TROUBLESHOOTING

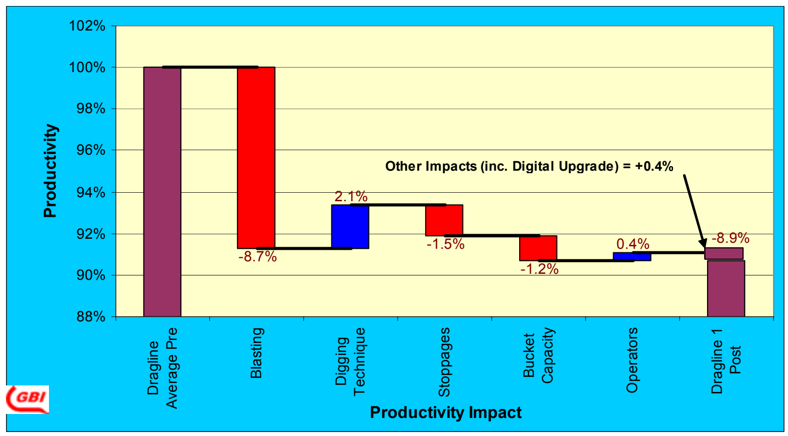
FORENSIC ANALYSIS OF PRODUCTION DATA

WHY TROUBLESHOOTING?

From the typical dragline monitor there are over 10,000,000 pieces of data related to production recorded annually. The potential for this data to reveal clues on "what went wrong" in specific situations is enormous. In the vast majority of anomalous situations data will at the very least provide knowledge on what did not contribute to the problem. Outlined below are some of the issues which impact equipment performance.

CASE STUDY 1. DIGITAL UPGRADE GONE WRONG

A mine justified the digital upgrade of electric drives based on a 4% improvement in performance. The result was a 9% decline. GBI investigated productivity changes at other mines having the same upgrade and found the average increase was 3.1%. Consequently, 4% was not an unreasonable target (33% of the upgraded draglines achieved this improvement).



GBI investigated the impact of:

- Blasting;
- Digging technique;
- Stoppages;
- Bucket capacity; and
- Operators.

The analysis demonstrated that poor blasting (in one strip in particular) was the primary contributor to the drop in performance. The digital upgrade did not improve performance and this information was passed on to the electrical contractor for remediation. Attention was given to the blasting for the following strip and performance improved dramatically in that strip and overall.

CASE STUDY 2. DRAGLINE OPERATORS ARE REPORTING REDUCED POWER IN DRAG MOTORS

The following plots were produced from real data at a mine where the operators were reporting a significant reduction in filling performance. The maintenance department had blamed a new bucket.

The technique used is to create X-Y plots of the average drag speed vs. drag load for every cycle during specific times. These form a mass of points with an upper boundary as the optimum performance achievable with the drag motors. In theory the upper boundary should equate to the motor specs. In practice this never happens, although motors which are performing well will achieve speeds equal to those on the motor specification curves.

The first point to be demonstrated was that the new bucket had no impact on the curves. The plots of drag speed vs. load for the periods before and after 11 May are shown on Figure CS1.1. The conclusion drawn was that there was no impact from the new buckets and that the upper limit of the plots represent motor/system performance. It was identified that something affected the drag system on 23/24 May which impacted on the performance of the motors. This is clearly demonstrated in Figure CS1.2.

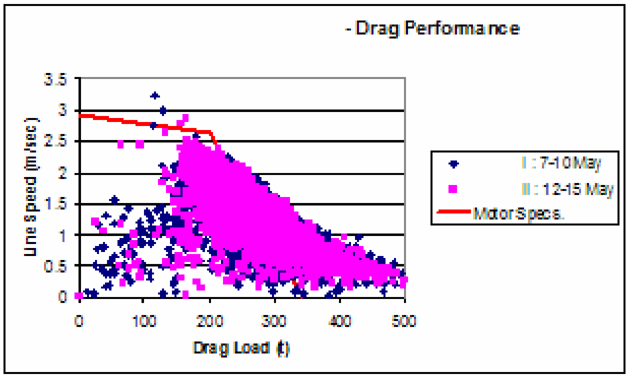


Figure CS1.1 Drag Motor Performance before "Problem Date"

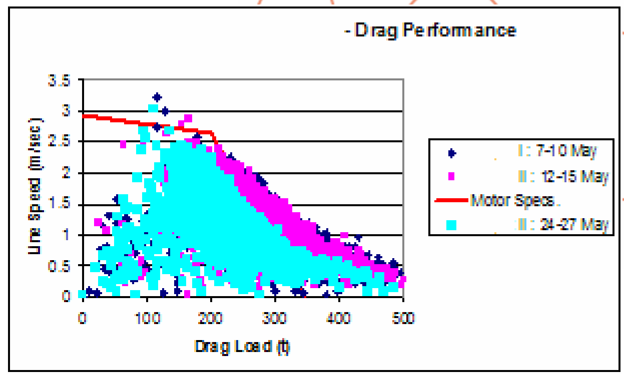


Figure CS1.2. Drag Motor Performance after "Problem Date"

