



Date: 21 December 2011

Subject: Final Conclusions FEMP workshop

Following you will find a brief summary of the most important conclusions of the workshops "Mining company of the future" held during the FEMP reunion at Caterpillar in Gosselies on November 4th, 2011.

Rien Pouls

Caterpillar Global Mining
Phone: +49 681 96789561
Email: marinus.pouls@cat.com



Introduction

During the FEMP/IAB meeting and reunion (3rd to 5th November 2011) a workshop was held with the participants. The participants were divided into 6 groups, each with a different topic and guided by a Group Leader, the topics were:

- Future developments in mass extraction (Prof. Martens)
- Utilization of Longwall Information in 2020 (A. Keller)
- Surface mining in 2020 (D. Mohr)
- Hard rock mining in 2020 (A. Wormeester)
- From mine to mill 2020 (M. Buxton)
- Room and Pillar in 2020 (R. Pouls)

Some guidelines were given on the objectives of the workshop, these were among others:

- What can the future developments have as an effect on human resources?
- What are the effects on educational requirements?
- What other challenges are we expecting in the future?
- What are your expectations?
- Identify subjects for thesis and university research?
- Further objectives were to be discussed within the different workshop groups.

Results of the Workshop

As a general comment it has to be mentioned that the time allocated to the Workshop was relative limited, which did not give the groups much time to discuss the topics in detail. This specially applied to the workshops in which some general information had to be given in the first part of the work shop. Reason being that due to time constraints only of the first 4 (above mentioned) topics an introduction presentation was made in the first part of the workshop.

Following is a summary of the results from the different groups (please note not all of the documents were received after the individual group presentations). As far as possible the results are summarized under the "Topic Guidelines" as a lot of the results from the groups were "identical".

Human Resources:

- Shift in skills
 - higher level of automation requiring more skilled maintenance staff and engineers
 - Operators have to start to understand what "automation" means (what are for example limitations, what can it do)
 - Operators are becoming controllers of systems (supervisors of more than one piece of equipment)
 - The typical UG "miner" will disappear and will become a multi-skilled person
- Possibly a reduction of personnel in mines but with higher skills
- How to keep people at remote mine sites
- How can we make "mining" interesting to people
- A better understanding of all process is required by those involved.
- Further education during the career will become more important as technical developments are occurring more faster

Educational requirements:

- Improve knowledge about automation (what can you achieve with it, limitations, advantages)
- More involvement of industry, technical developments in the industry are ahead of what is been trained at Universities. Presentations/lectures by engineers from manufacturers and mine operators can help to overcome this.



- Integration of different faculties, i.e. a mining engineer does not require to write programs but should have a general background. Instead of doing projects only within the department it may be a good idea to have projects involving different departments

Challenges:

- UG mining conditions will become more difficult (temperature, ground pressure etc) on equipment and humans. Cooling will be a requirement UG.
- Environmental impact on water, air etc
- How far can automation go? In case of a break down is there still a person needed or do we develop special vehicles to retrieve broken down equipment.
- Project development are taking much longer than in the past, how do we maintain continuation in the project as people come and go.
- To develop hardware/sensors to detect/scan ore/seam properties to improve automation or other processes such as amount of explosives, improving LW automation etc, cutting of material
- How to handle all the information successfully. Linking databases, real time data.
- Can we develop “intelligent” equipment, which learns from it’s own mistakes
- Effects of automation on (mining) regulations (such as emergency measures, rock stability, ventilation, road width etc). Issue would be to convince the authorities in accepting automation as a part of the system. For example humans are not required to work in certain areas as it is fully automated or only under certain conditions (equipment is not working etc)
- Can we use equipment, such as Shearers, to collect data
- It is possible to automate batch transport (i.e. Continuous Miner – Coal Hauler – Feeder Breaker, there may be too many variables). We will need a lot of algorithm for this

Expectations:

- Mining will be safer
- More cost efficient
- More “greener” production
- Less damages to equipment in case they are not controlled by humans (i.e. human error is eliminated)
- Improvements in extraction rates and quality
- Certain areas in the mine may see never a human
- Better information on the health of equipment = preventive maintenance
- Automation may lead to:
 - Less break down (because equipment can only be used up to certain “levels”. An operator can try to force a bucket into a muck pile, causing damage to the equipment)
 - No stoppages because of for example coffee breaks. Less time lost because of travelling.
 - Blasting can be done also during hauling and loading
 - “Lower” standards if people are not working in certain areas (dust, temperature, ventilation)
- Mining companies and equipment suppliers will work more closely together
- Mining companies will start to use less suppliers as the systems are becoming more complicated requiring a lot interaction
- “Decisions” will be transferred from the operator to the “machine/equipment”
- Maintenance people may require to have special suits for heat and higher dust concentrations
- Data collected by suppliers from their equipment can be used to optimize equipment being supplied to other companies
- Data collected in certain activities in the mine can have a positive influence on other activities as this information can be used to optimize this activity
- Diesel will be replaced by electric or hybrid engines especially UG
- Mining authorities may be interested in the online monitoring to obtain more data and reduce accidents



Thesis

- What types of mining related software will be needed in the future
- NOTE: A number of thesis can be compiled out of the responses

Special comments to workshop topics

- Surface Mining
 - Can automation of hauling have an effect on open pit design (ramps, width of roads etc)
 - Autonomous mining will require defined operational zones (boundaries will however move)
 - Automation can lead to higher hauling capacity
 - Road maintenance need to be reviewed (can this be done autonomous?)
 - System should not shut down completely if somewhere in the system something happens
- Mine to Mill
 - Use of feed information during extraction to optimize the short term results
 - Can only be successful if a good communication system exists between different activities
 - Requires continuous information on the feed (mineralogy, mixture, properties, grades etc)
- Hard Rock Mining requirements/developments
 - Completely automated mine Drill, loading of blast holes
 - Continuous Telescopic Rock Feeder
 - Combined scaling (requires visual inspection) and rock bolting machine maybe drill and charge
 - Truck loading automation module
 - Smaller drifts if ventilation requirement is reduced
- Longwall
 - Fully automated longwalls require many parameters (such as rock pressure, cutting resistance) to be able to be effective, new sensors etc are required (see also challenges)
 - Fully automated LW will give a higher productivity and better safety.
 - How can we convince new operators about automated longwalls.
- Future developments in mass extraction
 - Development speed will have to increase to keep
 - Improvements in shaft haulage
 - New extraction technologies are required