



Are Efforts to Mechanise SA Mines too Focused on Machinery Rather than Technology?

Presidential Address:
SAIMM AGM



Date: 13th August 2014

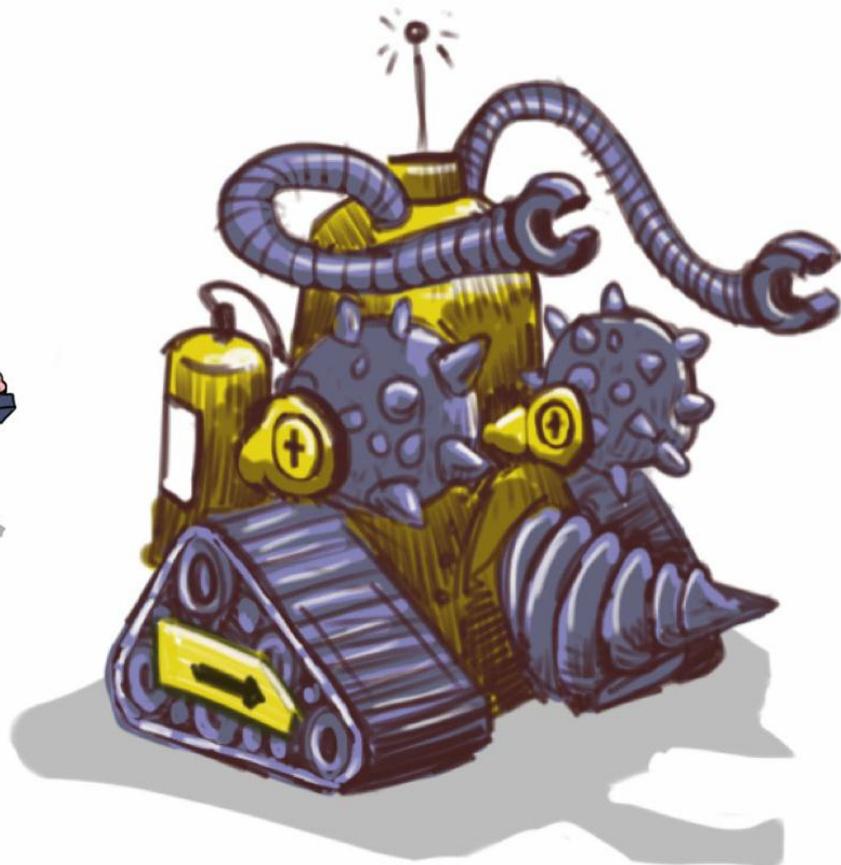
Time: 15:30

Venue: Johannesburg Country Club

By: Prof Jim Porter

Agenda:

- 1. Introduction**
- 2. Why this title?**
- 3. Some examples**
- 4. People, Systems & Technology**
- 5. Prepare for the future!**
- 6. Concluding remarks**
- 7. Acknowledgements**

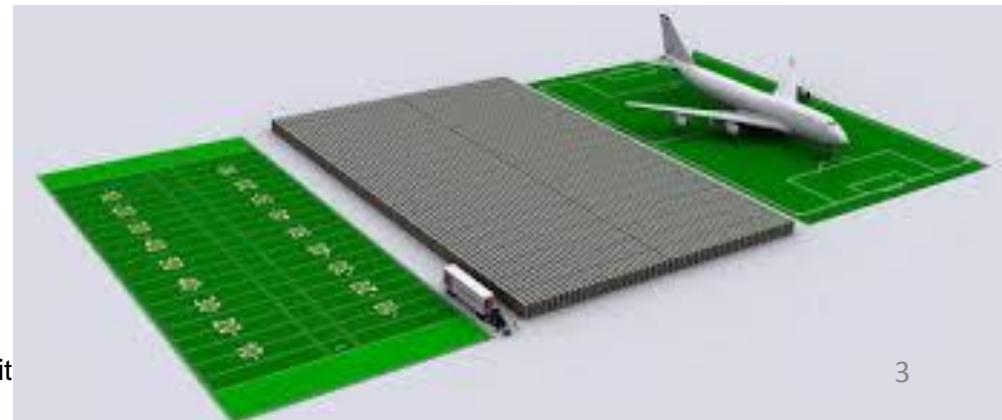


Introduction: Challenge and Opportunity

- According to Statistics South Africa (SA) the current unemployment rate is 25.5% of the workforce
- This includes 10 million people subject to high levels of poverty
- SA is currently number two on the world's Geni index that measures the disparity between high and low income earners.

