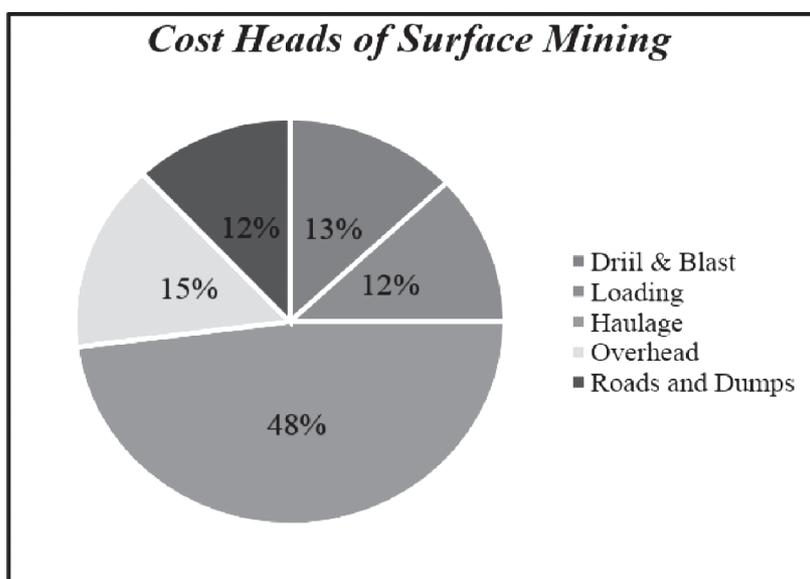


Figure 6: Operating costs of Surface Mining Operation

Thus, the dumpers are the crucial piece of equipment for transportation of mining material in surface mining. The dumpers make the largest percentage of the asset responsible for mining. With a new dumper costing in the range of 4 – 6 million USD per unit, mining companies would like to get the most out of their investments focus on effective utilization. Effective maintenance planning of mining trucks are, therefore, of paramount importance for the success of shovel-dumper mining.

Application of machine learning and artificial intelligence (AI) for maintenance of dumpers

When planning and execution for the maintenance system, there are five common approaches that can be applied to a critical mining asset such as dumpers: Reactive, Preventive, Condition Based, Predictive and Prescriptive.

For critical assets like Trucks, there is no place for reactive maintenance. Equipment breakdowns are often costly on many levels – downtime means loss of production and productivity. Parts can be expensive and then there are wasted outlays on labour and energy. Preventive maintenance will improve the reliability, but it might not be effective as there will still be unplanned breakdowns. It is reported that 82 % of machine failures occur at random intervals.

Condition based monitoring is the first step towards adopting a future forward maintenance strategy. It is based on monitoring of machines while they are still running. Data can be collected

on-line or off-line based on the type and criticality.

Predictive maintenance advances the condition-based approach further by using model based anomaly detection. Predictive maintenance is based on mathematical models and is based entirely on data. The models that build and train predictive maintenance require at least two types of historical data - fault data (that is, data for unplanned down time and the equipment operational status data (such as the voltage, current, and the like). And the amount of these two types of data should be large enough to so that the trained model is more accurate. Predictive maintenance relies on the online collation of sensing data and uses data analytics to predict machine reliability.

The highest level of maintenance strategy is the prescriptive maintenance which involves the integration of big data, analytics, machine learning and artificial intelligence. It takes the predictive maintenance a step further by implementing an action to solve an impending issue, rather than recommending an action. A prescriptive maintenance system will be a cognitive system: it will have the ability to think and can only perform at this level when there is interoperability. This is the maintenance system of the future and the goal of Industry 4.0. With prescriptive analytics, one can optimize equipment use, decrease cost and lengthen the life of the asset. Figure 7 shows the evolution of maintenance strategy.

