

## Looking into the future of surface drilling (its here already!)



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*This presentation includes some movie clips and other animations which dont not lend themselves to printing. This is a brief summary:*

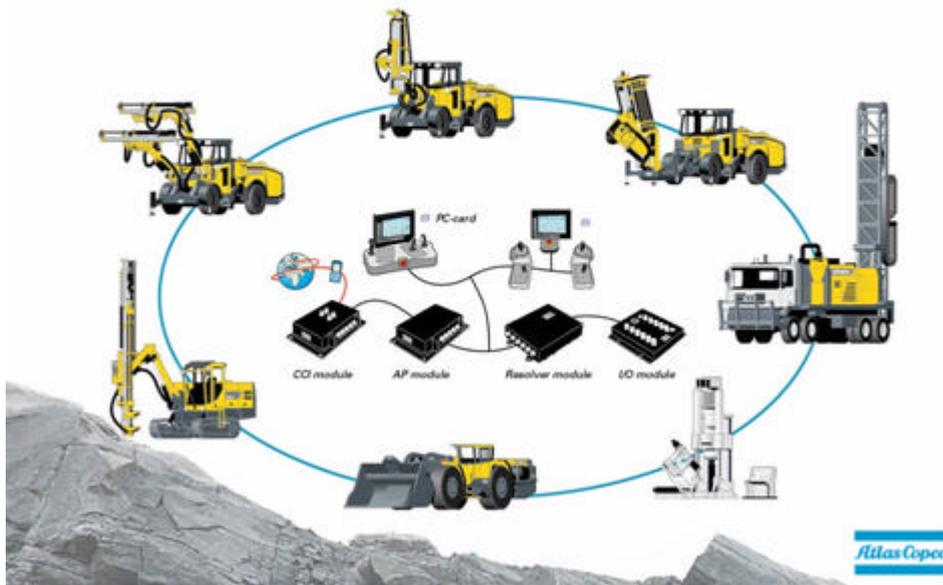
### **Background and history:**

The author of this paper joined Atlas Copco in 1975. Atlas had already then a project going since late 60ies for automatic positioning of Drill Jumbos. This was before the micro processor (The first was the 4 bit Intel as some may recall, which came around 75) Instead the mathematical functions for calculating positions (wanted and actual) were done "hard wired" using ECL logics. The project team consisted of ex. Bofors anti-aircraft gun control system designers. Maybe we will never see a faster system, but the flexibility of this system left everything to wish for and the size and power consumption was of course a concern. (Each boom used a box 600x 600 x 1000 mm, filled with electronic pc cards) Change of drill pattern; drift size etc. meant changing of cards or adjusting a number of switches. As soon as the potential of the programmable micro processors became obvious, new drill rig automation projects were started. It was still a difficult task, and not until 1986 could we introduce a commercial rig in Las Vegas . A 2 boom fully automatic drill jumbo named the Robot Boomer. All this is maybe history without value but for those who participated, but of relevance, is to discuss the reasons for this automation and the suggested benefits for the customer.

The arguments which in those days should make the user to get involved were almost entirely linked to labor cost labor safety and labor environment. Much effort was spent to convince the customer that the rig could do the whole round by itself.....

In the time period from 86 to 96 only few rigs of this type were sold, during which time period, the electronic solutions changed and improved. I am not aware that the rigs were ever used without an operator, but slowly a few other features of these rigs started to develop, both pure technically but also in the users minds. An increased availability was observed, less over break, better fragmentation, better repeatability, suddenly the list is long with features more linked to quality than labor cost. So! then the 10 years later, mid 90ies Atlas Copco started to introduce the present architecture of drill rig control systems based on CAN Bus technology and thus a distributed and modular design, which is very useful in as much as it can be adopted to different rigs types and different automation levels and degrees of remote or autonomous control. To be honest Atlas Copcos rigs of this new type in the beginning performed a little bit as a very good pc computer, with Windows in it, but no software like Word, Excel and the like. Few could do much more than they could with an old rig, even though the operator's panels, screens and controls looked and performed much better. Below slide shows the versatility of the AC RCS Can Bus system.

