



SMART Mobile Equipment Telemetry Survey

This survey was requested at the CIM Mining Standards and Guidelines Committee meeting held in Seattle (SME Conference) on February 19, 2012. It is intended to poll current SMART operators on their current use of the mobile equipment telemetry. A series of questions intended to examine the why, what, and adequacy of current tools and systems to collect, retain, analyse, and visualize mobile equipment events and telemetry.

The survey was sent out March 8, 2012. Results were returned from nine (9) respondents from a total of 21 requests.

A summary of the survey is that this data is useful now for making decisions regarding individual as well as fleets of mobile equipment. Future growth is planned when systems allow. The mobile information is used in making decisions about safety, production, planning, financial, and training. There is often a mix of equipment in a mine and this raises issues with a single solution to data retention and analysis. This results in in-house solutions to integrate the data. The current tools are deemed insufficient or unfriendly to use. Integration into existing fleet management tools or business systems is desired.

Category	Questions	% Yes	%No	% N/A
Usage	Is the data generated by the equipment of value to your company?			
	Is heterogeneity of a equipment fleet an issue?			
	Does your company currently collect the raw data available from the mobile equipment?	89%	11%	0%
	Does your company plan to collect the raw data from the mobile equipment in the future?	100%	0%	0%
Data Collection	Does your company use different OEM equipment for the same function -- e.g. haulers, shovels?	100%	0%	0%
	What tools and infrastructure are used in data collection?			
	Does your company use only the OEM solutions for collecting data from the unit?	33%	67%	0%
	Does your company use custom-built or third party tools for collecting data?	78%	22%	0%
	Is the raw data collected when needed (ad-hoc)?	33%	67%	0%
	Is the raw data systematically collected and transmitted from the units to a common location?	78%	22%	0%
Data Management	Are the challenges to collect data from the OEM equipment?	89% ¹	0%	0%
	Do you collect data a single time and store it in a master data base for multiple use (Yes), or each application collects its own data independently (No)	56%	44%	0%
	Is the data retained for any purposes?			
	What is the data used for in your company?			
	Is the analysis needed complex or relatively simple?			
	Is the data collected retained in an data historian or database (e.g. retained for 3/6/12 months)?	78%	22%	0%
	Is real-time data required?	100%	0%	0%
	Is the data used for forensic analysis?	100%	0%	0%
Purpose	Is the data used for predictive purposes -- CBM, Safety?	78%	22%	0%
	Is the raw data displayed as is (time series strip chart)?	56% ²	33%	0%
	Is there a need to further process the data before using it?	100%	0%	0%
	Why is the data collected?			
	Is the data collected used for safety related issues?	78%	22%	0%
	Is the data collected used for Production Control?	67%	33%	0%
	Is the data collected used for Production and Equipment Reporting/Accounting?	78%	22%	0%
Data Mining	Is the data collected used for Condition based maintenance?	78%	22%	0%
	Is the data collected used to study fleet related activities?	100%	0%	0%
	Is the data collected from the mobile units used to influence mine operations?	89%	11%	0%
	Are the tools available adequate?			
Do the current OEM vendor tools suffice for your purposes?	11%	89%	0%	
Do current third party tools suffice for your purposes?	33%	56%	11%	
Do you or did you need to develop tools in house?	100%	0%	0%	

Table 1: Questions and summary of responses from 9 respondents to this survey. The shaded questions are the focus of the specific questions

¹ One company didn't respond to this question but indicated that manual downloads resulted in stale data and production-loss when downloading