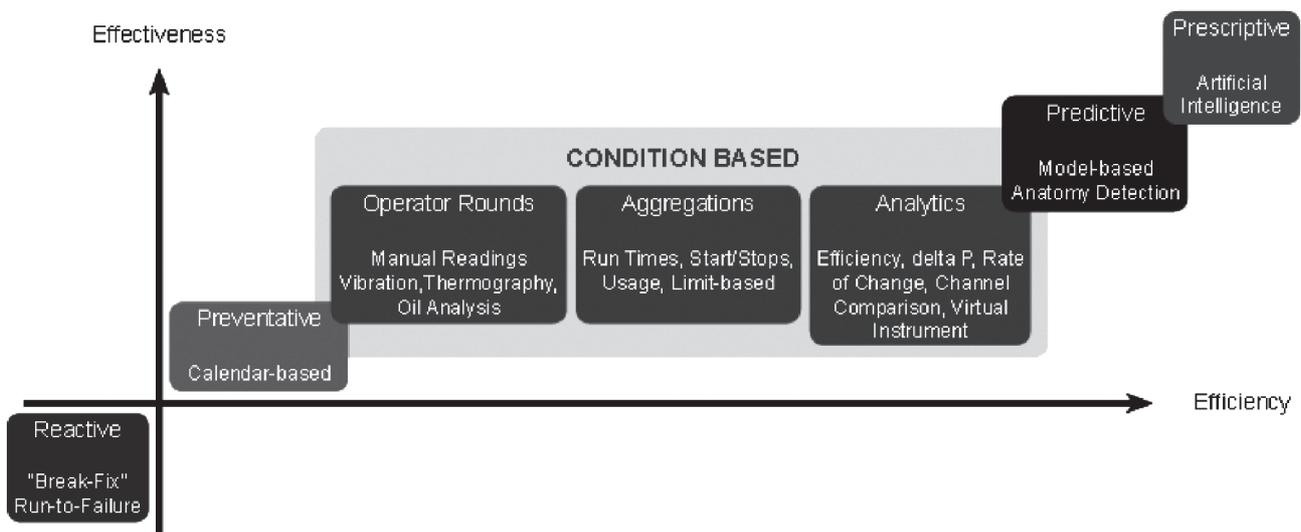


Figure 7: Evolution of maintenance strategy

The most important factor in achieving the efficient maintenance is access to real time operational data. The application of big data analytics in maintenance represents the fourth level of maintenance strategy which can be called “Predictive Maintenance 4.0”. Some used cases outcome indicate that this level of maintenance can reduce the maintenance time by 20 to 50 percent, increase equipment up time by 10 to 20 percent and reduce the overall maintenance cost by 5 to 10 percent.

Conclusions

Use of disruptive and innovative digital technologies across the mining processes is vital for the success of mining operation considering the complexities involved and its dynamic nature. The focus of mining industry has shifted from production at any cost to improving the productivity of its capital intensive asset through digital transformation using Industry 4.0 technologies. The present paper provides an approach to embark upon this journey with introduction of predictive maintenance of dumpers.

Acknowledgment

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Technical Note

FLAMMABLE AND TOXIC GASES IN OPENCAST COAL MINES

- Munir Ahmed¹

Introduction

Coal is produced from opencast as well as underground mines in India. It has been reported that a total of 455 coal mines in India produced coal as on 31st March 2018 (IBM, 2020). Out of 455 mines, 219 are reported to be opencast, 213 underground and 23 mixed. While the number of opencast and underground mines are comparable, production is dominated by open cast mines. In 2018-19, the share of production of raw coal from opencast mines was 686.212 million tonnes (94.2%) against 42.506 million tonnes (5.8%) from underground mines. Since opencast mines produce more than 94% of coal in India, associated environments issues are also substantial.

In figure 1, we can see normal operation of an opencast coal mine but actual problem of toxic gases starts when large quantity of coal is lost in old DL cuts or de-coaled areas as shown in figure 2.