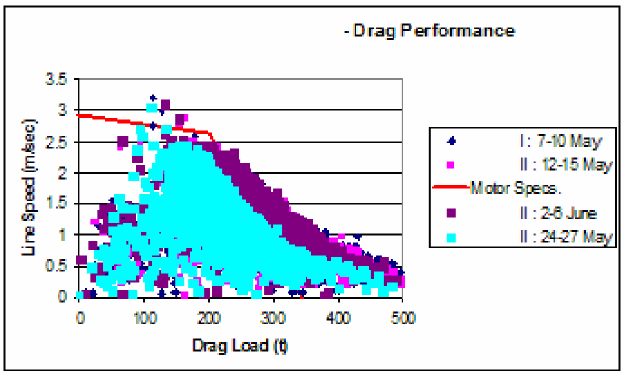


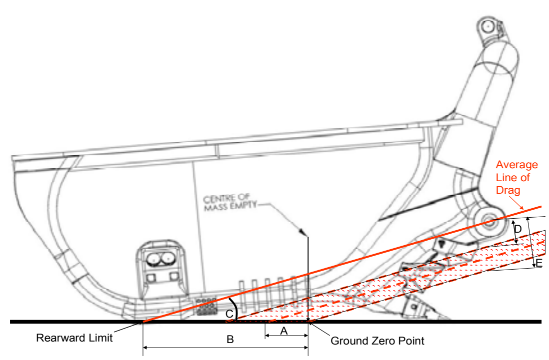
Figure CS1.3. Post 1 June Data Added

Figure CS1.2 shows the speed which could be generated for particular loads was up to 0.5 metres/second less after 23 May. This reduced the ability of the operator to fill the new bucket and confirmed that the complaints of the operators were justified. The tritronics data indicates a return to pre-23 May performance after 31 May / 1 June. Figure CS1.3 shows the data after 1 June added to Figure CS1.2. and that the 2-6 June peak performance lines up almost exactly with pre-23 May performance, and may be slightly better at lower loads.

The loss was confirmed as a change in the electrical settings on 23 May and rectified on 1 June. The dragline lost 13,000 BCM during the 8 day period but the losses were mounting at more than $3,000 per day in lost production and could have been much higher.

CASE STUDY 3. A NEW BUCKET DID NOT PERFORM

A mine purchased a bucket with capacity recommended by a modelling program. Over a 6 month period the bucket underperformed predicted payload by 8 tonnes. GBI's analysis focused on bucket and operational issues which discovered that both contributed to the under-performance.



Bucket Issues

- The drag hitch on the bucket was too high (relative to the geometry of the bucket) for it to carry out required functions.
- Optimal digging performance (maximum payload) occurred at 25 metres depth. The peak engage frequency occurred at 5 metres depth.

- The average drag angle (angle between the drag rope and the horizontal) was 16^0 compared with an apparent design of 30^0.

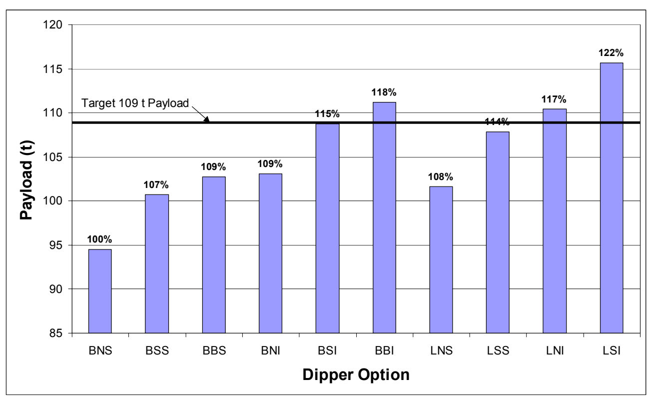
The bucket was better suited to deeper digging than that encountered during the period under study. GBI found that the design of the bucket was identical to one which went to a dragline digging 45-50 metres depth consistently. This bucket was put into a pit which rarely dug more than 25 metres. It is estimated that bucket issues cost 6 tonnes in average payload for the bucket.

Operational Issues

- There was a mismatch between peak engage location and peak payload location. Expanding on this:
  - operational technique was not optimised with respect to bucket performance and/or the bucket was not designed optimally with reference to the likely operational technique;
  - this mismatch would normally be caused by the drag hitch being located too high with reference to the point of the teeth; and
  - The dump rope was approximately 1.5 metres too long which reduced payload performance by 3 tonnes.
- Variation between operators was relatively low (dig rate variation - 22% compared with an "all dragline" average of 35%) and as such the underperformance was not attributed to this.

CASE STUDY 4. SHOVEL FILLS TRUCKS PERFECTLY IN TWO AND A HALF PASSES

A mine had trucks with nominal capacity of 218 tonnes. The average payload was 85 tonnes and the desired payload was 109 tonnes. Using a combination of data analysis and physical modelling, GBI implemented process changes (average payload increased to 95 tonnes) and recommended a number of dipper changes. The recommended changes were engineered by a structural engineer and performed by a local engineering workshop. The result was an average payload of 111 tonnes which filled the trucks in 2 passes. GBI saved the mine capital expenditure of >$3M plus $8M per annum in additional spoil movement.



HOW DO I KNOW THE DATA WILL TELL ME ANYTHING?

You don't. However, our experience demonstrates that the data has enormous untapped potential and in the vicinity of 90% of requests for troubleshooting we can identify what has gone wrong and recommend changes. In those cases where we can't determine exactly what has gone wrong we can almost always provide evidence of what hasn't caused the problem, thereby narrowing down the possible causes.

THE GBI DIFFERENCE

All analysis will be personally delivered to your site by one or more of our operations, IT or engineering people. They will advise you what the results mean for you. All GBI work carries an absolute guarantee.

For more information on forensic analysis please contact Laura Seviour on 07 31478300 or Laura.Seviour@gbimining.com