BUT

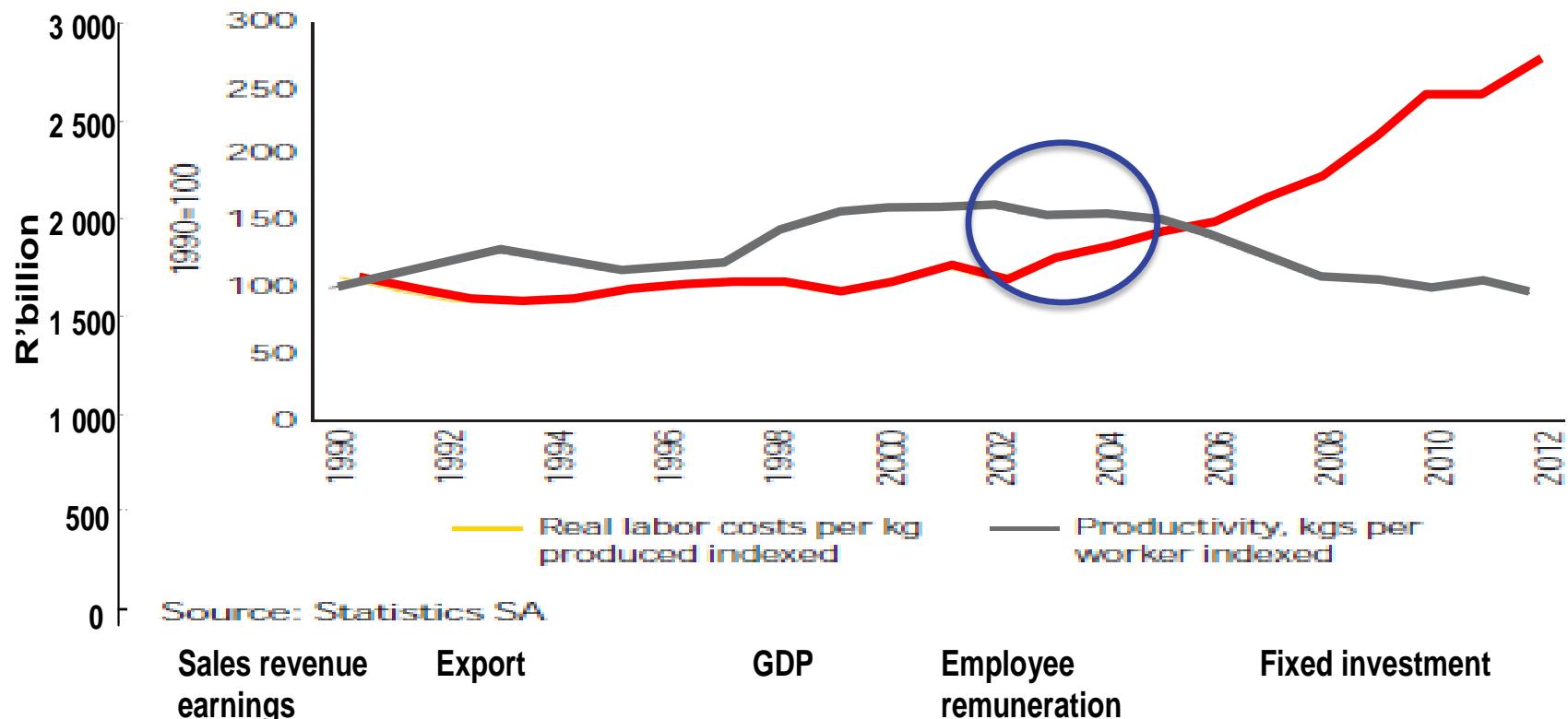
- The Chamber of Mines' South African Year Book, 2012/13: The value of SA's total metal and mineral reserves "remain some of the world's most valuable, with an estimated worth of R20.5 trillion (\$2.5 trillion)".



Introduction: The Challenges

The contribution of mining to South Africa over the past decade expressed in 2012 real money terms

Source: Chamber of Mines Statistical unit.



Source: Statistics SA.