² One company did not know if this was the case

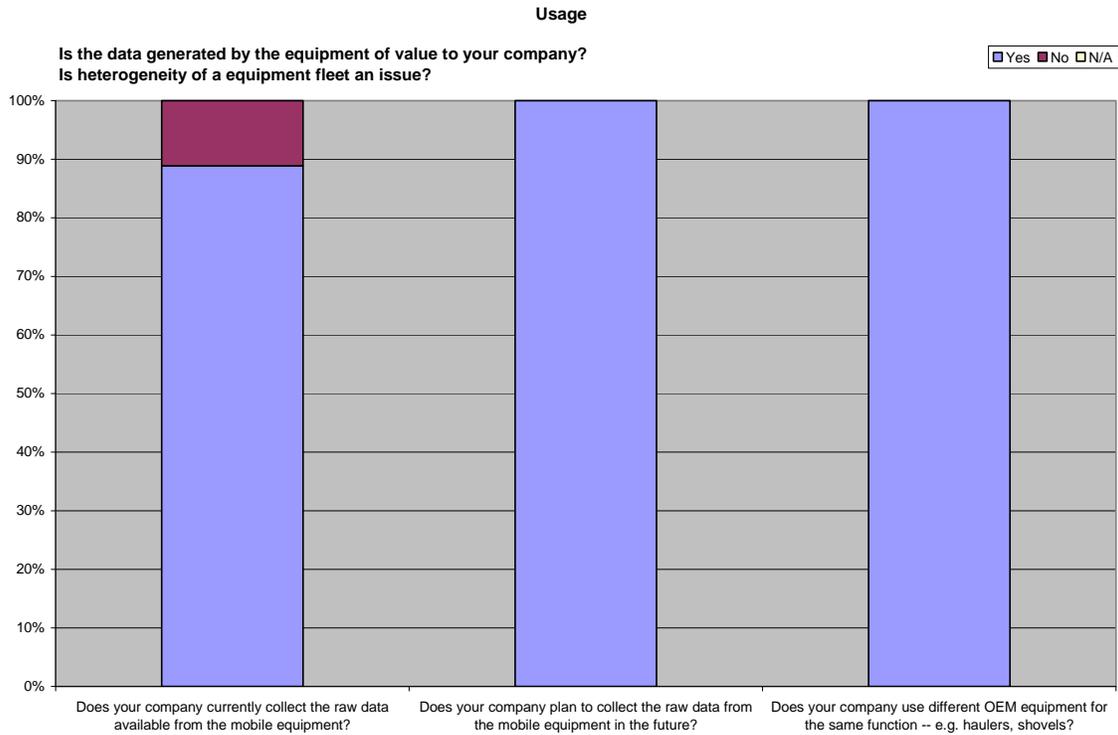


Figure 1: These three questions were focused on the value of the data to the operators and a measure of the complexity of the solution (multiple vendors)

Comments:

1. The raw telemetry and alarms are collected using a combination of data loggers, wireless communication, and database/data historians, fleet management systems (FMS), technicians, production PLCs, dispatch system; Only that which is available from the FMS application;
2. All responses indicated that either data collection would exist or be improved upon in the future
3. Most companies indicated a mix of mobile equipment fleets and a mix of management systems for each fleet. Few companies were settled on one type of equipment for one task.

