

MECHANIZING NARROW, TABULAR REEFS IN THE PLATINUM INDUSTRY - THE ULTIMATE CHALLENGE (JULY 2002)

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SYNOPSIS

We live in a time, which is characterised by vicious swings in fortune. Equity moves as if by magic across international fronts, seamlessly interfacing with areas of potential. Any hint of surplus in a single product market (such as Platinum) sends shock waves through the investment community and drives up the already inflated Beta factors.

Volatile exchange rates and Platinum Group Metal (PGM) price swings can shift companies from boom to bust almost instantaneously.

This is what makes us such risk averse, cost conscious entities- it is the motivating factor behind the mechanisation drive.

Taken in the context of our move towards a more progressive management approach (through empowerment of the previously disadvantaged, joint co-determination and corporate governance with more than a hint of pluralism) –surely there are forces, which are working against us.

The labour cost in our transformation process represents approximately 60% of total cost. To aggravate matters, wage increases are often conceded at above inflation levels –whilst no such guarantees are made in terms of increased productivity.

With the impending HIV –Aids dilemma, there is a very real need to remove the effort from the mining process –especially on the reef horizon where environmental conditions are at their hardest and the required physical levels of exertion make it difficult to produce higher volumes with the same or fewer workers. Although the impact of Aids on our economically active population is not covered in this document, it is worth mentioning that budgeted labour numbers are expected to increase by between 4 &10% over the next decade. Along with the increased training need, this is going to have a crippling effect on many operations. Although we launch many initiatives to expand our business, the major challenge of moving down the cost curve through a process of mechanisation is still to be addressed.

This paper highlights some of the typical problems, which are encountered in the “roll out” from the R & D phase into full production when utilising mechanised mining methods. It also points the way forward in an attempt to highlight quick win opportunities in mechanised mining.

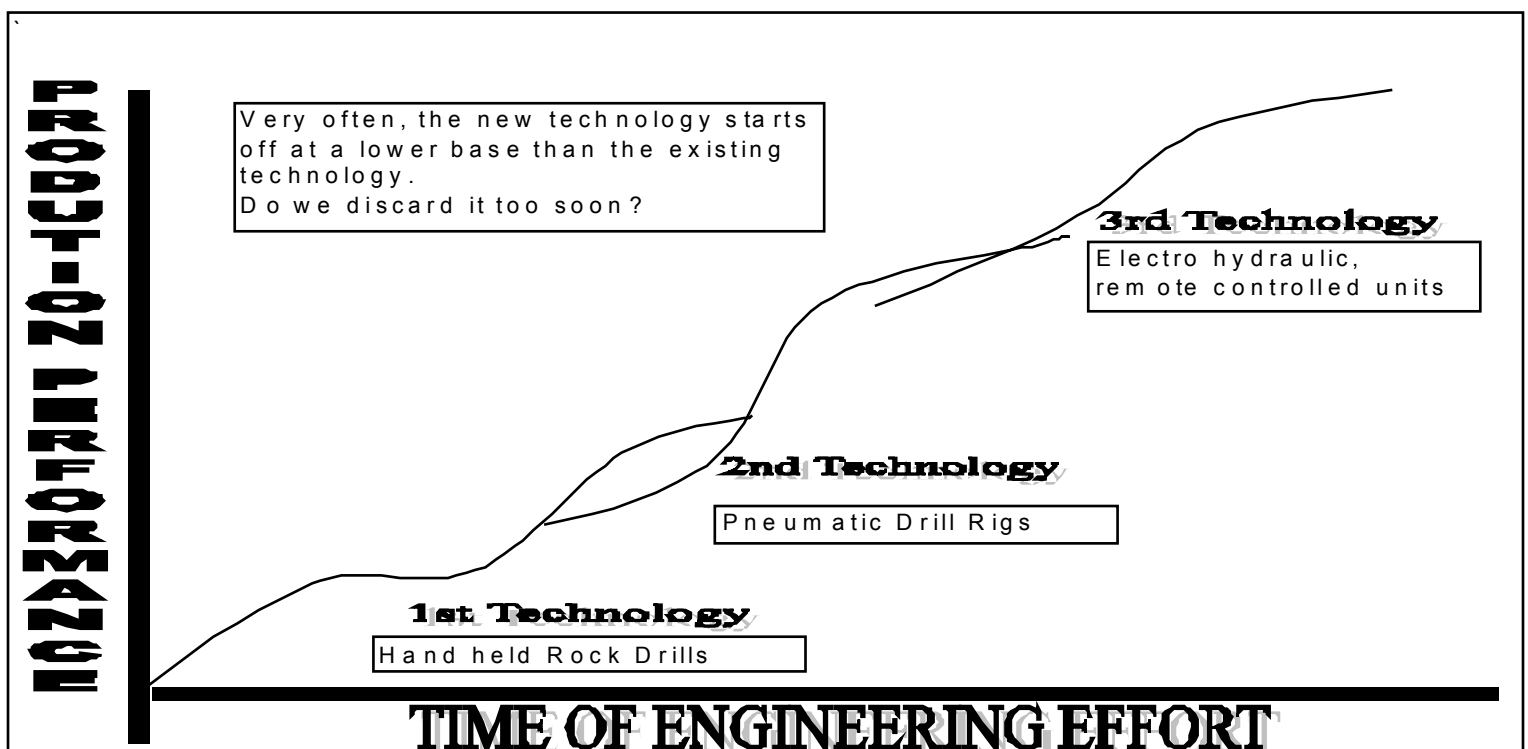
INTRODUCTION

Much focus has been placed on mechanising the stoping operation in order to achieve desired breakthroughs in productivity along with the other positive spin offs. (Enhanced safety, reduced physical effort and improved cost per ounce).

We continually discover technologies, which promise superior results to those currently employed. Yet when the time comes to deliver, the results achieved seem to fall short of our expectations. Is this because narrow platinum reefs are simply not conducive to mechanisation because of the harsh environmental conditions (the Null Hypothesis), or are we not optimising our chances of success? (The alternative)

Proponents of the prescriptive “S” curve strategy would indicate that Hand Held Pneumatic drills should have been replaced about 10 years ago. Productivity levels with these machines have long since levelled off –in fact, it is becoming extremely difficult to find people still willing to perform this physically demanding hazardous kind of work.

FIGURE 1:
PRESCRIPTIVE S-CURVE STRATEGY FOR MECHANISATION

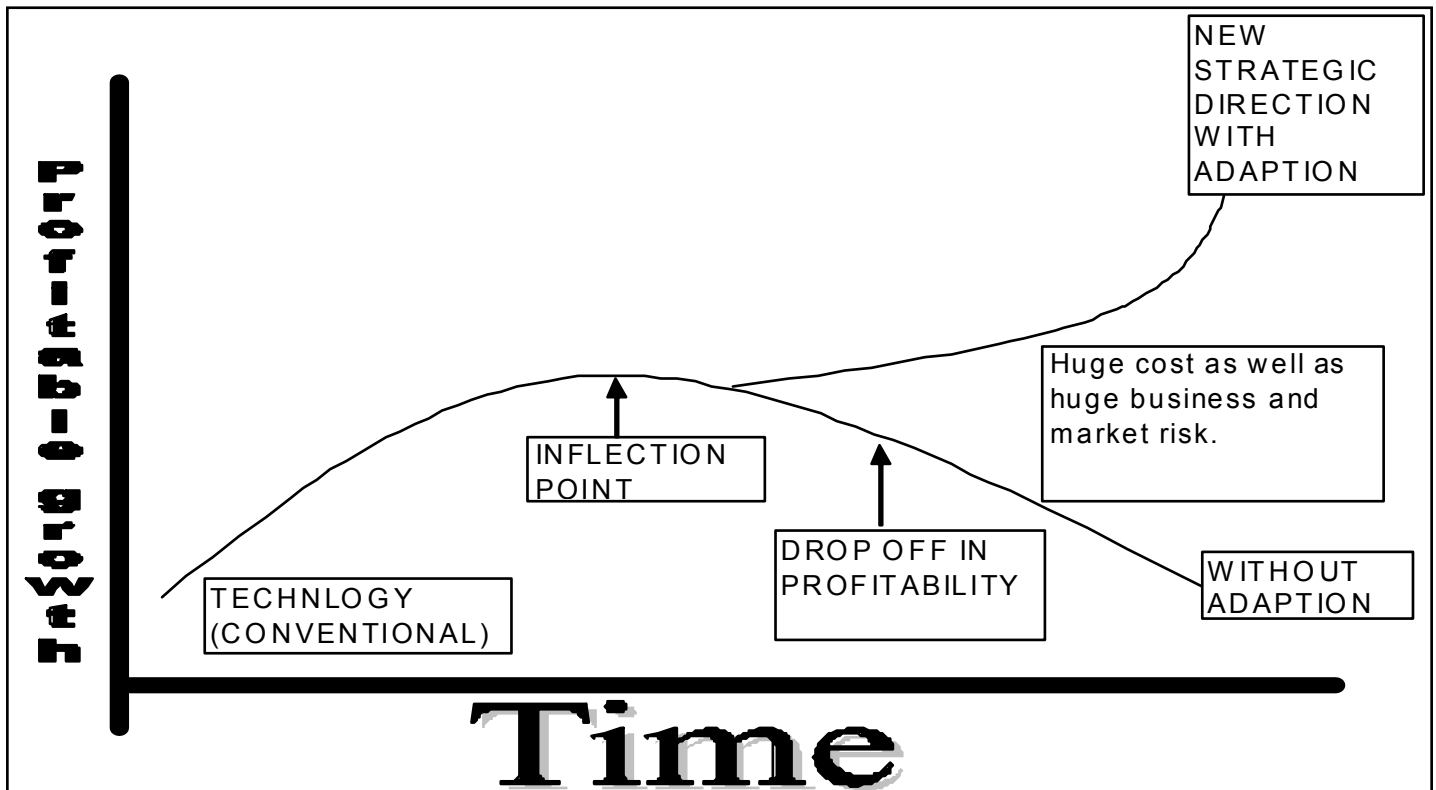


The theory depicted in Figure 1 illustrates that in a technology’s early stages, the rate of progress in performance is relatively slow. As the technology becomes better understood, controlled and diffused, the rate of technological improvement increases (SAHL 1981). The technology will asymptotically approach a natural or physical limit, which requires even greater inputs of time or engineering effort to be expended to achieve further movements in performance improvement.

