DATA MANAGEMENT

FOR

IMPROVED BLASTING AND PRODUCTIVITY

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ABSTRACT

A single blasting event can generate vast amount of data. This information may be pre-blast, during-the-blast and after-the-blast In light of today's technology, most efficient method of blasting data management is by means of computerized database which has all relevant information for getting desired results and for continuous improvement. Further, this paper presents a case study use of data record and analysis in a limestone mine which shows that data storage by use of software has improved mining operations, reduced drilling and blasting costs and improved blasting results. The concept of data2Desk is also being introduced.

1. INTRODUCTION

Drilling and blasting is made up of groups of tasks, which are performed to produce broken rock with specific fragmentation and muck pile shape & displacement while ensuring that safety, statutory requirements and/or environmental compliance are met. Data collection: pre-blast, during the blast and post-blast is critical to the blasting process, for blast design, for prediction of impacts, for taking corrective steps at execution stage and for further analysis for planning purposes. In the mines and quarries, data is mostly kept in the paper based system. It is often difficult to collect or review historical blasting data. Sometime data collected on paper is transferred back into an electronic system. The manual method of blasting data storage and file management takes time and resource for providing critical information for making decisions. However, blast information data collection and analysis has generally not benefited from recent technology. The review and analysis of past data can improve blast design, blast execution and help in the achievement of desired blasting outcomes and downstream productivity, and process improvement by adjustment of drilling and blasting parameters.

Generally blasting data related information is poorly managed with disjointed and unrelated information technology systems managing parts of blasting data. Data is often moved from one system to another, sometimes manually. Data is obtained from blast face profiling tool, vibration, flyrock, fragmentation prediction tools, and incorporating explosives and accessories used. A data management software ensures information storage, but also acts as an intelligent system to aid blasting operations. Based on the database and its search and analysis capabilities, the system can provide opportunities for taking corrective steps by changing explosive charge distribution, initiation timing and sequence for controlling fragmentation size, vibration and flyrock. Modular software may use information to create specific hole by hole, explosives loading and create load sheets according to geotechnical zone characteristics and results required.

2. BLASTING DATA

An important component to the management of any process is the measurement of key parameters, which in turn are used to monitor, control and provide the feedback necessary to improve the process. Any "optimization" (or improvement) of blasting should not only look at

the blast itself, but also to all consequences of blasting results. These considerations lead to overall-integrated concept. It is obvious that such approach does not only provide data for blasting improvement, but will be helpful for investigation of all other operations as well.

Several commercial database systems for mining and blasting are available for storing and analyzing data. However, blasting related data base systems have not found to be popular at the mine level by Indian mining and blasting organizations.

Advantage of using information technology data management are systematic storage of data, retrieval of data over a long time period, analysis of data for improving efficiencies, automated reports, view and analysis at distant location if desired. In general separate reports have to be prepared/ submitted to different regulatory authorities, to management and also for own requirement of mine operators. This paper discusses how data collection and analysis can provide a better understanding of the blasting operation, as well as additional control and improved outcomes. . Further, difficulty is that imported software need to be customized according to Indian practices and also updating the database. Further, while using similar explosives and initiating systems execution in different countries is not similar. Database is foundation for optimization of blasting and overall operation.

2. DATA MANAGEMENT

Although strictly speaking data-management refers to management of measured data. Besides measured data related to geotechnical and blasting parameters, explosives and accessories used, a large number of measurements during and after blast are carried out:

- Results including photographs and videos recorded during blasts
- Vibration monitoring results.
- Fragmentation size distribution
- Blast dust plume movement
- Performance loading, transport and crushing equipment

A blasting operation data management system, not only ensures information storage, but also acts as an intelligent system as an aid for blast design, prediction of impacts and analysis can be integrated with the organizations information system. Database is foundation for optimization of blasting and overall mining, tunneling or quarrying operation. Based on the database and its search and analysis capabilities, the system provides opportunities for getting dynamic drilling and blasting parameters, vibration constants and predictions, flyrock predictions, fragmentation size predictions. This helps in adjustment of drilling and blasting parameters based on optimized results. Data is obtained from blast hole face profiling tool, vibration prediction tool and direct data link to a database incorporating all the major manufacturers products and an interface allowing the user to add new product ranges and create custom products.

