

From sharing to widespread adoption of technology and best practice to improve occupational health and safety in mines

Final Report

**J M Stewart Consulting
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Executive Summary

The nature and scope of what is involved in facilitating the widespread adoption of technology and or best practice, with a view to bringing about significant improvement in occupational health and safety performance is outlined. A system for achieving the required facilitation is put forward. It draws on insights gained from a review of past work and present practice, and takes account of findings from the mental models research that was conducted to identify barriers and aids to the sharing and widespread adoption of technology and or best practice.

Key success factors are presented. It is pointed out that the key elements of the proposed system must be clearly evident so that Industry Executives are able to consider and agree to them as a basis for implementing the system. In broad terms the key elements of the proposed system are as follows:

- The establishment of an enabling climate for the widespread adoption of technology and or best practice by company Chief Executives collectively agreeing to implement the identified key leadership dictates in their organisations.
- Continued existence of the Taskforce, to identify the key issues that should be addressed to achieve the improved performance being sought, and to ensure that the system remains focussed on the identified priorities.
- Use of the various mechanisms and processes that have been outlined in ways best suited to addressing the key issues identified by the Taskforce.
- The establishment of a small specialist secretariat governed by a brief that requires it to facilitate operation of the system that has been outlined, and to provide the support required by the various teams of industry persons that need to be established for effective operation of the system.
- Collaborative funding of the activities of the specialist secretariat by all Chamber members, but with mines being responsible for demonstration projects conducted at their operations.
- Piloting of the proposed arrangements as a basis for testing the effectiveness of the system and for refining the system prior to progressively implementing the agreed system elements.

It is pointed out that the specialist secretariat, which may be seen as a key enabling mechanism, could be established either as a Chamber function, or outsourced by arrangement with an organisation that may already have most of the necessary expertise and interest, or a combination of the two.

It is proposed that Industry should first decide whether it is prepared to make the investment necessary to shift from sharing to adoption. In the event that this is agreed, it is proposed that the Task Force conduct a workshop to consider issues related to practical implementation of the system, including that of how best to pilot the system, and to formulate a proposal for consideration by the Chamber's Executive Council.

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1 Introduction

The South African mining industry is committed to continuous improvements in occupational health and safety performance as it strives to achieve the milestones and targets that have been collectively agreed to at Chief Executive level. Recent performance trends have led to the recognition that a fresh approach would need to be adopted if the sought after improvements are to be achieved. The Occupational Health and Safety Task Force was established to address this issue. The Task Force identified the greater use of available technology and best practice as one of the means for bringing about such performance improvements, and this is the focus of the present work.

There is a long-held perception by many that industry has not adequately benefited from the considerable effort has been devoted to the development of improved technology and practice in the area of mine occupational health and safety. This comment applies in particular to R&D funded through the Mine Health and Safety Council's SIMRAC programme, but also to the industry's use of technology that has been developed on mines, by suppliers, or in other R&D programmes, both locally and internationally. It is also contended that many mines have developed effective practices, but that industry has not collectively benefited from these innovations to the extent that it should have, despite the various efforts that have been made to share this knowledge. In essence, it is felt that although considerable knowledge exists, and that much of it is shared, the sharing process does not adequately lead to adoption of the knowledge in practice.

Objective: The primary objective of the work is thus to develop mechanisms to facilitate widespread adoption of technology and best practice, in order to bring about significant improvements in the occupational health and safety performance of the South African mining industry.

In addressing this objective it became clear that there are three quite different opportunities that need to be considered separately. They are to facilitate the identification, sharing and widespread operational adoption of:

- *Worthwhile* best practice,
- *Worthwhile* technology, such as that emerging out of the SIMRAC research programme, and
- A combination of practices and technologies specially identified to address a *priority area* of occupational health and safety concern.

The proposed mechanisms and processes need to cater for each of these requirements within a simple system that will allow any one, or all of them to be pursued separately at any given time. The development of such a *system* is thus an important elaboration on the above statement of the primary objective of the work.

It also became clear that it would be important to consistently use a simple term that would clearly and simply describe the nature of the required system. It was decided that the term *adoption* best describes what the system seeks to accomplish and it is thus the term used throughout this report.

Critical success factors: Based on the review of past and current approaches to technology and best practice transfer, which is considered below, the critical success factors for the proposed *Adoption System* are as follows:

1. The key elements of the proposed system must be simple and clear so that Industry Executives are readily able to consider and adopt them as a basis for enabling implementation of the system.
2. The adoption mechanisms and system must engender a sense of Industry ownership, particularly for any aspects that might be centrally sponsored or located.
3. The adoption mechanisms must be able to accommodate the different approaches that may be required for the adoption of technology and or best practice.
4. The system must facilitate focused attention being devoted to the few top-level priorities identified by industry.
5. The time spent by industry persons in working with the system must be minimised and free of undue complexity.

2 Enabling prior work

It is important to note that the proposals presented later are based on substantial prior work. It is thus appropriate that the nature and scope of that work be adequately brought to light. The key elements of the enabling prior work are presented below.

Review of past work: A great deal of experience has been accumulated in the many initiatives aimed at bridging the so called “innovation gap” as others have sought to convert knowledge gained into practical application. The work on technology transfer done previously through the industry’s collaborative efforts^{1 2} as well as similar work done by the National Advisory Council on Innovation³ was reviewed to distil out experience, in the form of insights of relevance and value to the present work⁴. These insights were endorsed and expanded upon through an investigation of the approaches currently in use by leading organisations that depend on the effective use of technology. A selection of the most instructive of the 108 insights presented in the earlier reports⁵ is given in appendix 1. These and the other insights form the basis of much of what is proposed later.

Investigation of current processes: In recent years organisations have placed a much greater emphasis on the application end of the innovation process. The huge advances in information technology in recent years are central to the more holistic approach that organisations have adopted to knowledge management. Leading organisations have realised that their future competitiveness depends on effective knowledge management, and in particular, on the acquisition and application of new knowledge. The various approaches adopted by a substantial number of leading organisations were thus investigated to identify relevant experience and mechanisms for bringing about the adoption of technology and best practice transfer. Much useful information was gathered and the insights gained provided strong guidance in selecting the mechanisms presented later. The organisations investigated and the various mechanisms and systems identified are listed below, with further details being provided elsewhere⁵.

Table No.1: Organisations investigated and mechanisms identified

Organisations investigated		
Implats	Sandvik	Wits university – School of Mining and Centre for Sustainability in Mining and Industry
Eskom	Sasol Chemicals	Chamber of Mines – Coaltech 2020
World Association of Nuclear Operators	Sasol Mining	International Council on Mining and Metals
Anglo American plc	Anglo Platinum	Engen
Reunert Systems	BHP Billiton	Gold Fields
Australian Minerals Industry Safety and Health Centre	SIMRAC	Western Mining

Mechanisms identified		
Stand-alone organisation	Communities of practice	Charter based holistic health and safety management system
Benchmarking database	Project based steering committees	A central facility for demonstration projects
Steering committees involving key stakeholders	Global peer group review mechanism	Electronic information systems
Specialist focus groups	Local peer group review mechanism	Incident driven identification of technology and best practice
Mandatory company standards	Partnerships with suppliers	Centrally co-ordinated technology management system
Manager level presentations and visits to share best practice	Focused high-level task force	Round table forum to facilitate improved equipment from suppliers

Mental models research: The Task Force recognised that the present work needed to be underpinned by a fundamental understanding of the barriers and aids to sharing and operational adoption of technology and best practice. A programme of mental models research was thus undertaken to acquire this fundamental understanding. This work was undertaken in parallel with the above investigations.

The research recognises that people's judgements about complex issues are guided by their mental models, which are the tacit webs of belief that people draw on to interpret and make inferences about issues that come to their attention. They cannot be determined without empirical research and they must be addressed through communication, in its broadest sense, to change people's attitudes, beliefs and behaviours. The process involves identification of the key issues and influences involved, in the form of an influence diagram, termed an expert model, which is then used as an analytical framework to guide open ended interviews of key people directly involved in the issue being investigated. The expert model developed in the present study is given in Appendix 2.

Embedded in the expert model is a sub-model that deals with the concept of innovation, which is the term that most appropriately describes the complete process of technological advance, from origination of a new idea, right through to its application in practice. It is thus a concept that includes *adoption*, but which extends upstream right to the beginning of the R&D process. The sub-model, and the concept of innovation, which underpin much of the work presented in this report are also given in Appendix 2.

A summary of the mental models research methodology as well as the major findings that emerged from the research is presented in Appendix 3. These findings are consistent with the insights developed in the earlier review work and they add further support to the system outlined in this report. Key findings from the mental models research is summarised below:

- *Aids to successful adoption:* Communicating with management and the workforce, and demonstrating personal commitment were identified most often as aids to successful adoption of technology and best practice. This was followed by the provision of active support to implementation activity and ensuring that appropriate technology was being adopted.
- *Barriers to successful adoption:* The barriers to successful adoption identified most often were the resistance to change factor, cost constraints, the workforce not seeing the benefit of the of the technology or best practice, the technological challenge involved and a lack of management buy-in.
- *Effective communication:* Effective communication was identified by 95% of those interviewed as the key to successful implementation of technology or best practice. The means of effective communication most often identified was personal interaction, meetings and workshops, and underground site visits.

The research confirmed that the most significant challenge is not a failure to identify or develop technologies or best practices, but rather to address the difficulty of achieving adoption of technologies or best practices. According to interviewees, the focal point for achieving adoption by mine employees at all levels is overcoming resistance to change by workers who do not readily see the benefits of change. At the leadership level, the primary challenge is getting “buy-in,” in order to get the capital funding and resources required to implement the technology or best practice. For leaders and workers alike, the research results indicate that the challenge of achieving adoption in organizations is fundamentally a behavioural one.

Although the mental models research was focussed on the identification of aids and barriers at the company level, the key findings are considered directly relevant to the industry-level focus of this report.

3 A coherent system of mechanisms, processes and structures

The enabling prior work has made it clear that there is no single mechanism to convert existing knowledge into widely adopted operational practice. Various mechanisms and processes may deliver good results in particular circumstances, but fail badly in others. This observation explains the diversity of views on how to achieve the adoption of technology or best practice. It also serves to highlight that a systematic approach to technology and best practice adoption needs to be put in place. This systematic approach, in the form of a coherent system of mechanisms, processes and structures, will need to enable the appropriate set of mechanisms and processes to be configured, and be used as appropriate, depending on the circumstances.

The key elements of the proposed system for facilitating the adoption of technology and best practice are presented in the diagram given below. In each case the primary purpose or role of the element is briefly stated in the diagram, but the various elements are elaborated upon in the sections that follow.

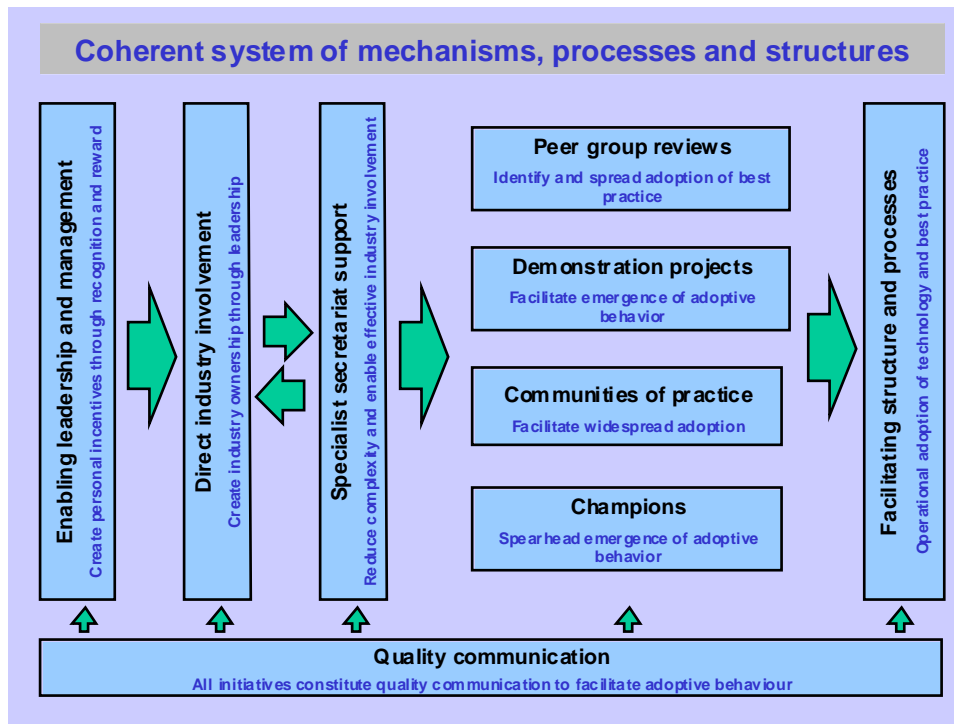


Figure 1: Key elements of the system for facilitating the adoption of technology and best practice.