The trick is to realise exactly when the technology is levelling off. Also, it is often unavoidable that with implementation of newer technology the performance of the new architecture in the early stages is inferior to the old. This is because it is still new and scales of learning (and scope for that matter) have not been mastered. It is often at this point that the new system is measured against the old and discarded because of its apparent inferior performance. The normal focus on short-term profitability also pressurises management to look for an exit strategy, rather than to roll out new systems to gain long-term benefits. Innovation therefore, in the “induced process”, is contrary to the proposed shift from the “fluid” to the specific state.

There appears to be a fundamental breakdown in the implementation process. Instead of beginning slightly below the base case levels of productivity and then cutting the curve and improving steadily, the implementation of each new piece of technology seems to indicate a strategic inflection point in which the technology dies an unnatural death – signifying a clash between the internal selection process of the actual workforce and the belief by management that mechanising narrow, tabular ore bodies is the way to go.

STRATEGIC INFLECTION POINT



It is obvious that there has been tapering off in efficiency over the years. This is aggravated by the rapid increase in costs (especially labour). Without some or other adaptation, profitability will gradually drop off until the business is no longer viable.

With adaptation, it is possible to move the business strategically and technologically into the future. Currently there seems to be misalignment between the company's strategic intent and the actual strategic action taken lower down the organisation.

“Strategic dissonance” occurs when such divergences between intent and action takes place. (Burgelman & Grove, 1996).

Not all dissonance is strategic of course. Companies continuously experience some level of dissonance as a result of routine disagreement.

The common thread running through the vignettes of strategic dissonance is that they signal that the company has reached, or is about to reach what is referred to as a strategic inflection point.

Inflection point has a rigorous mathematical meaning, but used more loosely, symbolises the giving way of one type industry dynamics to another, the change of one mining strategy into another, and the replacement of an existing technology regime by a new one.

“The valley of death” for the incumbents in terms of the stopping mechanisation challenge reflects the risk of the newly employed technology being less successful than the old. Whether the “risk” is founded or not needs to be established.

The saving grace for industries traversing the “valley of death” according to Burgelman, is the ability of their middle management to detect early warning signals, and through a powerful internal selection process, to follow a more robust strategy than that espoused by their leadership.

The senior leadership on the other hand, must be mature enough to not only realise that strategic dissonance is taking place, but that the rift developing between their espoused strategy and reality can even be necessary at times if the company is to survive!

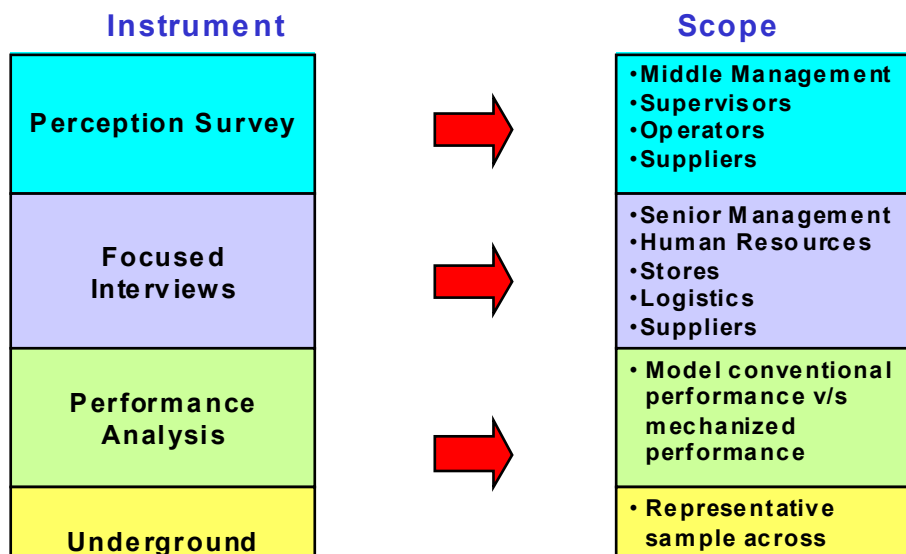
By conducting primarily descriptive research among the various role players involved in the mechanisation of narrow, reef mining, it was possible to establish several key areas of development.

OBJECTIVES OF THE ANALYSIS

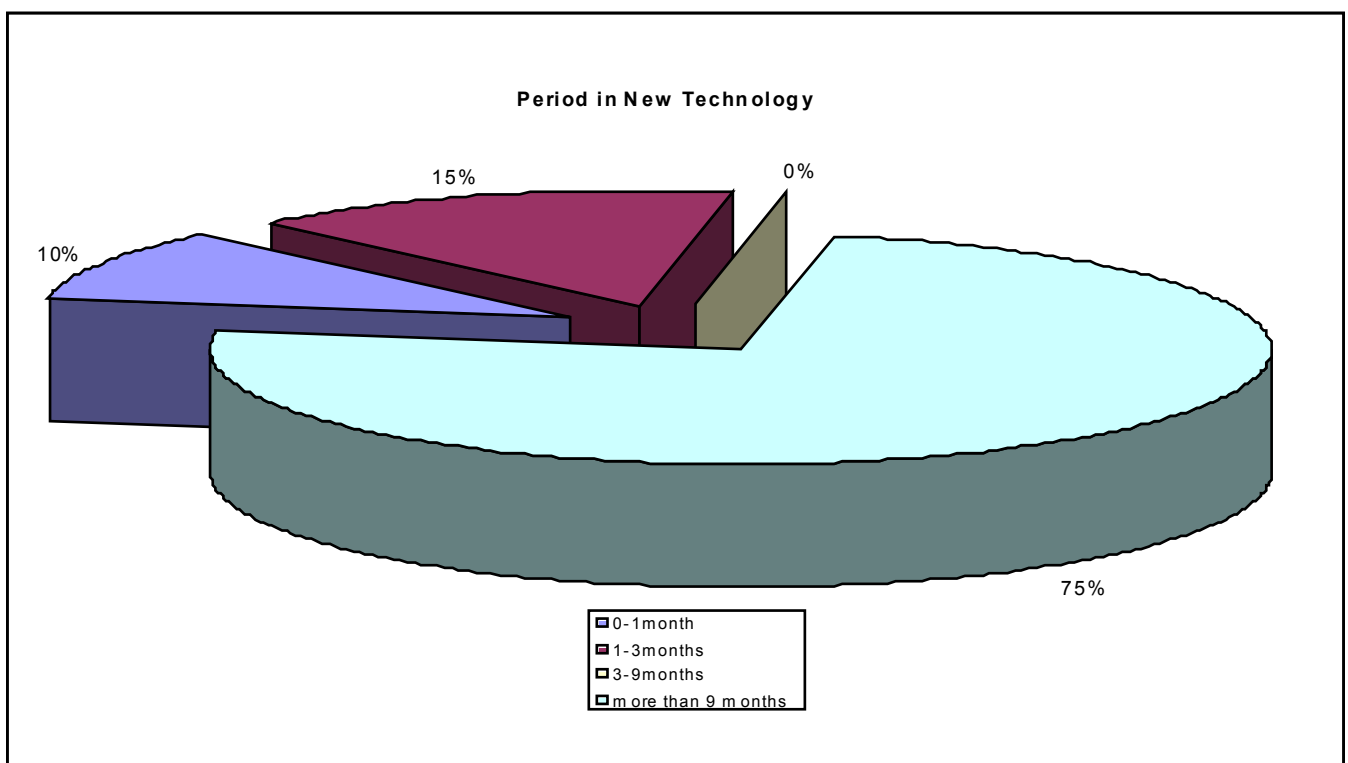
- Understand the perceptions and attitudes of stakeholders in new technology and mechanisation and thereby evaluate the level of commitment
- Understand and evaluate the effectiveness of the implementation or trial methods
- Identify the reasons for the success or failure of the implementation process

- Examine the internal selection process being followed and to make recommendations for a smoother transition process.
- Qualify and where possible, quantify the avoidable constraints to

