SEEING THE DETAIL IN THE BIG PICTURE

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SYNOPSIS

This address seeks to highlight the role played by bulk material handling (BMH) system designers (particularly, but not limited to, the coal mining industry) when entering the front end engineering and design (FEED) phase of a project.

The changes in the regulatory environment over the past fifteen years or so have placed greater and greater accountability on the owner of the mine(s) or plant than was the case previously. Concomitantly, the level of skills has not kept pace with the shift in accountability and responsibility nor the advancement in technology as it relates to operating and control systems.

The mining industry has sought to address the regulatory shift by generating the requisite mandatory, and where seen fit, discretionary codes of practice (CoP) and more often than not, site specific standard operating procedures (SoPs) as guidelines for the safe extraction and transport of minerals. However this has never been a 'silver bullet' and, although there has been a steady downward trend in fatalities and serious incidents, they do still occur.

Mine and plant owners have turned to the designers and engineers to 'engineer out' those aspects of BMH systems that still pose a hazard or have the potential to do harm in the work place.

BRAINS FIRST, BRAWN AFTER

The days of 'making a plan' underground can no longer be considered as an acceptable practice when components, structures and systems were modified and tampered with to either:

- Address shortcomings and misunderstandings between what was needed and what was delivered.
- Suit the personal preferences of mining or underground engineering staff.

The risks are too high, once again because of the level of skills and understanding of such systems. The unacceptability of these actions has been embraced by owners who, in turn, have said that the systems that are put in place have to address, besides the obvious performance criteria for the transport of the commodity, previously perceived points where there is a potential to inflict injury or serious harm.

This legitimate requirement fits squarely into the domain of the equipment designers and engineers. However this cannot be done in isolation. Ultimately, the end user has to engage with the 'brains' through whomever his representative is on the project, to make abundantly clear what the needs are with regards to the safe

operation and maintenance of the system (under the most practical and reasonable circumstances). The ongoing, regular interaction between the client and the service provider is crucial in creating understanding and buy-in between the two parties. This engagement aims to minimise the archaic and hazardous 'make a plan' approach.

The system, subsystem and component designers can now 'do their thing' by using and complying to the various standards and accepted BMH and engineering industry best practices to deliver what the end user ***needs*** both in terms of performance and safety. Emphasising the word 'needs' raises one of the difficult tasks with regards to the designers and engineers. A balance has to be created between delivering a safe system at a reasonable cost and meeting the ***wants*** of most of the mining operating staff. There is absolutely no question whatsoever that all systems have to comply with the most recent statutory requirements. However, what the higher level management in any profit making industry cannot allow is 'at all or any cost'. The most feasible and compliant techno-economic solution is what is sought by executive management.

SAFETY: FLOGGING A DEAD HORSE OR IS THE MESSAGE AS RELEVANT AS EVER?

The figure below indicates the trend in fatalities in the coal mining industry between January 2009 and March 2014 is a downward one (Department of Mineral Resources).