3.1 Enabling and reinforcing leadership and management

The mental models research has highlighted the important influence of leadership orientation towards technology and best practice adoption, and identified the need to foster a climate that enables adoption. It pointed out that creating a climate supportive of people working within the adoption system could be critical to improving OH&S behaviour (and results) over the long term. Defining the values of the organization, setting the priorities, leading by example, and demonstrating respect for employees at all levels are critical leadership roles, with strong personal communications (primarily dialogue) and high visibility and engagement of leaders with employees being important reinforcing elements. It suggested that employees at all levels should be engaged in the identification of OH&S issues and opportunities and involved in the process of adopting technologies and best practices specifically suited to the operating conditions of their mines. Furthermore, it highlighted that they should be appropriately recognized and rewarded for their involvement in identifying OH&S problems and opportunities, participating in the identification of technology or best practices, and supporting the adoption of these.

It is thus abundantly clear from the enabling prior work that management orientation towards the adoption process is of fundamental importance, and that an unfavourable orientation represents a serious barrier. Experience indicates that in many, if not most cases, an unfavourable orientation is a barrier that can, and very likely will lead to failure of an adoption initiative. Appropriately, Figure 1 illustrates that leadership and management need to create an environment that is enabling and reinforcing of adoption activity, and personally rewarding to those engaged in the adoption process. To make a difference, the enabling and reinforcing effect needs to impact significantly on such individuals. In particular, they need to be recognised and rewarded for behaviour that facilitates adoption, even if others originally developed the idea. Reward should not be confined to the

generation of a new technology or practice that improves health and safety performance, or for otherwise bringing about improved occupational health and safety performance. It is important to recognise the difference between these contributions and to ensure that not only the latter two are rewarded. Equally, behaviour that obstructs adoption should be recognised and acted upon, as should poor occupational health and safety performance.

The above represents a challenge to a company operating under a single executive management structure, and becomes a major challenge when considering consistent implementation of such requirements across a number of companies, each with its own independent executive management structure. However, if this fundamentally important enabling step is set aside, or treated inappropriately, the risk of variable innovation performance, and ultimate failure of any otherwise agreed collaborative effort will simply increase.

In principle this challenge may be addressed by the Chief Executives of the collaborating companies agreeing to a manageable set of principles for implementation within their respective companies. This approach appears to work well in situations when companies voluntarily agree to collaborate to achieve a jointly agreed goal. It is accordingly put forward as the approach that should be adopted to meet the occupational health and safety goals that have been jointly agreed to in this instance. The set of principles to be considered for adoption is as follows:

1. Companies to declare occupational health and safety technology and practice as an area for openness and collaboration.
2. Performance recognition and reward arrangements will explicitly include recognition of, and reward for, individual behaviour that facilitates adoption. This will be separate from, and in addition to, recognition and reward for the achievement of improved occupational health and safety performance.
3. Individuals responsible for behaviour that obstructs adoption, or for operations with a poor, and particularly worsening occupational health and safety performance, will be identified and appropriate action taken.
(It is noted that in some companies such action already includes disqualification from promotion, and even dismissal for repeat serious incidents, which are viewed as being indicative of an operation out of control.)
4. Companies will provide their staff participating in industry level activities to facilitate adoption with adequate time to fully participate in such activities.
5. Staff members released to participate in industry level activities to facilitate adoption will not be unfairly discriminated against in respect of their career development.
6. Companies to commit to implementing the above policies as soon as is reasonably possible, but within three years. This time allowance recognises the complexities that may need to be resolved in regard to the implementation of 2 and 3.

The above points illustrate the important influence that a positive leadership and management orientation can have on action to advance the transfer and widespread adoption of technology and or best practice.

3.2 Direct industry involvement

The importance of achieving industry ownership and buy-in for the successful adoption of technology and or practice has emerged as one of the most strongly and consistently expressed views in the enabling prior work. It is clear that any system devised to facilitate the widespread adoption of technology and best practice will need to satisfactorily address this issue. It is a primary success factor, and a most important insight.

A message that also comes out strongly from the enabling prior work is that the key people involved in the identification and adoption of new technologies and practices need to be involved in the process at the earliest possible stage. In the context of the present work this would be at the point where an Adoption Team is established to plan and oversee any particular innovation initiative. The primary purpose of such teams would be to facilitate widespread adoption of the technology and or best practice.

It is proposed that the establishment of such teams should become the primary mechanism for bringing about direct industry involvement at an early stage of the adoption process. They are then also a primary means for achieving the industry ownership required for successful technology and best practice adoption. Importantly, this needs to be borne in mind when setting up the team, as is illustrated below.

Adoption Teams: The following criteria should be met in setting up and operating an *Adoption Team*:

1. Membership of the teams to be voluntary with participants free to withdraw at any stage.
2. The teams to have a scheduled date for termination of their activities.
3. The teams to be composed of key people from industry who have indicated that they will be able attend meetings and participate as full team members.
4. The teams to include the person or persons that have agreed to act as champions.
5. The teams should not be larger than about 20 persons from industry.
6. The chairman of the team should have a vice chairman from a different company. The chairmanship should rotate among members on an annual basis.
7. The chairman and the champion should not be the same person.
8. Each team to have a person at company CEO level who has agreed to act as the "sponsor" of the team. The sponsor would not be a member of the team but would be available to help overcome any difficulties that seriously threaten the continued existence or successful functioning of the team, particularly those that might be sensitive.
9. The primary function of the team will be to ensure that the facilitation programmes are appropriately planned and focused, and that they remain that way.
10. The work of the team is to be supported by a specialist secretariat that will help ensure that the time required of industry members is kept to a minimum and that past experience is appropriately taken into account in the planning and facilitation work of the team.
11. The team would meet according to a schedule determined by the needs of the work. Such meetings would enable industry leadership, engender the industry ownership needed for success, and facilitate the emergence of early adopters from among its membership.

A few of the above points warrant further elaboration, as follows:

Firstly, it is important that industry, or the members of the team do not perceive the team as being part of an initiative driven by, or dominated by, a single company. Within the size, and the commitment and voluntary membership constraints imposed for efficient performance, the team should thus involve as many companies as possible, with the principle of rotating chairmanship being observed as an important priority. The Chamber has itself demonstrated both the viability and importance of this latter point.

Secondly, the identification of a high-level “sponsor” must not be regarded as a violation or subversion of normal line responsibility, either within the Chamber or the mining companies. It is simply the advance creation of an informal channel to help address sensitive or otherwise difficult issues that the team or its chairman is unable to resolve directly. It is a mechanism for removing blockages that are best not taken up formally through line management.

Thirdly, in addition to members indicating that they will be able attend meetings and, as far as is reasonably practical, to participate fully in the work of the team and they should commit themselves to remain as members of the team through to completion of its work. Experience warns that the disruption of team performance due to lack of continuity of team members can be crippling, and unfortunately, sometimes fatal.

Finally, in direct company involvement, the underlying principle that it must be that the involvement is driven by the simple business principle of seeking a valued net benefit for the company. Ideally, the involvement should thus be the expression of a core business imperative.

3.3 Peer group reviews

The primary purpose of the peer group review mechanism is to identify and spread the adoption of good practice. In essence the mechanism involves the use of peer group review teams to conduct detailed reviews of the operations of participating organisations, at their request, or at the request of industry, to identify both best practice, as well as areas in need of improvement. Best practice from others is put forward in a confidential report on the review as a means for addressing the identified weaknesses. Best practices identified during the review are documented and openly communicated to other participating mines.

The key elements of the mechanism and its operation are as follows:

1. *Participating mines:* The participation of mines in the peer group review process must be on a voluntary basis.
2. *Leadership and management:* An Adoption Team would be established to provide high-level management and to oversee the process.
3. *Establishment of review teams:* Participating mines would each identify a range of experts capable of commanding credibility as a peer group reviewer on other mines. This is a critical requirement. The names and contact details of those identified would be provided to the specialist secretariat set up to support the review process. The review team leader and the review team specialists in various areas would be drawn from this list. The secretariat would make the necessary arrangements to bring the peer group review team together, to appropriately brief them, and to

make the necessary arrangement for the review to be conducted. In addition, the team leader would meet the head of the operation to be reviewed beforehand to initiate communication and to discuss the review process.

4. *Focus of the reviews:* The focus of the peer group review teams in conducting their reviews would be guided by the priorities established by the Occupational Health and Safety Task Force through the annual workshop that they would convene and lead. This workshop is dealt with in more detail later.
5. *Selection of mines to be reviewed:* In most cases the mines to be reviewed should be self-selected, in that they should approach the secretariat with the request that they be reviewed. They would thus usually be mines experiencing occupational health and safety difficulties. However, an important function of the Adoption Team and the secretariat would be to identify mines with particularly noteworthy performance in various areas, with a view to arranging that they be reviewed in order to identify and document new good practices. The benchmarking arrangements being established at the Centre for Sustainability in Mining and Industry at Wits University should be used to assist in the identification of such mines, but a key input would also come from the members of the Adoption Team. The identified mine would then be approached with a view to arranging an appropriate review.
6. The identification of a mine or number of mines to be reviewed could also be driven by an initiative to identify practices relevant to a priority issue that industry has decided to address. In such cases a similar process would be followed, although in close collaboration with the Adoption Team responsible for the programme of work designed to address the special issue.
7. *Reporting:* During the review the team would note strengths that may be useful to other mines, as well as areas in which improvements could be made to improve health and safety on the mine being reviewed. Within two weeks of completing the review, the team should issue a draft of its confidential report to the mine that has been reviewed. The report will identify weaknesses that need to be addressed and ways in which this might be done, using good practice identified and documented at other mines. All of the recommended actions should have first been discussed with the relevant persons at the review mine so that there are no surprises. In parallel the review team would also document the good practices that were identified as being potentially useful to other mines. These would be communicated to the other participating mines, and introduced into an accessible electronic database.
8. *Accessible electronic database:* The secretariat would maintain an electronic database that would house all of the identified good practice and which would be readily accessible not only to participating mines, but also to all mines. The database should use or have links to other similar sites, such as the MIRMgate system operated by the Australian Minerals Industry Safety and Health Centre⁶.
9. *Facilitation of widespread adoption:* Widespread adoption of particularly important and beneficial best practices may need to be further facilitated by other means. The first would be through workshops held from time to time to present and discuss such best practices with interested persons from other mines. In addition, the workshops would be used to identify the interest and

need for the establishment of any Communities of Practice, or Demonstration Projects, and to initiate their establishment if considered necessary. Although it is expected that the need for best practice demonstration projects would seldom arise, they may be warranted in some cases, particularly if the best practice originates in another mining sector or mining country. Communities of Practice and Demonstration Projects are considered later. The workshops would also identify the need for any best practice guidelines and the secretariat would initiate an appropriate process for such guidelines to be prepared and in due course made available.

10. *Technical assistance*: From time to time a mine may need technical assistance in implementing a best practice that it has decided to adopt. The secretariat would assist in arranging such assistance, either in the form of a small team of experts in the area in question, or in the form of a secondment or personnel exchange.

A summary of the key points associated with peer group reviews is presented in Figure 2.