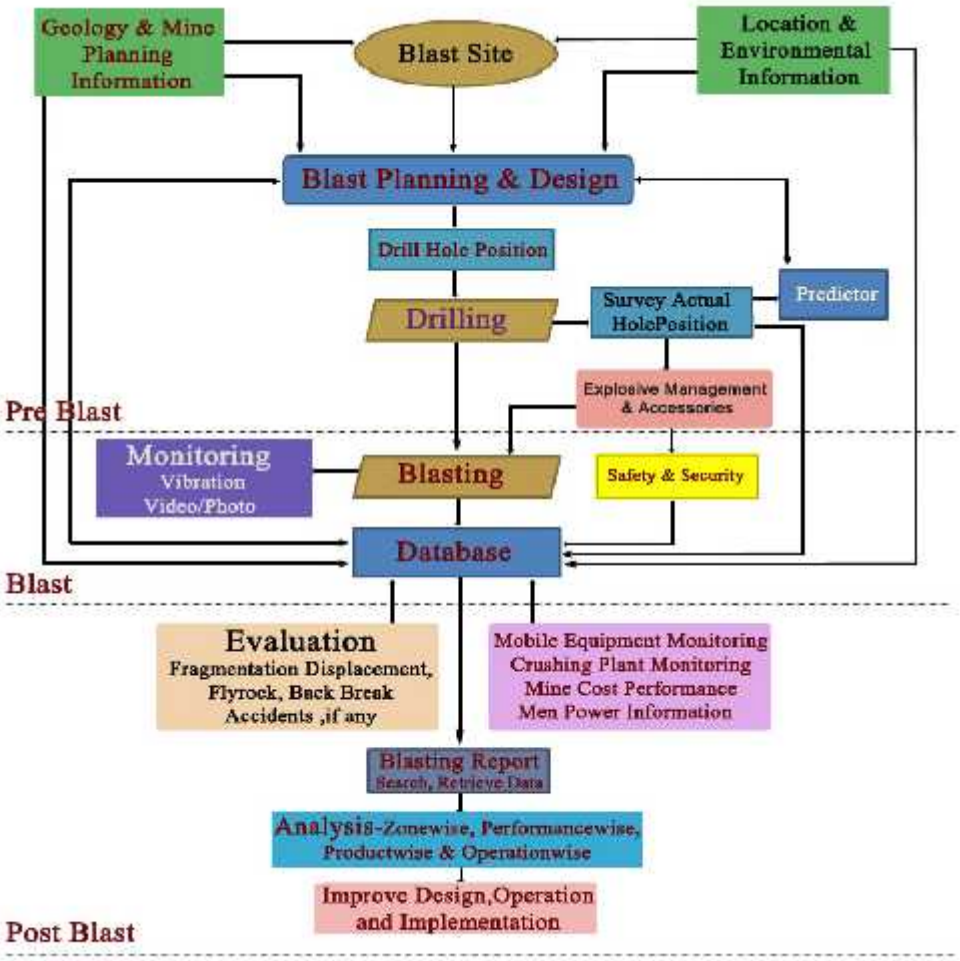


Figure1: Blast Information Database

3. CASE STUDY

Aditya limestone open pit mine belongs to Aditya Birla group. It is designed to produce limestone 6.6 for cement plant, situated around 2 km from away. The ore to overburden ratio is 1:0.33. Thus, total rock handling is around 9 million tonnes per annum. Presently, there are two working pits. This mine has been able store blast related data from the beginning of limestone open pit mine in 1965 till date has helped a mine in improving drill factor from 45 tons/m to 75 tons, breakage of limestone from 6.5 tons/kg to 14 tons/kg thus reducing costs by 50% while improving crusher productivity from 764 tons per hour to 932 tons per hour and controlling vibration, flyrock and dust. Data collection and adoption of many scientific techniques such as Indian indigenous air gap, indigenous stem plug, indigenous rock plug techniques and tools have also helped the mine in achieving the above stated results.