Figure 1 : Opencast mine operation

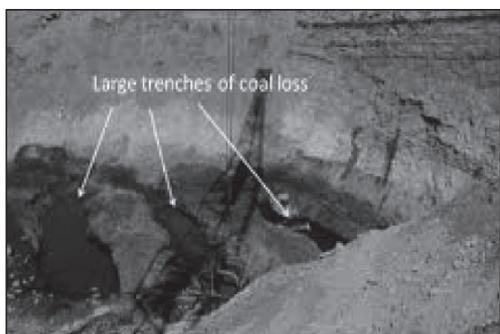


Figure 2 : Old DL cuts

Spontaneous heating and fire in coal mines is a major problem worldwide and has been a great concern (Singh, R. V. K., 2013) both for the opencast and underground coal mines. Lost coal often catches fire due to its property of spontaneous heating as shown in figure 3.



Figure 3 : Lost coal fire

Flammable and toxic gases which can become hazard for opencast working if found in dangerous concentration levels in active mine workings can be broadly classified into two groups.

1. Gases heavier than air
 - (a) Sulphur Dioxide(SO₂)
 - (b) Hydrogen Sulphide (H₂S)
 - (c) Nitrous Fumes (NO_x)
 - (d) Carbon Dioxide (CO₂)
2. Gases lighter than air
 - (a) Carbon Monoxide (CO)
 - (b) Methane (CH₄)

Gases heavier than air

- (a) Sulphur Dioxide (SO₂)

Sulphur dioxide is an extremely poisonous gas. Concentrations greater than 500 ppm are dangerous to life and health after short exposures. Probability of accumulation of this gas in opencast workings is very high because its density relative to air is 2.26. Sulphur Dioxide is produced by

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combustion of sulphur compounds found in fossil fuels including coal as shown in figure 4.



Figure 4 : Emission of SO₂

This gas is colourless with a strong pungent odour that can be detected when concentration reaches approximately 3 ppm. Sulphur dioxide is nonflammable and incombustible. SO₂ is highly irritating to the mucous membranes of the eye and respiratory track. In low concentrations the gas produces tearing, sneezing and coughing. It can be measured using a portable gas detector fitted with an electrochemical cell or by using indicator stain tubes. This gas is one of the main air pollutants. According to Central Pollution Control Board in India its permissible limit for annual Time Weighted Average (TWA) is 50 g/m³ and for 24 hours TWA is 80 g/m³ for industrial, residential, rural and other areas (CPCB, 2009). It can get accumulated in dip side and poorly ventilated areas like old approach roads to DL cuts, old DL cuts, old de-coaled areas, near sumps in dip side, well like structures and pot holes. It can also be found dissolved in stagnant water as shown in figure 5, which can come out in large quantity if stagnant water is disturbed by hand or by some fallen objects.



Figure 5 : Dissolved SO₂ in water

(b) Hydrogen Sulphide (H₂S)

Probability of accumulation of H₂S in opencast workings is high because it has a relative density 1.19 to air and as such, will tend to pool and stagnant in wells and poorly ventilated areas. Hydrogen Sulphide is a colourless gas that has a sweet taste and a pungent odour resembling that of rotten eggs. It is produced from the decay of organic materials and is naturally occurring seam gas in some coal and shale deposits. Hydrogen Sulphide is a highly toxic gas that irritates the mucous membranes and eyes and has narcotic effect on the nervous system. The gas acts on the nervous system causing headache, dizziness, excitement and staggering gait. Massive acute exposure levels produce anoxia resulting in death. Exposure to concentrations greater than 500 ppm can be fatal. It forms flammable mixture in air in the range of 4.5-45%. H₂S can be measured using portable gas detector fitted with an electrochemical cell or by using indicator stain tubes.