Sales revenue
earnings

Export

GDP

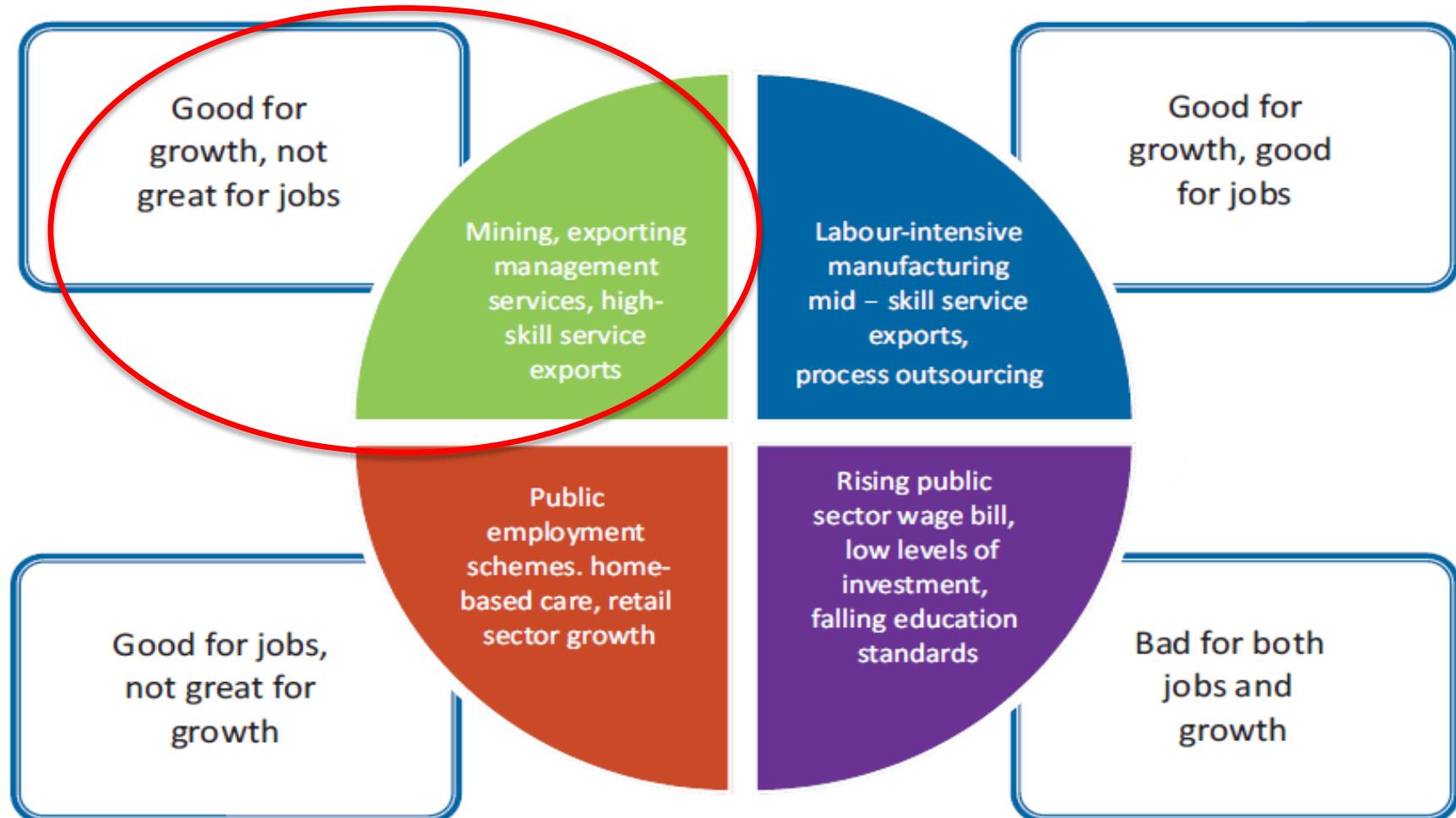
Employee
remuneration

Fixed investment

Introduction: The Opportunities

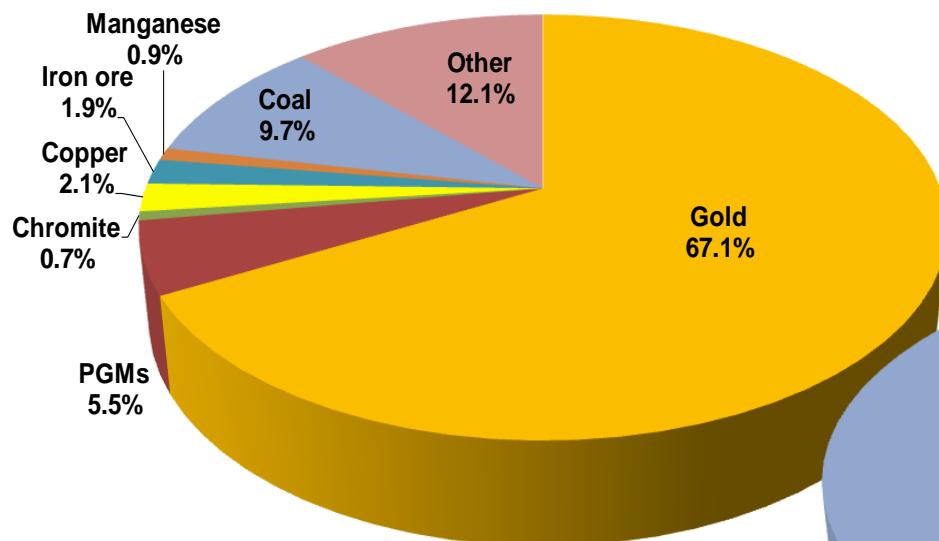
- In the past the South African mining industry has been a recognised innovator in areas ranging from rock mass stability to winder rope design to refrigeration
- BUT
- Currently, the majority of this wealth is sub-economic due to geological, geotechnical and metallurgical complexity – low productivity and at increasing depth!
- Maintaining and creating new jobs in mining can clearly be tied to the potential of bringing these future resources to account
- The National Development Plan recognises the role
- BUT.....

National Development Plan:

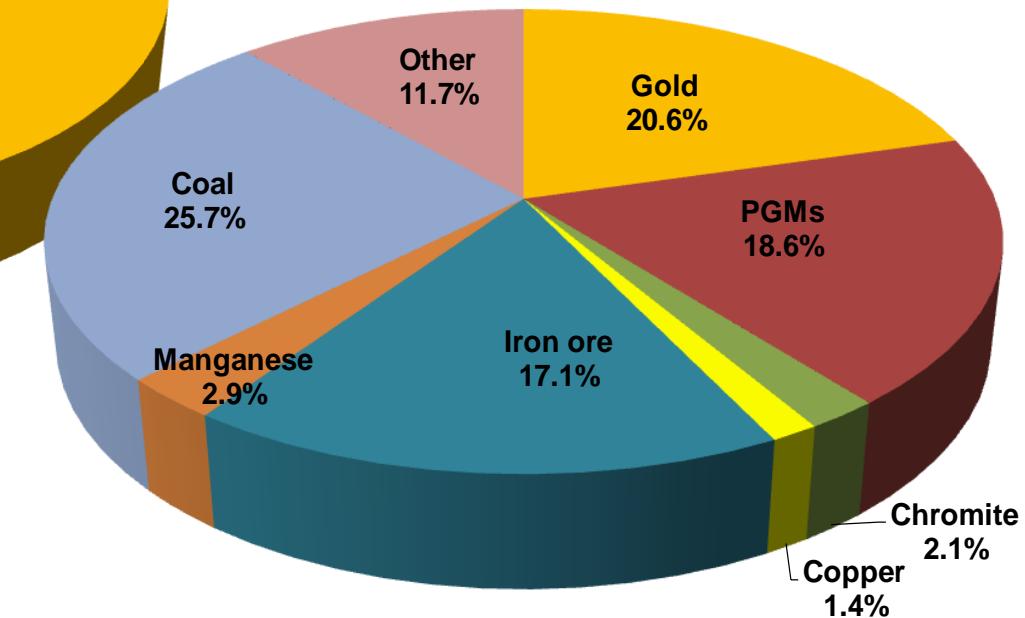


The SA Mining Industry has Changed:

Share in mining industry in 1980



Share in mining industry in 2012

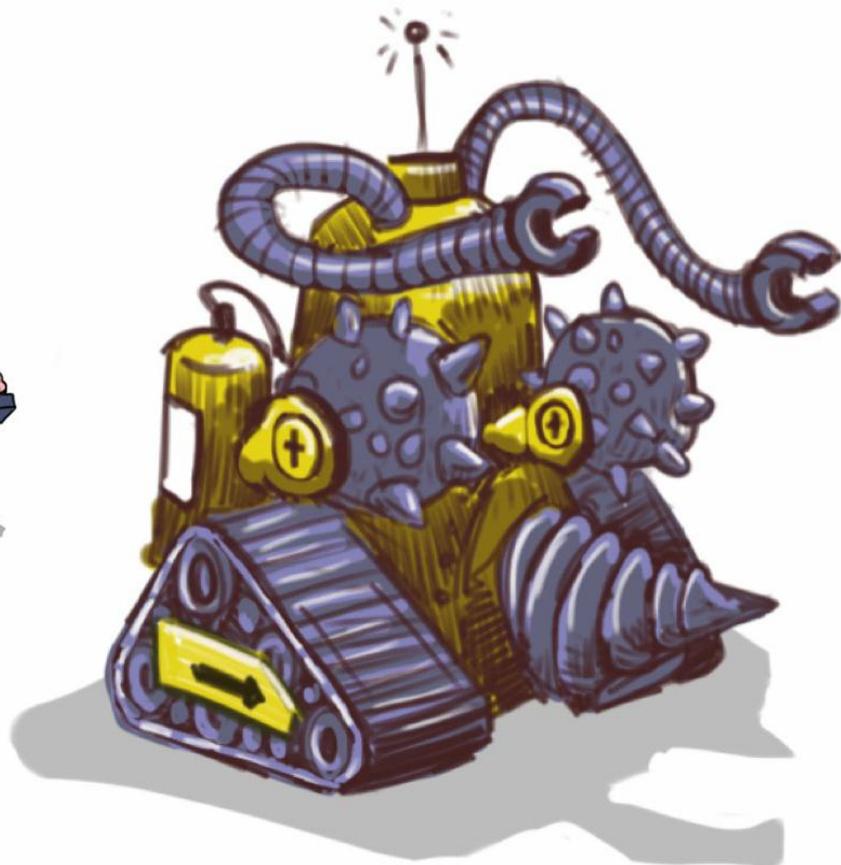


Summary so far: No 1

- South Africa faces considerable challenges in alleviating the real threat of unemployment and poverty that weak economic growth and urbanisation creates.
- Conversely, South Africa is richly endowed with many assets in terms of metals and minerals, agriculture, its oceans, a young workforce and increasingly mobile middle class.
- The opportunity in the mining industry lies in finding ways to better leverage understanding of human behavior to bring to the fore more successfully implemented technologies.
- The opportunity is also to consider what else can be done beyond the immediacy of direct mining jobs such as leveraging the legacy of mining infrastructure as well as developing mining capital goods.