Working pits have been developed with working benches of 9.0 m. height. At present, the work is going on in three benches. Adjacent benches are connected with ramps. Removal of

overburden (OB) soil, which is very thin in nature, is done by scrapping with dozer. The scrapped out OB is lifted with the help of shovel and dumper combination and is disposed off in waste dump yard. Drilling is done with the help of ROC L6 and IBH-10 drill machines of 100mm-115mm diameter. A set of maximum 25 holes is blasted as and when required. Excavation and loading operations are carried out by hydraulic excavators. At a time two excavators are used for this operation. Transportation of limestone from working face to crusher hopper is carried out in 35/60 tonner dumpers. At a time, 6 dumpers are deployed for operation. Each excavator is normally given 3 dumpers for loading. Before crushing, the limestone from crusher hopper is passed through grizzly screen for screening out intrusive clay. The clay free limestone is crushed to required size and transported to stockpile located inside plant through belt conveyor.

By keeping records mines have been able to reduce costs and improve blasting operations. On the one hand continual scientific innovations at Aditya Cement have been adopted.

Mine used to keep blasting related data initially in hand written format (Figure 2) and thereafter have been maintaining records in Excel sheet format (Figure 3). In 2011 Aditya mines obtained a software Blast Information Management System (Bhandari and Bhandari, 2006).