Figure 2: Summary of key points for peer group reviews

3.4 Demonstration projects

The primary purpose of demonstration projects is to initiate the process of facilitating widespread adoption of the technology and or best practice being demonstrated. The mechanism involves selecting a mine that has the potential to benefit significantly from the technology and or best practice in question, and that is willing to implement the project. The project serves as a means for creating familiarity with the technicalities of the application, and for identifying and communicating the information needed by other operations to make informed decisions leading to progressive adoption of a successful innovation across industry. It is a multi-purpose mechanism for reducing risk and achieving effective communication.

The key elements of the mechanism and its operation are as follows:

1. *Leadership and management*: Demonstration projects would be undertaken as a major component of the work of an Adoption Team that has already been established, and that team would thus provide leadership and overall management of the project.

2. *Preliminary considerations:* The decision to undertake a demonstration project must be preceded by considerations that fully take account of previous experience in conducting such projects. This is facilitated by way of a checklist that raises the key questions and issues that need to be considered. Such a checklist is provided in Appendix 4. Key questions include issues as fundamental as whether the technology or practice has been adequately developed for use in such a project, or whether the project should be run in partnership with the equipment supplier, or whether special training or organizational structures are needed for a successful project, and so on. The preliminary considerations serve the purpose of identifying the broad approach and scope of the project, and the mines that are expected to benefit most from the innovation.
3. *Selection of host mine:* The preliminary considerations would help identify the mines that are best suited to host the envisaged demonstration project. In particular, the host mine needs to be one of the mines that have the greatest potential to benefit from the innovation. It should also be a mine that is profitable and not under undue production or cost pressure. The mine should thus have the organizational capacity to take on the commitments associated with running a successful demonstration project. Having satisfied these criteria, the mine should also be willing and keen to host, and fund the costs involved in conducting the demonstration project.
4. *Special collaborative funding:* In special cases, where the potential benefits are particularly large, but where the risk of failure is such that neither a mine nor a supplier can be realistically expected to shoulder the financial risk associated with the demonstration project, other interested mines may be prepared to collaboratively underwrite the costs of the project. The secretariat would facilitate the establishment of such arrangements.
5. *Technology champion:* A condition for hosting the demonstration project should be that the mine would identify and appoint a person to champion application of the technology or best practice, firstly at the mine, but then also more widely in industry. The mine would adequately free the appointed person from his operational responsibilities so that the role of technology champion can be adequately fulfilled. The role of technology champions is presented later.
6. *Project management team:* The host mine would appoint a project management team to plan and oversee the detailed execution of the project. The secretariat should ensure that the detailed plan is consistent with the broad approach and project scope identified by the Adoption Team. The leader of the project team could be the Technology Champion, but this should not be a requirement. The Technology Champion should however be responsible for reporting progress on the project to the Adoption Team, and to all parties that have expressed an interest in receiving such information, as well as to key people on the mine.
7. *Reporting of performance outcome:* The performance outcome of the demonstration project would be written up by the Technology Champion in terms that make sense to the mine, but also in a way that would enable other mines to interpret the results in the context of their own circumstances. The report would be made available to the Adoption Team and on request to interested mines not represented on the Adoption Team.
8. *Facilitation of widespread adoption:* Widespread adoption of the technology and or best practice would be further facilitated through a workshop open to all mines. The workshop would also be

used to identify those interested in forming a Community of Practice, to discuss and overcome implementation problems, and to further develop the innovation, and to spread its adoption. The workshop would thus serve as an opportunity to initiate the establishment of a Community of Practice, which would be carried through by the secretariat.

9. *Technical assistance*: There are two aspects to the technical assistance that might be needed. The first is the assistance that might be needed during the demonstration project. Working through the checklist would identify whether this was necessary and in that event the secretariat would make an arrangement with the appropriate parties to secure the availability of technical support before the demonstration project starts. The second is the assistance that might be needed by other mines that have decided to adopt the technology and or best practice. On completion of a successful demonstration project the secretariat would ensure that technical support is available from one or more appropriate parties. In those cases where the Technology Champion, or the host mine is unable to provide the necessary assistance, or where it is inappropriate for them to be asked to do so, the mine would approach the parties identified by the secretariat for that purpose.

A summary of the key points associated with demonstration projects is presented in Figure 3.

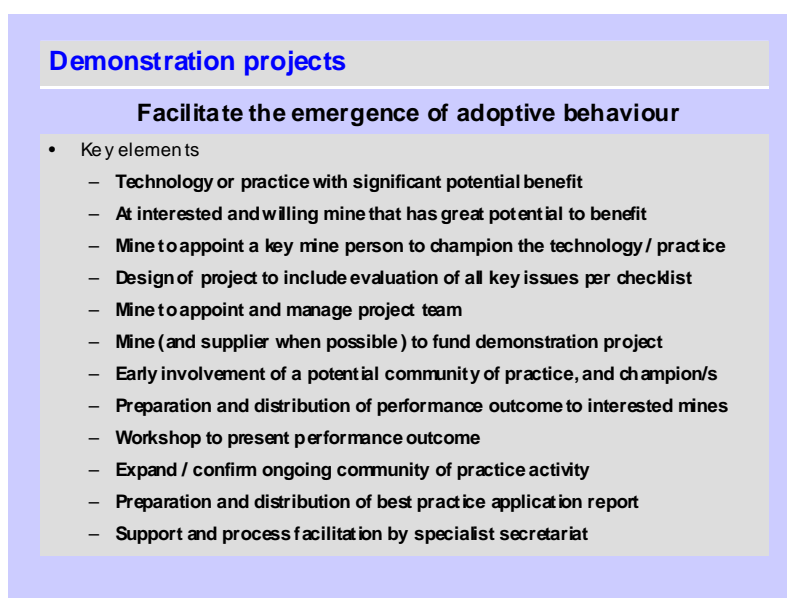


Figure 3: Summary of key points for demonstration projects

3.5 Communities of Practice

The primary purpose of the Communities of Practice is to spread improved adoption of the technology and or best practice being demonstrated. The mechanism involves the establishment of a group of individuals who voluntarily elect to interact in a relatively informal way to share information on a particular technology or practice with a view to improving its performance, and through their activities to widen its adoption across industry. Communities of Practice do not have the formal task orientation of the Task Force or Adoption Teams.

The key elements of the mechanism and its operation are as follows:

1. *Voluntary participation:* Membership of a Community of Practice would be on a voluntary basis with members free to withdraw at any stage. The Adoption Team covering the area in which the Community of Practice is to be formed would agree to its establishment.
2. *Chairmanship:* the Adoption Team would appoint the Chairman of the Community of Practice, and would decide whether Chairmanship needs to rotate among members on an annual basis.
3. *High-level sponsor:* The person acting as the sponsor of the relevant Adoption Team would also assist in addressing problems that the Chairman of either the Community of Practice or the Adoption Team are unable to resolve at their level of operation.
4. *Technology Champion:* The Adoption Team would identify a suitable person to serve as an Industry Champion for the work of the Community of Practice. The person would need to meet the criteria for the appointment of a Champion, as indicated later. More than one Champion might be appointed, depending on the interest expressed.
5. *Common interests:* The members of the Community of Practice should all be interested in sharing information on a particular technology or practice with a view to improving its performance, and through their activities to widen its adoption across industry. It would continue to operate for as long as its membership continued to grow and its members continued to gain benefit from their involvement.
6. *Informal processes:* The Community of Practice would operate in a relatively informal manner, but there should be regular meetings, which could be per teleconference. Much of the communication would be via electronic means.
7. *Guidelines and reports:* At an appropriate point the Community of Practice would decide when it was in a position to prepare a report to document the improved practice that had emerged as a result of its activity. The input into the preparation of such a document would come from members but the secretariat would facilitate preparation of the document. In some cases the document to be prepared would take the form of substantial guidelines for effective implementation of a technology and or practice.
8. *Termination:* The activities of the Community of Practice would be terminated when either its members, or the Adoption Team decided that it would be appropriate to do so.

A summary of the key points associated with Communities of Practice is presented in Figure 4.



Figure 4: Summary of key points for Communities of Practice

3.6 Champions

The primary purpose of appointing Champions is to energize and spearhead the progressive growth in the adoption of the technology and or best practice that they are championing. In essence the mechanism of Championship involves leadership to overcome implementation difficulties, as well as effective communication of relevant information to enable other operations to decide to adopt the technology and or best practice in question.

The key elements of the mechanism and its operation are as follows:

1. *Credibility:* An essential requirement for success is that the Champion should be credible. An appropriate person should thus be selected. Ideally, the person should be an individual with good levels of knowledge, energy, leadership, communication skills and personal credibility. The person should also be drawn from within industry.
2. *Involvement:* Having selected a person with the right potential, it is essential that the person be sufficiently released from normal operational responsibilities to adequately perform the function of Championship. To do this the person needs to become deeply involved in the details of the technology and or best practice to appreciate the issues and problems, and to assist in, or be knowledgeable about their solution.
3. *Leadership:* An important role of the Champion will be that of providing leadership in overcoming implementation problems that arise, and in particular to energize lagging aspects of the process. The Champion would also provide input into the development of strategies and plans for the progressive adoption of the technology and or best practice at both the mine and across industry.
4. *Communication:* Perhaps the most important role that the Champion needs to play is that of being an effective spokesperson for the technology and or best practice being championed. To do this the Champion would accumulate key data and with the assistance of the secretariat prepare appropriate documents and presentations to communicate such performance and technical data

to interested parties. In particular, the Champion would become deeply involved in the preparation of reports or papers concerned with performance of the technology and or best practice. The champion would seek out opportunities to present such information, including workshops, conferences, technical journals, meetings of professional societies, internal meetings, and so on.

A summary of the key points associated with Championship is presented in Figure 5

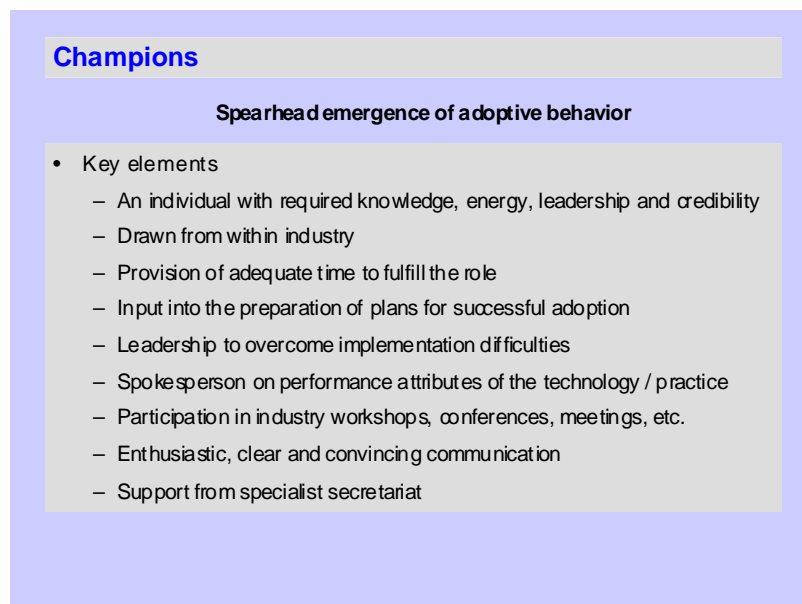


Figure 5: Summary of key points on Championship.

3.7 Specialist secretariat support

The primary purpose of the specialist secretariat support is to facilitate effective industry involvement by reducing the time and complexity encountered by industry persons participating in the system. In essence the secretariat is a mechanism that enables the time spent by key industry persons to be focused on making the industry input that is essential for success, without being unduly distracted by time consuming and sometimes complex process and administrative considerations that can be undertaken by a specialist secretariat

The key elements of the mechanism and its operation are as follows:

1. *Expertise:* The secretariat should consist of a small number of persons who understand the issues involved in facilitating the sharing and widespread adoption of technology and or best practice, and who have expertise in facilitating potentially complex processes. While many of the processes may become relatively simple routines, there will be exceptions, and understanding and expertise will be required to ensure that these exceptions are appropriately handled.
2. *Scanning function:* An important facilitating function of the secretariat would be to run an effective scanning function to identify the emergence of promising technology and best practice, such as that emerging out of the SIMRAC research programme. This would at times serve as valuable input into the work of the Adoption Teams.