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Do we have Common Language?

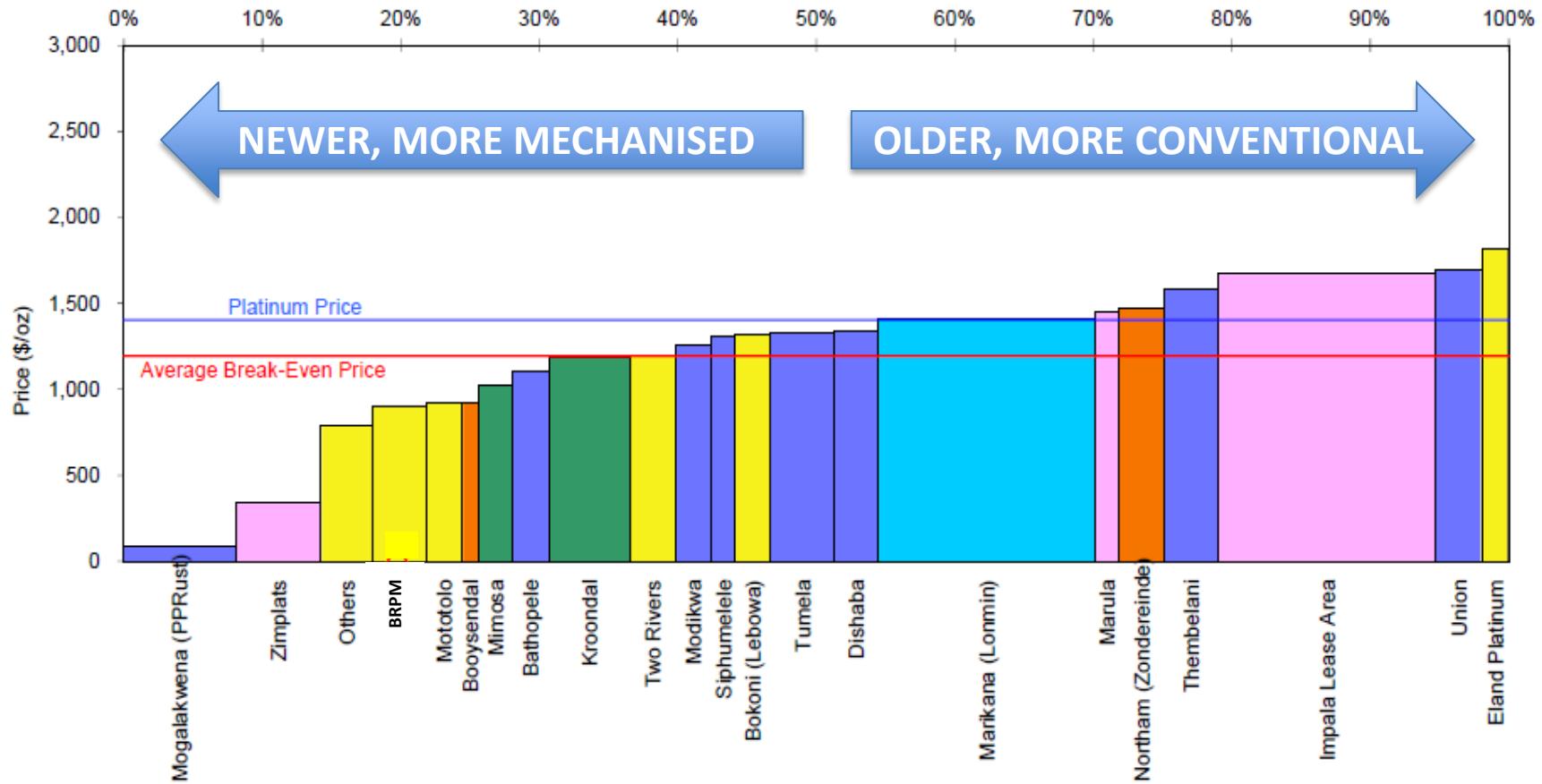
Mechanise: This is the action of replacing some or all aspect of human labour (work) in a process by the use of machinery thereby improving safety and productivity e.g. an excavator. However, machinery can also be used to improve the conditions in which a human works e.g. refrigeration plants.

Machinery: This is an artifact, tool or a collection of human engineered parts which together are used to improve efficiency (performance) of human effort e.g. an axe or a bicycle.

Technology: This is the purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities. It is derived from the Greek *tekhnologia* meaning “systematic treatment”.

**In other words, technology can be said to describe
the way that people get work done – simple; and
that is the meaning of technology that I use.**

The Opportunity Re-stated:

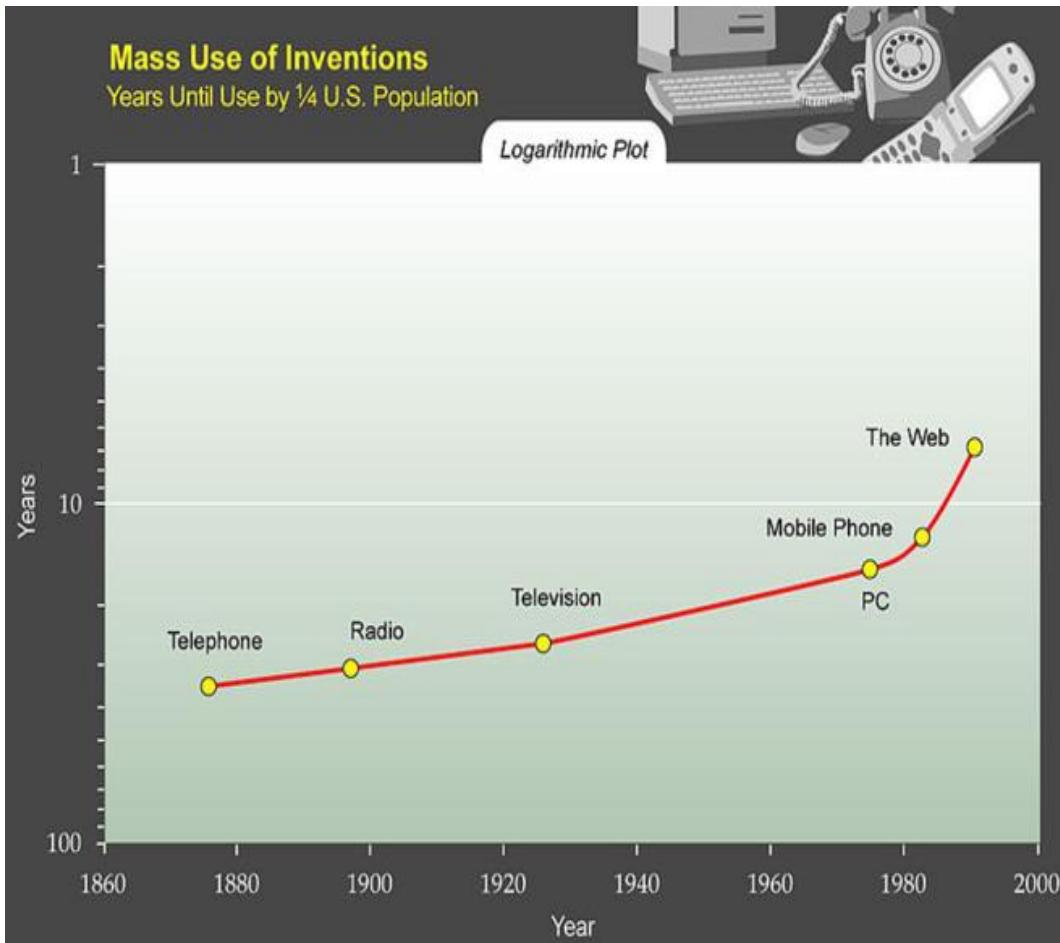


Source: J.P. Morgan Estimates – April 2014

Why this title?

- The point that I want to make is that in the past money has been spent on building machines and not on how to make the implementation sustainable. That requires an investment in technology/systems/behavior
- There is a clear and consistent track record of South Africans successfully rising to the challenges of the day but is this now enough to “Make a Plan”?
- Has there been too much reliance on devising “silver bullet” machines rather than developing new thinking for FASTER implementations through a better understanding of the people and system in which the machines are intended to work?
- The numbers show that the hard rock portion of the SA mining industry has to devise ways to change radically. The solution means working with all stakeholders even more than in the past

The Pace of Change – Has Mining Kept up!



**From invention to innovation
(yrs to 25% US population):**

- 79 – Fluorescent tubes
- 22 – CRT televisions
- 13 – Photocopying
- 04 – The iPod

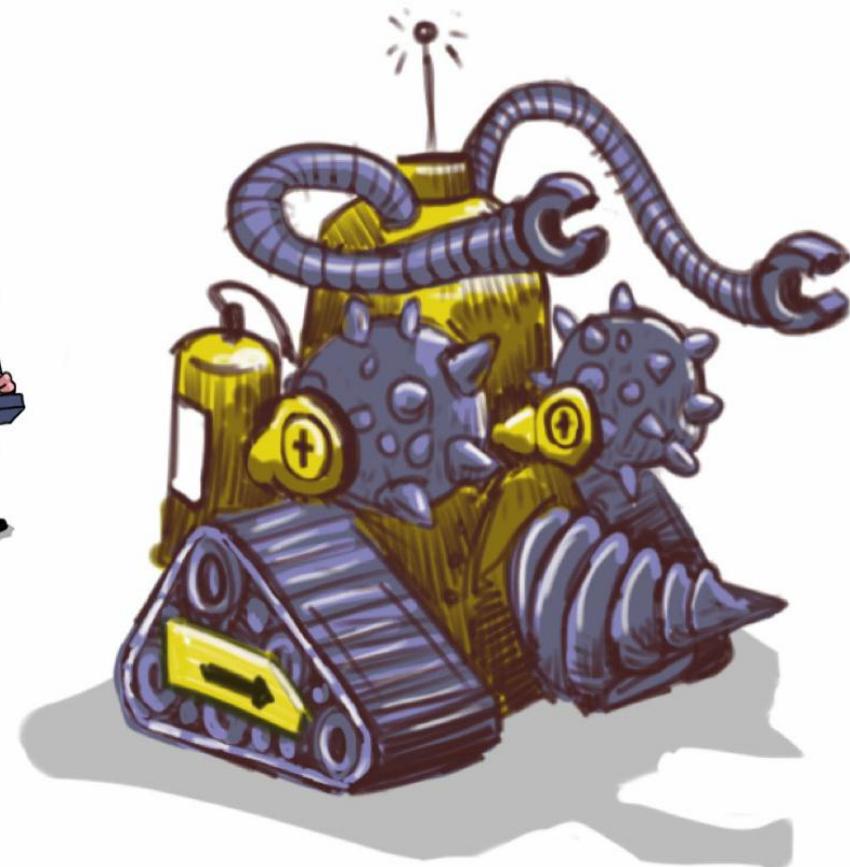
**What about low profile
machines for hard rock
application? Perhaps 20 to 30
years?**

Summary so far: No 2

- Machinery does not equate to mechanisation or automation without the context of both systems design and specifically, people behaviour models
- To say that the mining industry needs innovative technologies actually means that the industry needs new and innovative ways for people to achieve defined objectives
- The speed with which the mining industry is currently able to devise and deliver new ways of working (technologies) is not aligned to its environment.
- This presentation suggests that spreading innovation project resources according to the 40:40:20 moniker has an improved chance of faster and more sustainable results
- We also need to consider what has happened to SA mining research capacity over the past 20 years

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A long list on which to practice!