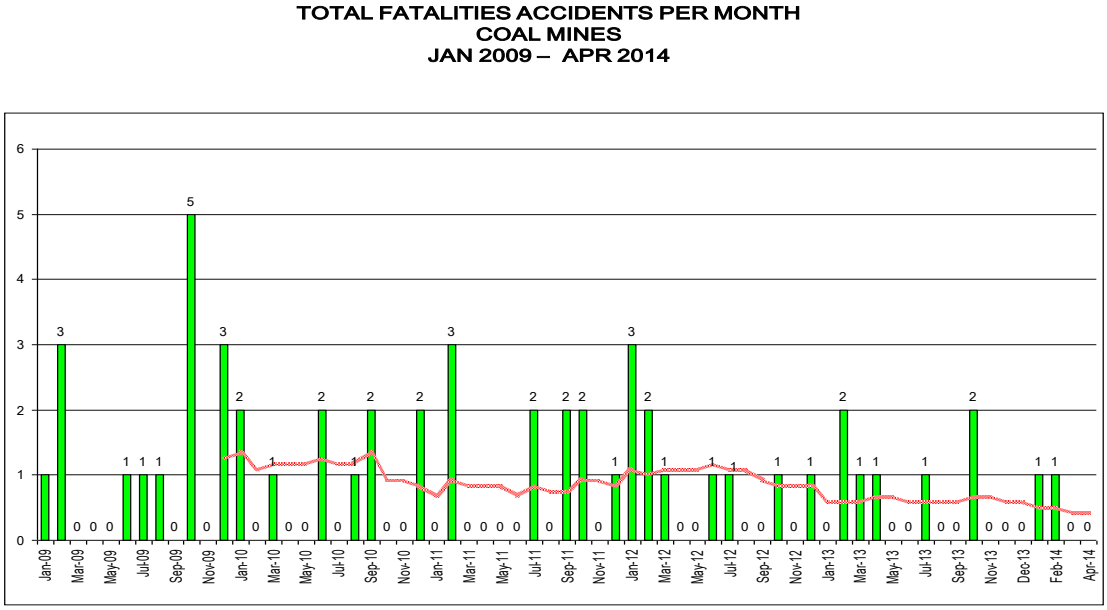

Figure 1. Total fatalities per month: coal mines. January 2009–April 2014

Conversely, the trend with regards to accidents in the industry has remained, to all intents and purposes, relatively stable (Department of Mineral Resources).