3. *Process facilitation*: The secretariat would take responsibility for facilitating the various processes of the Adoption Teams, including workshops and special meetings, the arrangements for the peer group reviews, and the detailed planning of demonstration projects.
4. *Data management*: The various facilitation processes will give rise to a substantial need for effective electronic communication and data management. The secretariat would take responsibility for ensuring the establishment, maintenance and operation of an appropriate electronic data management system, outsourcing expertise as necessary.
5. *Report writing*: Much of the work undertaken will need to be written up in reports or other documents to record key outcomes and to serve as a vehicle for communicating such information. The secretariat would take responsibility for preparing draft documents for consideration by industry, and for finalizing and distributing such documents as required.
6. *Administrative management*: The secretariat would be responsible for the usual administrative management requirements associated with meetings and project management, including that of taking agreed action, or ensuring that others take such action.
7. *Continuity and institutional memory*: An important incidental function of the secretariat would be to provide continuity of approach and purpose as new teams are established from time to time, and the inevitable changes in industry representation occur. In the longer term the secretariat will also become a base of institutional memory.
8. *Funding*: It will be necessary to fund the secretariat on an ongoing basis. The basis for doing this will need to be agreed by industry. It is proposed that the usual approach to funding activities undertaken by the Chamber on behalf of its members be adopted.
9. *Location*: The secretariat could be established either as a Chamber function, or as an outsourced function by arrangement with a body that may already have most of the necessary expertise and interest, or as a hybrid involving both.

A summary of the key points associated with the proposed specialist secretariat support is presented in Figure 6.



Figure 6: Summary of key points on the specialist secretariat support.

3.8 Quality communication

The key principle that underlies the design of the system described above has been that of identifying and involving the key persons involved in the adoption process, to ensure that they acquire the understanding and key information needed for them to make well-informed decisions and take appropriate adoptive action when justified. The system is thus a special means of ensuring that *the right people receive the right information in the right way at the right time*. The findings of the mental models research, which are presented in Appendix 3, have pointed to the importance of this aspect of the system.

In particular the findings of the research were found to be consistent with other research and experience, which has shown communications to be the most powerful influence on people's decision-making and behaviour. Effective communications – leaders' deeds plus their messages – supported by appropriate formal and informal communications is critical to encouraging, supporting, and reinforcing adoption behaviour at all levels. The mental models research thus suggests that behaviour-focused communications processes, methods and tools have scope to be deployed by industry as a best practice. Noting that behaviour-focused communications include all communications, messages and interactions that can influence behaviour, the proposed Adoption System would become an example of best practice to other industries.

4 Processes and structures

The above mechanisms need to be selected and applied in particular ways to achieve the widespread adoption of either technology, best practice or combination of the two in the case where an integrated approach is taken to addressing an identified priority issue. It was earlier pointed out that these were the three quite different opportunities that need to be considered separately. The present work has included the preparation of process flow charts to guide the approach to be taken in addressing each of these three opportunities.

The particular approach that needs to be adopted for the case where both technology and best practice are combined in an integrated approach to address an identified priority issue is illustrated in the figure presented below.

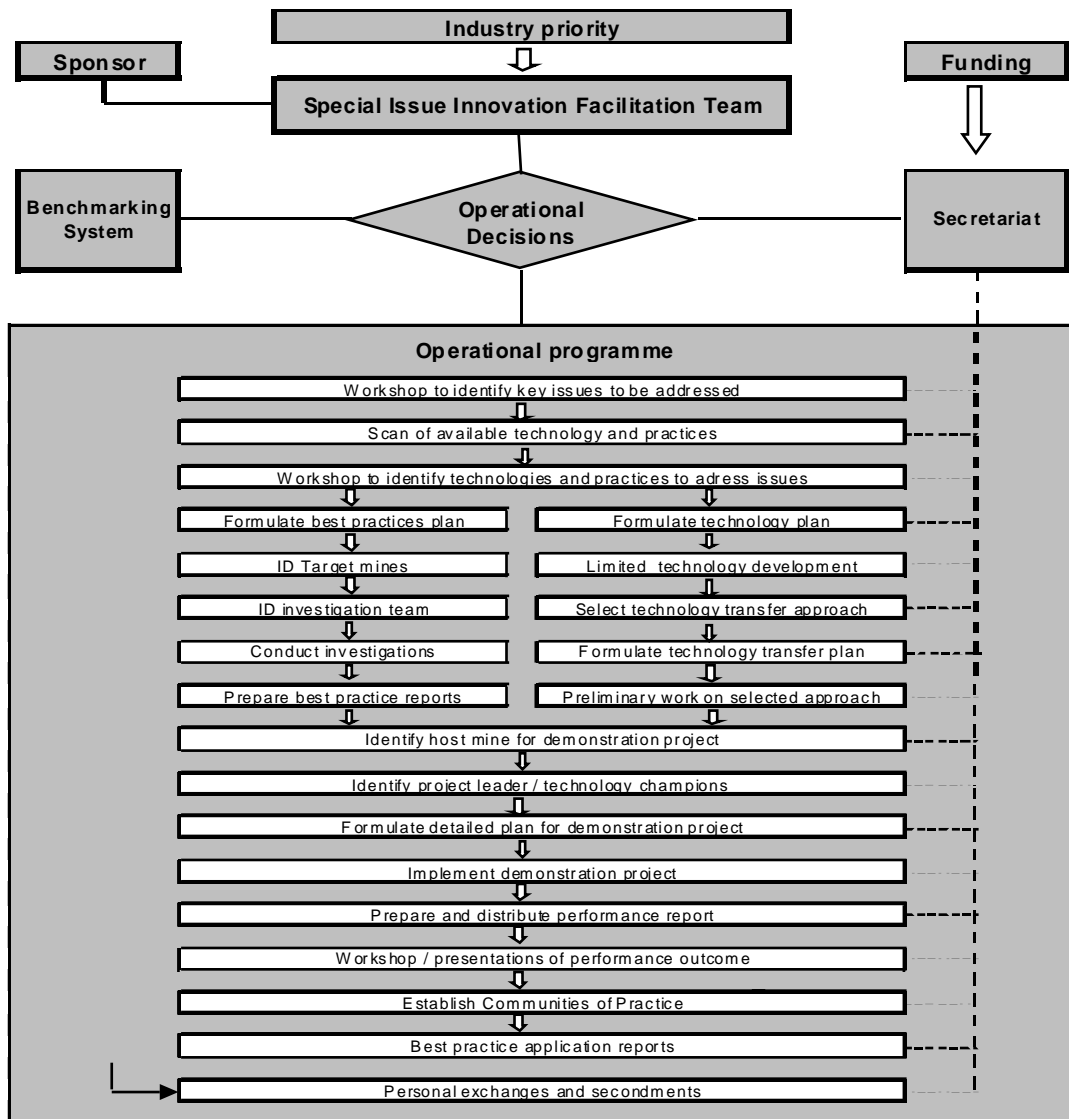


Figure 7: Schematic representation of proposed approach to facilitating the widespread adoption of technology and best practice to address a priority issue identified by industry.

It will be evident from a study of this figure that application of the various mechanisms to address the identified priority issue need to be implemented through a coherent process located within an appropriate structure. The point is further illustrated in appendices 5 and 6, in which similar schematics are presented for facilitating the widespread adoption of best practice and technology respectively. Given that the details of the various mechanisms have been already presented, the various elements in the operational programmes presented in these figures are not elaborated upon.

It is however appropriate to point out that there is scope for these flow charts to become the basis of guidelines (protocols) prepared for use by the secretariat and the Adoption Teams in addressing these opportunities. It is envisaged that the establishment of guidelines and protocols for these and other opportunities would be one of the functions of the secretariat.

In regard to the structure indicated in Figure 7, attention is drawn to the important leadership role of the Task Force.

Operational leadership: A crucially important role that the Task Force needs to play is that of providing leadership in the identification and prioritisation of the occupational health and safety issues to be addressed. It also needs to take an oversight responsibility for ensuring that the identified priority issues are appropriately addressed. It is envisaged that the identification and prioritisation of the issues that need to be addressed would be undertaken in an annual workshop process that is convened and led by the Task Force. It is envisaged that the workshop process would involve the following:

1. Participation of selected experts and leaders in the field of occupational health and safety management.
2. Facilitation techniques that will ensure the emergence of soundly thought through issues in need of attention.
3. The development by the secretariat of a more detailed statement of the scope and planning of the processes and work required to address the identified issues.
4. Consideration and prioritisation of the identified issues in the light of the scoping and preliminary planning that has been done.
5. Within the mandate of the Task Force, deciding upon the work that should be undertaken, or otherwise arranging that the initiation of such work be included within its mandate.

From the above it follows that the Task Force may wish to pursue a number of priority issues in parallel in order to bring about the significant and continuous improvements in occupational health and safety improvements being sought. This would require that a number of appropriate Adoption Teams be established to address the identified issues. Given the significant resources required to set up and successfully run an Adoption Team it would be unwise for more than five such teams to in operation at any one time. The structure required for coordinating and supporting these teams is illustrated in the following figure.

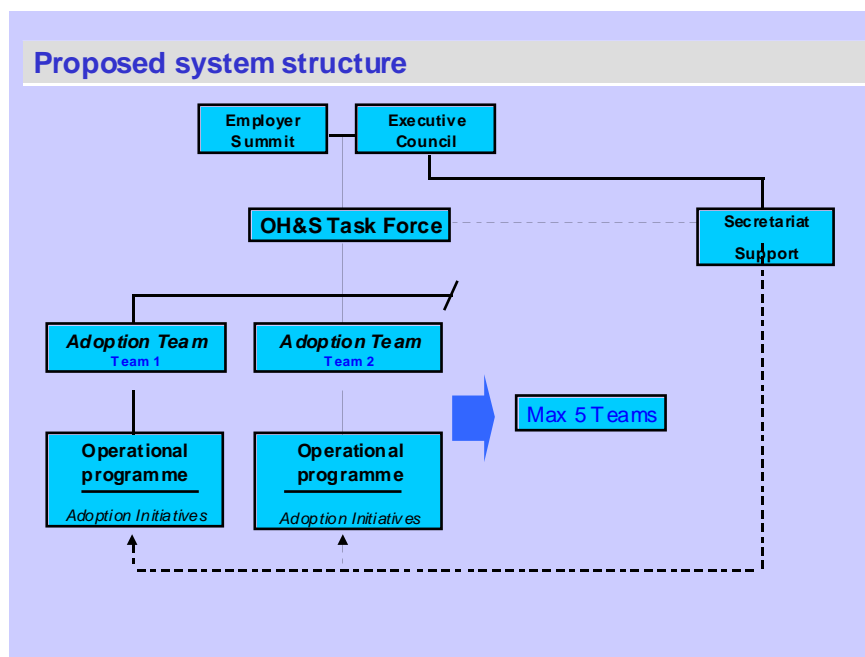


Figure 8: Schematic representation of the proposed system structure

The system envisages continued existence of the present Annual Occupational Health and Safety Employer Summit, and of the Occupational Health and Safety Task Force, until such time that industry meets its occupational health and safety performance goals.

5 Change management: support for a systematic approach to adoption

Changing OH&S performance in a way that is sustainable over the long term calls for recognizing and supporting a systematic approach to the adoption of technology and best practice. People at all levels of the organization are part of the system of adoption, and they will need to embrace the proposed adoption system. It will be evident from the outline of the system presented above that the approach is in some respects quite sophisticated and rigorous, and this will need to be supported at all management levels and functions that interact with the system. It follows from the mental models research that significant barriers may need to be overcome should the prevailing mental models of these people not be well disposed towards the approach embedded in the proposed Adoption System. Effective communication will thus be a critical feature of the change management process.

It is in this context that the intention to piloting the system as a first step towards implementation of the Adoption System is particularly important, in that the process of piloting the system will become the primary means for achieving the required effective communication. This should be a key consideration in the planning of the piloting exercise, which should be regarded as a demonstration project, and approached in the same way that has been advocated earlier for such projects.

