Safety in Mines Research Advisory Committee

Final

The effectiveness and profile of the SIMRAC research effort in improving safety in gold and platinum sectors

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EXECUTIVE SUMMARY

Since the establishment of the Safety in Mines Research Advisory Council (SIMRAC) in 1993, it has expended large sums of money, levied from the mines, on research to address safety and health issues in the mining industry. SIMRAC has initiated this project to assess the impact of this substantial research effort in improving safety and eliciting industry opinion about the effectiveness of the SIMRAC system, the research programmes and the use of research findings.

This research project dealt, importantly, only with safety issues and focussed only on gold and platinum mines. It was conducted amongst representatives (more than 75 personal interviews) of government, labour and mining groups and mines.

The research indicated SIMRAC as not a waste of time and money. General positives that have emerged are the strong stakeholder support for the intent of the organisation, the view that SIMPROSS, in providing a project management and administrative support function, is doing sterling work, and overall acceptance of the funding (levy) mechanism to fund industry-wide research. General problem areas include a lack of technical expertise by both labour and the Department of Minerals and Energy, a disproportionate research focus on gold relative to platinum, a generally neutral stance by stakeholders towards active participation in SIMRAC and occasionally a blurred distinction between SIMRAC and major research providers.

Mine safety is a multi-faceted issue and to isolate the unique contribution towards safety improvement of research or new technologies is very difficult. Understandably therefore, the correlation between safety improvement and research outputs was rated relatively low. To their credit, stakeholders take the blame for this 'disconnectedness' and the fact that only a small percentage of research output is used at all.

With the SIMRAC model in essence sound, the key question arises as to how to provide more value to the industry. Recommendations to address this aspect include:

- An in-depth analysis of research needs, which should include a greater focus on human behaviour and training.
- Platinum mines to be addressed separately.
- A significant percentage of SIMRAC funding channelled to joint projects (on a Rand-for-Rand basis), and active planning and budgeting for technology transfer/training within projects.
- Stronger project governance through project champions.
- SIMRAC accreditation schools for rock engineers, mine inspectors, safety representatives as general examples.
- Stronger linkages between research outputs and legislation, codes of practice, accident investigations and training material.

Lastly and most importantly, SIMRAC should be re-positioned (branded) amongst all its stakeholders in order that there is a shared understanding of what SIMRAC is about and what it is not, so that expectations are managed.

1. Introduction

1.1 Background

Since the establishment of the Safety in Mines Research Advisory Council (SIMRAC) in 1993, it has expended large sums of money, levied from the mines, on research to address safety and health issues in the mining industry. SIMRAC has initiated this project to assess the impact of this substantial research effort in improving safety and eliciting industry opinion about the effectiveness of the SIMRAC system, the research programmes and the use of research findings.

LHA Management Consultants (LHA) was commissioned to undertake this project.

1.2 Project aims and scope

The primary project aims were to:

- Undertake an opinion survey amongst a sample of gold and platinum mining industry stakeholders.
- Assess the industry's approach to safety and exploring the relationship between research outcomes and safety improvements.

This research project dealt, importantly, only with safety issues and focussed only on gold and platinum mines. It was conducted amongst representatives (more than 75 personal interviews) of government, labour and mining groups and mines. Approximately R200 million has to date been spent by SIMRAC on safety research, with the following broad areas the important beneficiaries thereof: understanding and managing seismicity; rockburst control; mine support design; and understanding geotechnical conditions. The research attempted to achieve a holistic understanding of the SIMRAC 'system'. This comprised both opinion-type questionnaires and depth case studies at individual mines.

1.3 Report structure

Following this brief introduction, the report is structured as follows:

- Chapter 2 deals with the topline opinion survey findings.
- Chapter 3 presents the detailed results and comments of the case studies undertaken at a sample of gold and platinum mines.
- Chapter 4 provides the salient conclusions of this research project and, importantly, puts forward recommendations for the improvement of the 'system' in order to increase the effectiveness and impact of research results.

2. Opinions and perceptions of SIMRAC

2.1 Background

The Safety in Mines Research Advisory Council (SIMRAC) is a permanent committee of, and reports to, the Mine Health and Safety Council. It is constituted on a tripartite, equal representation basis with five (5) members each representing 1) employers in the mining industry, 2) employees in the mining industry and 3) departments of the State.

Three subcommittees have been established, namely gold and platinum mines (SIMGAP), coal and other mines (SIMCOM) and occupational health (SIMHEALTH).

SIMRAC's mission and mandate is to initiate and manage research aimed at improved understanding of significant occupational health and safety risks; the development of implementable solutions that will lead to improvements in occupational health and safety conditions and performance in the South African mining industry and to advise the Mine Health and Safety Council on matters as required by the Mine Health and Safety Act (Act no. 29 of 1996).

SIMRAC Project Support Services (SIMPROSS) is an organisation staffed by employees of the Council. SIMPROSS renders project management and support as well as administrative and secretarial services relating to the execution of surveys and research projects.

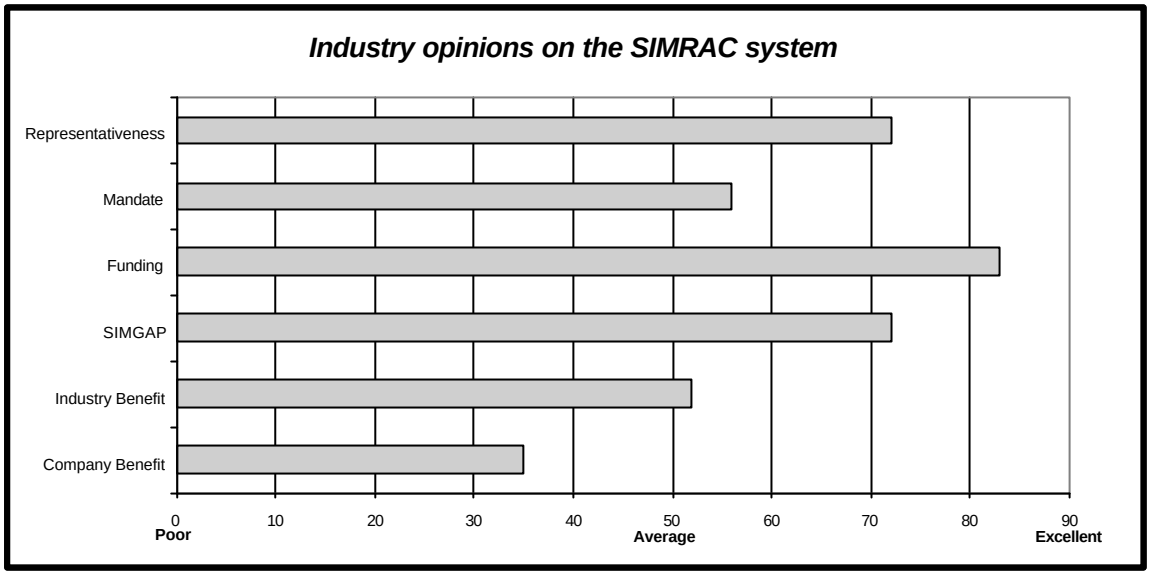
2.2 The functioning of SIMRAC

The SIMRAC 'system', which functions in the manner as described above, was assessed as to its 'effectiveness' in respect of a number of issues. These issues included:

- Representativeness, i.e. whether the interests of tripartite members are equally looked after.
- Fulfilment of mandate, particularly in terms of safety research.
- Funding methods, i.e. generating funding for research through levies from the mines.
- Effectiveness of SIMGAP, as the research focussed on gold and platinum mines.
- Usefulness to industry and specific company, i.e. whether the industry as a whole and specific mining groups or mines have benefited from SIMRAC research solutions.