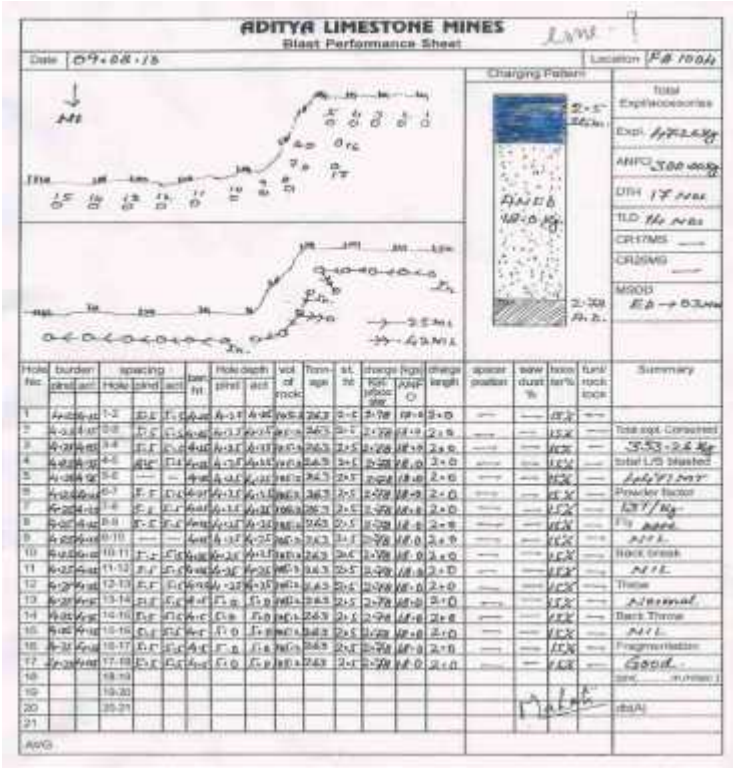


Figure 2: Data Stored manually

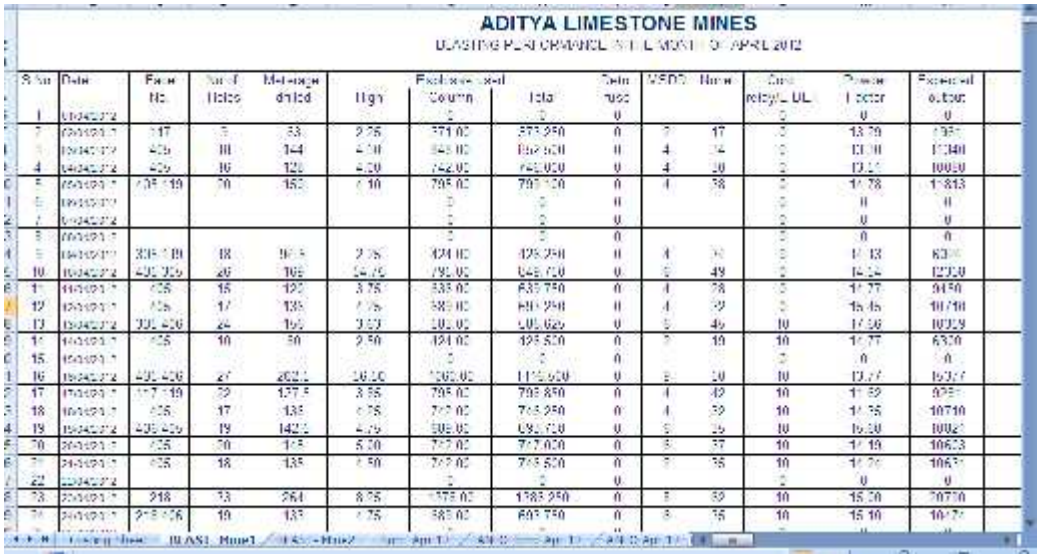


Figure 3 Data stored in excel sheet

3.1 Blast Information Management System (BIMS) provides information to meet the strategic and operational needs for planning, controlling and decision-making for optimizing mining operations (Bhandari and Bhandari, 2006). BIMS provides methods to store, manage, document and retrieve drill and blast related information The system stores blast details, blast parameters, blast pattern, face profile, explosive consumption, charging details, costs, weather information, pre-blast survey, post-blast evaluation data, fragmentation information, photograph(s), videos, accidents, misfires, flyrock, vibration record and information for vibration analysis (Figure 4). Video and photographic records (Figure 5) also provide opportunity to analyze displacement and flyrock, back break/over break records to be maintained and analyzed. These also indicate face movement and hole by hole behavior.

Integration with other software such as that used for vibration monitoring and analysis, fragmentation analysis etc. can be carried out so as to provide simplified management system.