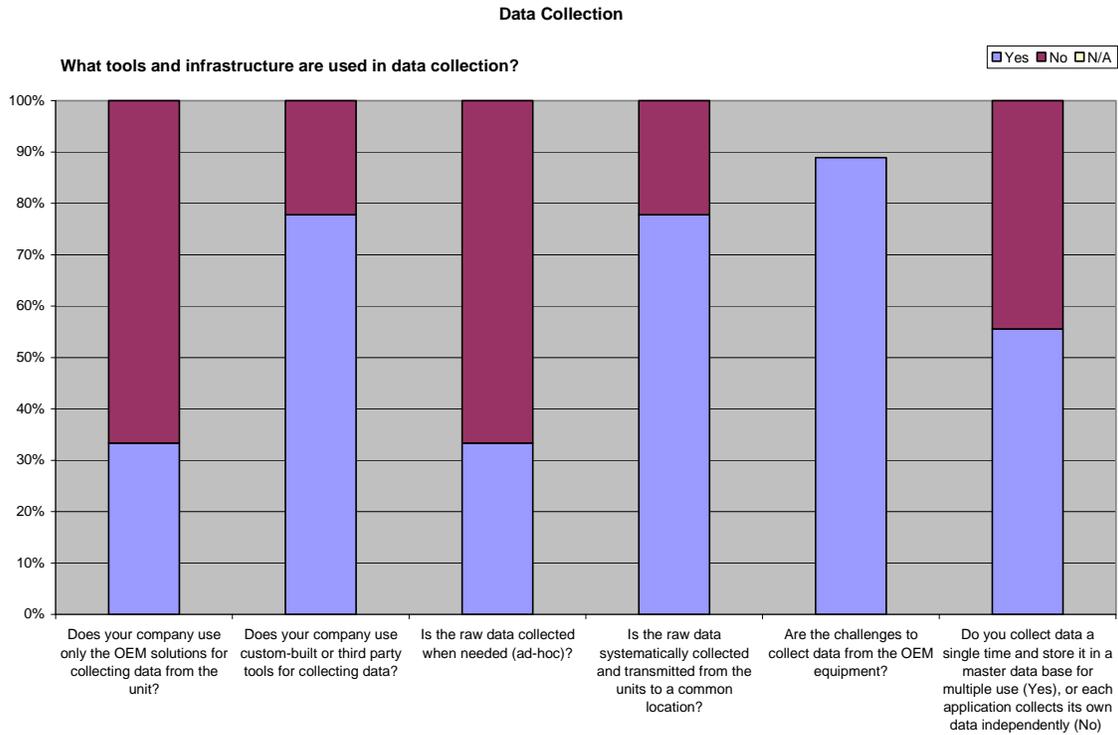


Figure 2: How is the data is collected and retained?

Comments:

1. Wide variance from OEM, custom tools; to maybe later.
2. Custom or third party data loggers, wireless communication; custom systems; and custom tools are used; OEM tools on limited equipment
3. Warranty or incident investigation (black box recorder); ad hoc; automatically; where available custom in-house ; continuous; ad hoc;
4. The range was from 24/7 to manual; retention ranged from centralized data warehouse to control room to local user only.
5. Many issues ranging from proprietary collection protocols; changes in protocol and telemetry available; fleet management system issues; equipment doesn't have data gathering functionality; lack of published info on data parsing; OEM limits but most sufficient for needs; site/contractor restrictions; It was pointed out that middleware helps;
6. Results ranged from each equipment generates its own data; individual databases; data aggregated to control room; aggregated to a central warehouse; limits imposed by OEM capabilities

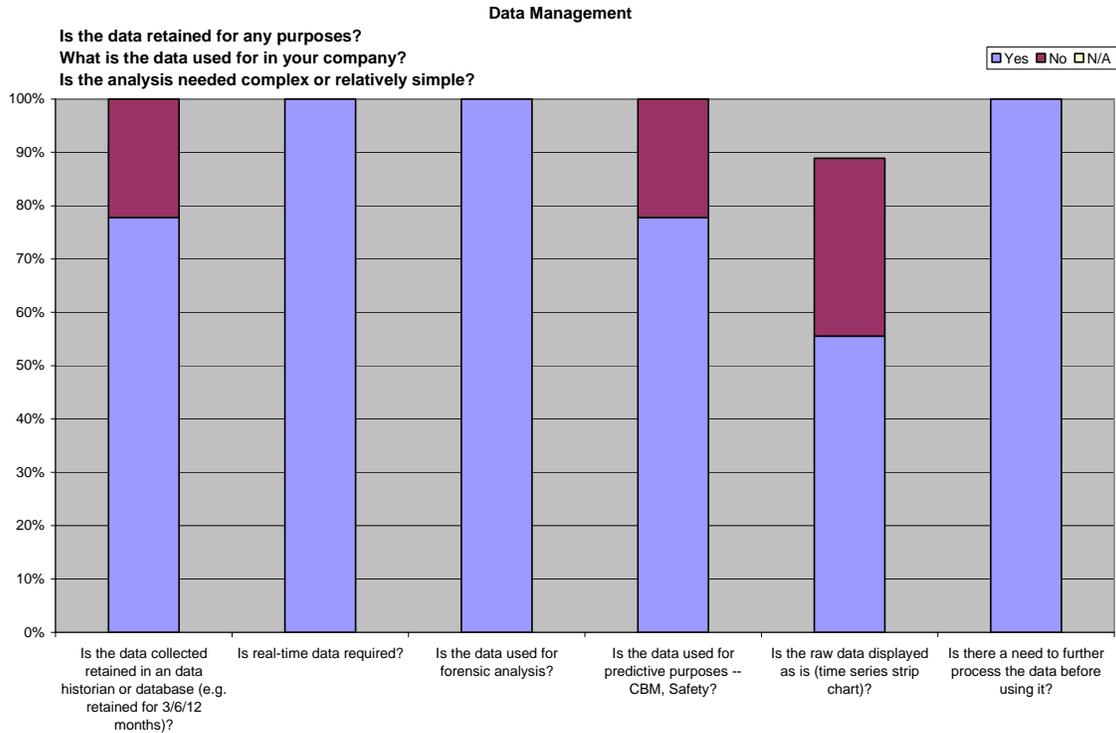


Figure 3: Is the data retained for any purpose; what are the purposes; and what is the complexity of the analyses?