6 Broad overview

Having exposed the nature and scope of what is involved in facilitating the sharing and widespread adoption of technology and or best practice, it is necessary to address the key success factor that requires the key elements of the proposed system to be clearly evident so that Industry Executives are able to consider and agree to them as a basis for implementing the system. In broad terms the key elements of the proposed system are as follows:

- The establishment of an enabling climate for the widespread adoption of technology and or best practice by company Chief Executives collectively agreeing to ensure that the identified key leadership dictates are implemented in their organisations.
- Continued existence of the Task Force to identify the key issues that should be addressed and to ensure that the system remains focussed on the identified priorities.
- Use of the various mechanisms and processes that have been outlined in ways best suited to addressing the key issues identified by the Task Force.
- The establishment of a small specialist secretariat governed by a brief that requires it to facilitate operation of the system that has been outlined, and to provide the support required by the various teams of industry persons that need to be established for effective operation of the system.
- Collaborative funding of the activities of the specialist secretariat by all Chamber members, but with the mines being responsible for funding their own participation as well as demonstration projects conducted at their operations.

- Piloting of the proposed arrangements as a basis for testing the effectiveness of the system and for refining the system prior to progressively enlarging its scope of activity.

As has already been pointed out, the secretariat could be established either as a Chamber function, or as an outsourced function by arrangement with an organisation that may already have most of the necessary expertise and interest.

7 The next steps

It is proposed that the next steps should be as follows:

1. Presentation of the proposed system to industry at the Employer Summit, to identify whether industry supports going ahead with the proposed Adoption System. The system would be refined to take account of input received at the summit.
2. A workshop arranged by the Task Force to review the practical issues associated with implementation of the system, and to identify and prioritise the issues that should be addressed through the proposed arrangements. In particular, the Task Force would identify the issue that should be used as a basis for piloting the proposed arrangements.
3. Identification of the key issues that need to form the basis of a proposal to be submitted to the Executive Council of the Chamber for approval.
4. Subject to the necessary approval being obtained, the system should then be piloted, refined to take account of the experience gained in the piloting exercise, and implemented further in accordance with the mandate received from the Executive Council.

8 Conclusion

The identification of mechanisms and processes currently used by mining companies to facilitate adoption of technology and best practice indicates that such systems are often extensive and well developed within these companies. Unfortunately, in some respects this has the potential to very much work against adoption of, and commitment towards, the industry wide system proposed in this report, either on the grounds that it is unnecessary, or as a manifestation of the "hot invented here" syndrome. Conversely, the proposed system has the potential to greatly enhance the effectiveness of the in-house systems, and to expand the benefit individual companies, and industry as a whole, derive from implementing new and better technology and practice. These are competing dynamics, with the former having the potential to outweigh the latter, unless strong leadership is expressed to create the enabling climate required for successful operation of the proposed system. The key determinant will thus be the extent to which the Chief Executives of the mining companies are able to agree the key elements of the system, as well as the key enabling principles for implementation within their companies. It will clearly also depend on the success achieved in piloting the system. Focussed attention will need to be given to these issues.

Appendix 1: Key insights from past work

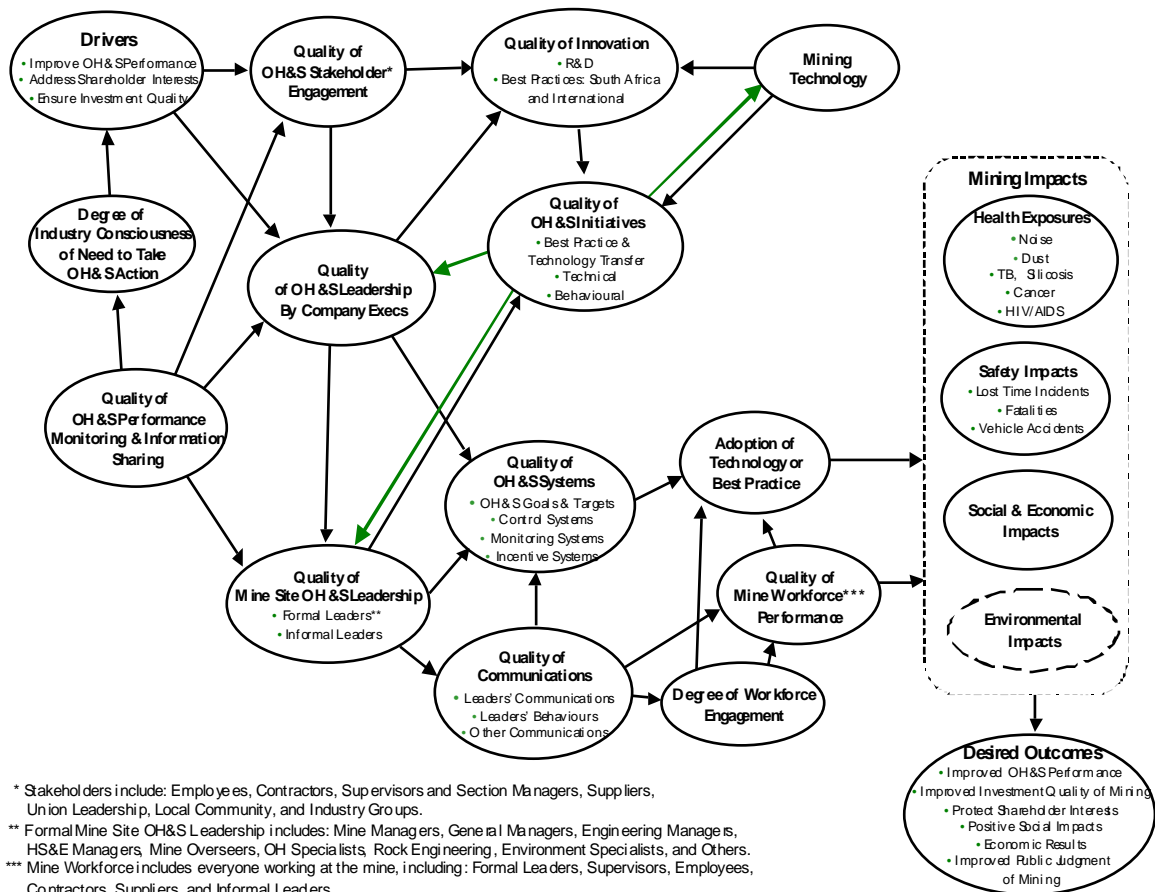
Given below is a selection of the more important and interesting insights and concepts identified in the enabling prior work.

1. Technology transfer needs to be seen as comprising two distinct phases; the first phase is to provide sufficient understanding of the technology and its performance to place potential recipients in a position to decide whether or not to adopt the new technology, while the second phase is to transfer the knowledge and skills necessary to implement the technology.
2. The potential recipient of a technology or best practice needs to experience a real business incentive to embark upon the acquisition and implementation of the new technology or practice.
3. Recipients of the new technology need to be assisted, and to have access to expert assistance at an early stage of the transfer process.
4. The recipient organisation needs to have a person at an appropriate level to facilitate and champion the technology transfer and implementation process.
5. The technology champion needs to be adequately supported by both his/her superiors and the technical experts of the technology or best practice provider.
6. Champions need to be innovative and have credibility and integrity, placing successful implementation above personal ambition.
7. Where the risk of implementing a new technology is too great for a potential recipient organisation to bear it alone, some form of underwriting or joint risk sharing may be necessary to enable successful transfer and implementation of the new technology.
8. Each technology transfer and implementation plan needs to ensure that all of the issues known to be crucial for successful technology transfer and implementation are considered, as well as any other issues identified as potentially important.
9. Access to venture capital for finalising development and commercialisation through equipment trials, undertaking demonstration projects and setting up the necessary technology supply capacity, including the creation of technology specific spin-off companies, needs to be facilitated.
10. People at all levels must see the benefits of the technology, as well as its successful implementation, to themselves.
11. Peer communication of applications and benefits of new technology and best practice should be facilitated as it enables and generally assists the process of technology and best practice transfer.
12. The first recipient organisations to implement a new technology should be those that have the greatest need and potential to benefit from successful implementation.
13. Institutional support may be necessary to manage and facilitate the technology and best practice transfer process.
14. Special reward and recognition arrangements for individuals may be needed to overcome negative competitive dynamics, including the *not invented here* (or *by me*) syndrome. Such arrangements could include measures in personal performance contracts that are linked to successful adoption and implementation of new technologies and practices that benefit the organisation.
15. The organisational climate needs to be tested to establish its conduciveness for the adoption and implementation of new technologies and best practice.
16. A mind set that is favourable towards the identification of user needs, and the development, adoption and implementation of new technology as a basis for addressing those needs should be stimulated.
17. Technology brokers should be considered as a means for identifying technologies or practices developed and applied for other industries that have the potential for beneficial application in the mining industry.
18. The introduction of new expensive technology should be done on a mine experiencing success and growth. In times of hardship mines are risk averse and stick to known technologies.
19. A primary cause of technology transfer failure is a lack of change management. Change management skills in industry are poor.
20. For success in sharing best practice and technology there is a need for an abundance mentality approach, but this makes it very personality dependent.
21. Secondment of people to different mines provides a good basis for sharing technologies. People assigned to help operations in other mines come back stimulated, and with new ideas for their own operations.
22. For industry level success in facilitating technology transfer, leadership is crucial – captains need to take collective leadership position – they need to properly resource a technology transfer operation – they need to make key staff available as champions on secondment – and somehow to collectively agree to set up creative tension in their respective companies (sanction/reward system for poor/good technology transfer performance).
23. With some technologies it is better to provide a service to mines rather than sell them the equipment/technology, so that problems of operation and maintenance can be invisible to the mine and dealt with efficiently by others especially skilled to do the job.
24. Groups have the perception that better results come from their own efforts. This perception acts as a barrier and is consistent with the not invented here syndrome.
25. Managers have too much on their plate and the communication and understanding of any new system therefore needs to be simple, logical and straightforward.
26. Key first step in rolling out technologies is to get support of and train mine management – the manager – section engineer – engineering manager – maintenance foreman.
27. A key success factor for communities of practice is to ensure that no one person or group dominates – a rotating chairperson should be used with the secretary coming from another company.
28. It is essential to get project buy-in at a host operational site. If this is not possible then the project should be discarded.
29. In planning the cycle of peer group reviews it is essential to allow enough time for the affected operations to implement improvements, and for the available staff to be able to competently cope with the programme.
30. Too much technology change is due to fashion and not hard numbers based on performance and costing. People are too busy to generate the needed information and plans for effective technology transfer.
31. Partnerships represent a good way of getting development done as well as for achieving good transfer and implementation of technology and practice.
32. Groups and mines are not sufficiently mature for meaningful cooperative action – cooperation tends to be in less promising areas with worthwhile things being kept to themselves. This dynamic applies even between mines within a single group.
33. When line people are battling then chances of successful technology transfer drops to zero. Under-performing shafts struggle – they stick to tried and tested technologies. Shafts performing well tend to be the quick and easy new adopters.
34. Task teams need to be run by a coordinator with a full time commitment, and not as an add-on to someone's existing job.
35. Levying demands and imposing strong expectations can quickly convert a Community of Practice into a project team focused on tasks and deliverables. The team will drive towards satisfying the boss instead of producing and sharing new knowledge. Communities of Practice should not be confused with teams or task forces.
36. In technology transfer attention should be focused on the early adopters, as they are key in achieving a critical mass of best practice users.