**But this was just examples, we have more!**



Now again 10 years later you can say, using above expression, we have a very powerful pc a modern OS system and now a whole bunch of standard and optional users programs. The future is now finally here. Maybe in PC computing, one day we don't need the laptops, maybe we can project pictures through brain waves to the audience, but for me, its enough to say, the future is here, we will see an endless row of new features for enhanced control of rock excavation for instance in quarries and quarry machines.

Before I leave the history section, let me say a word on labor usage. Even rigs as of today are very seldom left completely unattended. But in some mines, one

operator can remotely operate a number of rigs, in tunneling one man can operate 4 booms equipped with extremely fast rock drills (COP 3038 on AC L4 rigs) and for extended periods the rigs can complete a task such as a fan in production drilling without human interference. As well as bigger parts of the loading hauling and dumping cycles of the LHD. In surface mining and quarrying, we will soon see one operator/ several rigs! Thus today labor cost has reduced, labor safety has increased. An example is automatic bit changers underground why the operators seldom need to leave rig cabin at face

## **The part of the future which is already here.**

### *The performance and design of Aircrafts and drill rigs, an identity!*

One of my earliest bosses was an aeronautical engineer. Maybe his expression "What purpose has speed if the direction is wrong" was reflecting his education. We others had to stay on the roads so the direction was given. But maybe he already then imagined drilling of today. There are a number of similarities with the development in " the air"

### *Start and land*

A lot of passengers are setting value to the fact that they often start from a given place and arrive at another also predetermined place (though some of us have experienced exceptions). This is equally important in bench drilling, and we have not until now started to equip ourselves with relevant gear for this , as already used in aircrafts , such as compasses, GPS systems , Laser / radar ranging systems and more. This technique as introduced on ACs Smartrigs is now rapidly spreading over the world.

( A number of these features will be shown and explained in the live presentation)

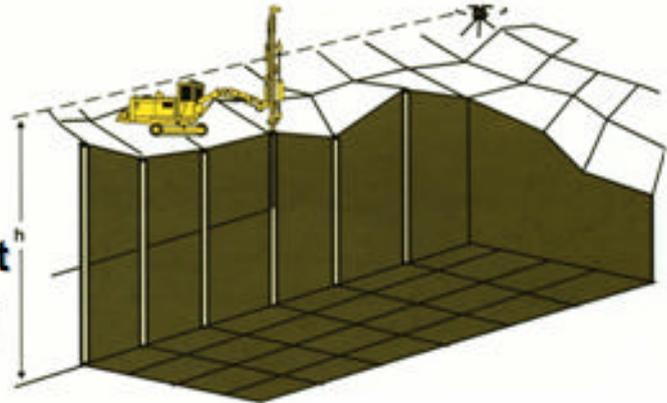
## Laser Plane

*All holes are drilled to exactly the same depth*

- Reduces specific drilling
- Better fragmentation

### Benefits:

- Reduced drilling cost
- Reduced explosives cost
- Less secondary blasting
- Reduced crushing cost



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## Automatic Rod Adding System (AutoRAS)



- Automatic adding of rods to a predetermined depth
- Allows operator to do re-grinding, maintenance etc. during drilling.
- Supervised by drillsteel break detection system

**+ Better rig utilisation (1-2 more holes drilled / shift)**

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## Automatic Feed Positioning (AutoPOS)



- Reduces set-up time
- No operator set-up errors
- Reduced blasting cost

### Example:

- $2^\circ = 3,6 \text{ cm/m}$  at 20 m bench 72 cm at hole bottom

- + More parallel holes -> Better blasting
- + Even bench bottoms.