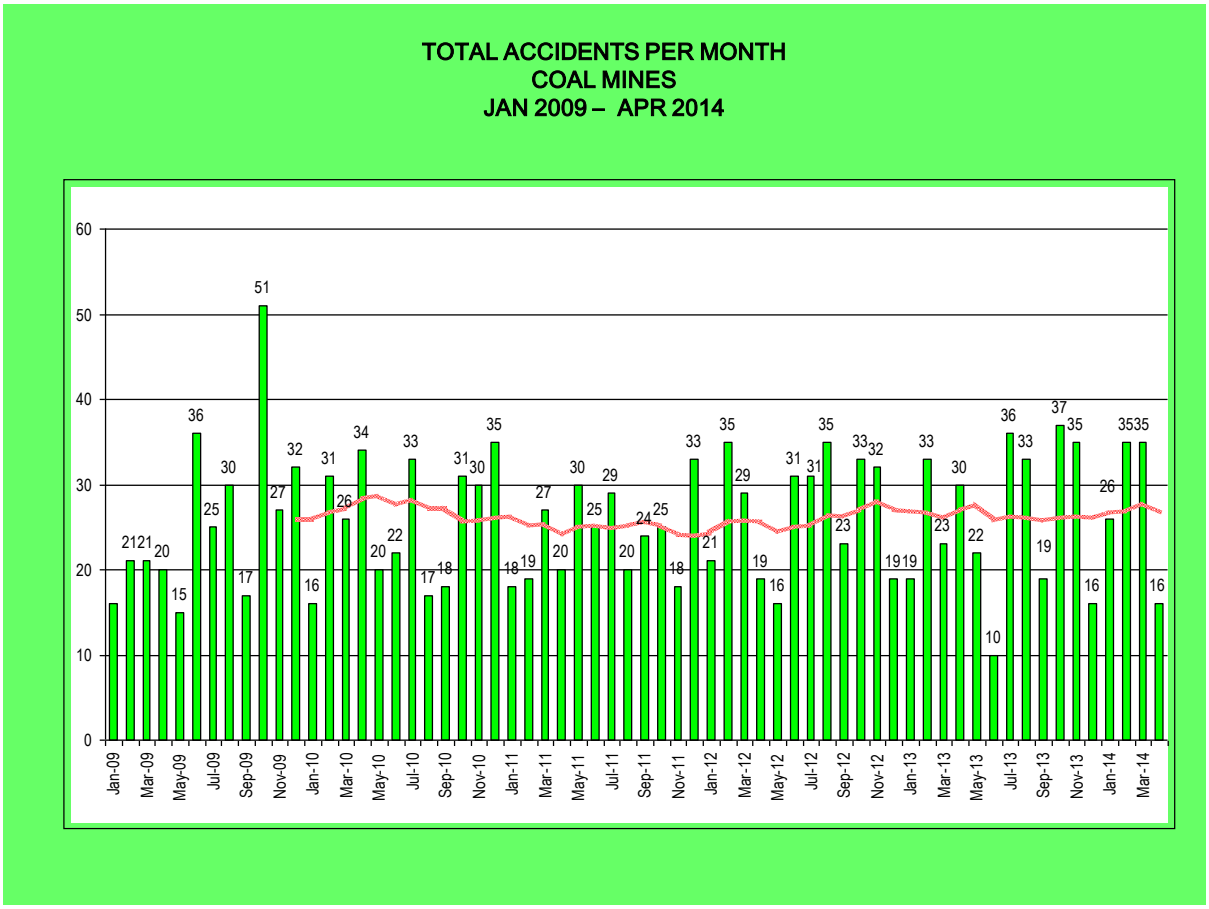

Figure 2. Total accidents per month. January 2009–April 2014

Notwithstanding the trend in fatalities in the coal mining industry, accidents are still occurring and show no significant, continuous downward trend.

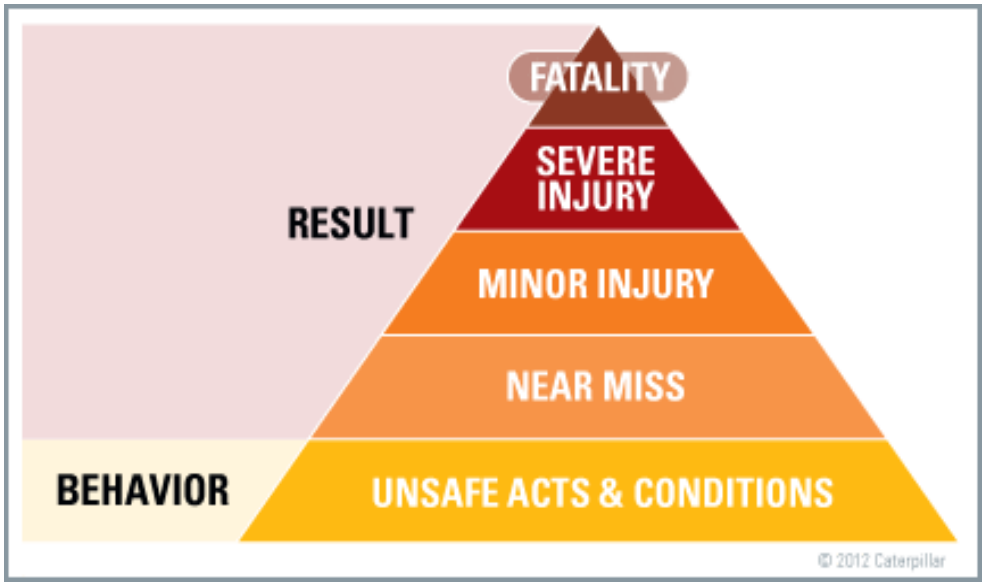

Figure 3. The Heinrich Triangle

The much debated and contentious Heinrich Triangle (Caterpillar safety document, attributed to Herbert William Heinrich 1886–1962) indicates that companies need to be mindful of the activities at the bottom of the triangle. The case being that if these are left unchecked the inevitable outcome is a fatality. The downward slope shown in Figure 1 may, for some, be a source for complacency that has insulated them from the continuing dangers that the coal mining community still faces on a day-to-day basis. Thus it is this writer's view, based on the information furnished by the Department of Mineral Resources, that the safety message is just as relevant today as it ever has been, based on the above thinking.

PLETHORA OF PAPERWORK – PROTECTION OR GREY CELL NEUTRALIZER?