Appendix 2: Expert models

Expert Model of Mining OH&S Performance

The simple expert model developed by Decision Partners to guide the mental models interviews and to interpretation of the input received is presented below:



Influences on Mining OH&S Performance – Simple Expert Model developed by Decision Partners

Expert model on Innovation

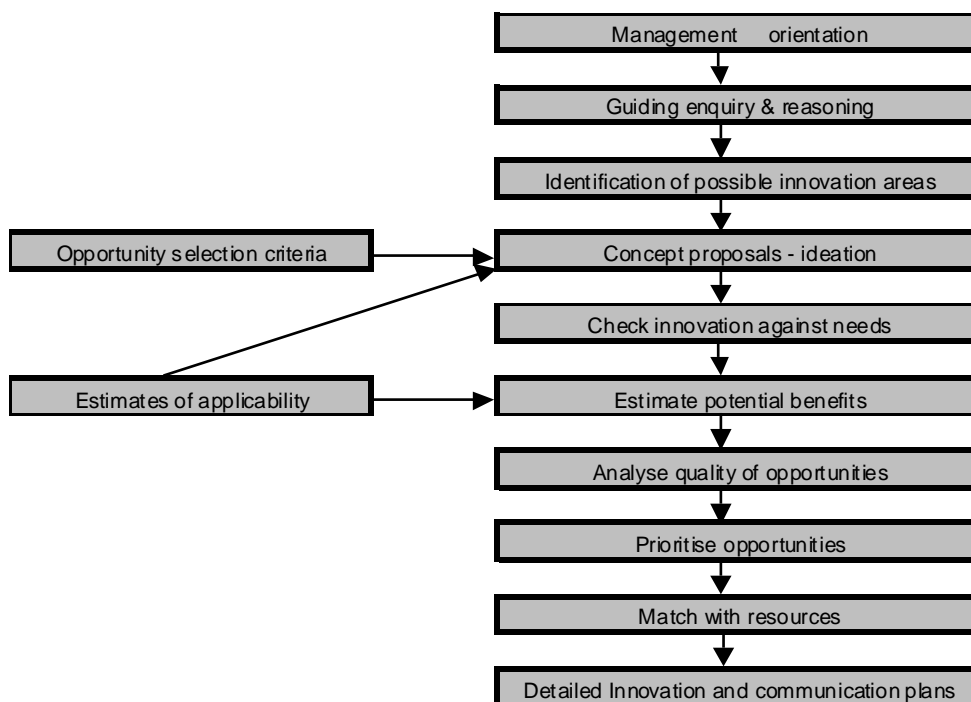
Although innovation is sometimes confused with simple invention, it must be emphasised that the process of identifying, sharing and then operationally adopting technology and or best practice is what the concept of innovation specifically covers. More generally, the concept of innovation involves the following:

The concept of innovation: *Innovation involves the creation, exchange, evolution and application of knowledge, in whatever form, for the success of an organisation, the vitality of a nations economy and the advancement of society as a whole. Innovation cannot therefore be claimed in the absence of successful application.*

The process of developing the expert model for the mental models research included the development of a basic model of the innovation process. This model has significantly added to the guidance

provided by the reviews of past and current work on technology and best practice transfer described in the report.

Key points of influence in the innovation process: Given below is the simple expert model of innovation that has been developed. It identifies the key points and flows of influence during the innovation process. The model has provided useful guidance during the development and presentation of the processes and arrangements that have been proposed.



Basic model indicating key points of influence in the innovation process

Appendix 3: Summary of mental models research and key findings



Improving Adoption of OH&S Technology & Best Practice: Mental Models Research Final Report

June 2007

A. Introduction

Members of the Chamber of Mines of South Africa recognize there is no shortage of useful knowledge about technology and best practices on health and safety management that could contribute to improving health and safety performance. The challenge is to ensure that such knowledge is adopted throughout the industry.

With this in mind, the Chamber of Mines asked Decision Partners to help generate insight into the aids and barriers to adopting OH&S best practices and technology at the company level. Decision Partners conducted science-based mental models research with key executives and mine-level leaders in six South African mining companies to discover their perceptions of OH&S adoption practices. Insight obtained from the research will be used by the Chamber of Mines to guide the development of strategies on this issue.

This report highlights key findings and considerations from the mental models research. More detailed information is contained in the full report.

B. Overview of the Approach

Methodology

Decades of research have shown that people's judgement about complex issues is guided by their mental models. The concept of mental models is well-established in psychology and has been the focus of extensive research. A person's mental model can be thought of as a tacit, complex web of deeply held beliefs that affect how an individual defines a problem, reacts to issues, forms judgements, and makes decisions about a topic. The mental models research method seeks to reveal and characterize in-depth these complex webs of belief.

Mental models research involves conducting individual, one-on-one interviews, during which participants are guided through a semi-structured agenda of topics framed by expert understanding of the context. This expert understanding is often represented by an expert model, which summarizes everything that a community of experts knows or believes about a topic. These experts may include managers in various functions and at different levels in an organization. They can also include subject matter experts across a wide range of fields. In this case, the expert model was developed by Decision Partners based on discussions with Chief Executives, a Meta-Analysis of ICMC Safety and Health Conference presentations and inputs from Chamber consultants John Stewart, Nancy Coulson and May Hermanus.

Research Sample

Decision Partners conducted 31 interviews by telephone with corporate executives and mine leaders in 6 companies namely Anglo Platinum, Lonmin, AngloGold Ashanti, Gold Fields, Sasol Mining and BHP Billiton Energy Coal SA. The interviews averaged 50 minutes in length, ranging from 34 to 71 minutes.

The Key Executives (Corporate) category included people in the following positions: Senior Rock Engineering Consultant, Safety and Risk Manager, Engineering Services Manager, Operations Manager, and Rock Engineering Manager.

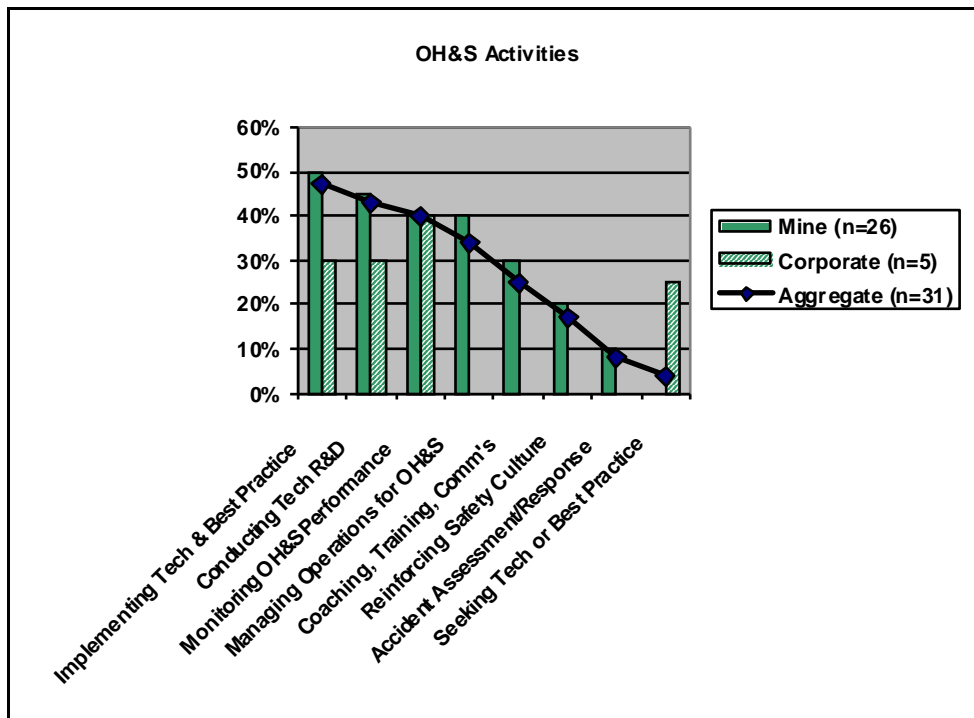
The Mine Leaders category included General Managers, Operations Managers, Production Managers, Mine Overseers, SHE and Occupational Health Managers, Rock Engineers, Engineering Managers, Concentrator Managers, Chief Rock Mechanics, Underground Environment Specialists, Technology Specialists, Occupational Health Specialists, and Other Specialists.

A discussion guide was used to help focus the interview conversations. It offered each participant an agenda of topics in a manner that allowed researchers to identify and understand people’s views and their underlying rationale. Questions in the guide encouraged free expression on the part of interviewees and their elaboration on topics in an effort to reveal unanticipated views and individual thinking in depth.

C. Research Highlights

Leadership OH&S Activities

Interviewees were asked to identify OH&S activities that are practiced within their organizations. Their responses are summarized by the following chart:

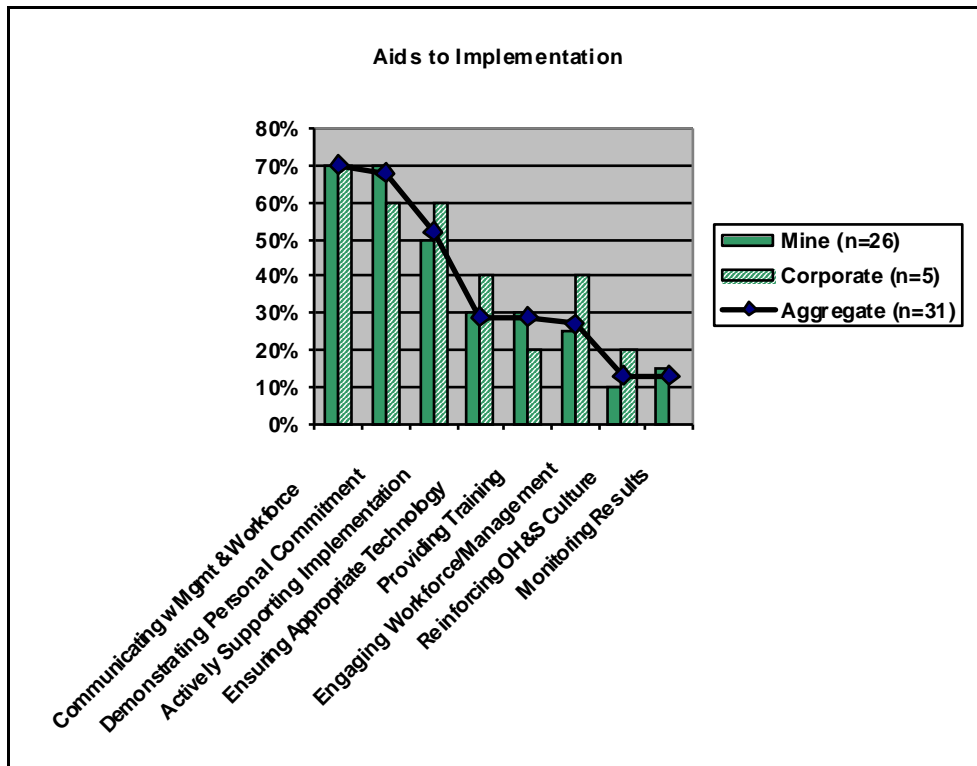


Explanatory notes:

1. *Implementing Technology and Best Practices* – At the corporate level, supporting or “driving” the introduction or implementation of technologies and best practices at the mine. Mine leaders mentioned being more involved in the actual implementation of new OH&S initiatives.
2. *Conducting Technology R&D* – Conducting research and development into new technologies that are available or in need of development.
3. *Monitoring of OH&S Performance* – Includes monitoring, auditing, and benchmarking activities and using the results to identify the required OH&S initiatives.
4. *Managing Operations for OH&S* – Managing the operations to ensure OH&S performance is adequate, targets are met and equipment is properly maintained.
5. *Coaching, Training, Communications* – Coaching, training, communicating about OH&S technologies and best practices.
6. *Reinforcing Culture of Safety* – Reinforcing the values and standards of a safety culture within the organization.
7. *Conducting Accident Assessment/Response* – Investigating and responding to incidents.
8. *Seeking Technology or Best Practice* – Finding and distributing technologies and best practices among mine sites and mining companies.