- Multiple types of blasting barricades
- First use of LHD in u/g reef pillar extraction
- Multiple types of hydraulic props
- New types of timber pack support
- New types of elongate support
- New scrapers and scraper winches
- Emulsion rock drills (95:5 and 98:2)
- Various types of stope face drill rigs
- High pressure water jets
- Diamond wire cutting of ore
- Electronic detonator blasting systems
- Pre-conditioning of deep level stope faces
- Semi and full mechanised development
- Semi-mechanised stoping methods
- Design of alternative stores and maintenance management and delivery systems
- Backfill systems design and implementation
- U/g tracking and communications options
- Vertical shaft sinking projects
- Decline sinking projects
- Establishment of an international company delivering mining technical systems and services
- Design, development and implementation of the first corporate wide, on line mining technical system servicing +2 000 concurrent users
- Various experimental computer system (PlanIT Optim, MineServ)
- Establishment of a materials flow properties testing laboratory at Wits University

High Pressure Water Jets: 90:10:0

- No change to mine design required
- Face layout modified
- 55 Kw electric motors powering system



Need

- Faster more efficient and safer face cleaning

High Pressure Water Jets: 90:10:0

Technology

- Regarded as simple, jetting guns were sometimes dangerous and the issue was pumps.

Technology Transfer

- It just seemed to happen

Surprises

- Incidents
- Gold losses
- Settling and pumping

Habits!

- Early success as it reduced manual effort and removed people from unsafe areas
- The habit of working to complete a task and then going to the “station” meant no real improvement in tonnage output.

Hybrid Mining Methods: 80:10:10

- On reef mechanized access development.
- Conventional stoping
- Mechanised ore transport from face.
- Used on a number of gold mines in the 80's and 90's

Need

- Characteristics of the reef horizon LHD's offer greater flexibility than traditional scraper cleaned ASG's



Hybrid Mining Methods: 80:10:10

Technology

- Used existing equipment and the biggest single issue was dilution from the deep and wide ASG's

Technology Transfer

- Not complicated because of existing technology

Surprises

- Dilution and old mine infrastructure made logistics a challenge
- The high cost per ton stoped was the metric used rather than the more system wide cost per ton milled.

Habits!

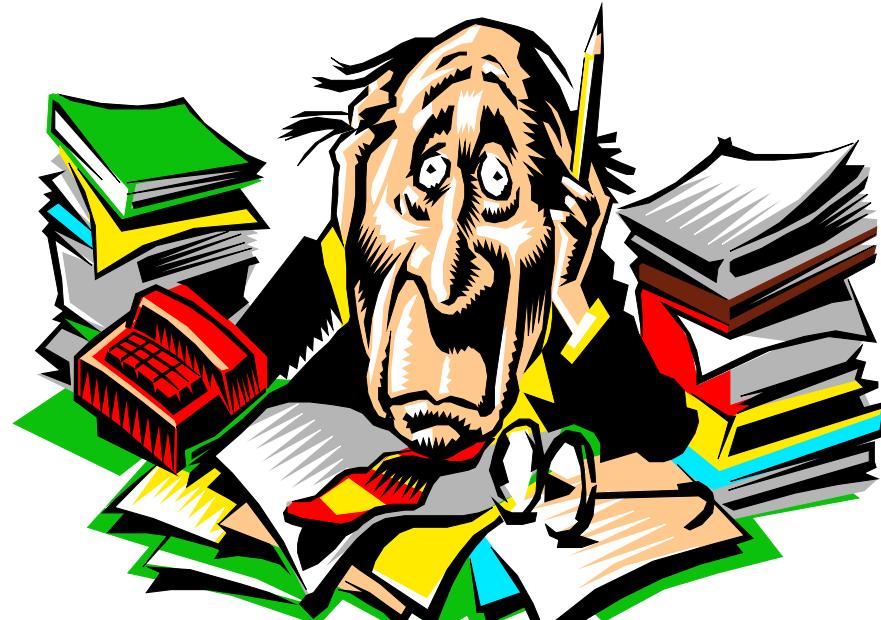
- Machine breakdown or availability became a stock excuse for not achieving planned performance.

Computer Systems Design:60:40:0

- First mainframes in the 1970's at JCI
- CAD tools found application in 3D mining world
- Complex mathematical modelling (APCOM)

Need

- Replace paper based planning in tabular hard rock mines to increase “what if” capability.



Computer Systems Design:60:40:0

Technology

- Development of database techniques that allowed for full data manipulation in a 3D graphical interface providing an on-line environment available to multiple users and mobile devices

Technology Transfer

- Considerable effort was invested in training, implementation and change management but some managers got left behind

Surprises

- Managers not able to demand performance from users
- Facilitated the advanced levels of mathematical complexity used by the mining industry

Habits!

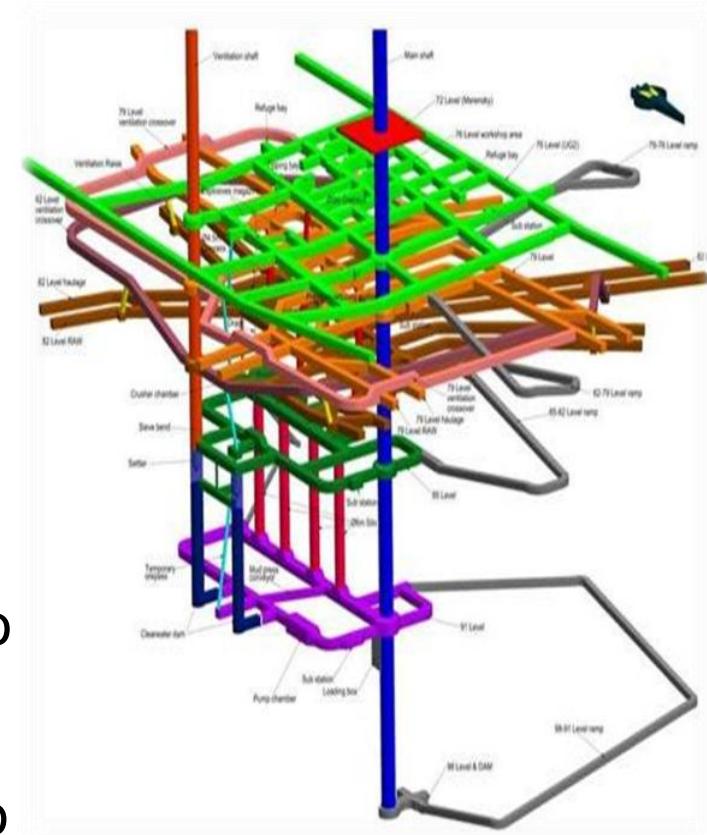
- Virtual mining environments with virtual dashboards created too many theoretical plans. Happily, this is changing

Semi-Mechanised Development:50:40:10

- the length of time in which there are large cash outflows before revenues start to accrue from the production build-up
 - Track record of build-up profiles not meeting design targets

Need

- At what was called the Freddies No 1 Shaft Project (Tsepong North); how can development crews be recruited, trained and brought up to full productivity in the safest way possible



Semi-Mechanised Development:50:40:10

Technology

- Development by drill rigs (initially) and LHD's
- Key to the successful execution of this project was in recruitment policy

Technology Transfer

- Recruitment was done on a top-down basis
- Crews were on-site going through induction and training up to two months ahead of deployment

Surprises

- Did not work with shaft crews
- How successful the programme was with development teams

Habits!