© Nitrous Fumes (NO_x)

Nox consists of a group of gases that include nitric oxide (NO), nitrous oxide (N₂O), nitrogen dioxide (NO₂) and nitrogen peroxide (N₂O₄). Of these NO₂ presents the greatest risk to mine workers due to its prevalence and the serious health effects that may occur after exposure to low concentrations. NO₂ is reddish brown in colour with an acrid smell as acid taste. It has a density relative to air of 1.6. It is nonflammable and incombustible, but it supports combustion. NO_x is produced as a component of diesel equipment exhaust or as a result of the detonation or burning of explosive (figure 6).



Figure 6 : NO_x emission

It is usually found in working areas immediately after blasting (figure 7). The amount of gas increase during incomplete detonation of explosives or from poorly maintained engines.



Figure 7 : Occurrence of NOx

NO₂ is extremely poisonous gas that is highly irritating to the respiratory system. Dangerous concentration may be inhaled without causing significant discomfort to the worker. More severe symptoms may then ensue several hours later after exposure has ceased. Concentration of 100 ppm may seriously irritate the respiratory system and concentrations up to 200 ppm are dangerous to life and health if breathed only for a few minutes. It can be measured using a portable gas detector fitted with an electrochemical cell or by using stain tubes. In recent times an accident due to NO_x poisoning has occurred in Dhanpuri OCP of SECL causing death of Blasting Overman. NO_x is one of the main air pollutants and according to Central Pollution control Board in India its permissible limit for annual TWA is 40 g/m³ and for 24 hours TWA is 80 g/m³ for industrial, residential, rural and other areas (CPCB, 2009).

(d) Carbon Dioxide (CO₂)

It is a colour less gas with a slight pungent or acrid smell and a soda water taste. It has a density relative to normal air of 1.53 and will accumulate in low lying and unventilated areas. CO₂ plays a major role in the body's respiration and cerebral circulation systems. At low concentrations, it acts as a respiratory and central nervous system stimulant. At high concentration it depresses the central nervous system causing unconsciousness and narcosis. It can be found in some mines as a seam gas and also in diesel engine exhaust emissions, mines fires explosions and blasting operations. CO₂ in high concentration can also displace O₂ and O₂ below 6% can be fatal. It can be measured using portable gas detector fitted with an electrochemical cell or by using indicator stain tubes.

Gases Lighter than Air

(a) Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless, tasteless gas with density relative to normal air 0.97. CO is formed during incomplete combustion of any carbonaceous material. Concentration of CO can go to a dangerous level in a condition where diesel machinery are being maintained in an enclosed workshop or shed with poor ventilation or with such ventilation which is causing circulation of air as shown in figure 8.



Figure 8 : Emission of CO and CO₂ from dumper exhaust

Conditions as shown in figure 9 in which coal fire is covered by dumping OB is perfect for generation of CO. It is always present in the proximity of coal fires.



Figure 9 : Coal fire in OB dump

CO is both flammable and explosive. The flammable limits in air are 12.5 to 74% with the most explosive concentration being 29%.

CO is recognized to be most dangerous toxic gas found in coal mines as it is impossible to be detected by smell or taste. It poisons the body by being

absorbed into the bloodstream and preventing the blood from taking up and transporting the necessary oxygen to the various cells and organs i.e., red blood cells will attach to carbon monoxide molecules forming carboxyhemoglobin rather than attaching to oxygen molecules and forming oxyhaemoglobin. As exposure is continued the blood becomes saturated with carbon monoxide until the blood can no longer absorb oxygen.

CO can be measured using portable gas detector fitted with an electrochemical cell or by using indicator stain tubes. CO is also one of the main air pollutants and according to Central Pollution Control Board in India its permissible limit for 8hour TWA is 0.02 mg/m³ and for 1 hour TWA is 0.04 mg/m³ for industrial, residential, rural and other areas. Possibility of accumulation of CO in active mine workings is very high and in certain conditions its escape to atmosphere becomes difficult.