As alluded to in the synopsis, in order to adapt to the increasing accountabilities and guidelines put forward by government, mining houses had to create additional written proof of their commitment to safety in the workplace. This needed to cover generic topics that applied to the entire company (generic mandatory CoPs) as required by the department, and discretionary generic CoPs that were not a requirement in terms of the applicable regulations but nevertheless demonstrated the executives' focus on safety. This has been the reality in all mining sectors.

Added to the above, what was considered to be common practice, by virtue of experience and word of mouth, was codified for specific actions. This codification has become the Standard Operating Procedure that exists on a site-to-site basis at the various companies.

No one has kept a running audit on the amount of paperwork that has been generated over the last decade and a half. However, anecdotal evidence indicates an almost exponential/explosive growth. The author has spent some time (over a number of years) speaking to artisan and mining personnel where they have commented on the fact that the expectation that they should know every single CoP and SoP is unrealistic. And herein lies the rub. After filling in and filing away the mandatory paperwork required by the operation and regulations, it is the writer's contention, borne out by accidents that have occurred underground (Figure 2) that have the necessary SoPs and CoPs in place, that people:

- Adopt a 'tick box' approach and just go through the motions; or
- Are overwhelmed by the amount of paperwork and deal with it when they have the time
- Ultimately the paperwork covers their collective rear ends and they do not have to apply their minds to the task(s) that lie ahead ('we've already given it some thought by filling in the documents').

Accordingly, the common sense that prevailed in days gone past, having been codified, needs no further engagement of the grey cells.

DESIGN PHILOSOPHY AND RISK

This is shown in a flowchart to position the thinking with respect to where it all starts (Figure 3).

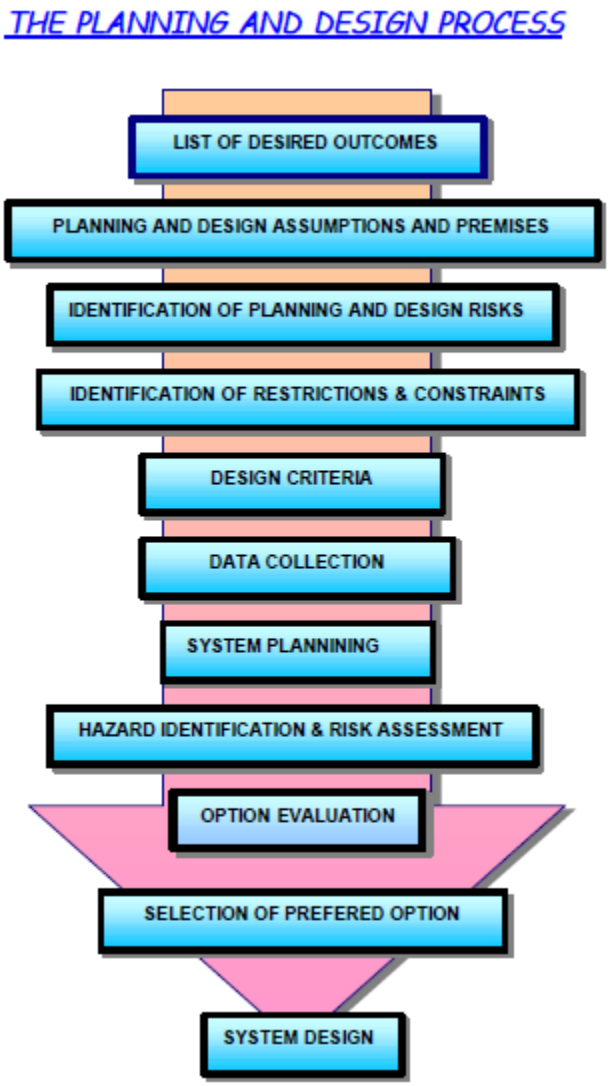

Figure 4. Guidelines for the integrated planning and design of underground coal mines

Prof G A Fourie, Mr D J van Niekerk

The next flowchart (Figure 5) drills down to the underground transport of run-of-mine (ROM) coal.