RESEARCH METHODOLOGY

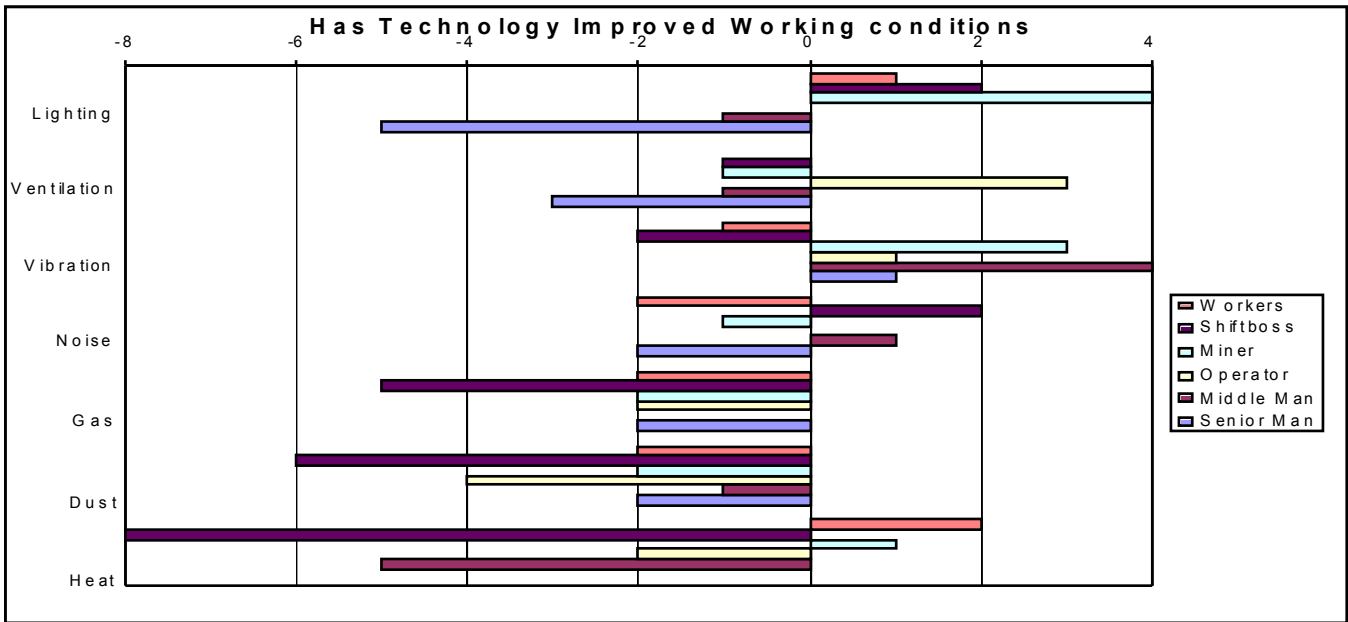


How long have respondents worked with New Technology

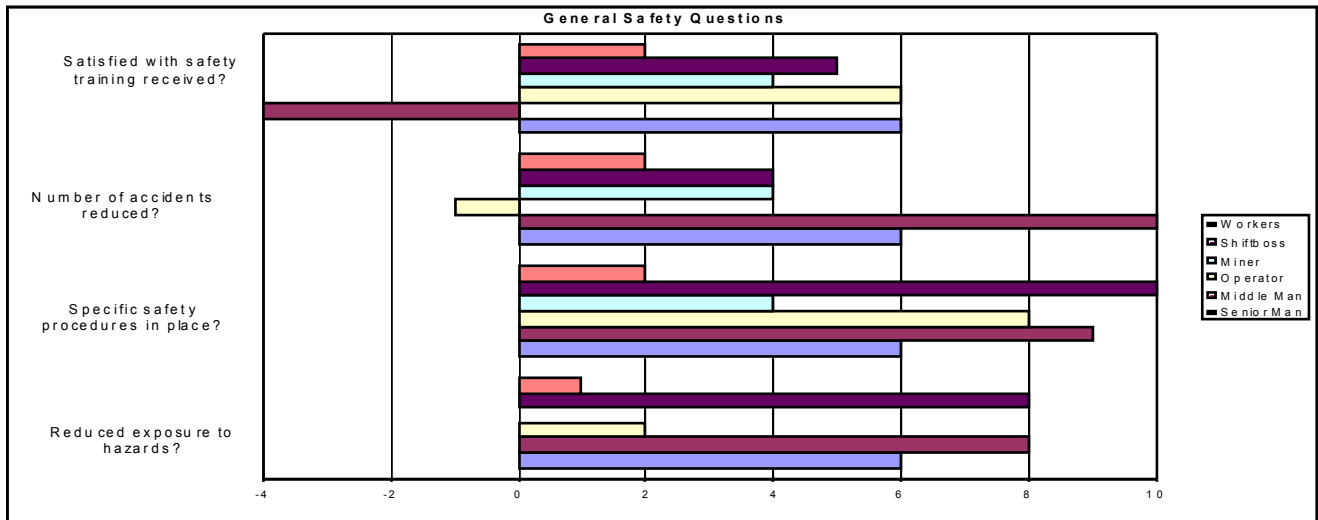


RESULTS OF THE PERCEPTION SURVEY

Has Technology Improved Working Conditions

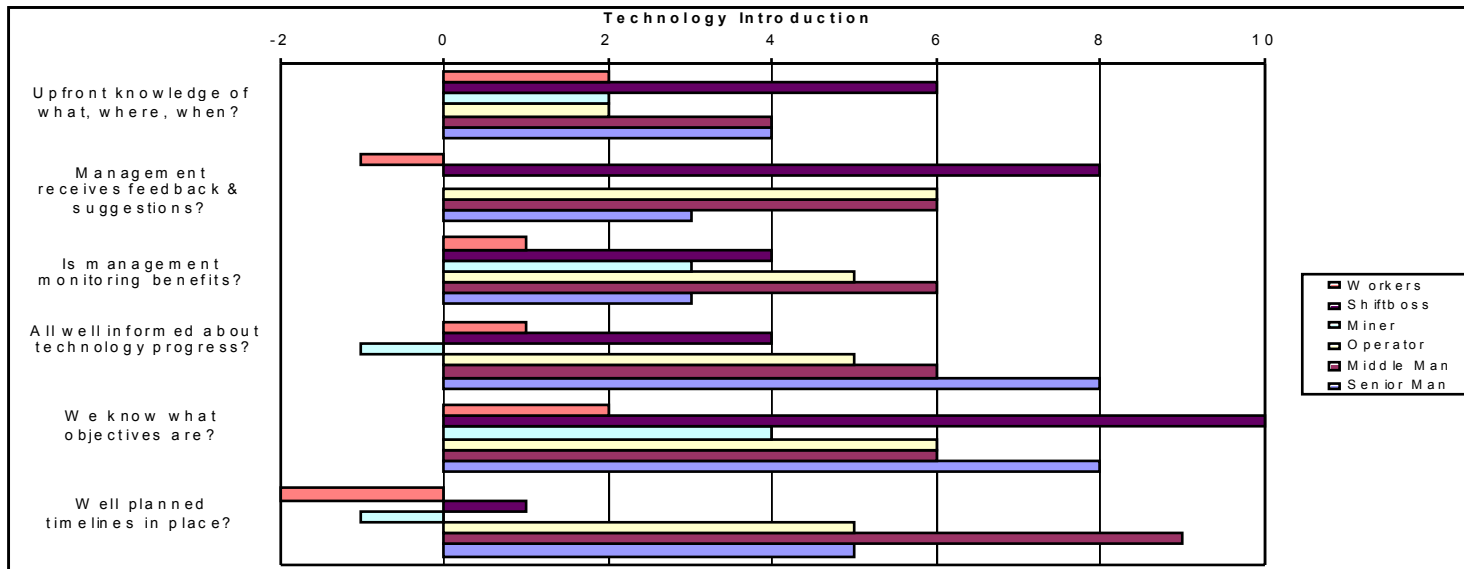


General Safety



General consensus is that safety is enhanced. Training of supervisory levels is lacking!

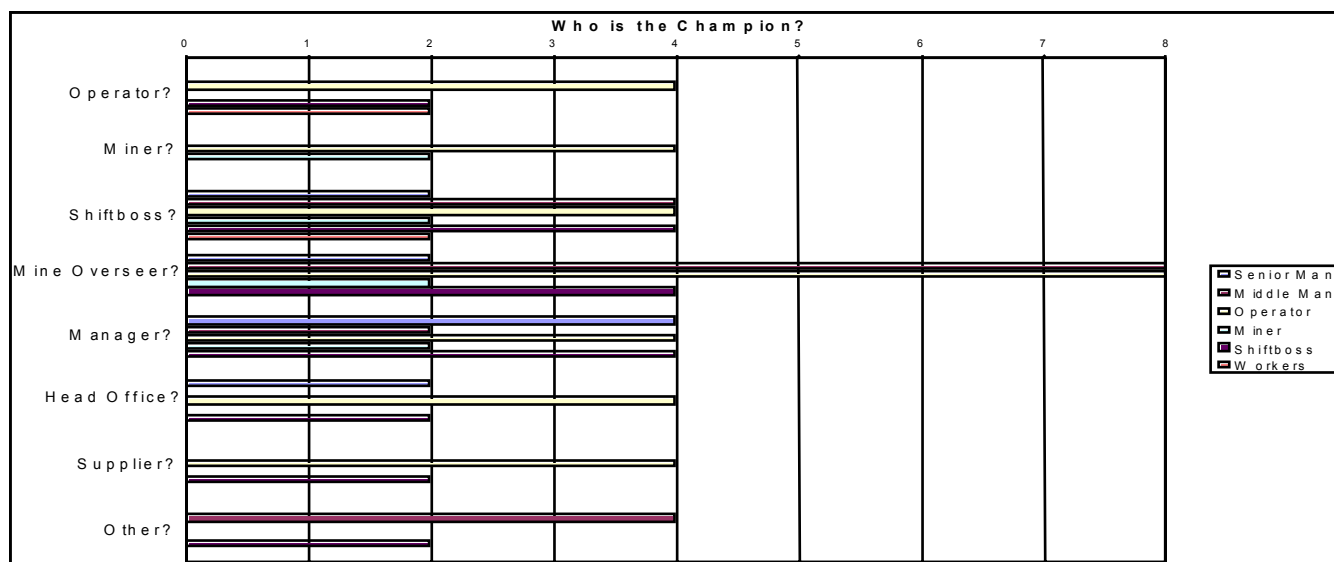
Technology Introduction Process



Huge difference in opinion between management and the workers in terms of the introduction process itself. Introducing new technology is a tactical