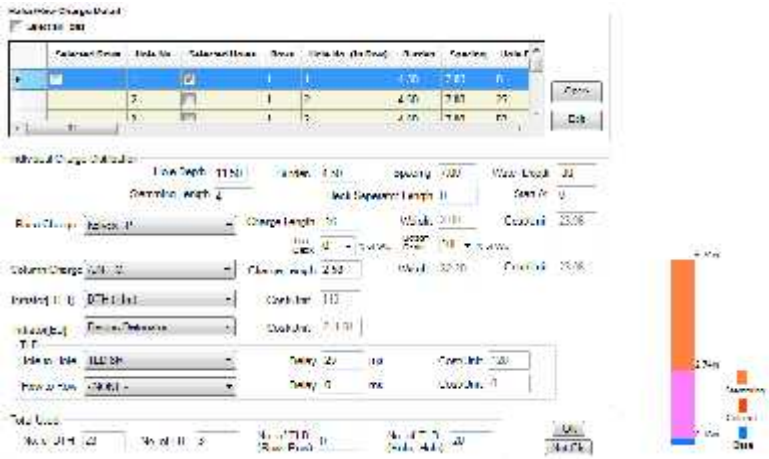


Figure 4 Blast details

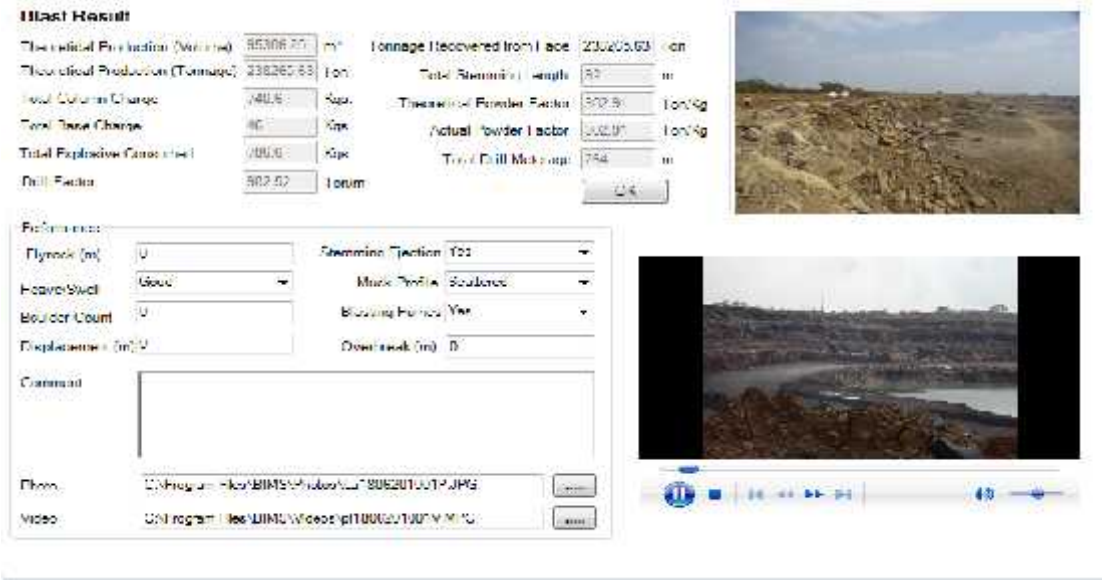


Figure5: Result of blasting along with Photograph & Video

3.2 Reporting and Searching

Many central and state agencies, concerned with Explosives Security, Mines Safety and the Environmental Protection (DEP), are increasing their expectations for strict accounting of inventory and blast documentation. Blasting company executives and managers are now facing the possibility of incarceration, fines and suspended operations if their documentation is not in order. The database can be tailored according products and practices, to customer requirements and can be maintained.

This database has also searching options using which the user can look for the records of blasts as per his defined criteria. Currently, the software uses the following criteria for the search option: between dates, by performance of explosives or initiating system, by vibration limits, by fragmentation size, by location of blasting zone or accident etc.

Blast Detail

Blast No. AC0105200001	Blast Date 01-May-20	Blast Time 10:15:30	
Mine Name:		Operation:	
Pit Name:		Rock Type:	
Bench Name:		Material Blasted:	
Zone / Face:			
FACE DETAILS		**BLAST PATTERN**	
Hole Diameter		Pattern	
Face Length		Rows No.	
Hole Angle		Total Holes	
Sub Grade		Burden	
HoleDepth		Spacing	
BLAST RESULT		**POST BLAST EVALUATION**	
Volume Broken		Flyrock	
Tonnage Recovered		Boulder Count	
Explosive		Over Break	
Powder Factor		Heave / Swell	
Drill Factor		Muck Profile	
Blast Fumes		Stemming Ejection	
Vibration		Fragmentation	
PPV		Comment	
Station Distance			
ZC Frequency			

Calculation of costs related to blasting, drilling cost, explosives cost, accessories cost, and manpower cost all as separate entity, so that each & every step of the mining activity could be optimized by using this information. A report can also be generated of annual return to IBM.

H-8 Annual Return to IBM

1. Licensed capacity of magazine (Specify unit separately in Kg/Tonne, Numbers, Meters) Licence Nos	Item	Unit	Capacity	
			Magazine 1	Magazine 2
Magazine-1: E/NC/RJ/22/815	Explosive	Kg	100000	400
Magazine-2: E/NC/RJ/22/814	Safety Fuse	Mtr	0.00	0.00
	Detonating Fuse	Mtr	0.00	0.00
	Detonators	Nos.	0.00	0.00

Classification of Explosive	Quantity Consumed during the year	Quantity Consumed during the year	
	Large Dia (above 32mm)	Small Dia(Up to 32mm)	Large Dia(above 32mm)
1)Gun Powder	0	0	0
2) Nitrate Mixture			
a) Loose Ammonium Nitrate	3,253.20	0	0
b)Ammonium Nitrate in Cartridged form	0	0	0
3. Nitro Compound	0	0	0
4.Liquid oxygen Socke	0	0	0
5. Slurry Explosives	476.88	0	0
6) Detonators			

Many records have to be maintained for statutory requirement. Mine has to provide returns to regulatory authorities PESO, Indian Bureau of Mines, Director General of Mines regarding consumption of explosives quarterly, monthly and yearly. Besides management also want end of the month reports. The data base application is password protected thus restricting the use of the software and no unauthorized access to the data is possible. However, further improvement is needed for managing the data collection method and further transfer to management.