Effectiveness was assessed in terms of subjective opinions and perceptions rather than by quantitative measures.

The opinion survey results are given in the following diagram and thereafter discussed further, particularly in respect of rationale and trends.



Industry opinion above refers to the combined response of all survey participants. Differences exist and these are highlighted below, but they do not detract meaningfully from the overall result. Comments that were made more frequently are added where appropriate.

2.2.1 Representativeness

The industry is generally in agreement that the tripartite alliance of SIMRAC works in principle, but not in practice. There is strong stakeholder support for the intent of the organisation, as is also later shown in the case study research. No proposals were made relating to a change in the structure of the tripartite alliance.

Deficiencies that were identified as contributing to a lack of practicality are the following:

- Employers: This group is mainly perceived as consisting of representatives of mining group head offices and as having a dominating decision-making impact (*"communication from one tower to another")*. In general, there is a lack of input and priority towards SIMRAC from mine management level.
- Employees: Employee representatives are considered to be disadvantaged as a result of lack of resources and limited technical ability. Also, as in the case of employers, lines of communication to safety representatives and workers at the mine level are severely lacking. Employee inputs at SIMRAC are hampered by low attendance of meetings. In their defence, employee representatives' capacity to engage lies at the heart of the problem.
- State: It is felt overall that the regional offices of the DME have limited awareness of SIMRAC research and are ill equipped to implement research findings.

2.2.2 Fulfilment of mandate

There is considerable diversity of opinion on this issue, exacerbated by the fact that some are more informed than others. While differing levels of 'informedness' need to be accepted, industry responses indicate that this is below par in mine management and employee cadres. Both the flow of information 'up' in terms of the identification of safety risks and needs for research and 'down' in respect of transfer of results and knowledge is perceived to be the problem. More direct and personal contact rather than increased indirect methods of communication is required.

Significantly more effort should be made to effectively communicate success stories and to clearly align research priorities to actual risks. On the question whether anybody in particular needs to be blamed, the industry is fairly united in that no blame can be apportioned.

2.2.3 Funding

This issue applies mostly to employers. Feedback was remarkably positive, although some inherent shortcomings of the levy funding mechanism cropped up:

- Levies are regarded as 'conscience' money – an excuse to do nothing more about safety issues.
- Levies are an expense item that generally does not hurt individual mines, where it is paid by head offices.
- The mechanism is inequitable in the case of natural disasters, e.g. a seismic event resulting in many fatalities.

Alternative funding options were also probed, with limited success. Some argued dual and equal funding by the mines and the State (50:50 basis) and the deduction of in-house safety research spending from levies payable to SIMRAC.

On the basis of the overall research evidence it is concluded that no alternative to the levy funding mechanism is required.

2.2.4 Effectiveness of SIMGAP

The ability of the SIMGAP sub-committee to adequately address the safety research needs of the gold and platinum sectors was under discussion here. The overall positive result, however, stems largely from the gold sector.

Platinum mines feel neglected in terms of safety research as they perceive that research is biased towards deep level gold mines (*"we are paying for the research and the gold mines receive the benefit")*. The main point emphasised by the platinum mines is that the geological conditions for gold and platinum mines are vastly different, and that platinum and chrome mines would make a better fit.

Whilst strategically respondents viewed a separation of gold and platinum as important, some practical concerns were often raised:

- Sub-committees are already overburdened and more would worsen the situation.
- Committees are poorly attended, particularly by key people.
- Committee members are given short notice of ad-hoc meetings and workshops and inadequate time to review reports for accurate feedback.
- Committees are dominated by head office people and not by 'people on the ground'.

Overall, however, the SIMGAP sub-committee needs to ensure greater end-user involvement in its activities as well as care that the strong focus on rock engineering research is not out of kilter with other research needs.

2.2.5 Usefulness of research

The safety research conducted by SIMRAC is viewed as more beneficial to the industry as a whole than to individual groups or mines. The research is viewed as generic rather than addressing mine-specific risk environments. Overall, however, the opinion findings indicate a less than satisfactory outcome. This aspect is explored in much greater detail in the next chapter.

It should be noted that by nature respondents would have their own interests at heart and not those of the industry. In this regard it is noteworthy that support for the intent of SIMRAC is high, but that lack of implementation success results in opinions on benefits not meeting expectations.

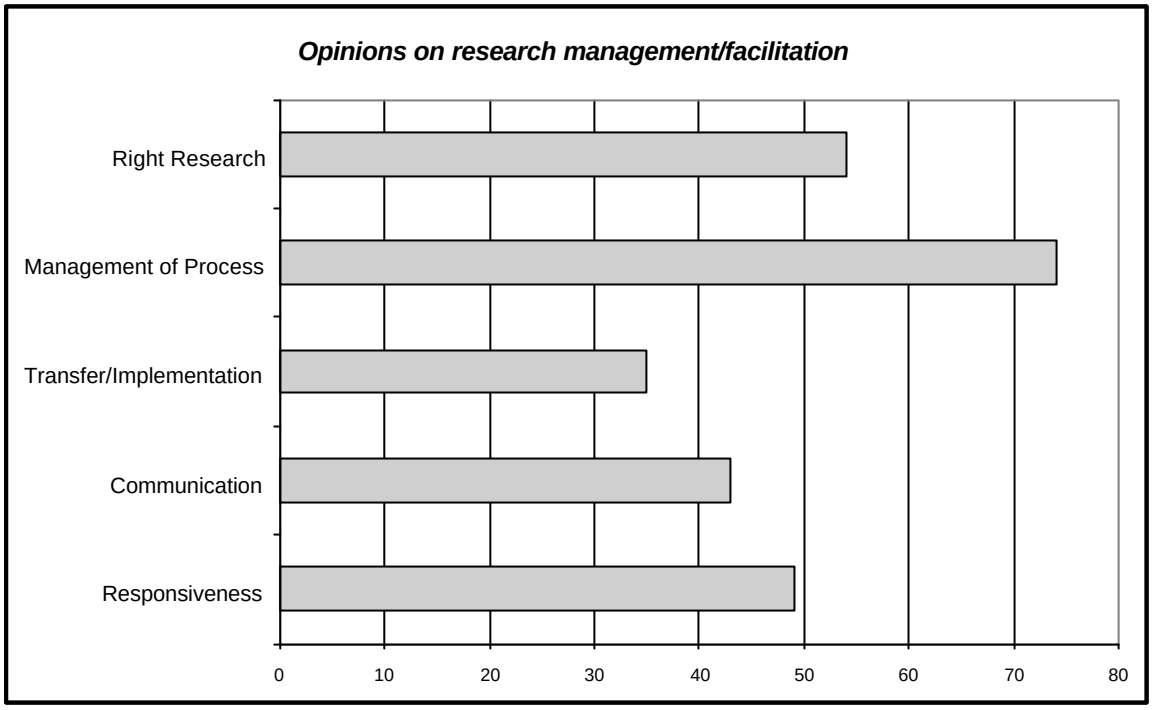
Proposals for the usefulness of research to be increased centred largely around training, human behaviour and health, in that order.

