

Yilmaden “smart mining” applications

Today, the mining industry is at an inflection point and faces a disruptive technological innovation leap including but not limited to the adoption of robotic machines, artificial intelligence, internet of things (IoT) technology and data analytics. We call this period “smart mining” era and we believe it will likely disrupt the commodities market in numerous ways as it has potential to improve the efficiency of resource extraction.

Technology raises productivity and improves safety in all areas of mining operations by changing the way metals are produced with complete digital transformation. In spite of having a history of long lead times, mining companies have been continuing to invest in these new technologies and the pace has also picked up recent years. Especially data analytics, mobile applications and automation have taken place in the industry, providing significant efficiency gains.

There are several factors, which support the phenomena. Increasing data availability, computational power expansion with the development of new analytics methodologies, connectivity, mobile technology contribution and widespread tele-remote applications are the most prominent among them. That is to say, collecting, saving and sharing robust data and analytics platforms can create additional value by improving efficiency and unlocking new revenue and growth opportunities. Furthermore, use of advanced sensors in real-time process and artificial intelligence in decision-making process has vital importance in upgrading productivity.

Smart mining technologies can significantly transform mine economics. In line with this transformation, Yilmaden mining technologies have evolved recently. For example, we have implemented sub-level stoping method and mechanized mining for the first time in chromium mining in Turkey. Even though it is not the cutting-edge technology, it is the first implementation in chromium, in Turkey. We deliberately give this example to show this new mining technique has almost doubled our production capacity which has reached to 1 million ton per year with less allocated human resource while the cost of mining has decreased significantly.

On the other hand in our Kazakhstan operations we have implemented other “smart” techniques such as variable cave production thickness, smart markers system, rate of deformation estimation in the gallery and the last but not least connectivity among the systems in our dispatching process. Variable cave production thickness method allows us to determine the thickness between two horizontal galleries and adapt this pillar thickness according to the reserve geometry. As a result, ore is extracted in the most feasible way based on ore’s shape and extracted waste from the mine is minimized. The other applied method, test mining, is used in cave-flow module program to specify remaining ore in the ground after blasting. In this methodology, we place smart marker system (mass flow sensors) in the ore; then extract the ore by blasting. With advanced sensor technology, we could determine remaining markers still embedded in the ore and visualize the ore waiting to be extracted. The third new method that is implemented in Kazakhstan is the rate of deformation estimation of not opened yet gallery. This project is a good example of our collaboration with several prestigious universities to implement new mining technologies. In this study, we get technical support to determine the service life of the unopened gallery. Therefore, we could plan the duration and the speed of the extraction.

Even though all smart techniques has an impact on increasing feasibility, the effect is constrained if interconnection is not ensured among smart applications, database, software and hardware. Employing connectivity is our key success factor to reach out our defined productivity and cost reduction goals.

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The value creation also comes from deeper understanding of resource base, optimization of material and equipment flow, improved anticipation of failures and the increased mechanization through automation. Comprehensive geological info increases the reliability of the project and provides better ground for investors' decisions. It also maximizes the efficiency while minimizes the environmental impact with optimum waste extraction. Indigenous program for utilization drones in our exploration as well as in mining operations, has been initiated to deeper understanding the resource base.

Anticipation of failures, in other words predictive maintenance, is another key issue since mining is an endeavor intrinsically performed in remote corners of the world. Especially in geographies with severe weather conditions like Kazakhstan, any failure can hinder the production for a long period. Therefore, predictive maintenance working on sensors to vehicles and new software linked to ERP systems play vital role for our sustainable mining activities.

Needless to say, realization of smart mining projects requires appropriate organizational structures and necessary measures such as recruiting new talents. For sustainable mining activities, hiring young talents is not enough; retention of these talents is the other equally important factor. In order to succeed it, Yilmaden has initiated long-term internship program where trainees could use this opportunity and transform into full time position, it provides scholarships for senior year students, participates to prestigious universities' career days and utilizes social media to explain its activities. Yilmaden internalizes continuous improvement and provides training programs and on-site visits to extend talents' knowledge and experience.

The benefits from smart mining and its productivity potential for the industry is huge. Smart mining practices increase the production capacity while decrease the cost per ton. We can confidently state that they are more environmentally friendly and more *occupational health and safety driven* applications. Practices such as automation of mining, use of driverless trucks and boggers or automated drone solutions are likely to become common in the sector. Furthermore, smart mining initiatives by various major companies are expected to play a crucial role in overcoming the challenges and so all mining companies should more or less adopt smart mining applications.