- Blast data management to ensure blast meets environmental standards and reporting.
- Blast environmental monitoring such as ground vibration, airblast etc. to meet safety and regulatory requirements.
- Fragmentation monitoring across the site in real time to pin-point wastage and allocate costs.
- Environmental reporting often requires distribution of data to third parties.
- Acquisition of data from single points is not cost effective.
- Very wide area coverage is required.
- Limited or no power available at the measurement point.
- Access to specialized measuring instruments is common.
- Access to data by a non-production staff, on and off site.
- Real-time data acquisition required, for use by non-real-time users.

All of these challenges mandate a new way of doing things. Fortunately, we are living in a connected world. One way is to use smart phone or other devices for collecting data and transferring to mine system. A data2Desk system is useful method.

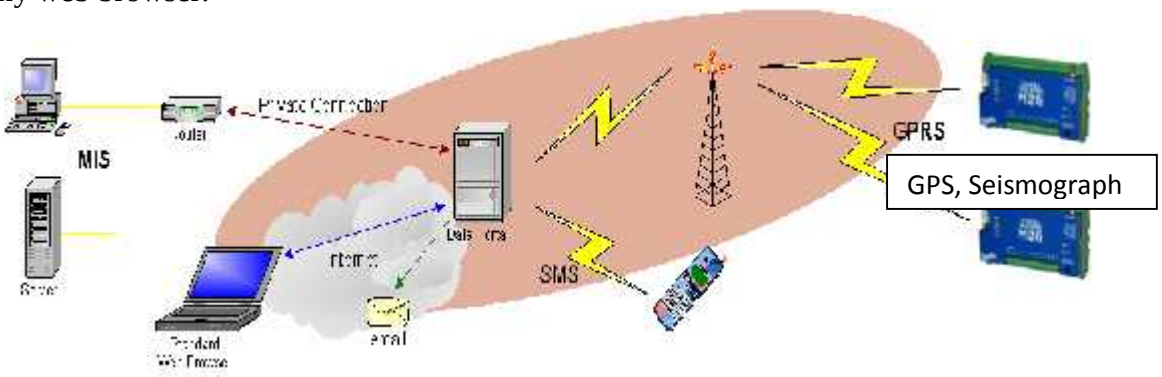
4. Data2Desk

Data2Desktop is an end-to-end technology framework packaged as a simple data service to monitor remote data points. In the mine there are large numbers of faces spread over a large geographic area where blasts are carried out. This requires the application of a new creed of technology overlaying the traditional systems, that are capable of reaching further to acquire more data, and sending it directly to those in the organization that require it, all in real time. This new set of business imperatives is now putting pressure on management to monitor more and more data in real time, and distribute this to more people in the organization, also in real time.

The recent upgrades to the mobile phone network coverage and speed, combined with the internet backbone available, and even the satellite data communications infrastructure available today are creating an extensive and reliable communications infrastructure that is ideal for these applications. An attempt has been made of the opportunities that these technologies can have in the blasting operations, and what the potential benefits can be. **Data2Desktop** is an end-to-end technology framework packaged as a simple data service to monitor remote data points, log the data securely on servers and present the data on demand or by exception to authorized users.

Data2Desktop can use most communications means including mobile phone and satellite networks to send data from remote locations to the Data2Desktop servers, where the data is

stored in your own separate database. Data on these servers can be accessed by authorized users from any web browser.



CONCLUSIONS

Drilling and explosives suppliers are always looking to improve their products, while new technologies and techniques are emerging. Never the less they do offer the potential to improve the process and therefore worth exploring. To demonstrate that an improvement has been achieved there needs to be a comprehensive measurement system, which is capable of setting baseline, and then tracking the changes made to the process. If we can demonstrate a reduction, an improvement in the product the customer receives or a lowering of the cost of producing the product then which out ways the cost of change then improvement is worthwhile. This information stored and analyzed helps in better control and optimization of mining operations. Data base helps to quickly respond to information and remain successful in today's competitive market place.

The use of new technologies in the connected world is inevitable, as it provides the best-in-class means today of communicating with thousands of points securely and cost effectively. Working alongside traditional methods, the new imperatives of the connected world can be achieved without the large capital outlays that were the hallmark of the previous technology projects. With end-to-end services like Data2Desktop, there is need to implement this technology. Taking advantage of this infrastructure to accomplish the additional management tasks of remote asset management as a compliment to your existing BIMS system can lead to fast implementations with surprisingly low capital outlay and running costs.

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