2.3 Facilitation and management of research

The survey also covered industry opinion on SIMRAC's performance and effectiveness in the following areas:

- Conducting the right research and, if not, what needs to be changed.
- Management of the research process and general strengths and weaknesses.
- Transfer and implementation of research results.
- Communication with stakeholders.
- Responsiveness to changing circumstances.

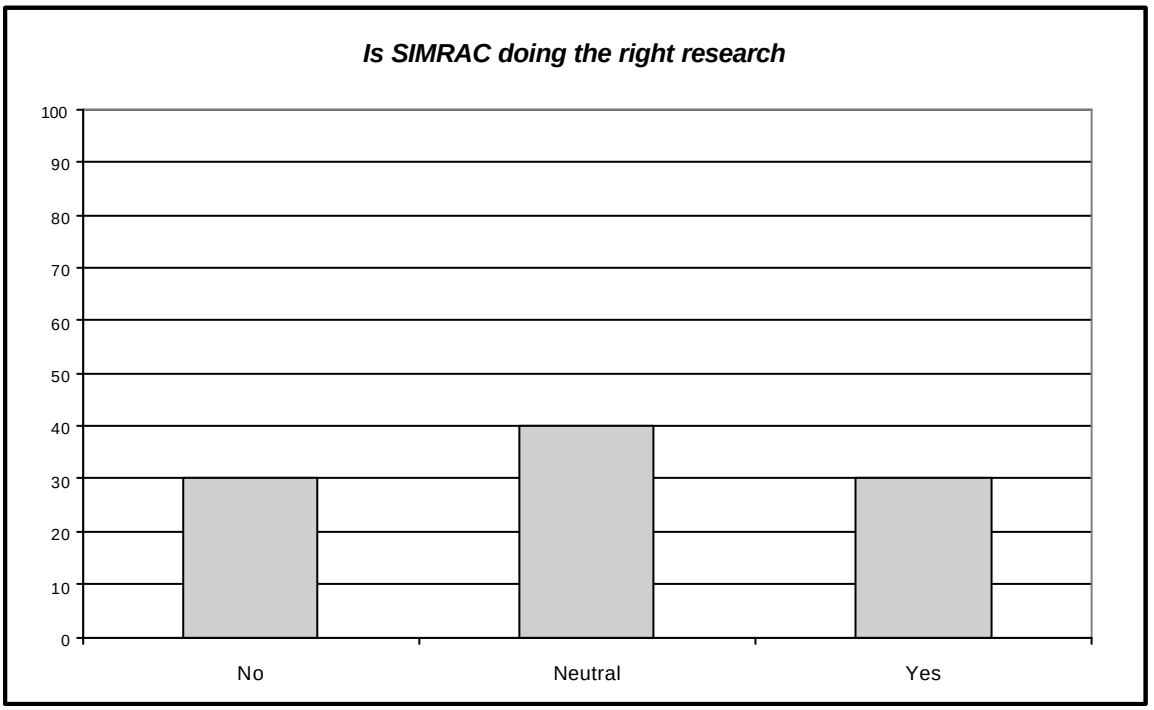
The overall survey result is shown in the diagram below.



With the exception of the management of the research process, the overall result in other areas is less than satisfactory. Each aspect is discussed in more detail below.

2.3.1 The right research

A statistically representative perspective of whether SIMRAC conducts the right research could only be obtained from the employer participants.



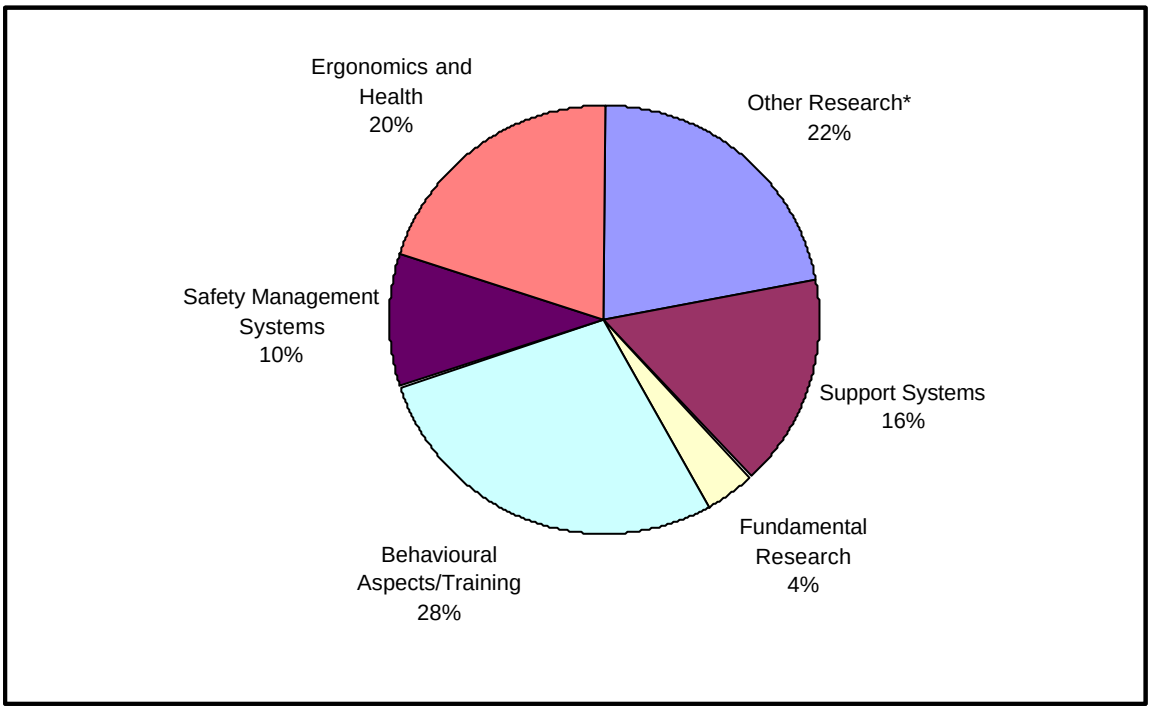
The negative perceptions arise largely as a result of:

- An imbalance in output as a result of a high inclination towards rock engineering research.
- Unreliable accident statistics that often do not reflect the true causes of accidents, leading to misguided research proposals.
- Inadequate involvement of end-users in needs analyses and risk assessments resulting in the 'true needs of the industry' not being identified.

The high level of neutrality results mostly from limited awareness and pure uninformedness. A fair proportion of respondents were totally unable to mention or recollect any SIMRAC research topic as they had never been exposed to such information (please note that these respondents were qualified rock engineers or safety managers).

On balance, the overall result is an average rating. Whilst this is certainly not poor, the relatively high proportion of 'negative' views is disconcerting.

The collective response on what research topics should be addressed in future is provided in the diagram below.



*Note: * Other research includes, among others, research on flammable gas, noise reduction, off-site environmental issues, rock bursts and early detection of seismic events, transport, awareness campaigns, engineering design and ventilation*

Perhaps the important lesson to be learned from the result is the dire need for an improved understanding of the human factor, both in terms of behaviour and health. The low emphasis given to fundamental research is possibly unfair, but reflects the perception by industry to rather use what has been done than undertake further work to increase the knowledge base.