Aids to Successful Implementation of Technology or Best Practices

Interviewees mentioned a variety of ways that they and other leaders can enable the successful implementation of technology and best practices as illustrated on the following chart:



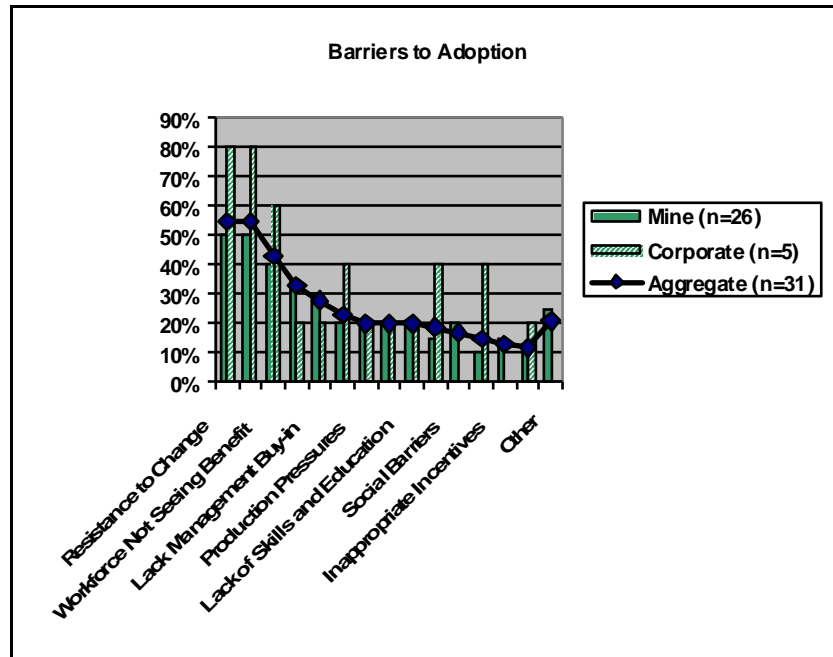
Note: Given the small size of the corporate cohort, variances between the cohorts in this and the charts that follow are not significant.

Suggested actions included the following. (Note: These aids to successful implementation arose spontaneously during the conversations with interviewees; they were not prompted.):

1. *Communicating with Management and Workforce* – Most interviewees discussed the importance of communications in ensuring successful adoption. Some also stressed the importance of listening. The importance of communication, particularly personal, face-to-face communications with employees, was a major theme throughout the interviews. Dialogue and the ability to get employee feedback were emphasized by some.
2. *Demonstrating Personal Commitment to Project* – Most interviewees said that in order for adoption to be a success, leaders must show personal commitment to what is being implemented. Several said they had to show they were “passionate” about the initiative.
3. *Actively Supporting Implementation* – Many said they actively supported the implementation of the technology or best practice through their operational roles, often as “champions.”
4. *Ensuring Appropriate Technology* – Some interviewees noted that technologies must match the needs of the mining operation and must be appropriate for the conditions at that mine.
5. *Providing Training* – Some interviewees discussed the importance of conducting training and/or providing coaching to facilitate change.
6. *Engaging Workforce/Management* – Some interviewees said engaging the workforce and/or management in the planning process was critical to obtaining “buy-in.”
7. *Reinforcing OH&S Culture* – A few interviewees discussed their role in reinforcing an organizational culture in which OH&S becomes everyone’s responsibility. They believed that a culture of continuous improvement and continuous learning was important and that health should be emphasized along with safety.
8. *Monitoring Results* – A few Mine Leaders spoke about the importance of this.

Barriers to Successful Implementation of Technology of Best Practices

Interviewees raised a number of barriers that they or others face when attempting to implement a new OH&S technology or best practice as illustrated on the chart below:



Barriers to the successful adoption of technology and best practices identified in the mental models research included the following (Note: These barriers arose spontaneously during the conversations with interviewees; they were not prompted.):

1. *Resistance to Change* – Many interviewees said they had faced “resistance to change” from leaders and workers at various levels or from others, including unions and contractors. Most who mentioned resistance to change went on to specify beliefs about the causes the resistance, including leaders or workers who didn’t see the potential benefits, production pressures, etc. (discussed below).
2. *Cost* – Many said that cost is often a barrier to technology and best practice adoption. About 25% said that the cost of a project or obtaining the necessary capital investment had been a personal challenge in the past year.
3. *Workforce Not Seeing Benefits* – Many interviewees suggested that a key challenge is people in the workforce who do not immediately see the potential benefits of a change, which creates a barrier to implementation.
4. *Technological Challenges* – Some mentioned technology and infrastructure challenges.
5. *Management Buy-in* – Some interviewees said that insufficient buy-in at various levels of management posed a barrier. A few mentioned the challenge of getting supervisor buy-in or the need for a solid “business case” to “sell” the initiative.
6. *Training Capacity* – A few noted that labour shortages throughout South Africa were affecting training capacity and, consequently, the level of workforce skill.
7. *Production Pressure* – Some interviewees mentioned production goals as barriers.
8. *Workforce Buy-in* – Some said that getting individual workers to implement the new behaviour was a challenge.
9. *Lack of Skills and Education* – Some indicated that a basic lack of skills, caused by a lack of education within the workforce, posed a critical barrier.

10. *Organizational Culture* – Some mentioned their organizational culture as a barrier.
11. *Social Barriers* – A few interviewees mentioned social considerations that can prevent workers from performing well. Barriers here included poor living conditions, inadequate nutrition, family crisis, and sleep deprivation.
12. *Lack of Time* – Inadequate time for implementation was mentioned by a few interviewee.
13. *Generation Gap* – A few mentioned the generation gap or differing value systems between older and newer workers as a barrier.
14. *Inappropriate Incentives* – The lack (or inappropriateness) of recognition and rewards for implementing technologies or best practices was seen by some as a barrier to adoption. While the ranking as a barrier appears low here, it likely reflects on Resistance to Change and the Workforce Not Seeing the Benefits.
15. *Other* – Other barriers discussed included the “Not Invented Here Syndrome”, a lack of visible leadership support, difficulties with contractors or suppliers, the difficulty in implementing new practices developed elsewhere, lack of a systematic approach to identifying needs and identifying solutions, and an unstable business environment.

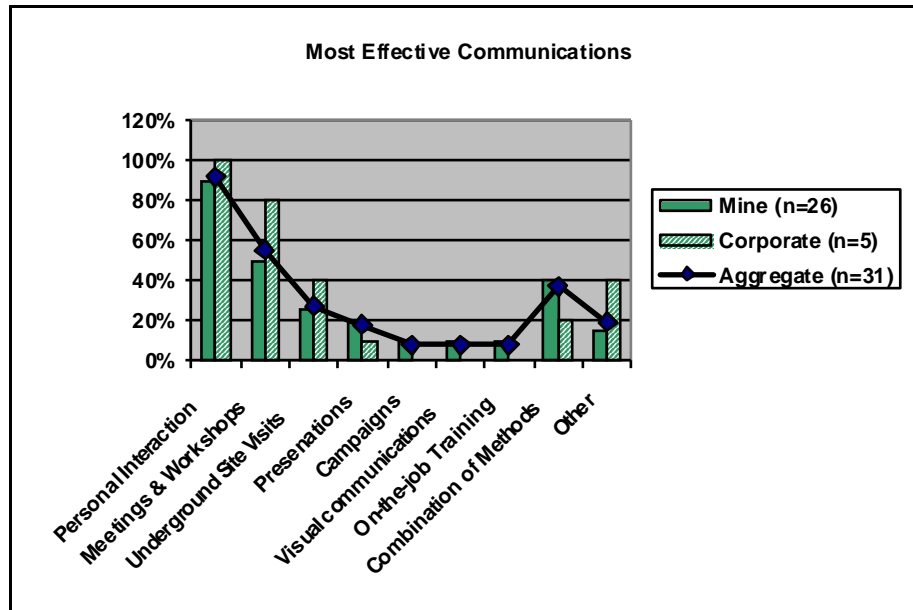
Effective Communications

Throughout the interviews, interviewees stressed the importance of communications in achieving workers’ commitment to and ownership of their roles in health and safety. The majority (95%) suggested that effective communications is the key to implementing a technology or best practice: “It’s the most important aspect of implementing technology.” Communication was understood by most as comprising the actions of leaders (engaging workers through dialogue, actively demonstrating commitment, etc.) as well as the messages. The importance of effective communications was stressed as a defining element of quality leadership at all levels.

When interviewees were asked to identify the most effective forms of communication, the majority (90%) mentioned dialogue and personal interaction (“one-on-one,” “face-to-face,” or “two-way” communications). About half (50%) mentioned meetings or workshops as effective methods of disseminating important information that also allowed for immediate feedback and interaction with workers.

Interviewees were also asked to think about less effective forms of communication. Impersonal, “one-way,” or “directive” communications were mentioned as ineffective, because “people can’t see the reasoning behind it” and leaders “don’t get the buy-in.” Written or mass-delivered communications (e-mail was mentioned specifically by 50%) were identified as ineffective methods of communication.

The most effective communication methods as identified by the interviewees are illustrated in the following chart:



D. Considerations from the Research

The research revealed that from OH&S Leaders' perspectives, the most significant challenge is not a failure to identify or develop technologies or best practices. Rather, it is the difficulty of achieving adoption of technologies or best practices. According to interviewees, the focal point for achieving adoption by mine employees at all levels is overcoming resistance to change by workers who do not readily see the benefits of change. At the leadership level, the primary challenge is getting "buy-in," in order to get the capital funding and resources required to implement the technology or best practice.

For leaders and workers alike, the research results indicate that the challenge of achieving adoption in organizations is fundamentally a behavioural one. The following quotes – from interviewees in three different companies – illustrate some dimensions of the challenge:

- "We are trying to implement first-world standards, while living in a third-world country."
- "Our company has come a long way already, from a military style of management to a caring culture. The biggest change in safety will be as a result of change in people's attitudes and behaviours towards safety."
- "If you talk about technology, we can spend millions of rands designing machines, but I think the answer would be in addressing the behaviour of people, and that's a very, very different challenge to overcome."

Based on our consideration of the research results, we offer the following as effective ways for industry leaders to address behavioural challenges at both the leadership and the worker level.

Shift to a People-Centred Enabling Culture

The research findings suggest that some companies are working to shift their OH&S focus to a more people-centred model, in which the value of people and their well-being is the core of the organization's values. Interviewees engaged in this process indicated that the focus on "Zero Harm" has resulted in a change from a production-orientation to what the interviewees described as a "people-focused culture." They reported significant improvements in OH&S behaviour within their

operations. (Note: It would be interesting to correlate their perceptions of improvement with OH&S measures at their sites.)

Support a Systematic Approach to Adoption

Changing OH&S performance in a way that is sustainable over the long term calls for recognizing and supporting a systematic approach to adoption. People at all levels of the organization are part of the system of adoption. Addressing the behavioural component of the system calls for behaviour-focused communication designed to foster the behavioural change required. This is addressed below.

On the process side – taking a page from successful practices in other business functions – features of a systematic approach to adoption would include:

1. Using a disciplined, scientific reasoning process throughout all management levels and functions. The day to day work of individuals and groups in the initiative should tap current understanding in the relevant disciplines (such as risk perception and risk communication), be guided by new knowledge (such as that produced by the mental models research) and protocols, including decision tools, anchored in readily measurable objectives.
2. Identifying and selecting appropriate new opportunities using selection criteria that reflect strategic and tactical business objectives blended with values-based safety and health performance objectives.
3. Dynamic matching of resources to opportunities.
4. Guiding realization of opportunities by determining the total critical requirements for success (adoption) in sufficient depth and precision prior to any significant expenditure.

The engagement of employees through effective communication would be a critical feature of the system.

Foster a Climate that Enables Adoption

Experience suggests that creating a climate that supports people working within the adoption system could be critical to improving OH&S behaviour (and results) over the long term. Defining the values of the organization, setting the priorities, leading by example, and demonstrating respect for employees at all levels would be critical leadership roles. Strong personal communications (primarily dialogue) and high visibility and engagement of leaders with employees would be important reinforcements of the organization's OH&S values.

In such organizations, employees at all levels would be engaged in the identification of OH&S issues and opportunities and involved in the process of adopting technologies and best practices specifically suited to the operating conditions of their mines. They would be appropriately recognized and rewarded for their involvement in identifying OH&S problems and opportunities, participating in the identification of technology or best practices, and supporting the adoption of these.

Enable Adoption Behaviour through Effective Communications

As research and experience show, communications is the most powerful influence on people's decision-making and behaviour. Effective communications – leaders' deeds plus their messages – supported by appropriate formal and informal communications will be critical to encouraging, supporting, and reinforcing adoption behaviour at all levels of the organization.

Behaviour-focused communications processes, methods and tools could be deployed by the industry as a best practice. The purpose of such communications is to build shared understanding that enables individuals to make well-informed decisions and take appropriate actions. Behaviour-focused



communications would include all communications messages and interactions that can influence behaviour.

The industry could draw on relevant disciplines, such as psychology, decision science, risk communications and risk management, along with over 40 years of research in risk perception to develop a state-of-the-science approach tailored to the specific needs of the industry.