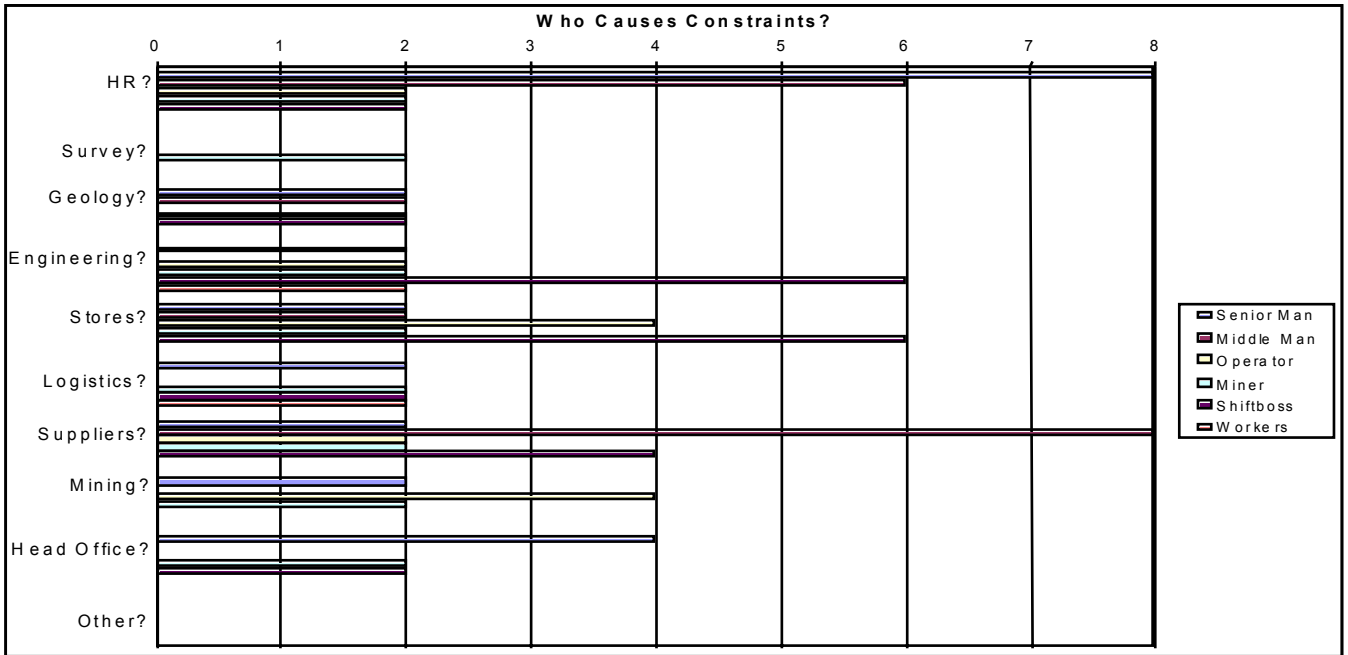
Level strategy ... Several gaping holes need to be closed in the approach.

Who is the Champion



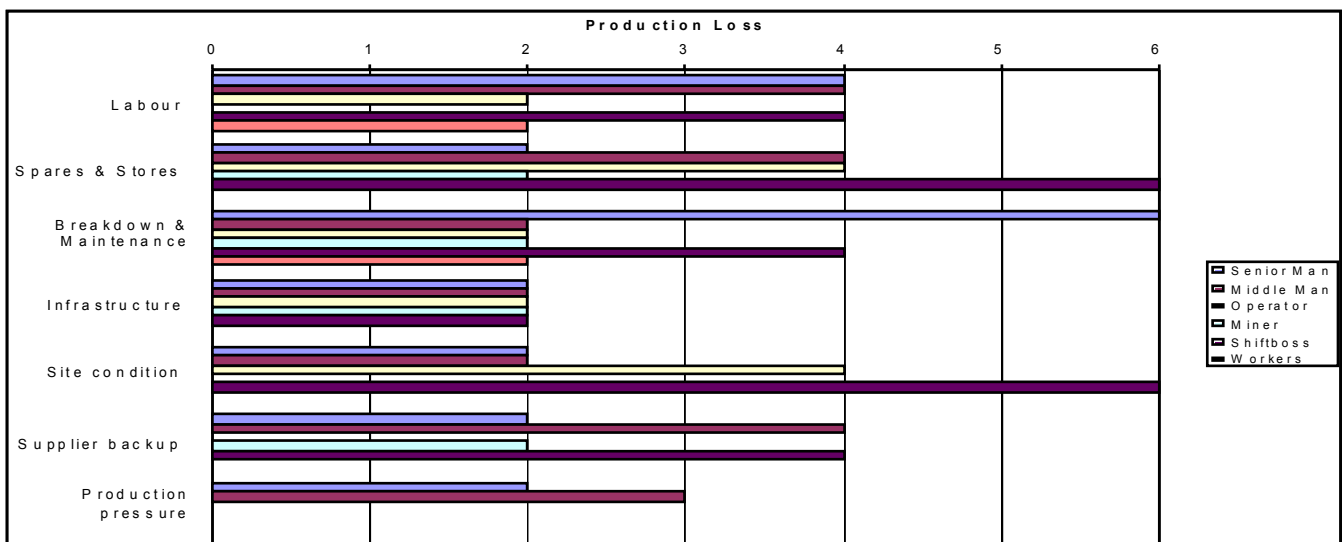
Opposing view points on who the process owner is for the roll out.

Who causes the Constraints



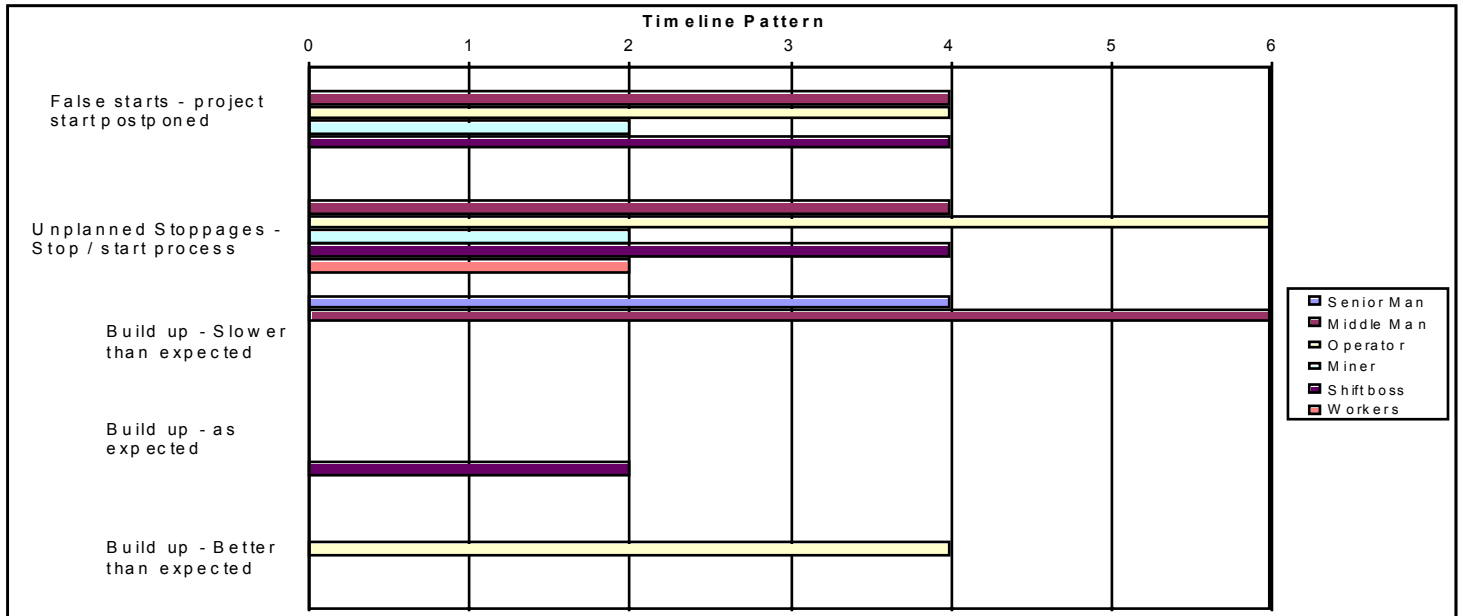
Senior and tactical management levels blame their human resources department and to a lesser extent their suppliers for creating a bottleneck in the system. The operators themselves are more concerned with availability of strategic spares, mining layout and labour availability problems.

What causes production losses



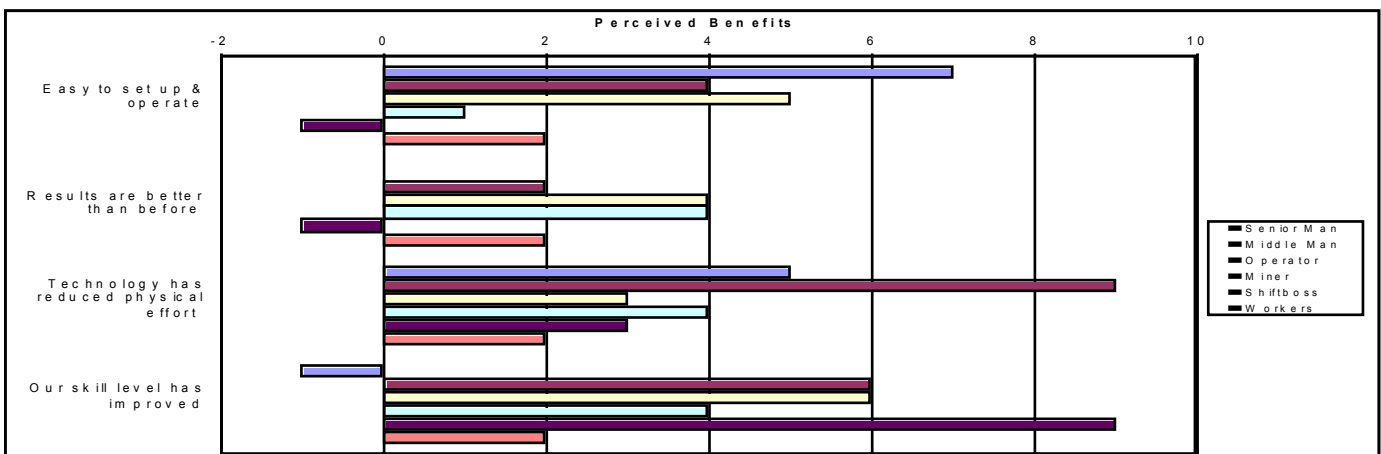
Some correlation exists here. Spares and stores seems to be a real problem. So does site preparation and supplier backup.