2.3.2 Management of research process

SIMPROSS as the managing arm of SIMRAC is highly regarded by the industry, with a rating above 70 per cent. Positives that emerged include:

- Good programme management.
- Good administration.
- Generation of an enormous volume of information.
- Knowledgeable staff.

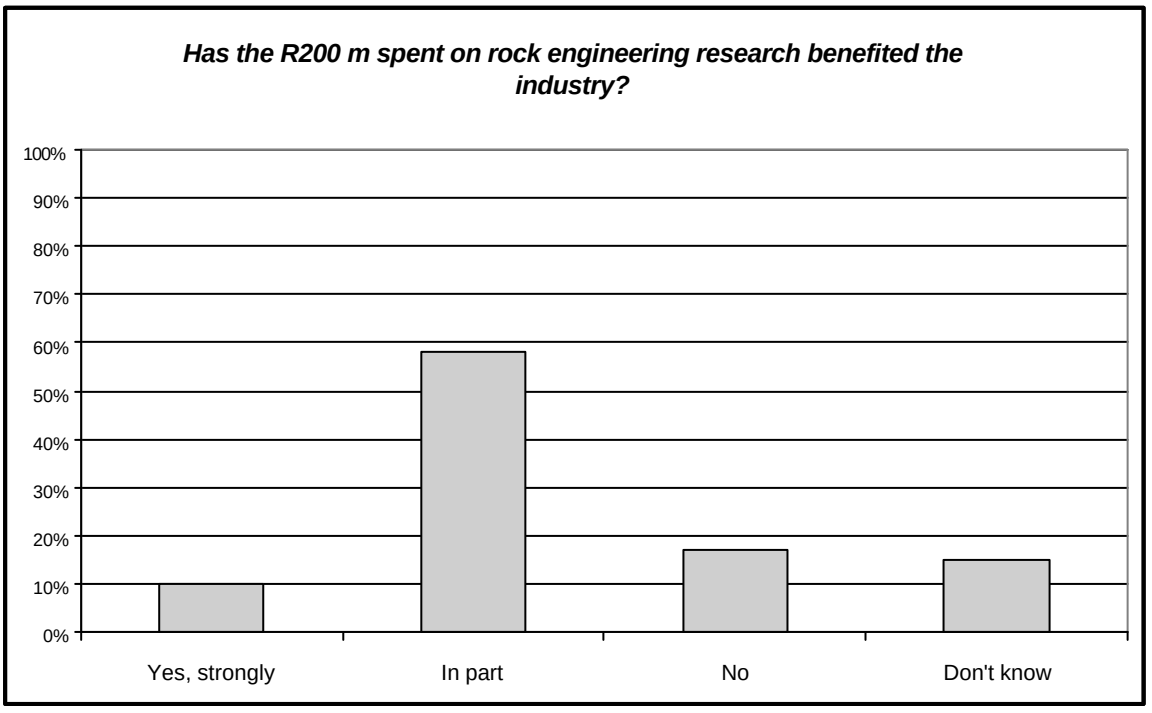
Often mentioned negatives include:

- Lack of mine input at problem definition stage.
- Research results are available too long after project is initiated and target dates are often not met.
- Mine involvement during different stages of the research process is lacking.
- The same research houses are conducting the research – new insights and perspectives are needed.

2.3.3 Transfer and implementation of results

SIMRAC's performance in the transfer of results and implementation efforts received a relatively low rating. This is largely a result of low levels of receptiveness, inadequate mine management communication, complicated and highly technical research reports, information overload, limited access to computers coupled with usage problems such as downloading pdf files and a too vast and diversified target market.

Research on rock engineering over the period 1993 to 2000 is perceived to have benefited the industry only in part.



2.3.4 Communication and responsiveness

The issue of communication has often been mentioned previously in other areas. What is important to note is that wider direct forms of communication can never be overemphasized, particularly in committee-driven environments. One always perceives that because the members of the committee are informed, everybody is (many people read minutes literally minutes before the next meeting). Innovative and user-friendly techniques (e.g. brief newsletters, executive summaries of reports, SIMRAC promotional material, etc) need to be employed to both communicate wider and build awareness.

One mine managers commented as follows: *"two years ago we knew about every project at SIMRAC. We were regularly contacted and asked to comment on project justifications. Now we are poorly informed".*

Lines of communication that require two-way contact are in particular:

- Head office mine management to line management.
- NUM to mine workers.
- DME to regional branches.

This research project again identified the dire need for more personal attention (*"we are finally being listened to"*). One needs to be careful not to become addicted to the e-mail 'culture'.

3. Impact of research on safety in mining

3.1 Introduction

LHA conducted a number of case studies to further explore the impact of SIMRAC research on safety. The purpose of these interviews was twofold:

- Firstly, to obtain assessment ratings on a number of questions.
- Secondly, to explore the thinking underpinning these assessments.

These depth interviews are summarised in this section using the following format:

- Understanding general industry approaches to safety: In this section the views of respondents on the following topics are given:
  - Overall safety record and factors (successes and failures) that have influenced their safety record.
  - Contributors to improving the respondent's knowledge base on safety.
  - Technologies that have made a significant impact on safety.

- Exploring the relationship between research and safety improvements. Here the views of respondents are given on the following issues:
  - The role of research in establishing the mines' position with regards to safety.
  - Assessing the impact of SIMRAC research on mine safety.
  - Assessing SIMRAC research areas.
  - Exploring future research focus areas.

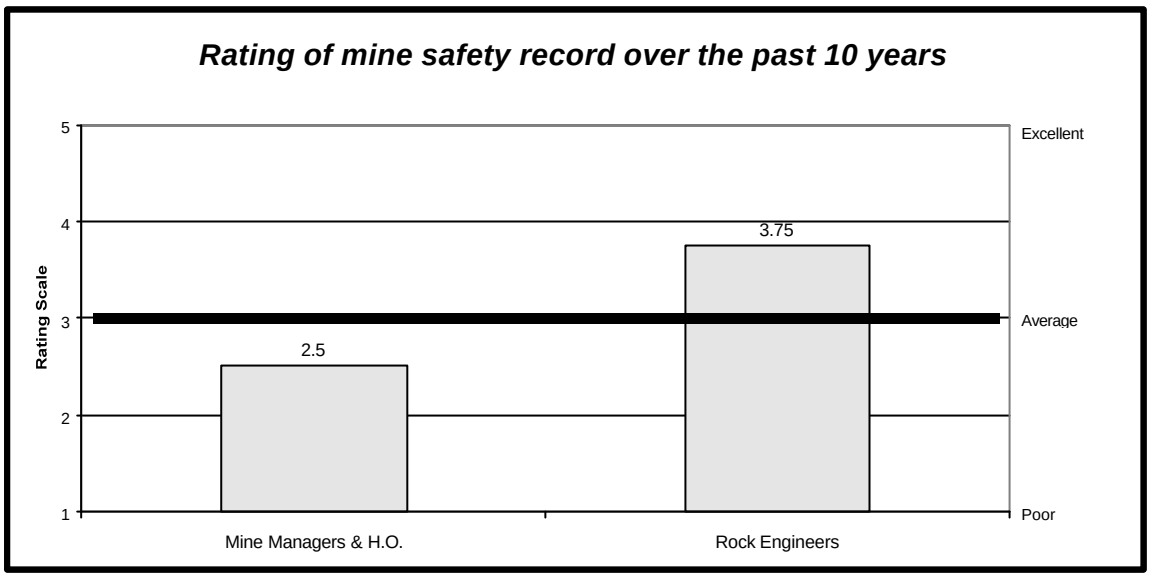
3.2 General industry approaches to safety

In this section, the experiences of respondents on the following topics are discussed:

- Company safety record over the past 10 years.
- Factors that have impacted their safety track record.
- Improving the knowledge base on safety in mining over the past five years.
- Technologies that have made the largest impact on improved safety.