- Repetitive training in an environment that built teams and new habits

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Basis of the 40:40:20 Moniker:

The format of the moniker is: **X:Y:Z**.

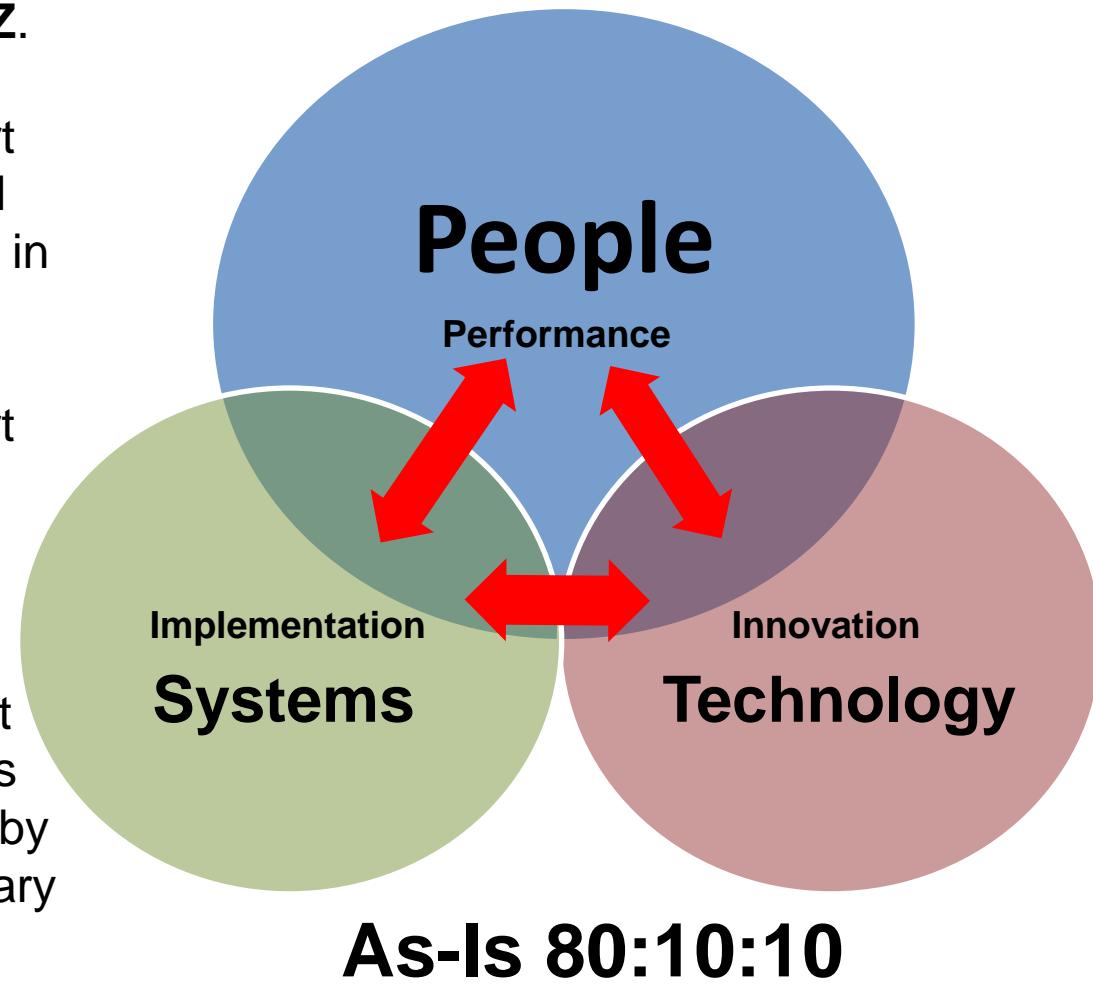
Where

X = an expression of the total effort to design and build the engineered component of a project. Measured in monetary terms. The **Technology**