Introduction Timelines



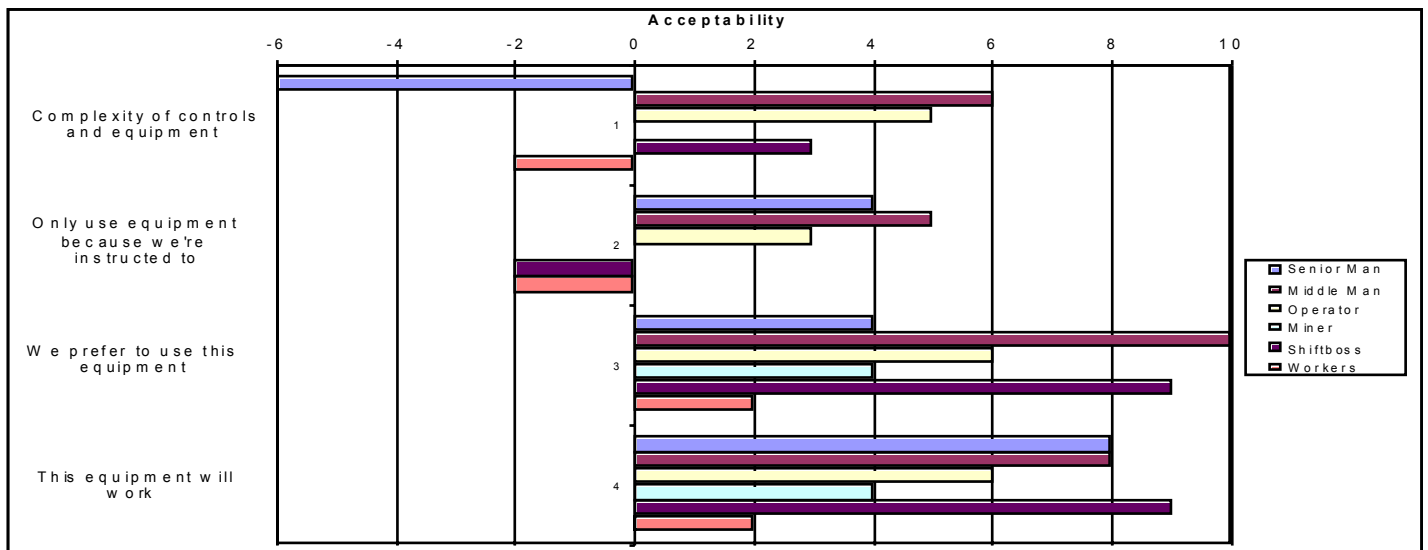
Diverging viewpoints on the actual build up. Structured feedback on progress would improve worker awareness on how the project is actually progressing. Delays and stoppages need to be examined carefully; the bottlenecks, which influence the slow build up, must be removed where possible.

What are the perceived benefits



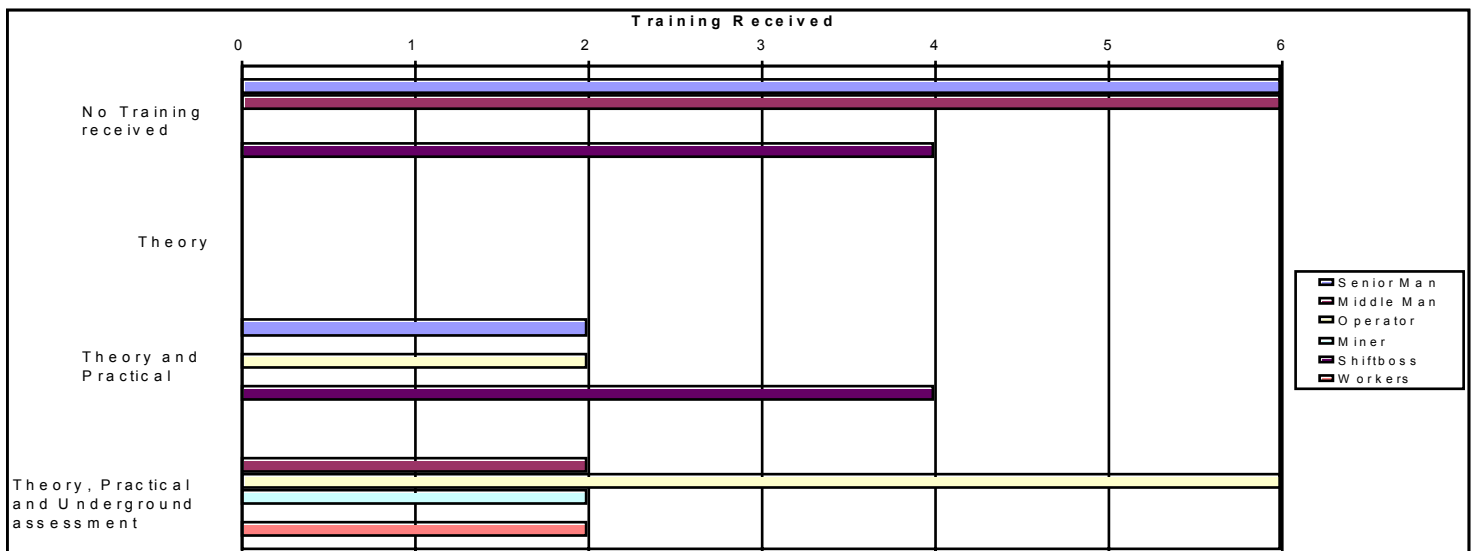
One of the main reasons mechanising is to reduce the physical effort involved in mining. Although there is consensus that this is the case, it is not that convincing. While middle management is adamant that the physical effort has been reduced and the skill level elevated, the operators obviously still exert themselves. Their thinking is aligned with the direct supervisor – except in terms of the result being obtained.

How acceptable is the technology



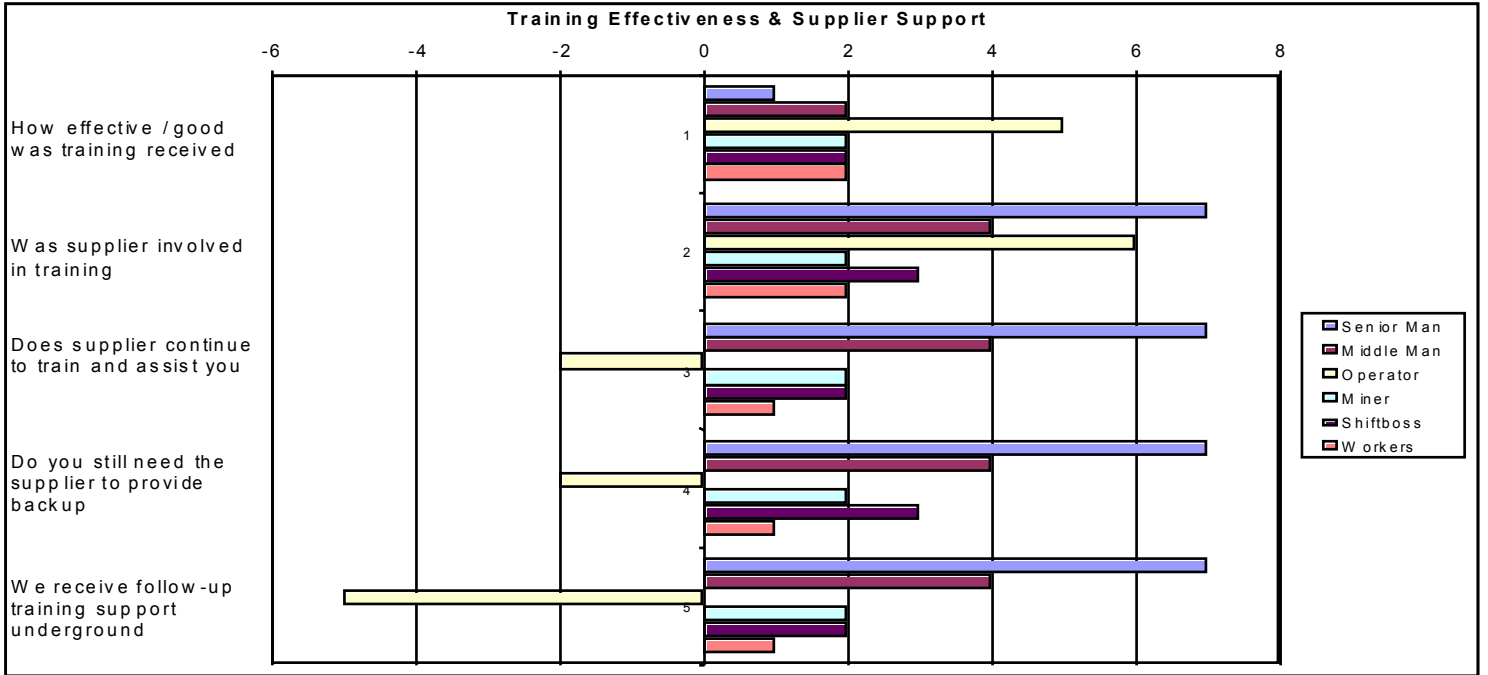
The acceptability of this technology leaves much to be desired. It is possible that poor communication and fear of job loss has had an influence on the workers' perception. Strangely enough, senior management view the technology as complex and difficult to implement whilst the workers find no such problems with it.