3.2.1 Views on overall safety track record

Respondents rated the safety record of their mine/company over the past 10 years in the following manner.



Mine managers and head office respondents rated their safety record as 'below average'. Rock engineers rated their safety record as 'above average'. The interpretation of these ratings requires the following considerations:

- Mine managers and head office respondents rated their safety record from a holistic (total mine) perspective, i.e. considering all aspects of mine safety. In contrast, rock engineers only considered the safety record related to 'fall of ground'.
- The 'below average' rating given by senior management is supported by comments such as *"our safety record is not yet good enough"*. However, respondents generally felt that there is an improvement trend in their overall safety record.

3.2.2 Factors impacting the safety track record

Respondents were questioned to uncover the factors that have impacted their safety track record. Reasons for successes and failures, respectively, are discussed below.

Reasons for Successes

The four primary drivers of safety success on South African mines are given (in decreasing order of importance) below.

- ***Mine management's increased focus on safety.*** This factor was frequently mentioned by respondents as the primary driver of improved mine safety. Typical comments in this regard included:

- *"Full compliance", "zero tolerance"* campaigns.
- *"Changes in the mindset of mine management. In the past, the approach was 'drill and blast'. The focus has now shifted to how we manage people".*
- *"A first-world approach to safety: fatalities are totally unacceptable".*
- *"Improved communication between management and workers"; "Feedback from workers to higher levels of management has resulted in the successful implementation of many changes".*

- ***Worker education and training.*** General education and training at all levels was mentioned as an important contributor to improved mine safety. Furthermore, the training of workers in 'support requirements', 'raising awareness of hazardous conditions' and 'rock engineering principles' was also mentioned.
- ***External pressure.*** Respondents mentioned two important external influences that have contributed to improved safety:
  - DME: The DME's 'no-nonsense' approach to improving mine safety. During the discussions, a number of respondents mentioned the closure of Beatrix Mine as a typical illustration of this approach.
  - Image: External pressures by the press [read investment community] and general public have also contributed to an improvement in safety performance.
- ***"We are getting better at doing the basics right".*** This statement summarises the positive impact of aspects such as:
  - The implementation and adherence to rock engineering standards.
  - Implementing codes of practise.
  - Implementing (available) stope support technology.

In summary, management's 'safety mindset' is currently perceived as the prime driver of improved safety on mines. The contribution of technology was acknowledged, but not as a prime driver of improved safety.

Reasons for failure

Four main themes were identified and are discussed below:

- ***Safety culture.*** Respondents commented on issues such as:
  - A lack of a safety culture, and
  - The attitude towards safety. Typical comments included: *"Safety is not always a priority – there are the issues of production driven targets and workers taking shortcuts in haste".*
- ***Training and experience.*** The focus here was on worker experience and training related to dangerous/hazardous geological conditions:
  - The ability to identify such conditions, and
  - The knowledge and experience to know how to react to the same.
- ***Communication. –*** Insufficient communication between management and workers on the topic of mine safety. Typical comments by respondents included:
  - *"There is inadequate communication between mine management and the*

large workforce to establish a basis for the control of safety".

- *"Failure to get what is discussed at management level down to the workforce at the face".*
- *"Communication gap between workers and management".*

- ***Standards.*** Some respondents mentioned inadequate standards as a contributing factor. However, more respondents commented on the failure to adhere to standards as an important consideration, i.e. the 'human element of standards'.

Comparing successes and failures

The similarities between the successes and failures are interesting, notably in the areas of safety culture, training, communication and the 'human factor'. From the interviews it is evident that respondents believed that addressing these 'failures' has contributed to 'successes', i.e. improving mine safety.

3.2.3 Improving the safety knowledge base

Respondents were questioned to assess how their knowledge base on safety in mining has improved over the past five years. A summary of their responses is given below.

The primary contributors (in decreasing order of importance) to improving the safety knowledge base of respondents are:

- Own experience and training.
- South African National Institute of Rock Engineering (SANIRE) meetings and symposiums.
- Exposure to risk assessment procedures – a technique to uncover true causes of incidents.
- International exposure – respondents mentioned the following international trends as significant:
  - Different and more stringent legal and operating environments.
  - Exposure to the safety culture in other countries. The word 'culture' was used to mainly describe *"… [overseas] companies views on injuries and fatalities"*.

Only one respondent directly credited SIMRAC with contributing towards improving his knowledge base on safety. This should not be interpreted in a negative light – only that the profile of safety research needs to be raised by targeted implementation actions.

3.2.4 Technologies that have made the largest impact on improved safety

The respondents were requested to describe three technologies that have made the largest impact on improved safety. A number of technologies were mentioned. However, four technologies were frequently credited with making a significant

contribution. The four, in decreasing order of awareness, are:

- Pre-stressed elongates: Replacing rapid yield hydraulic props and providing support as close as possible to the face.
- Mine planning and design software, resulting in improved mine designs.
- Backfill, providing permanent support closer to the face.
- Seismic technology, notably the development of monitoring networks, the recording and analysing of seismic events.

Respondents were also asked to name the suppliers of the technologies mentioned above. The following table gives the supplier most frequently associated with the four important technologies mentioned previously.

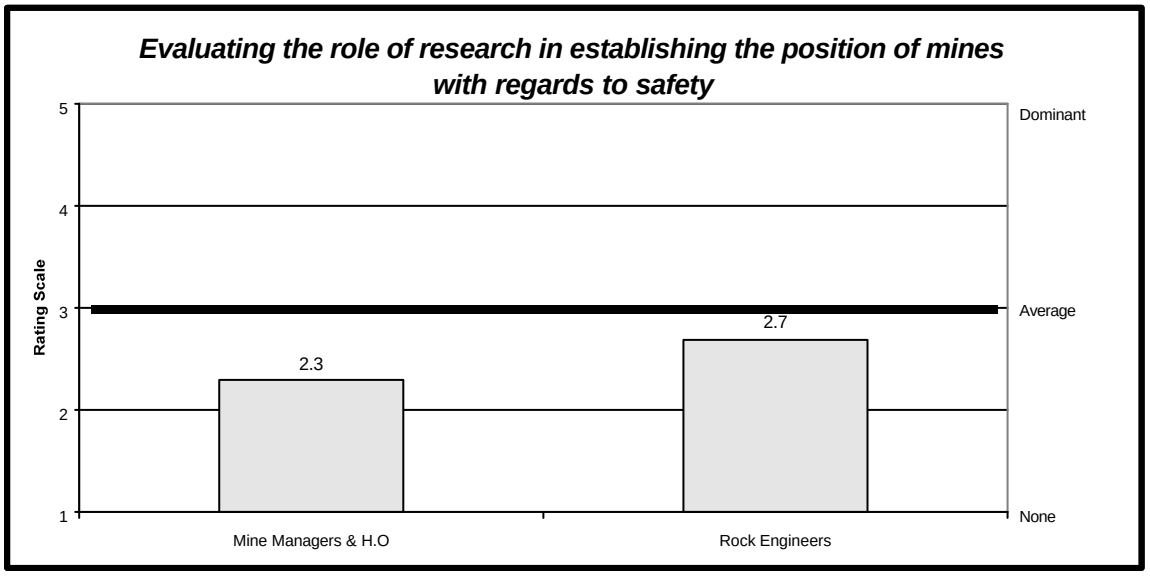
Technology	Supplier most frequently associated
Pre-stressed elongates	External suppliers and in-house development
Mine planning & design software	Miningtek
Backfill	COMRO
Seismic monitoring	ISSI

Only 22 per cent of all respondents credited or associated SIMRAC with the technologies mentioned above.