(b) Methane (CH₄)

Ignition of methane has occurred during blasting operations and it has been detected in conveyor belt tunnels, cavity surrounding coal chutes. It is a colourless, flammable, non-toxic gas that has no

odour in its pure state. Methane is found in varying levels in most coal and shale deposits. It is a simple asphyxiant due to its ability to displace oxygen from air where sufficient quantities exist. Oxygen deficiency causes headaches, nausea, and dizziness and is likely to result in death when O₂ concentration falls below 6%. Methane's non specific odour provides no warning of its presence in potentially dangerous concentrations. It has density relative to air 0.55. It is lighter and tend to accumulate at the roof level of enclosed spaces where limited ventilation exists. It can come out of blast holes in coal seam rich in methane as shown in figure 10, can accumulate in the cabin of drill machine drilling in coal seam with high content of methane as shown in figure 11 or underneath a machinery parked over cracks in ground above the coal seam as shown in figure 12. Methane mixture in air in the range of 5.0-15.4% is explosive. The most explosive methane-air mixture is 9.46%. The most easily ignited methane air mixture is 7.5%. Methane can be monitored using wide range of portable gas detectors.



Figure 10



Figure 11

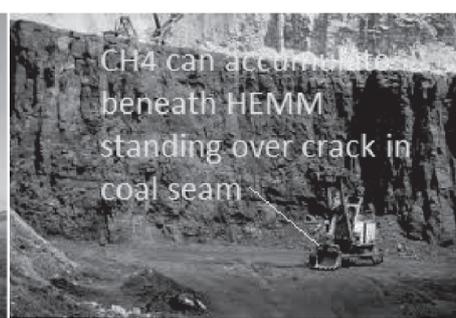


Figure 12

Conclusion

Now it is a time for evaluating risk due to the hazard discussed in this paper for opencast coal mines, formulate preventive measures to avoid incidents/accidents due to this hazard and include this in safety management plan of every opencast coal mine. Draw such programs which can improve awareness among work force and personnel engaged in securing safety in mines. Arrange training of mine personnel and such training program shall include knowledge about locations which are potential to accumulation of flammable and toxic gases. Controlling the safety hazard and taking

precautionary measures, detection method and the use of monitoring devices should be priority areas.

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Down the Memory Lane

M.H.R.Rao

Director (Technical) Rtd, Bharat Gold Mines Ltd. K.G.F.

The world famous gold mines at KGF in Karnataka 100 KM from Bengaluru which started operations from the year 1880 reached great depths up to 3200 mts below ground. The works were extensive along the 10 KM long schist belt with many parallel ore bodies and intersected by many faults a few of them major and active. The Kolar gold mines were world famous not so much for its great production though more than 800 Tonnes of metal gold was produced in 100 years as for its difficult mining conditions and violent ground movements due to geological disturbances measuring more than 6 to 7 on the Richter scale resulting in large scale collapse of mine workings, damage to shafts and resulting very heavy casualties to mine workmen and even collapse of surface structures.

One such fateful day was on 25th September 1965. A violent rock burst took place at 11 AM resulting in severe damage to a stope below the 55th level (about 5000 ft below ground) in the Nundydroog mine, the northern extension of KGF. At that time a crew of 4 men were engaged in clearing and supporting a stope for production. The stope had reached 60 feet below the level and the system of extraction was by underhand method with granite masonry support and a ladderway as entry to stope. I was in charge of this section. Message was soon received that severe damage had taken place to the area and one workman was trapped in the stope. I soon arrived at spot and took charge of the situation. Two more colleague officers from other sections also arrived. The situation was assessed. Part of the ladder way was damaged due to collapse of a portion of the granite wall support. One workman was trapped below. It was ascertained that the man was alive through feeble voices heard. We soon got organized and started rescue operations. We had to withdraw many times due to constant ground movements which posed a danger to our lives.

While work was thus progressing there arrived

on the scene the Superintendent of the mine accompanied by the Director of Mines Safety of the Southern region. The DMS had recently taken charge. He summoned us for a discussion and to assess the situation.

