Ministry of Mines
Government of India

Letter No:31/46/2016-M

Prl. Secretary/Secretary, All State Governments,
CG - IBM, DG-GSI,
CMD of Mining PSUs-NALCO, HCL, NMDC, SAIL, RINL, MECL, BGML, MOIL.

Date: 01-11-2016

Subject: Applications of Unmanned Aerial Vehicles (Drones) in mining sector

Sir,

Hon’ble Prime Minister, in his address at the National Meet on Promoting Space Technology based Tools and Applications in Governance and Development, in New Delhi on 7th September, 2015, emphasized on the role of space science in achieving good governance and asked all departments to explore the effective use of space technology. Following PM’s vision, Mining Surveillance System (MSS) was conceptualized by Ministry of Mines and has been developed and launched on 15.10.2016. MSS is a satellite-based monitoring system which aims to establish a regime of responsive mineral administration, through public participation, by curbing instances of illegal mining activity through automatic remote sensing detection technology.

Furthering the efforts to utilise the space-technology after launching the MSS, the Ministry of Mines has explored the usability of the Unmanned Aerial Vehicles Technology (UAVs) or commonly referred to as ‘Drones’, for the mining sector. A note has been prepared detailing the extensive applications of the Drone technology in mining sector which is attached herewith. The category-wise summary of the application of Drones has been summarized below:

For exploration work by GSI, MECL & PSU’s notified for exploration:
- Carrying out initial aerial survey of the area to help in planning for taking up exploration activities
- Physical terrain mapping and segregation of land use
- Surveying and mapping of forests
- Detailed study like contour mapping and etc.

For mining PSUs:
- 3D modelling and digital elevation modelling of mines for efficient mine planning.
- Volumetric analysis of the extractions and dumps will not only be helpful for routine automation but also for periodical stock verifications.
- Tracking movements of trucks on the mining site using target tracking feature on drones.
- Reclamation studies using the ortho-photography or LiDARs
- Lease boundary fixation using the on-board GPS of drones.

For States and IBM:
• Lease boundary verifications and geo-referencing of the leases.
• Carrying out aerial surveys at regular interval to study the difference in patterns which in turn can be used for analysing the mining activities.
• Monitoring of illegal mining activities, even in cases of sand mining.
• Using thermal cameras, drones can also be deployed at night to see if any illegal mining activities / transportation are being carried out.
• Target tracking feature can be ideally used for tracking movement of illegal trucks.

It is requested to explore the usage and deployment of drone technology in your respective organisations and share the action taken in this regard with the Ministry.

Yours faithfully,

Encl.: Note on application of Drones in mining.

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Note on Application of Drone in Mining

Introduction:

An unmanned aerial vehicle (UAV), commonly known as a drone, as an unmanned aircraft system (UAS), or by several other names, is an aircraft without a human pilot aboard. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator, or fully or intermittently autonomously, by onboard computers.

Compared to manned aircraft, UAVs are often preferred for missions that are too "dull, dirty or dangerous" for humans. They originated mostly in military applications, although their use is expanding in commercial, scientific, recreational and other applications, such as policing and surveillance, aerial photography, agriculture and drone racing. Civilian drones now vastly outnumber military drones.

Application of Drones in Mining;

Use of drones in mining particularly in underground mining for ‘stope’ surveying is very useful to know the accurate profile of ‘stope’ walls without exposing humans to enter the ‘stope’. Drone-based data collection can also boost productivity; surveying projects that once took days or weeks using traditional surveying techniques are now possible in just a few hours. With fewer man hours required to produce large, accurate data sets, and no need for externally-sourced imagery, the result is vastly reduced costs. In fact, many operators report that a single imaging drone – comparable in price to a mid-range GPS rover – can pay for itself in just a few months. Drones can add value to:

a) Short-term planning- Pit & dump management, Communication of daily/weekly mining plans, Haul route surface optimization.
b) Long-term planning - Haul road, dump and pit design, Geotechnical, Surface stability monitoring, Joint mapping, Control for mining in void areas, Mapping of steep inaccessible inclines.
c) Drill & blast - Up-to-date surfaces for optimised blast designs, Pre- & post-blast data, Identification of misfires & wall damage.
d) Geology - Stock pile management, Grade control & exploration planning
e) Hydrology -Drainage and water management, Watershed, drainage basin & water flow mapping, Thermal detection of ground water inflows, Tailings dam management
g) Heritage & environmental management - Reporting, Erosion detection, Vegetation change tracking, Inundation tracking, Slurry pipeline stability & leakage detection, Game counting, Surrounding community mapping
h) Community - Community relations/marketing, Impact reporting, Oblique imagery
i) **Regulation and operation of mines:** In case of regulations and operations, the activities are volume of extraction which has been reported by the mining agency, whether the volume has been reported correctly or not. It is generally a time taking process.

j) **Managing waste dumps:** Dumping of waste from extraction needs to be monitored whether the waste is being put in the right site as per the regulations or norms are being violated.

k) **Post mining Reclamation of land:** For Reclamation activities, mining agency needs to reclaim the land after the mine has been closed. IBM has to monitor whether the reclamation has been done as committed by the agency. Count the number of trees that has been planted or calculate the total green cover area that has been developed as part of reclamation drive.

l) **Surveillance or monitoring** of any illegal mining activities being performed in any area.

m) **Apart from the Dust monitoring** in the atmosphere around the mine is also performed, generally when IBM officials visit the site, mining activities are called off which prevents from getting accurate data.

In view of above, use of drones may be considered to be used for regulation and operations of mining industry, which can help in volumetric analysis, lease boundary analysis, thermal analysis of open pit mines and also a system which is capable of real time dust monitoring, surveillance to curb illegal mining activities and various other applications.

**FAQs on applicability of Drones in Mining:**

a) **50 Hectares of area/Mine, time required for Terrain mapping and volumetric analysis:**
   For approximately 1 Km by 0.5 Km of area, it can be covered with 1-2 flights for taking pictures and post flight analysis, creating 3D model using software taken another 12-16 hours to give the results depending on the accuracy of model required and computer capabilities. Hence complete analysis can be done in less than 24 hours.

b) **What is the vertical and horizontal distance accuracy of analysis? (Depth especially in case of underground excavation analysis)**
   It may be more than 95% accuracy in horizontal and more than 90% accuracy in vertical. Flying at lower altitude gives us better accuracy.

c) **What is the accuracy of volumetric analysis that is carried out?**
   The volumetric accuracy, its coming about ~ 75-80%, in a typical mapping done at 200m altitude and GPS accuracy was low. Decreasing the altitude to say 100m or even lesser will give us better results, but after required R&D

d) **Is it possible to stream this data post analysis live through internet?**
   Yes data can be shared through internet it can be exported in form of TIFF, PDF or video format and shared live, uploaded on the cloud and viewed globally