3.3 The relationship between research and safety improvement

3.3.1 The role of research in establishing the position of mines with regards to safety

Respondents were questioned on the impact/influence of research on establishing their mine's current position with regards to safety.



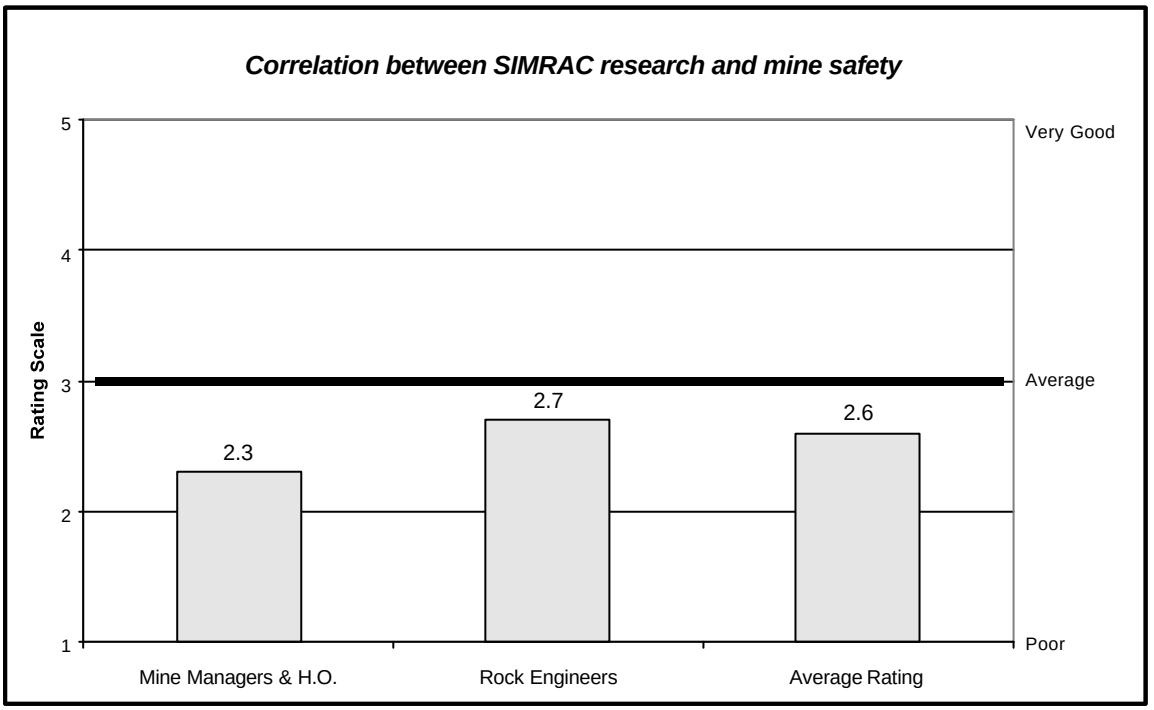
Mine managers and head office respondents rated the impact of research as 'below average'. Rock engineers rated the impact of research as 'average'. The general feeling was that the prime drivers of safety were:

- A changed attitude towards safety.
- Getting better at doing the basics right, typically stope support systems.
- Creating a safety culture on the mine.

Research *per se* was therefore not credited with making a significant impact on the positions of mines with regard to safety.

3.3.2 Assessing the impact of SIMRAC research on mine safety

Respondents were requested to rate the overall correlation between SIMRAC research and improved safety in mining:



All the respondents rated the correlation as 'below average'. The average rating was 40 per cent. LHA further questioned respondents on their reasons for these ratings.

These depth discussions are summarised below:

- ***Is SIMRAC a waste of time and money?***

  Respondents were critical of the impact of SIMRAC research on mine safety - some respondents did rate the impact of SIMRAC as *"poor"*.

However, not one respondent argued that SIMRAC activities should be terminated.

Comments made by respondents in this regard included:

- *"The correlation [between SIMRAC research and improved safety in mining] is, at best, tentative and it is also not as good as it should be"*.
- *"There may be a perception that there is a strong correlation. But, if we are honest, then we must admit that we are actually **using** a small percentage of their work"*.
- *"SIMRAC is not a waste of time and money. The issue is how to assimilate the technology and how to use it".*
- *"SIMRAC rates 'high' on improving rock engineering knowledge. They rate 'poor' on actual safety impact"*.

- ***Why is the correlation between SIMRAC research and improved mine safety low?***

The responses to this question are grouped into five broad themes:

(i) Theme 1: All parties should accept equal 'blame'.

Respondents acknowledged the low correlation between SIMRAC research and improved mine safety. The first reaction was to blame SIMRAC. During subsequent probing, respondents acknowledged that all role players are represented on SIMRAC, and that blaming SIMRAC was effectively pointing fingers at themselves.

Specific comments made by respondents:

- *"We cannot blame SIMRAC for the 'disconnectedness' between research outcomes and improved mine safety".*
- *"SIMRAC and the mining industry should accept equal responsibility (blame) for the 'disconnectedness'".*

Again, respondents qualified their criticisms with comments such as:

- *"The SIMRAC system is basically sound".*
- *"SIMRAC has produced some research gems".*
- *"The three main parties in SIMRAC have all bought into and agree and support the <u>intent</u> of the organisation. However, it is at the <u>strategy implementation</u> level (i.e. <u>how</u> to implement this intent) that SIMRAC falls down".*

Two reasons for the 'disconnectedness' were identified:

- ***Apathy.*** *"SIMRAC is plagued, to a certain degree, by apathy and some mistrust among the role players"*.
- ***SIMRAC committees and proposal selection.*** The key issue appears to be the proposal selection process. Industry representatives appear to be unable to devote sufficient time to the analysis of needs and proposals, and therefore to the selection of projects. Furthermore, in the words of one respondent: *"…the system for the selection of research proposals is sometimes a game of 'compromise politics': You (your company) agree to support research proposals in*

exchange for later support for your proposed research". This in turn may influence/impact the poor implementation record of SIMRAC research: the mines are not totally convinced of the merits of the actual research. Respondents at mine level did frequently mention that *"they are not consulted in project selection"*.

(ii) Theme 2: What can be done to overcome the 'disconnectedness'?

The key issue here was *"how do we [the industry] extract more value from the current set-up?"* A solution (in the words of a senior industry respondent) was:

- For SIMRAC: *"Focus on the customer"*.
- For the industry: *"We need to get off our backsides to ensure that we get the most value out of the SIMRAC system"*.

Note the dual responsibility to increase the value of the SIMRAC system.

It was interesting that only one mine had procedures in place to actively extract value from the SIMRAC system. This mine had established a forum where the key aim is to study every SIMRAC project in order to extract maximum benefit for the mine.