With the appropriate tools and training in behaviour-focused communications, leaders at all levels of the industry could become OH&S champions, enabling adoptive behaviours throughout the industry and within their organizations. This approach could be readily adopted and practiced by people involved in mechanisms for adoption such as peer group reviews, demonstration projects, communities of practice and acting as champions of various initiatives. Their early adoption could be a strong demonstration, and signal, of the industry's significant commitment to improving OH&S performance through the widespread adoption of technology and best practice.

Contact information:

For further information on this report, please contact Gordon Butte or Sarah Thorne, Decision Partners, at 1-877-588-9106, or reach them via email at gbutte@decisionpartners.com or sthome@decisionpartners.com.

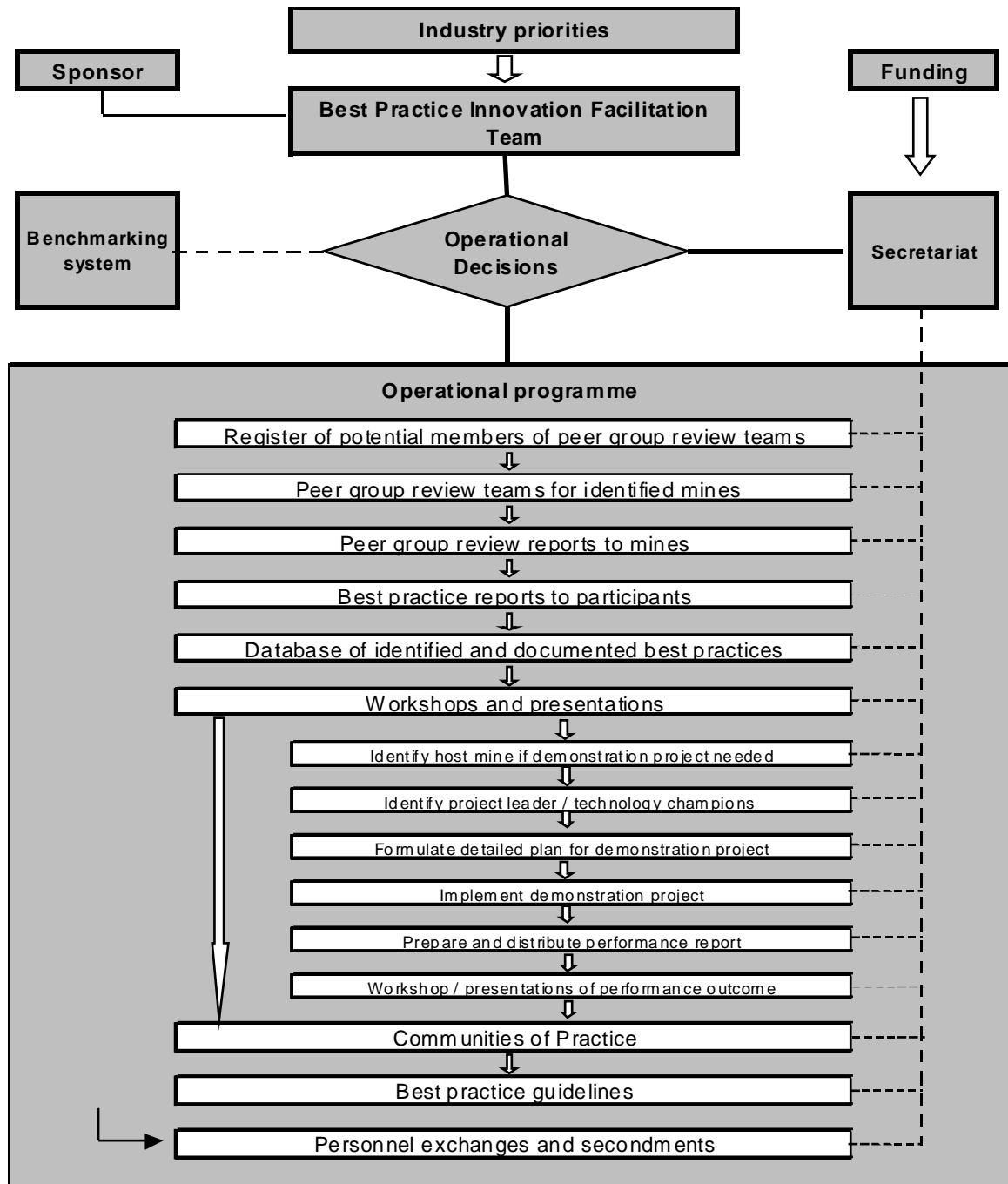
Appendix 4: Checklist for demonstration projects.

The following checklist should be worked through at the time of considering and planning a demonstration project:

1. Is there still a need for the new technology or practice?
2. Is the technology, practice or knowledge ready for transfer and adoption by industry?
3. Is further development required to arrive at a commercially and practically viable technology or practice?
4. Has the equipment to be tested been adequately designed to withstand the harsh underground environment?
5. Has the operation of the technology or practice been adequately simplified for mine application?
6. Is a demonstration project warranted or will a desktop study provide adequate performance information?
7. Which mines would benefit most from adoption of the technology or practice?
8. Which of those mines are interested in hosting the demonstration project and are prepared to pay for it?
9. Which persons in potential host mines have the incentive and attributes necessary for championing the technology or practice?
10. Has the mine appointed an appropriate champion?
11. Which persons on the host mine need to be brought into the planning of the project at the earliest stage possible, and has this been done?
12. Which persons should be invited to join an oversight group to assist in spreading the adoption experience?
13. Has the mine staff responsible for the demonstration project been provided with adequate time and resources to successfully undertake the project?
14. Who will take responsibility for documenting and writing up the outcome of the project for communication to others?
15. What technical support is needed to assist mine staff with the adoption process?
16. Are new skills or organisational structures needed to achieve successful adoption?
17. Will the equipment supplier be able to meet industry's needs in the even of a successful demonstration project?
18. Can or should the technology or practice be implemented as part of a larger more beneficial system?
19. What are the possible unintended consequences of the technology or practice and how will they be addressed if they arise?
20. Do the risks warrant consideration being given to setting up arrangements to underwrite the demonstration project?
21. Has adequate time been allowed for the demonstration project to be undertaken to its proper conclusion?
22. What are the criteria for the demonstration to be considered complete and successful?
23. What are the criteria for the technology or practice to be considered a success once adopted?
24. Which persons or mines are going to be most affected by adoption of the technology or practice?
25. What steps need to be taken to ensure proper communication about the new technology or practice in regard to its application and its positive and negative impacts?
26. What special training is necessary for mine staff to facilitate successful adoption?
27. Which persons on the host mine could make or break the project and how have they been accommodated?
28. What will be the benefits to the various people on the mine who are or will be affected by adoption of the technology or practice, in particular the workers and first line supervisors?
29. What measures, in addition to training, need to be adopted to gain support of the workforce for the new technology or practice?
30. Which persons will be negatively affected and how have their concerns been taken into account to secure their support?

Appendix 5: Best practice - mechanisms and processes

The system of proposed mechanisms and processes for best practice identification, sharing and widespread adoption is shown schematically in the following figure:



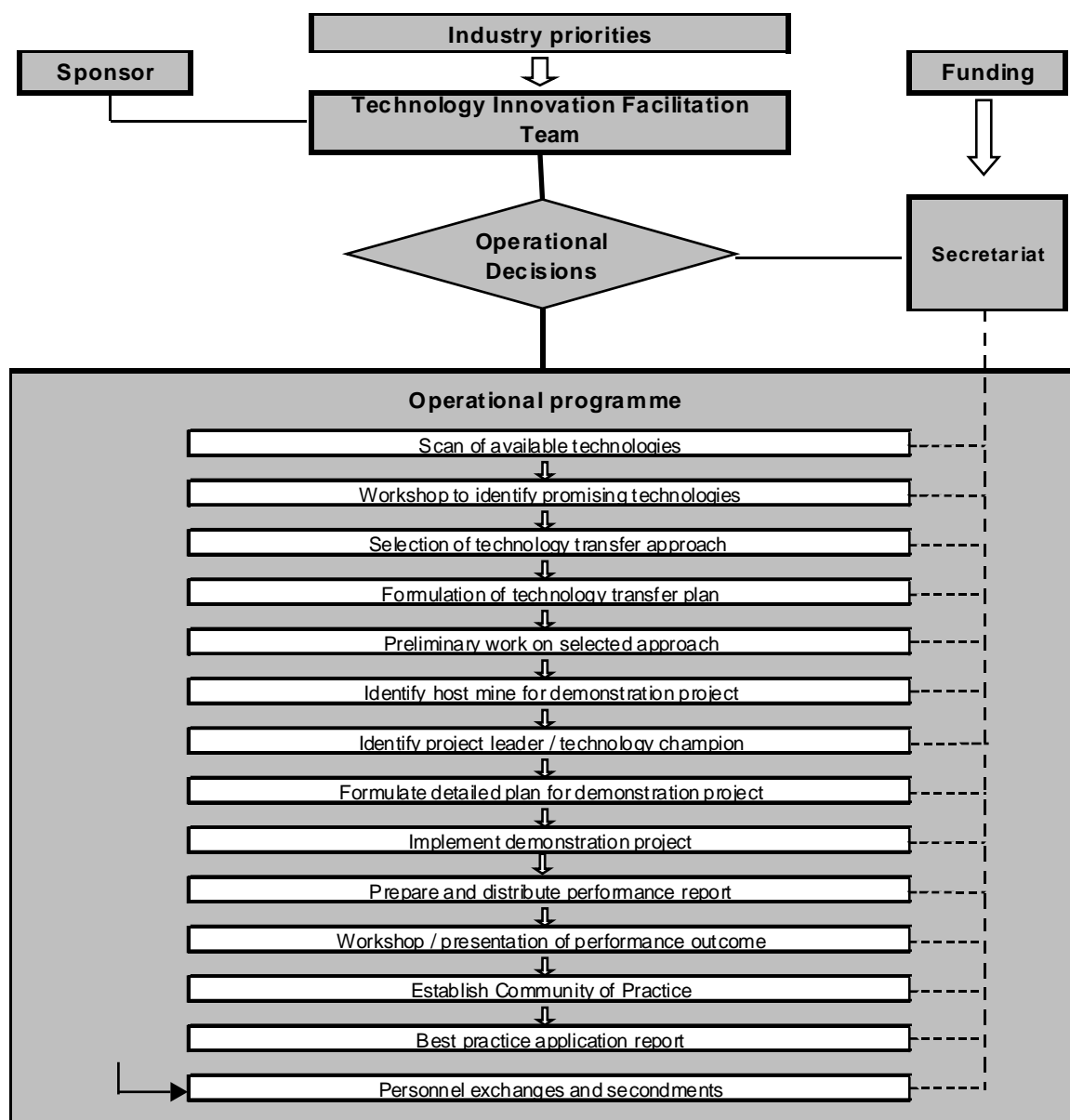
1.1 Schematic representation of proposed best practice transfer arrangements

The above system draws on the successful system developed and used by the World Association of Nuclear Operators, WANO⁷. Given the outline of the various mechanisms presented in the body of the report, the various elements in the operational programme presented in this figure are not elaborated upon here.

It is possible that the best practice arrangement outlined here could be implemented in conjunction with the benchmarking group at the Centre for Sustainability in Mining and Industry at Wits University.

Appendix 6: Technology - mechanisms and processes

The proposed set of mechanisms and processes for the identification, transfer and widespread adoption of promising technology is shown schematically in the following figure:



Schematic representation of proposed technology transfer arrangements

The proposed system envisages an ongoing process that would be overseen by a Technology Adoption Team. The Team would be established to operate for at least three years but not more than five. Given the outline of the various mechanisms presented in the body of the report, the various elements in the operational programme presented in this figure are not elaborated upon here.

It is possible that the technology adoption arrangement outlined here could be closely linked with the efforts of the Mine Health and Safety Council to secure adoption of worthwhile technology and practice developed through the SIMRAC research programme.

References

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- ⁷ World Association of Nuclear Operators: *Peer review programme*, www.wano.org.uk