During this time a few ground movements some violent took place. This disturbed the DMS. He ordered stoppage of all rescue operations as he feared for the safety of the members of the rescue team. He was also doubtful if the trapped man would be alive under the existing conditions. I explained to the DMS that the man was alive and we were duty bound to try and rescue the worker.

I assured that we will take all precautions for our safety. While this discussion was continuing one of the workmen who also happened to be the worker Union's representative told the DMS that they had volunteered for this rescue work and suddenly asked what the DMS would expect them to do if he himself was similarly trapped. I pleaded for the excuse of the DMS and left the place to continue with the rescue operations.

Work continued in spite of many difficulties and by about 4.00 PM we reached the trapped workman. He was safe protected by the timber stage support. He had a few minor injuries. He was hoisted to the safety of the level. When we finally reached the level with the rescued worker I was surprised to see our Superintendent and the DMS still in the level. They had not left the place. Their conscience had perhaps compelled them to stay.

The DMS was supremely happy and congratulated us. He appreciated our dedication and courage in saving the life of the workman under such difficult conditions. Later the rescued man was sent to hospital for examination. The whole episode was soon forgotten and normal work resumed. Nearly one year later when all this was forgotten a letter dated 1st August 1966 from the Home Secretary, Government of India was received. The letter is reproduced below.

COPY

“

L. P. SINGH
Home Secretary
Government of India
MINISTRY OF HOME AFFAIRS
NEW DELHI -11
The 1st August 1966
D.O. No.17/1/65-Pub.11

Dear Shri Rao

I have great pleasure in communicating to you the award by the President, of Jeevan Raksha Padak class 11, in recognition of the courage and promptitude displayed by you on 25th September 1965 in saving a worker trapped in a mine. Please accept the warmest congratulations of the Ministry of Home Affairs on this award.

Yours sincerely
Sd/- L. P. SINGH

”

COPY

Shri M. H. R. Rao
Kolar Gold Mining Undertakings,
(Nundydroog Mine)
Coromandel P.O.
K.G.F- 6

The Citation of the President's award is reproduced below -

**CITATION IN RESPECT OF
SHRI MAVATTORE HIRIYANNA RAGHAVENDRA RAO
Kolar Gold Mining Undertakings (Nundydroog Mine) Oorgaum
P.O. K.G.F-2, for the award of Jeevan Raksha Padak, Class II**

On the 25th September 1965 at about 11.25 AM a rock burst of major intensity occurred in the Nundydroog Gold mine of the Kolar gold Mining Undertakings.

As a result of the rock burst one of the worker was trapped in broken granite rock and timber. The ground was still moving under the heavy stresses operating under such circumstances , and further bursts were occurring , there by posing imminent danger , but rescue operations were organized immediately under the leadership of the underground agents Sarvashri Daniel Hercules Victor , Mavattore Hiriyanna Raghavendra Rao and Palladka Anantha Krishna Shettigar with the assistance of thirteen other persons. Of these Sarvashri Kalla Goundapalayam Armugam Ranga Swamy, Perungotturahi chammy Nappan, Karasmangalam Valmunion Doraisamy and Nagapoondly Murugan Govindan undertook the most dangerous operation of clearing the debris piece by piece. The rescue operations continued for over three hours under very hazardous conditions and the trapped man was rescued at about 4.30 P.M. During all this period there was likelihood of rock bursts causing a further crash and collapse of the area.

In organizing and undertaking the most hazardous of the rescue operations Sarvashri D.H.Victor ,M.H.R.Rao, P.A.K.Shettigar, K.G.A.Rangaswamy, P.C.Nappen, K.V.Doraiswamy, and N.M.Govindan displayed conspicuous courage under circumstances of very great danger to themselves.

Sd/ L. P. Singh
Secretary to the Govt. of India,
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