(iii) Theme 3: Isolating the unique contribution of SIMRAC is difficult.

In discussions on this topic, mine managers frequently raised the following comment:

> *"It should be remembered that mine management is already focussing on areas that are also researched by SIMRAC. It is therefore difficult to determine SIMRAC's unique contribution to improved safety in mining".*

(iv) Theme 4: The important role of mine inspectors

About 17 per cent of respondents mentioned, without any prompting, the important role of the inspector of mines in improving mine safety. Typical comments by respondents are:

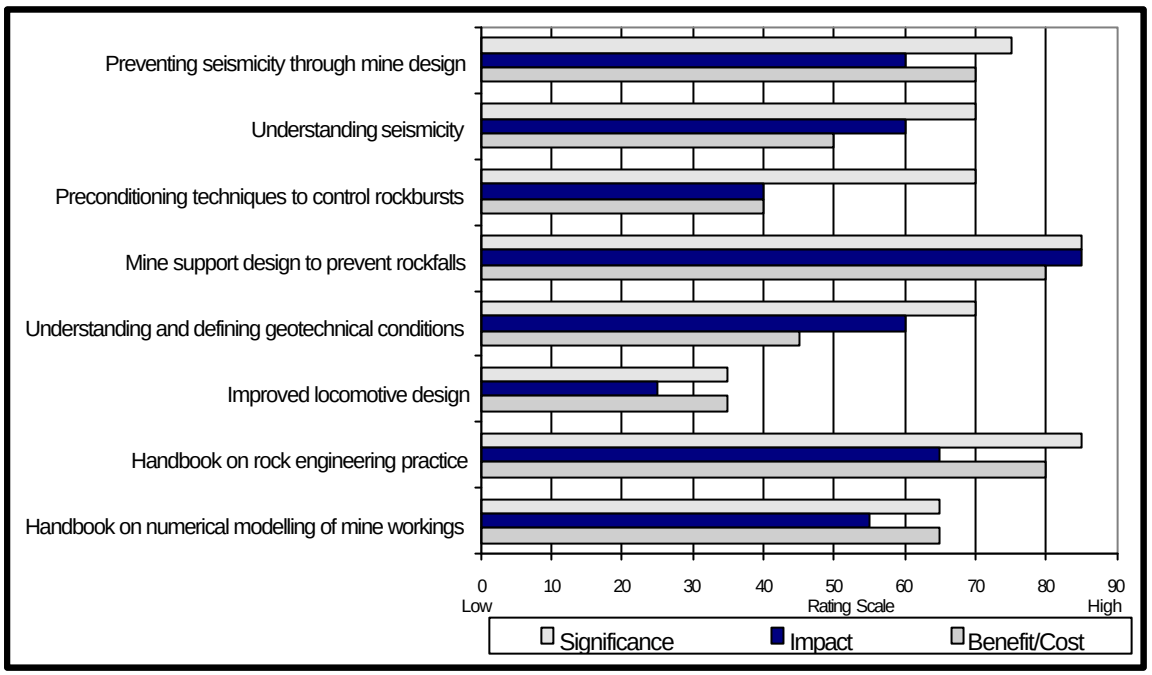
- *"The local inspector of mines has greatly contributed [to mine safety]".*
- *"We have a full-time dedicated mine inspector. His contribution to improving safety is invaluable".*
- *"The positive contribution [to mine safety] by mine inspectors must be mentioned: they do regular mine inspections and they are always available to advise".*

(v) Theme 5: The valuable role of SIMPROSS staff

A number of respondents mentioned, without any prompting, the valuable role of SIMPROSS staff. A typical comment: *"The sterling work done by SIMRAC/SIMPROSS staff cannot and may never be under rated. They are dedicated, passionate people"*.

3.3.3 Assessing SIMRAC research areas

SIMRAC research expenditure since 1993 was categorised into eight focus areas. Respondents rated the significance, impact and benefit/cost of each focus area. Ratings are given in the graph below:



- Mine support design to prevent rock falls received the highest ratings on all three assessment criteria.
- Preconditioning techniques to control rock bursts and understanding and defining geotechnical conditions received lower than average benefit/cost ratings.
- Seismicity: Understanding seismicity received relatively lower benefit/cost ratings. LHA believes that these lower ratings are influenced by the complex nature of the seismic problem. Typical comments by respondents in this regard:
  - *"The problem is just too big. We can build many models and we can operate within all the guidelines. But, it will never, ever be sufficient".*
  - *"Research is understood by managers but not by first-line supervisors. These high-level technical reports must be simplified to enable first-line supervision also to understand".*
- Locomotive design: Respondents were generally very critical of work in this area. Typical comments included:
  - *"Why does SIMRAC spend any money when suppliers are (and should be) already spending more research money on this topic".*
  - *"This work should be done by suppliers!".*
- Handbooks: Respondents generally commented favourably on the relatively low cost of work in this area.
  - Rock engineering practice. The only criticism was: *"VESS models/guidelines were published before final research results were available. The bottom line is that the VESS models (as published) are invalid".*

- Numerical modelling: The second volume was only distributed recently. The lower impact rating may be contributed to the perception of respondents that they need to purchase *"coding software"* in order to read the CD-ROM.

3.3.4 Future research focus areas

The views of respondents on future SIMRAC research are summarised below. It should be noted that the aim was to obtain broad guidelines.

- ***Safety culture***. There was overwhelming support for research into better understanding and influencing people's behaviour. The following comments by respondents will attempt to delineate the scope better:
  - *"Bringing about a safety culture on mines".*
  - *"Research to uncover why people, who have been trained and equipped to work safely, engage in unsafe and fatal acts".*
  - *"About 50 per cent of the [research] expenditure on rock bursts and rock falls should be directed to understanding and influencing people's behaviour*".
- ***Training***. The training of underground workers in strata control principles was also frequently mentioned. Some respondents, however, felt that SIMRAC should not be involved in training *per se*, but should develop the course content for the training of workers in strata control, typically the identification of hazardous ground conditions, etc.
- ***Support Systems***. Respondents mentioned a range of support related future research topics, including:
  - *"A quick and reliable non-destructive method to evaluate the quality of existing support: A miner walks up to existing support and uses this technique to evaluate/rate the quality of the support".*
  - *"Support design in seismic mines".*
  - *"Active support at the work face".*
- ***Seismicity.*** Respondents at seismic mines felt very strongly that research in this area must continue. Specific comments included:
  - *"The chances of success in this field are low. But, we must keep going – people are being killed".*
  - *"We must improve our ability to predict; to withstand the damage created by seismic events; and to develop the technology to remove workers from the work face".*
- Other suggested research focus areas included:
  - Mining methods, mine layout and pillar design.
  - Developing technology to evaluate rock stability in development ends and/or stope faces. This technology must be developed for use by unskilled mine workers.
  - Backfill.
  - Productivity improvement methods.