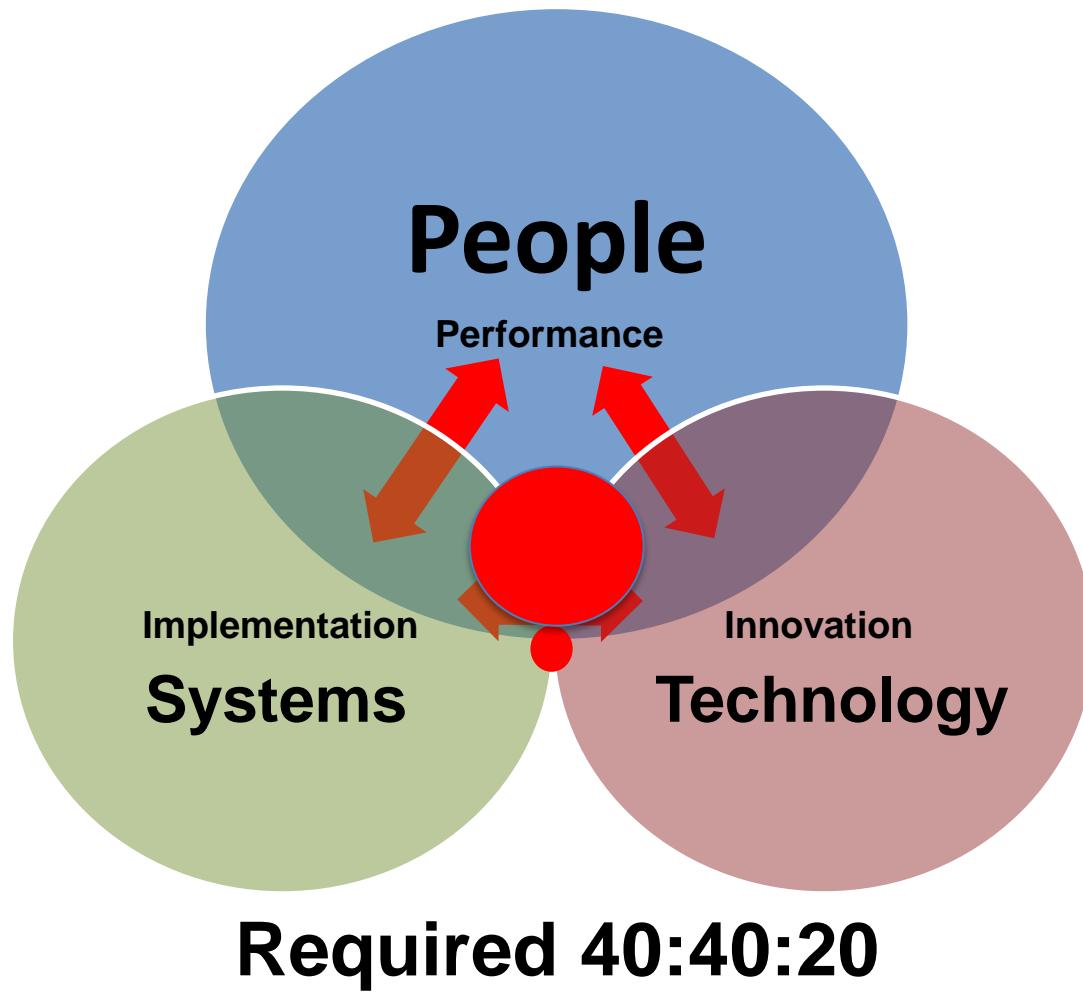
Y = an expression of the total effort expended in implementation. Measured in monetary terms.

Change management or **Systems**

Z = an expression of the total effort expended on stakeholders in terms of driving usage and performance by the executive, measured in monetary terms. **People**



Basis of the 40:40:20 Moniker:



Why technology often fails (the short list):

- **Systems Engineering**
 - Our industry still suffers from a “siloed” approach to project design
- **Human Factors**
 - As engineers we tend to avoid the importance of doing a thorough design for people systems
- **Organisational Maturity**
 - It does happen that there are instances where the project is not aligned appropriately with the parent organisation
- **Stakeholder Analysis**
 - Are the main sponsors of the project truly committed for the long-haul?

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Preparing for the future:

- Develop a common language
- Move from 80:10:10 project design to 40:40:20
- Nurture new-style leadership
- Understand culture of decision making
- Multi-stakeholder collaboration
- Orebody specific solutions

One of the issues is that SA does not have 20 or 30 years to identify and develop a silver bullet! It has to work with what can currently be envisaged. And meet job expectations!



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Concluding Remarks:

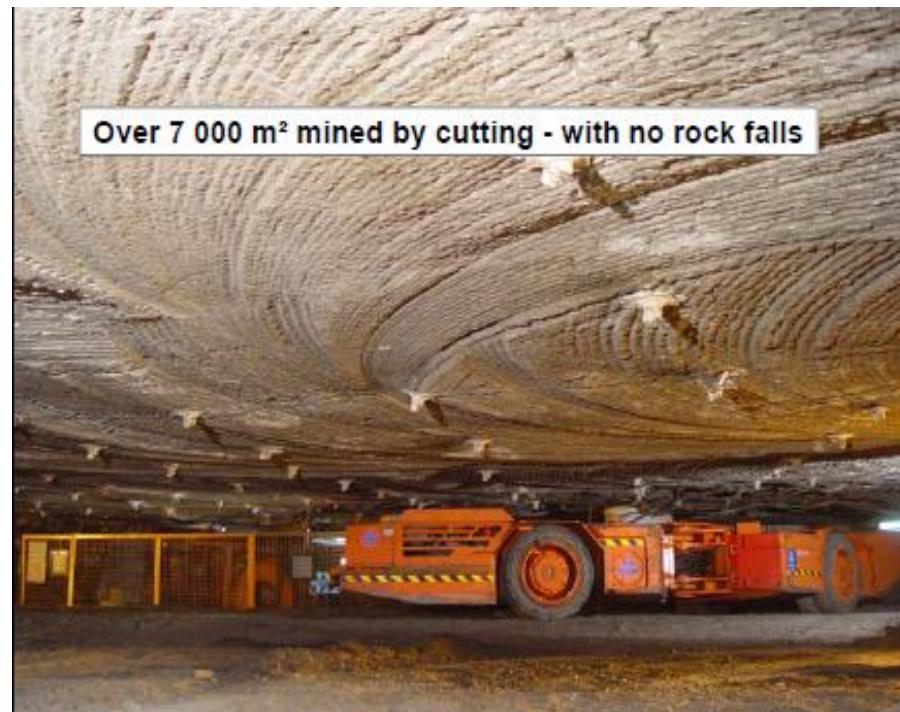
- The debate on resource nationalism is to be encouraged. It keeps the needs of the mining industry front and center with the interests of all stakeholders
- South Africa has a proud and successful mining heritage with world class resources still unexploited
- The pace of change in just about every aspect of our lives continues to accelerate amid increasing complexity, in part driven by the world heading towards 10bn people
- In order to weather changes, the speed or rate at which projects are successfully executed must improve
- One way that this presentation suggests is for there to be a focus on the design and budgeting of project implementation

Concluding Remarks:

- On the basis that experience indicates too great a focus on ‘build’ and insufficient focus on change management and leadership
- Planning based on the 40:40:20 moniker leads to closer business and systems integration between People, Processes and Technology
- This is the basis for quicker turnaround in the implementation of new technologies as it recognises that people’s behaviour must change as a result of the new technology investment
- Lastly, the broader subject of stimulating employment in the mining sector can be stimulated through (E.g.):
 - Incentivising capital goods manufacturing
 - Government incentives to stimulate regional growth based on mining infrastructure

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Acknowledgements:

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- Innumerable people all over the world in this wonderful industry called 'mining' who have shared thought and experience over the last 40 years.
- Rod Pickering who has been the undiluted champion and evangelist of mechanisation in hard rock mining from day one.
- JPMC (Pty) Ltd for contributing my time
- My wife of 33 years Sandy, who has totally given up on me.....untold thanks for your support.

THANK YOU