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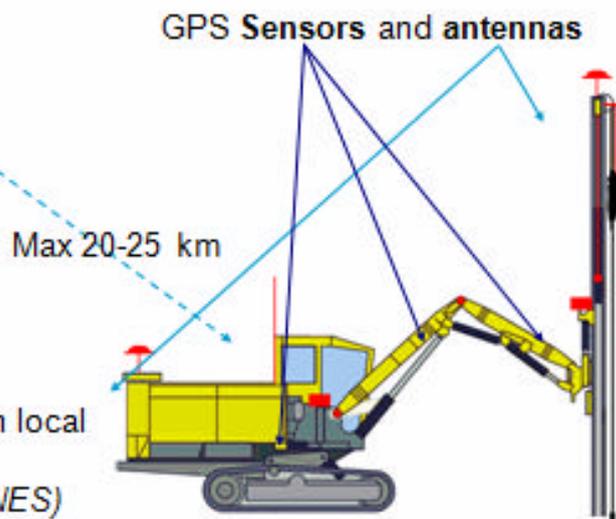
## Hole Navigation System (HNS) – HW



Radio Base Station  
Assembled at a  
fixed point

Drilling **with** drillplan in local  
coordinates  
(*QUARRIES, MINES*)

Drilling **without** drillplan in local  
coordinates with ANMASK  
or similar (*Road constructions*)



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## Data management

### Hole deviation measurement, ROC Probe 45

- Based on a 3-axial magnetometer.
- 0,5-1.5 meter long.
- 45 mm diameter.
- Can be used in holes down to 51 mm.
- Can measure up to 30 m long holes.
- Can measure inclinations from vertical up to 30 degrees from vertical.
- Can be used in holes containing water.

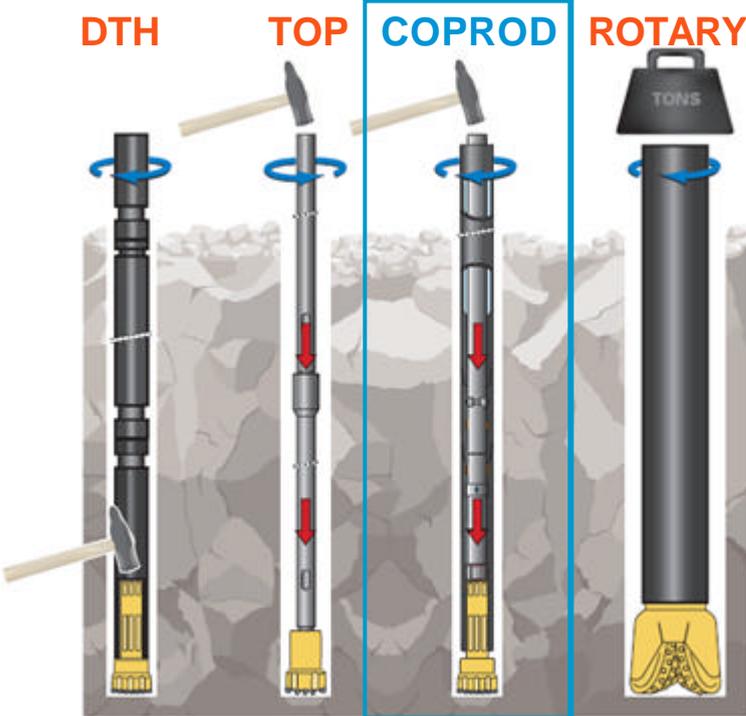


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Actually we have an added problem over the airlines; they leave us in a cab to get to the right airport, when things went wrong. That cab will not take the drill bit 3 meter to the side at the bottom of the hole. Long term future we will be able to steer the drill to the right spot, today we have to do our outmost to come right from the beginning and work out alternatives if not.

The autopilot of the drilling is the means to drill "dead" straight. Top hammer drilling will take you fast and cheap from A to B. In "rough weather", bad rock DTH used to be the alternative, but at cost. Atlas Copco's COPROD system is in many ways the best of the best, combining the hole quality of the DTH but with the speed and cost of Top Hammer.