During the depth discussions on future research areas, respondents made a number of interesting observations:

- *"I know there is pressure to focus on adding value immediately. Research should be done now in order to build our knowledge base - in order to add value in future. The SIMRAC model is the right way to go. The question is just are we optimising the value that SIMRAC can deliver".* (Mine manager)
- *"Our mining depth will remain at 3 000m for the life of the mine. We have the technology to mine at this depth. I believe the focus to improve our safety should now turn to people"*. (Mine manager)
- *"Research value is created when the following conditions are met:*
  - *There is a reasonable chance of a successful outcome.*
  - *Research is driven by a specific need that must be met/satisfied within a specific period of time.*
  - *The end-user was intimately involved in all stages of the research project, including the design and specification, as well as implementation."* (Senior Rock Engineering Manager*).*

4. Conclusions and recommendations

4.1 Conclusions

The key findings of the study relating to SIMRAC's role, impact, processes and profile, respectively, are discussed below.

4.1.1 The role of SIMRAC

At the outset it can be stated that the research indicated that SIMRAC is not a waste of time and money. General positives that have emerged from the research are the:

- Importance of the tripartite alliance underpinning SIMRAC, and that the existing structure should remain.
- Agreement and support for the intent of the organisation.
- Acceptance of the levy funding mechanism with no meaningful alternatives suggested.
- SIMRAC research is relevant to South African mining conditions.

In summary, the research indicated general support for the SIMRAC model. Outreach mechanisms need to be put in place, however, to ensure greater contribution and participation by decentralised levels of mining management and workers.

4.1.2 The impact of SIMRAC

SIMRAC research outputs have significantly increased knowledge in the areas of rock bursts and rock falls. In the words of one respondent: *"The organisation has produced some research gems"*.

The impact of the organisation as measured by the correlation between safety improvements and SIMRAC research outputs, was rated relatively low. This low rating can be explained by the following considerations (not presented in any order of importance):

- The general lack of implementation of SIMRAC research results - only a small percentage of SIMRAC outputs is actually used.
- Mine management's increased focus on worker education and training. Technology is not currently perceived as a prime driver of improved safety.
- Mine safety is a multi-faceted issue. Isolating the unique contribution towards safety improvements of SIMRAC research is very difficult. This separation is further complicated by the overlap between SIMRAC research focus areas and initiatives by mine management.
- A disproportionate research focus on gold relative to the platinum mining industry.

4.1.3 SIMRAC processes

Strong support emerged for the work done by SIMPROSS, notably in the areas of research management and facilitation and their administrative support function.

Concerns were identified in the following areas:

- A lack of technical expertise by labour and the Department of Minerals and Energy (DME). This impacts negatively on their ability to contribute as equal partners in the various committees.
- A perceived lack of active participation (bordering on apathy) by all stakeholders in the various SIMRAC committees.
- Project selection: Firstly, project selection is impacted by industry representatives that appear to be unable to devote sufficient time to the analysis of needs and proposals. Secondly, direct inputs from stakeholders (mine managers, engineers, safety representatives and mine inspectors, etc) at mine level are lacking.
- The transfer of SIMRAC research outputs to stakeholders at the mine level are inadequate:
  - SIMRAC processes, notably communication and implementation management have improved but are not yet adequate.
  - Mines are not actively exploring and pursuing opportunities for transferring SIMRAC outputs into their operations. The same apply to labour and DME representatives at mine level.
- Project governance is lacking with research projects running without project champions from the industry.

4.1.4 The profile of SIMRAC

Stakeholders' perception and knowledge of SIMRAC vary greatly. There is clearly significant 'noise' in the market that is negatively impacting SIMRAC's profile.

Occasionally, a blurred distinction between SIMRAC and major research providers was also evident: criticism against such research providers was projected on SIMRAC.

4.2 Recommendations

4.2.1 Needs analysis

SIMRAC should employ a process to explicitly and publicly develop and formulate its research objectives and thrusts and use a weighting system as a means of providing budget guidance to its research efforts and a rationale to mining role players and the public.

This framework of objectives and thrusts should address, inter alia:

- How the formulated objectives will meet the statutory responsibility of the organisation.
- Does the budget allocation recognise the highest priority and highest quality programmes.

Such a process should take note of the following current imperatives:

- Detailed consultation with all stakeholders at all levels in the industry. As an example, consultation with employers must include head office and mine respondents.
- A greater focus on the human element of safety, typically establishing a safety culture, understanding and influencing behaviour, and training.
- A needs analysis that is based on a risk assessment approach.

The outputs of the needs analysis must typically be a three-year strategic business plan to fill the identified knowledge and technology gaps.

4.2.2 Platinum industry

The platinum mining industry should become a separate focus area – it should be separated from gold. Practical issues relating to the establishment of new sub-committees need, however, careful consideration.

4.2.3 Technical capacity of the DME and labour

The technical capacity of the DME and labour to provide input into the SIMRAC processes must be strengthened. Mechanisms must be investigated and implemented to ensure that all members of the tripartheid alliance provide 'equal' technical inputs. Funding might have to be separately allocated to create such capacity.

4.2.4 Transfer and implementation of knowledge and technology

In this regard the following should be considered:

- The transfer and implementation of knowledge and technology should become an integral part of all SIMRAC project plans and budgets.
- The transfer and implementation should be guided by the following principles: "SIMRAC should utilise industry respected individuals who can visit mines to (a) inform same about the SIMRAC research outputs, and (b) together develop mine-specific solutions.
- The establishment of SIMRAC accreditation schools for rock engineers, mine inspectors and safety representatives, as general examples. This recommendation is aimed at keeping all relevant stakeholders updated with

SIMRAC outputs.

- Stronger linkages between SIMRAC research outputs and legislation, codes of practice and accident investigations:
  - Legislation: This recommendation would allow for the co-ordination between technology development and regulatory development.
  - Accident investigations: Officials should be informed to ask the following types of questions during accident investigations: *"These are the SIMRAC guidelines – were they implemented?"*.

4.2.5 Project governance

It is recommended that the following three principles should be incorporated in all SIMRAC projects:

- Managing delivery against financial and physical milestones.
- Value add during the project life: It is important that industry respected and knowledgeable roleplayers provide guiding, coaching and mentoring inputs throughout all the project phases. This is typically done by a project steering committee.
- Project champions – individuals from industry that carry the responsibility to ensure that objectives are translated into research plans, that these projects are performed by the best performers and that projects deliver according to the 'agreed to' objectives.

4.2.6 Joint project funding

As mining technologies become more complex and mining processes become more tightly integrated, the need for sustained, strategic alliances between researchers, equipment developers and mining operators is becoming more critical.

Funding from both the private and public sector to catalyse and sustain such partnership has become very limited in recent years. Collaboration is needed throughout the entire innovation process, from concept development to commercial demonstration. Greater collaboration between researchers, suppliers and operators will improve knowledge flow and will facilitate the relevance and adoption of new technologies.

LHA recommends that ± 30 per cent of SIMRAC's funding be channelled to joint projects. Joint projects would be funded together by SIMRAC and mines, groups of mines or suppliers on a Rand-for-Rand basis. This joint funding (similar models are used by the DTI) would endeavour to overcome many of the inherent 'failures' of one-sided funding and research agency scenarios.

4.2.7 Positioning of SIMRAC

There appears to be widely differing views amongst all stakeholders on the role of SIMRAC and the associated expected benefits.

It is therefore imperative that SIMRAC creates a shared understanding amongst all stakeholders of the 'agreed to' SIMRAC strategic intent, strategy and expected benefits.

LHA recommends that SIMRAC embarks on a focussed communications campaign to unambiguously position SIMRAC in the minds of all stakeholders. This campaign should be specific about what is included and excluded from SIMRAC activities.

Measurable objectives should also be set and evaluated during and after the communications campaign.