Comments:

1. Most do to some degree while others are planning to.
2. Most responses have or want near real time but are wary of sensor or alarm issues; alarm overload
3. Typically, used for incident reporting; equipment health monitoring; production and reliability measures. The scope is usually limited in nature but most indicated future capability and growth are happening. One is not using data in this way
4. Most are using this in limited fashion but all indicated a desire for increased capacity in this area
5. This option was available but alternatives e.g dashboards were an option.
6. All indicated a need to clean or process the raw data for cleaning, filtering, and creating actionable events.

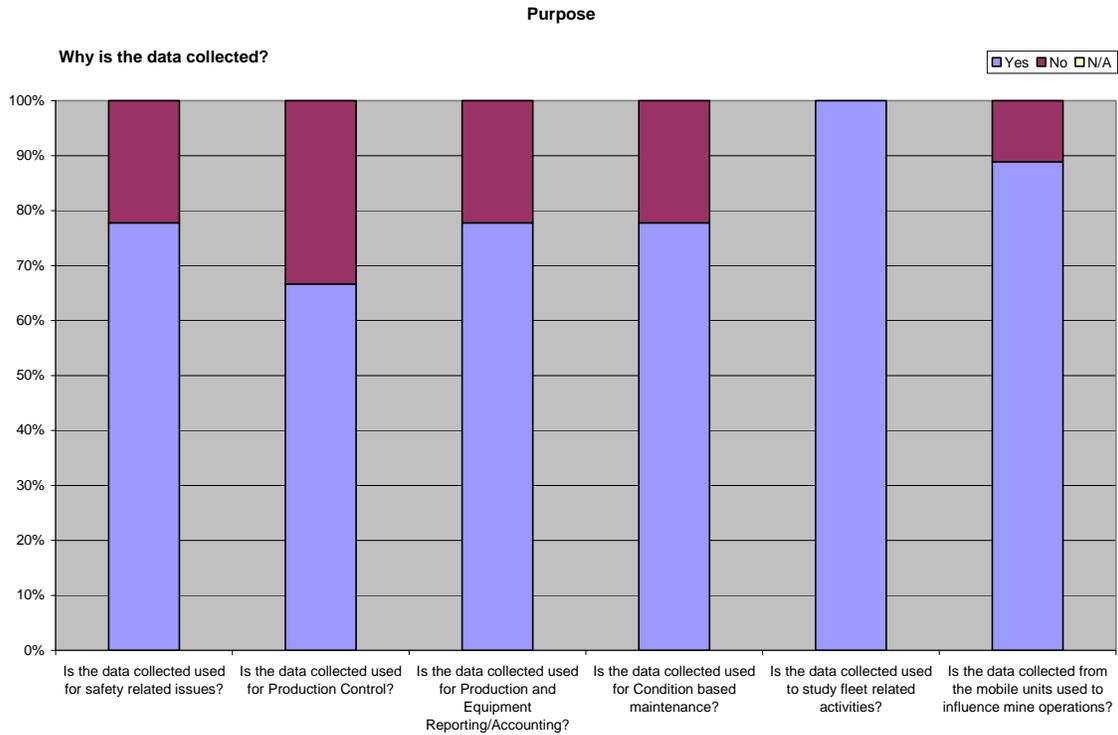


Figure 4: Why is the data collected?