Type of training received



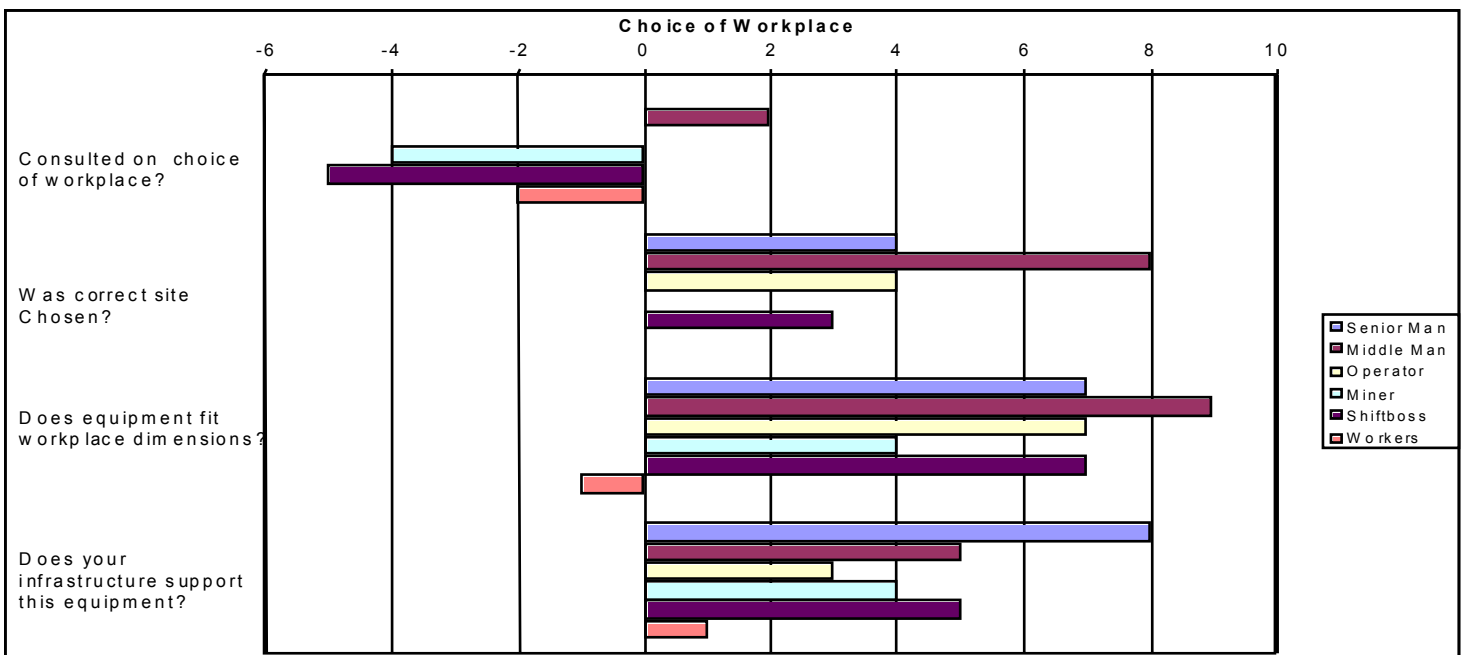
Key focus area. If senior and middle management receive no training on the technology they are to manage, how will they know what kind of performance criteria to expect from these mining systems? How can they align their workers needs to the expected performance criteria?

Training effectiveness and Supplier support

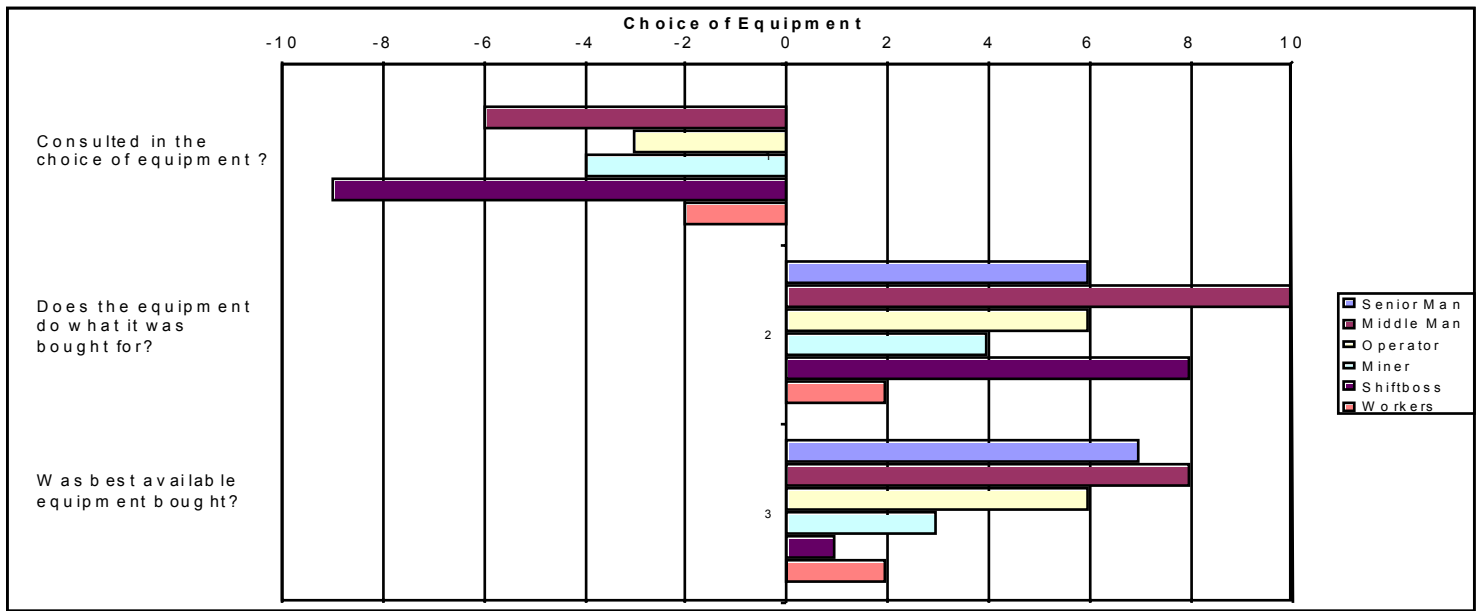


Although operators feel they don't really need supplier back up, their emphasis on the fact that they get nothing indicates their isolation. How is it that management has completely different viewpoint? Where is the breakdown in communication?

Choice of workplace



Choice of Equipment



Consultation on the choice of equipment is another area of concern. The immediate supervisor doubts or is at least is not confident in the actual selection. This implies that he may be forced to use it. Downstream negative effects can be expected.

Contrary to a powerful middle/ lower management driven internal selection process, consensus seems to be that the choice of the technology is largely in the hands of the corporate executives and senior management. This must be a cause for concern... Ownership of the process and the technology itself should reside with the operators and supervisory level. They must have input into the selection process.

Who chose the Equipment



INTERPRETATION OF THE FOCUSED INTERVIEWS

MANAGEMENT'S VIEW

- Management does not believe in their supplier's capability. They believe that Core competencies should remain with their mine. Will outsource breakdowns, repairs.
- An effective Incentive Scheme takes too long to implement – negatively influenced morale and motivation of teams. 18 months later at signing stage.
- Recognizes that implementation is a learning curve –things take longer than planned to happen. Targets during trials/implementation should be set lower than expected production performance.
- We have no choice (HIV/AIDS) but technology will still pass conventional in terms of performance and costs
- Suppliers attract costs but are slow to deliver. They are not willing to share the risk of a new product launch with the mine.
- Focus is on production pressure, not on testing new equipment.
- Running projects from working costs –this increases costs of production with no immediate visible gain in productivity.
- We use suppliers in competition –this will promote innovativeness
- Head Office decides on one type of technology –this is not necessarily suitable for current configurations and infrastructure.
- No choice –have to move towards technology. However expects great difficulty in finding and implementing appropriate technology for the existing infrastructure and layouts in difficult ground conditions.
- Lack of champion. Wish list for effective technology implementation includes a team: M/O, Mining Eng, Supplier and a Capital Budget. Will then provide operators to this team.

HUMAN RESOURCES VIEW

- No formal involvement of HRD in the planning and introduction of new technology
- HRD “discovers” new equipment when visiting underground.
- Trials need an end –trial periods are open ended.

- HRD has tools available for job profiling, competency assessments etc., which are not being used to determine operator profile.
- Certain issues such as legal requirements are overlooked due to lack of HRD involvement. Typical requirements are Risk assessments, SABS testing, GME approval.
- HRD experiences different approaches to the introduction of new equipment at respective shafts –no consistent methodology.
- Believes a Code of Practice/ structured approach is required to enable all departments/stakeholders to contribute towards effective implementation of technology.
- No HRD Business Plan which supports the mechanization strategy and targets.

THE SUPPLY CHAIN

1) STORES:

- Are not involved as part of planning process for new projects. Not part of any project review process.
- Roles and responsibilities towards new equipment unclear –willing to help.
- Reporting structure problematic –sub-stores reporting to different positions, logistics, finance, and main store.
- Sub-store only responsible for stock items –sections responsible for trial or test. Special orders for equipment, spares, etc. are made out hap - hazardly by line management.
- Payment to suppliers often becomes an issue after delivery, because the proper ordering channels are not followed.
- Conflict between stores efficiency and security measures –delivery directly to shaft problematic. Causes re-handling, re-routing and delays to end-user.
- All new equipment requires different sets of spares. This impacts on ability to fund standard requirements. (Need for standardization)

2) SUPPLIERS:

- Mine does not specify what they expect from equipment –no User Requirement Specification (URS).
- Realize the need for the following elements:
 - Local manufacture
 - Value for money (compared to what is available currently)
 - A consistent mechanized blast per day
 - Labour reduction.
 - Increased tonnage
- However, they receive different signals from different levels. Does the shiftboss really understand the mechanization objectives?
- Suppliers have a need to test different applications and design combinations but this is prevented by buyers.
- Technology implementation improvement areas in their opinion:
 - Targeting of particular areas for specific applications
 - Setting of objectives and performance criteria for each type of equipment.
 - Involvement in choice of equipment to match each application.
 - Performance and progress measurement
- General reservations:
 - There is an improper implementation approach
 - Use of contractors could tarnish performance of equipment
 - Change of management and crews interfere with continuity.
 - Perceived lack of commitment by top management –no visits to mechanized projects
 - Supplier/client misalignment regarding status of equipment: R & D vs. proven product
 - Clients tend to shift the goalposts.
 - Implementation is piecemeal. A complete working system needs to be matched to unique underground conditions.