## Blast Hole Drilling Methods



### *Speed and cost*

The airlines are expecting the suppliers of aircrafts to increase speed and to reduce cost. In the sky there is an obstacle that can be overcome, but not easy, the sound barrier. Believe it or not, but in some ways we are also struggling with such a barrier. There are limits to how much power we can push down the borehole, through the drill rod. Pushing it much furthermore like the Concorde will increase the cost dramatically. Getting as close as we can, but with increased control and availability will give the customers more drill meters, maybe more so than from brute force. But yes you will also see some increased drill rates in the future, much due to higher operating frequency of the rock drills. Problems associated with reflected waves and interference will make this easier in short hole drilling (drifting) than long hole (bench). Due to increased speed, and utilization, and availability we do see a trend towards lower cost per hole. This will continue.

### *Noise and emissions*

The air industry is now reclaiming some more convenient airport closer to downtown. This can only be done thanks to cleaner and quieter aircraft's. The benefits are obvious, time and money for the passengers. The quarry industry has a very similar problem / possibility. Aggregate transport is a considerable part of cost. Quarries close to end user are winners. Atlas Copco has now introduced a silenced drill rig that will put the quarries back in town. The technique will most certainly be developed even further and spread over different rigs sizes.

## Think Environment

## Think **SMARTRIG™**

### Less...

- ... noise
- ... pollution
- ... oil spillage
- ....fuel consumption



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The drill manufactures have spent a considerable effort adopting the diesels to new legislation Tier 2 and 3. We will all have to accept that this is the right way to go for the future, but short term, the new emission rules increases size and cost of engine installations and maybe more surprising fuel consumption. We may want to discuss electric drill rigs in large quarries when this is possible.

Meanwhile we will have to enjoy the fact that the new advanced control systems on these Smartrigs in many cases reduces fuel consumption with 20-30% due to better management of engine speed , flushing, and better hydraulic systems. In honesty again this big amount was partly an unexpected feature also for us. This is similar to the fact that we not until 1990 started to realize the real benefits of automation underground.

*Availability and serviceability*

On an overseas flight many years ago, I sat beside a manager for an airline company and we started to discuss availability etc, on our "rigs" He was very happy because they were now (years ago) capable to get more than 5600 hours per year operational time (taxing and flying) out of their new jetliners ( 767) . I was impressed by the number, and I still am. There are 8760 hours in a year so we are talking 60 % utilization. Only 10 hours per day for getting passengers on and off, service, refuel, planned and unplanned maintenance. I have often heard people mixing availability with utilization; here we are talking machine moving from hole to hole, or drill. Not waiting for shift change, fuel truck, operators, changing bits. Not waiting for blast, service personnel,.....

For reasons the air industry has certain restrictions when it comes to breakdowns in the air of more important components such as engines, wings and more. But certainly a driving force is the huge capital cost as well. You may all, as I have been irritated when the plane doesn't take off as scheduled; reason some instrument failure or what. But in many case, the problem is fixed by replacement of a sophisticated instrument in half an hour or so. (Though I left a plane once seeing a hydraulic pump being replaced with a sledge hammer trough the window)

Many years later our industry still has a way to go before getting up to this standard, ( well, the sledge hammer we have reached) but AC has introduced a system which will move a considerable way in the right direction. The AC PROCOM

## So what, if rig is down? You may want to have a look at Pro Com!



- Global Satellite-Based Drill Rig Monitoring System
- ProCom is part of a service agreement, like for example ROC CARE



Now all this was examples of the future which is already here for you to benefit from.

What about the next future.

## **The sneak preview**

In the live presentation, examples from ongoing development will be highlighted.

The theme is systems for on line real-time observations of parameters such as hole position, grade and more. Being able to do such measurements operations can be optimized while being carried out and not weeks or month afterwards. As an example fragmentation may be corrected while drilling, not for the next round when the pit is full of boulders and dust. The right composition of limestone will be identified prior to blast.

Or in short, now finally we have the tools, let's use them.