Comments:

1. Operator training, investigations, reliability, failure prevention; fatigue and collision; in the future
2. Load capacity; production cycle, shift; equipment efficiencies; grade and bench control; maintenance issues; operator behaviours.
3. Machine event information only; load-weight if reliable; production;
4. Yes, no, in the future; limited equipment focus growth in the future.
5. Multi fleet and multi site
6. not all are ready; but typically production and efficiency; mine layout (roads)

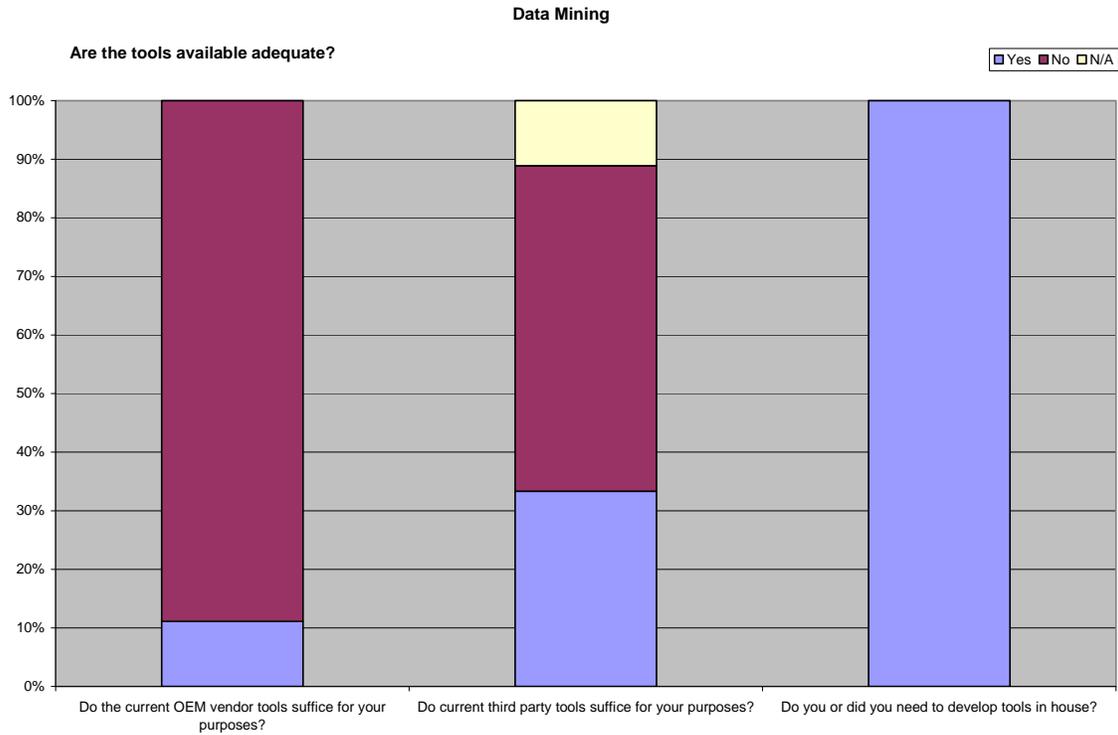


Figure 5: Are the tools available adequate for the purposes of the operators?

Comments:

1. Use minimal set; OEM tools unfriendly to use; only for data collection; cost lack of features; health monitoring is good but not complete solution; typically a subset of what is wanted.
2. Some indicate it is difficult integrate for multiple fleet types; others use extensively; others are not in position to evaluate
3. All indicated some form of in-house development or requirement to link, analyse, manage, retain the data. Either it has been done or will be in the future.



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General Comments:

- Due to running a number of sites real time data acquisition through a dispatch type system on a wireless network is not practical due to limitations on establishing a wireless network, therefore relying on vendor satellite systems or data downloads. Currently in early stages of exploring full capability of OEM provided systems to monitor health and events.
- Secured a combination of third party and OEM data retrieval processes and share a common repository. This data is used to analyze and trend equipment production data.
- We were driven to develop custom tools so that the OEM data could be viewed in a friendly format and enable the development of predictive tools.
- This area is currently high on the list of things to standardize and improve effectiveness of.
- Operations and maintenance data are not routinely collected at this time. Our company uses 3 different FMS vendors, all of which provide different and limited sets of tools and database access. We will be investigating different options for 3rd party data collection because we lack sufficient information from the OEM applications.
- Built a data collection system to bring in the raw telemetry and alarms to a central repository (historian and SQL database). It has easily exceeded the ROI outlined in the business plan.