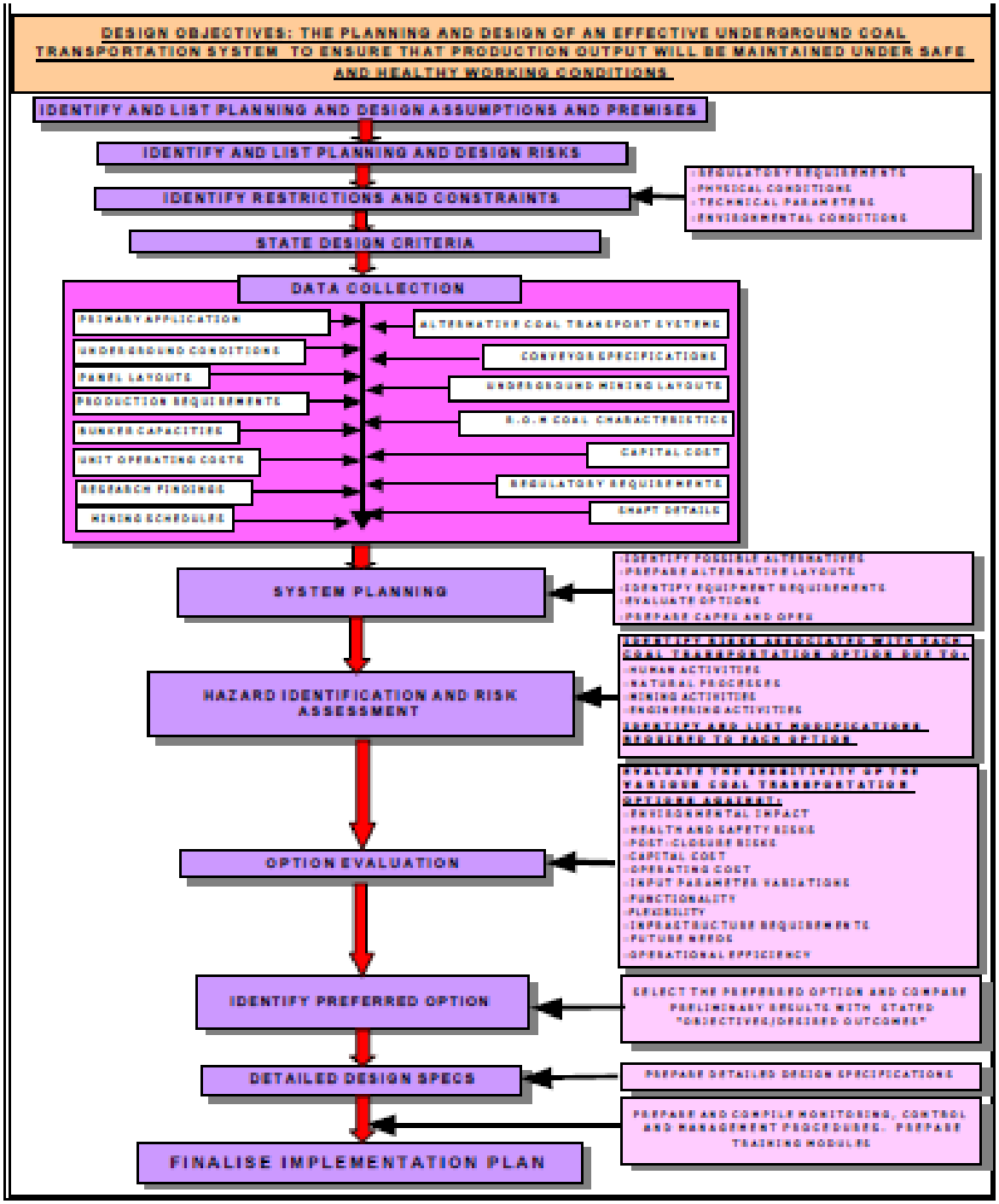

Figure 5. Guidelines for the integrated planning and design of underground coal mines