- Lack of project champions
- “Get your s.... off my mine!!!”

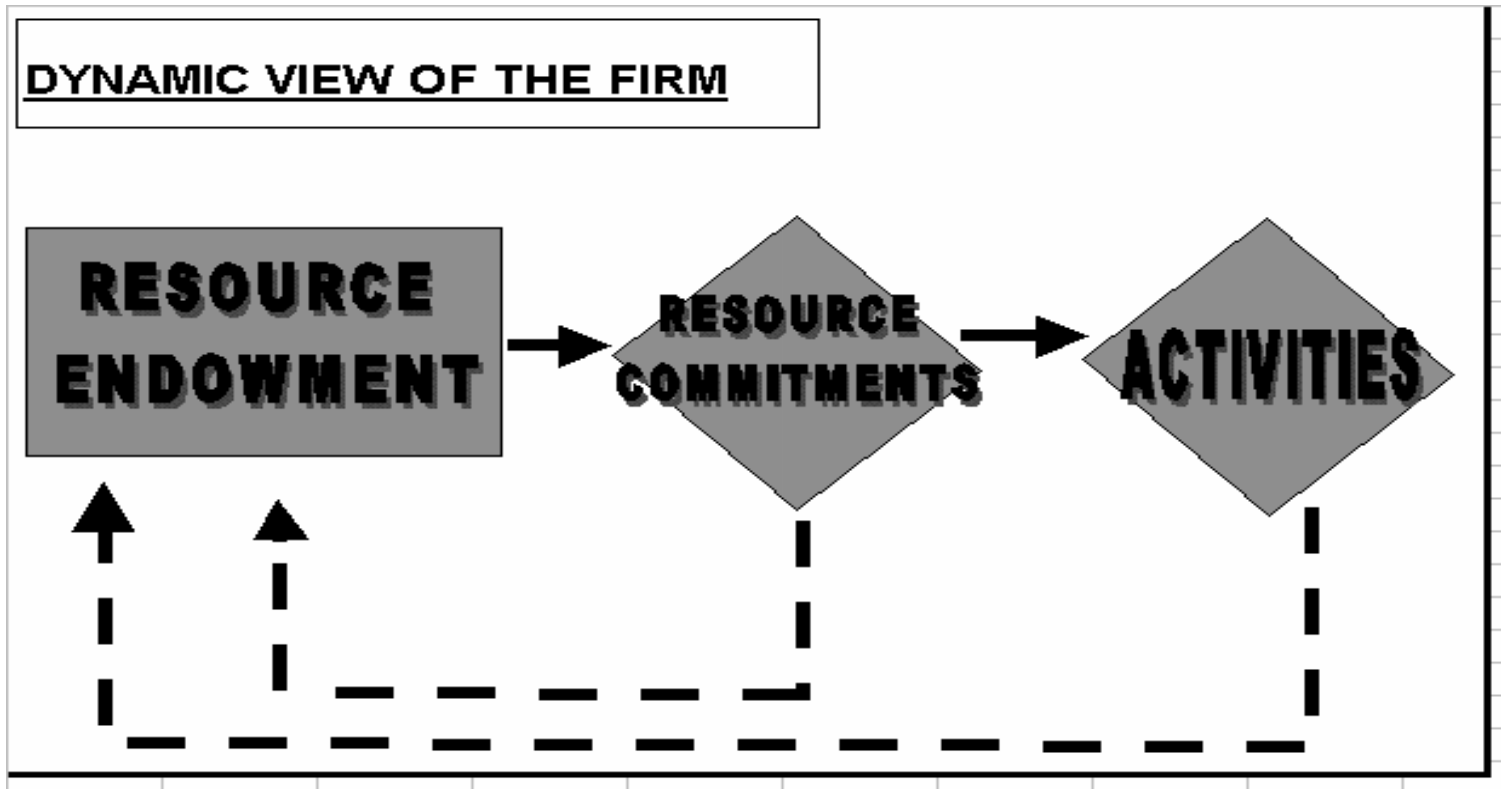
THE DILEMMA:

We are faced with the enormous challenge of coming down the cost curve through a process of mechanization. The implementation process itself though, is clearly flawed.

Poor communication and alignment between key role players seems to be the major contributor to the slow, seemingly ineffective roll out process.

Although a solid mechanization strategy exists at corporate level, the roll out of this strategy is somewhat stifled. If we are to equip ourselves with the right endowments to survive the foreseeable future, technology must be given every possible chance to prove itself. By investing in certain technologies, a firm's future capability is set to a certain extent. Refer to figure 2.

FIGURE 2:



The lumpy “resource commitments” described by Ghemawat (Ghemawat, “Strategy and The Business Landscape” pp. 120 –131) dictate a firm’s ability to compete in the short to medium term. Capital comes at a cost. Depending on the perceived risk, it may come at a crippling cost – especially if we invest in sub-optimal resource endowments

By making lumpy resource commitments, we ‘lock’ our firm into certain way of doing things. It dictates the way we are able to perform activities and what kinds of activities we will be able to perform. The influence here will have significant, lasting effects on the firm’s future menus of opportunities or choices. The irreversibility of such major decisions, or equivalently, the cost of changing one’s mind about them mandate a deep look into the future.

Alignment among all the stakeholders in the choice of the technology to match the selected mining configuration is clearly critically important. The irreversibility of these decisions make equipment selections a logical starting point in designing and benchmarking new mining system.

Eisenhardt's "Competing on the edge, Goulds " corporate level strategy and Ghemawat's "Strategy and the Business Landscape" all warn of the "marry in haste, repent at leisure" aspect of making long term business commitments without first probing their external environment and potential customer base for signals of value.

They also agree on a couple of fundamentals:

- Commitments can lead to inferior performance if they fail or sustained superior performance when they work
- There are multiple possible outcomes, we should address this by preparing for this through scenario planning
- We cannot stay totally flexible. The risk of being locked out of a potential opportunity increases as we increase flexibility and follow a or "straddle" a "late mover" strategy.
- We can lessen the blow of making a wrong decision by inserting "probes" into the future. These probes pick targeted areas to launch transformation and can be used as exemplars or platforms to extend the business if successful. If successful, you can scale up- if not, "High learn to burn" ratios provide timely feedback in a way which permits revisions of commitments (still small) in response to bad news. If we realize the potential of these high learn to burn ratios, we can enhance our ability to adapt to the future through experimentation, engaging in pilot programs, appropriately staging or sequencing commitments, setting milestones and triggers for terminating commitments etc. By stepping off R & D and mechanising on a small scale, not only do we reduce the risk of making the wrong resource commitments, but we also allow ourselves to roll out technology in a focussed, methodical manner.

It is important here, that a solid internal selection process is followed in a firm's pursuit of value creation. Very often, the middle management- or even shop floor employees recognise an opportunity set for the firm. If the firm is loosely coupled and the internal selection is consistent with the pressures of the external environment, then the divergence between the intended strategy and the that followed in reality can be a good thing. It is the maturity of the leader and the strength of the human capital employed by the organisation, which make the real difference! Here again, involvement and commitment of all stakeholders needs to be ensured before any decisions are made.

Some typical issues, which need to be agreed upon, are:

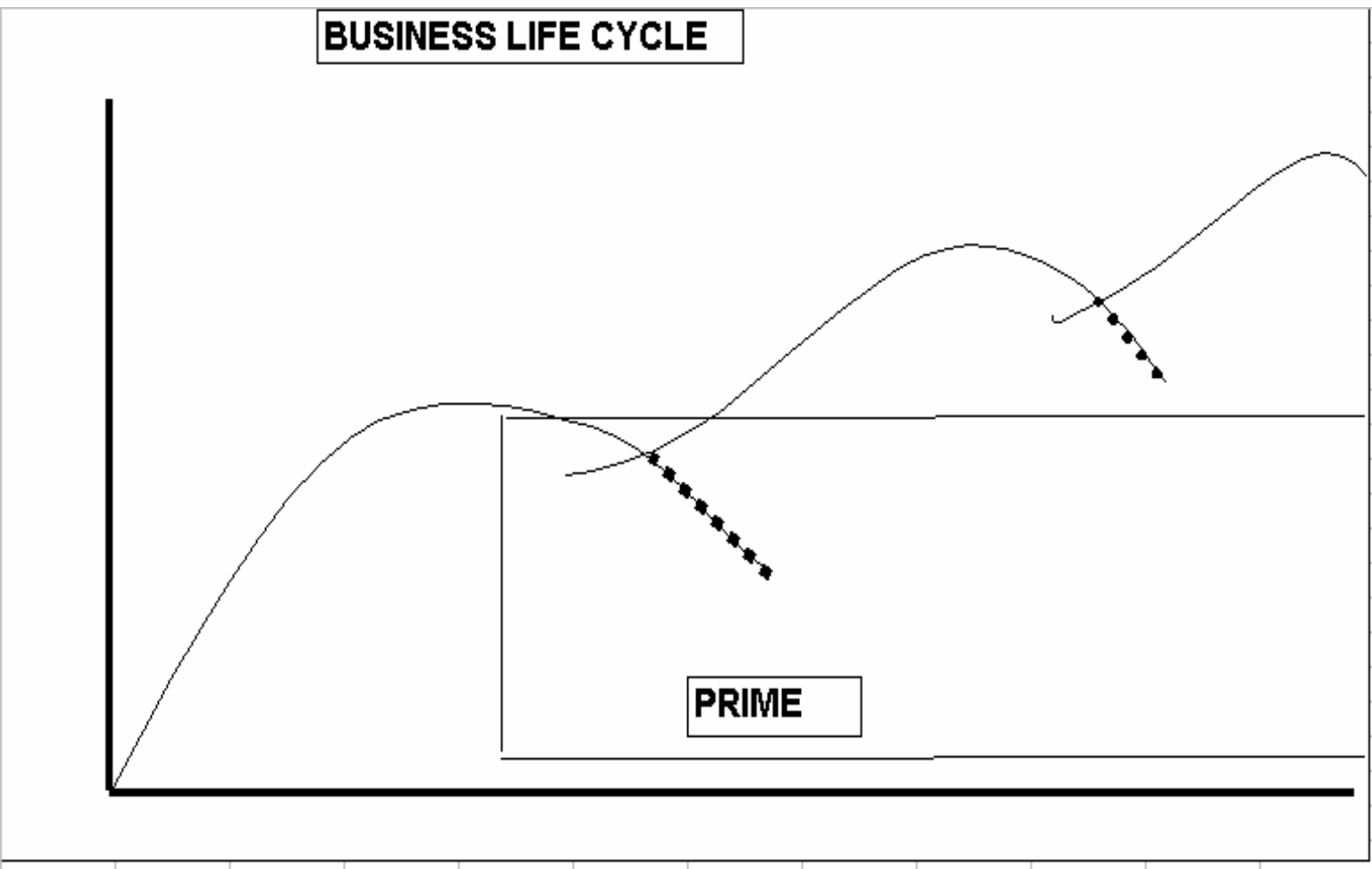
- Who are the stakeholders? (Typically they should be members of the population listed in this article- though there could be others)
- What are their needs?
- What is the potential of the mining system?
- What are the lead times in the delivery of the roll out process? (Roles and responsibilities need to be clearly defined.) Communication must be clear, concise, accurate- goals must be properly broken down and agreed upon by all stakeholders. Deviations from these goals must be clearly understood.
- Who is the project champion? This links back to Roles and Responsibilities, but a process owner should be held accountable if dissemination of information is to be accurate and alignment is to be consistent.

By looking for warning signals, mistakes of the past can be avoided. A critical mass of intellectual and physical capacity is built up by exploiting the best of the past (selection), adding something new (mutation) and mixing the blend of old and new with the not quite new (recombination).

By inserting these low cost probes into the future, it is possible to stay competitive and evolve with time. This allows a longer life cycle for firms, which with adaptation and combination of the old and new, manage to traverse the “valley of death” successfully when launching technology because they draw from their experience, build on capability and speeding the blend with novelty.

What are the implications for Business?

FIGURE 3:



The prime stage of a business can be extended indefinitely by allowing a company to evolve over time. Instead of “leveraging a company up” and then “stripping out the value” attributable to the shareholder by paying out dividends to compensate for the dropping P/E Ratio we can use the sustainable value that the firm creates to build a future and increase shareholder value by increasing the size of the total pie. As labour cost increases, distributable profits decrease. Without a breakthrough in mechanisation, leveraging up and eventually stripping out wealth and closing shop would be the inevitable outcome of a failed mechanisation drive.

AREAS OF OPPORTUNITY:

Ownership:

By aligning the stakeholders through a structured process of communication and consultation, goals will become clear. A tracking system, which gathers information and closes the loop in terms of regular feedback, is also vital if the technology is to be successfully launched. Ownership and accountability must be clearly designated and communicated to all team members.

Project Management:

The roll out of any new technology must be project managed. It may be useful to utilize an independent third party to facilitate the process. This removes bias and will hopefully pour oil on troubled waters when necessary. This may also improve communication among stakeholders and provide accurate, impartial feedback on progress.

Benchmarking:

It is vital to benchmark each technology against planned parameters –as well as industry best practise. A model which captures the relevant revenue streams as well as costs should be populated on a continuous basis. These should be compared to a base case scenario. (In this case–conventional mining).

Supplier Interaction:

Suppliers are a significant and often crucial input into the value chain. By leveraging their resources through strategic alliances, (as opposed to outsourcing), they can be made to invest in a technology which increases not only the potential value of the technology, but also the likelihood of sustainable success.

Probes into the Future:

By inserting relatively low cost probes into new technology, it is possible to gauge the potential of different options. High learn to burn ratios should be maintained if the investment in sub-optimal resource endowments is to be prevented. Remember, once made, the commitments to certain technologies, production efficiencies and their associated costs are relatively fixed in the short to medium term.

Mix the Old & New:

Use people who are familiar with the technology to teach new teams. This may slow the process down somewhat, but experience gathered during the R&D phase will prove invaluable to the roll out team. Continuity should also be maintained in the supply chain. Their knowledge and experience must be brought to bear on the implementation process. As improvement is made in design and benefits in scale and scope are realized, the new technology will evolve to cut the line of the prescriptive S curve.

A STEP INTO THE FUTURE –HOW TO TAKE IT.

Look for opportunities to share the distribution of value & grow the total size of the pie. This infers creating win-win strategies and involving all stakeholders in the creation of sustainable and shared value for your business.

This links back to the business life cycle. By creating new products for your suppliers to sell and, by valuing their inputs, companies are able to plan their own future with the other stakeholders. Intellectual capacity literally doubles. The next mature step in this relationship is to ‘time pace’ the introduction of new products and services in rhythm with market requirements. To do this, your business will have to be in sink with stakeholder requirements (& capabilities).

Time pacing involves changing because of the passage of time. It goes beyond being able to predict what will happen in the future, it moves to creating its own future. It is a major reason why Intel and other similar firms have consistently overrun their competitors outmanoeuvred them and generated a relentless flow of advantages. The time pacing must be synchronised with current and future capabilities as well as stakeholder’s needs and abilities. If not, the technology will become incompatible with current capabilities and the company will fall into the “error catastrophe” trap.

What is the corporate executives' role in all this?

Executives must have a clear vision of their business. They need to know what they wish their business to be. They must realise that the marketplace is dynamic, markets; technologies and customer needs evolve over time. Competitors come and go. Customers needs shift. Tactics need to be adjusted but not what they envision their role to be. This is where "probes" and "time pacing" become so important.

The executive needs to support the strong internal selection processes followed by their middle and lower management. They need to guide their businesses into the future by allowing the right capabilities to develop within the firms and by assuming a role of a responsible, well-informed corporate partner.

They need to shape the future ahead of the customers (and other stakeholders) wants & needs. The creation of the future is in rhythm with growth requirements of today. The customer as well as economics of learning drive today's value from the past. Interactive and valuable relationships are built through synergy with customers, suppliers, complementors' and even entrants into your arena. By developing key relationships, today's value becomes the shaper of tomorrow's future.

By pacing change in a structured, progressive way, linking business objective to corporate strategy and continually looking for patching opportunities to match your evolving technology with your own unique capabilities- you will be able to create sustainable value into the future.

This is a far cry from establishing a position in a favourable business landscape and then protecting it through the erection of high barriers to entry such as those created by our previous political dispensation. We have moved somewhat it seems, from a supply side economy (post world war 2). This progression has been rapid but somewhat predictable.

The concept of value creation with a powerful focus on the internal customer is emerging. The more progressive thinking has already shifted from Porters 5 Forces to strategic out partnering and the acceptance that competitors perform more than one role; they complement firms' product offerings as well.

In a country like South Africa, with an exponentially increasing population, an economically active unemployment rate in excess of 30% and the lowest productivity levels (arguably) in the world, surely there is a huge need to look at creating corporate strategies which focus on increasing the total size of the pie...Or at least extracting the highest value at the lowest cost for each slice.

It is the recognition of the need to reduce complexity of the parent organisation, which is the key to increasing value. The speed, flexibility and time paced change in rhythm with customer needs is the approach we need to follow. This does not infer restructuring under the threat of a hostile take over, or delaying in order to cut out central costs. It infers allowing a business to evolve in an unrestricted manner, so that intellectual property available within and outside an organisation can be harvested. Probes should be allowed to grow into successful branches of a business regardless of the choice of structuring.

Whilst the concept of “have lunch or be lunch” so aptly describes the competitive arena of many business environments, it is the creation of value for the customer today- and tomorrow which will allow us to expand and grow into meaningful contributors of our country’s destiny. This calls for clever integration and optimisation of the many intricacies of our Organisations – including its technological resources, on the edge of time and chaos –through powerful, value driven leadership.

GLOSSARY OF TERMS:

STOPE / STOPING:
involved

That mining operation performed on the reef
with the extraction of mineral bearing ore

TONS:
System

As defined by the Standard International Metric
(1 ton is equivalent to the mass of 1 metric cubic of
water weighed at sea level)

M² /MAN:

Square metres (centares) are the unit of measuring on
the stoping (reef) horizon and are based on the square
metric metre. The unit per man is those m² measured
divided by the number of employees costed.
The result is measure efficiency, usually expressed as
an integer.

DRILL RIG:
the

A mechanical drilling machine, used to improve the
spacing and direction of drill holes and to speed up
drilling process. (SEE APPENDIX 1)

OUNCE OF PGM:

One ounce of PGM is that apportioned basket of
platinum group metals which consists of platinum,
palladium, rhodium, ruthenium, gold and to a lesser
degree copper zinc and nickel.

LOGISTIC OPERATION:

that portion of the mining operation that deals with
the supply of material and the removal of broken ore.

SHOT HOLE:

that single hole that has been drilled and blasted.

SEQUENTIAL MINING:

the alternate blasting and cleaning of one or more
panels in a mining sequence.

MISFIRE:

a charged hole that was intentionally lit but was
partially or wholly unsuccessfully blasted.

MECHANISATION:
labour

the substitution of mechanized equipment for a
Intensive operation.

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