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The big decisions concerning rates of delivery, layouts, absorbed power, belt widths and speeds form part of the other criteria that are very important in terms of the business case and whether it is a financially viable project or not. However, closer scrutiny of the figures above clearly indicate that hazard identification and risk assessment are an integral and important element of the process as well. A comprehensive hazardous operation (HAZOP) assessment highlights construction, operating and maintenance issues that may have fallen between the cracks with all

the noise and pressure of delivering a system on time, to specification. The HAZOP cannot be conducted without the real end user being present (most of the operational and maintenance experience and expertise rests with them). In order to meet the requirement of good integration, the traditional engineering disciplines have to sit around the table as well. This is where it all comes together, where the team creates the understanding and agrees upon the deliverables in terms of the safe operation and maintenance of a bulk materials handling system.

THE DEVIL IS INDEED IN THE DETAILS

As the team (EPCM, EPC, client and end user) wade through the designs from layouts, general arrangements, down to the detailed nut and bolt stage, the focus on safety needs to be carried through the entire process. This is where the timing of the HAZOP is critical — that it is early enough to make some changes without incurring costly redesign, but far enough along in the process that the safety issues can be relatively easily identified and rectified. Details such as working in wet conditions, safe access to and handling of heavy componentry (e.g. large conveyor pulleys 6 m off the ground), guided fitment of sub-assemblies such that people's hands do not get crushed, have to be considered. This is detail.

CONCLUSIONS

1. The greater emphasis in the regulatory environment in terms of owners' accountability and the sanctions that are imposed, coupled with the misplaced perception that a plethora of paperwork somehow allows maintenance and operating personnel to 'park' their brains, places greater responsibility on BMH design companies and individuals.

   The attention to detail in terms of developing not only the correct techno-economic solution, but one which addresses the health and safety of users and maintainers is a daunting task.

2. The above demands that knowledgeable, expert and experienced personnel (from all the relevant disciplines) from the end user/client, EPC and EPCM have to work very closely together during the course of FEED to make sure that comprehensive and meaningful risk/HAZOP reviews of the system takes place.

   The final call rests with designers and engineers to deliver a system that meets the client's performance criteria without introducing unacceptable levels of risk and harm over the life of the system.

3. As pointed out above, the codification of what is, essentially, knowledge gained through experience and word of mouth, has lost something in the translation. The decimation of knowledgeable people (through retirement, retrenchment, greener pastures) who have, over a number of years, gained a good understanding of what conveyors are all about is a lesson to be learned not only in this industry but all others. This demands that training and re-training takes place in a way that an in depth understanding is created regarding the 'bear traps' in a system that has stored energies in

the form of potential, kinetic and elastic energy. The creation of this understanding will go a long way to addressing the bottom end of the Heinrich triangle.

REFERENCES

1 Department of Mineral Resources.

2 Professor G A Fourie, D J van Niekerk (2001).“Guidelines for the Integrated Planning and Design of Underground Coal Mines”.

3 Caterpillar Safety Document.

ABOUT THE AUTHOR

D J THOMPSON

The author qualified as an aircraft instrument technician at South African Airways in 1973.

This was followed by a BSc Eng. (Mechanical) from the University of the Witwatersrand in 1980. After leaving SAA he joined Dorbyl Heavy Engineering as a project engineer; winder design at Vecor Vanderbijlpark in 1984. This involved design, manufacturing oversight and project managing the installation of winders in the hard rock industry.

In 1992 he joined Swartkops Power Station as the mechanical engineer at the facility. The plant at the power station included a wagon tippler, surface coal bunker, conveyor feed to the boiler plant and ash recovery conveyors.

He has been employed at Sasol Mining since 1997 as a senior and subsequently principal mechanical engineer. The duties cover the management of two engineers (among others) who are dedicated to both underground and surface bulk materials handling system design, construction oversight (where necessary) and solving BMH related problems on the mining complex.

In 2003 the author gained his MCom in Business Management at Rand Afrikaans University.

He is currently a registered professional engineer with the Engineering Council of South Africa.

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