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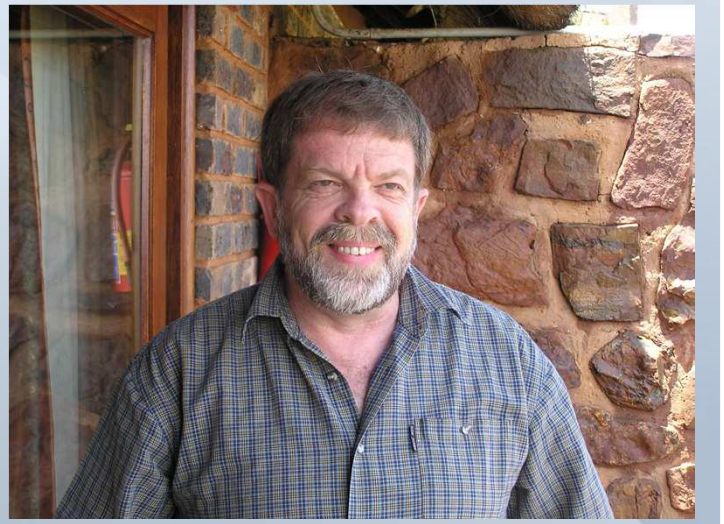
An Eccentric Practitioner's story of 15 years of TOC Implementations in the Mining Industry

Arrie van Niekerk, Tavanec CC, South Africa

22 May 2014

Arrie van Niekerk

Arrie van Niekerk obtained his B Eng (Metal) from the University of Pretoria in 1978 and was trained as Jonah in 1993 and Jonah-Jonah in 1998. He was the project leader for the implementation of TOC in more than 60 mines and 15 manufacturing companies in South Africa and has 15 years practical experience in this field.



His key strengths are:

- Recognized expert in the application of TOC applications
- Developed unique solutions for enhanced Production Flow in Mining
- Process facilitator on TOC and change management
- Skilled facilitator of Open Dialogue and Team Development as enabling processes

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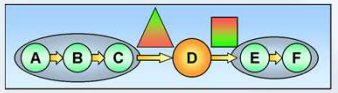
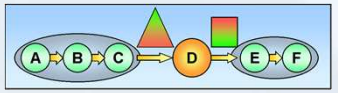


The following is a mosaic of several practical implementations of TOC in Mining Operations. Over the years, a repetitive pattern evolved and this story strives to portray that picture. It is a story of phenomenal results and achievements by some daring and dedicated role players in some of the most challenging working environments in South Africa. The essence of the story is true; although the names, places, some figures and actual data have been modified.

I will tell it as a single story, but please remember that it represents more than one application

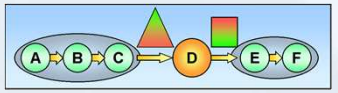
Prepared and Presented by Arrie van Niekerk

Context of the Story



- **Typical Deep, Narrow Reef mining in South Africa**
  - Up to 3700m below surface (2km below sea level)
  - Reef width <2m
  - High rock temperatures (up to >50ºC)
  - Manual drilling of blasting holes
  - Explosives to break the rock,
    - 1 blast per day
  - Vertical Shafts for People & Material
  - Seismic events regular
  - Every mine / shaft UNIQUE

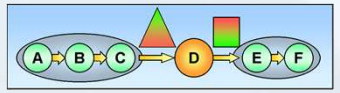
Results Achieved

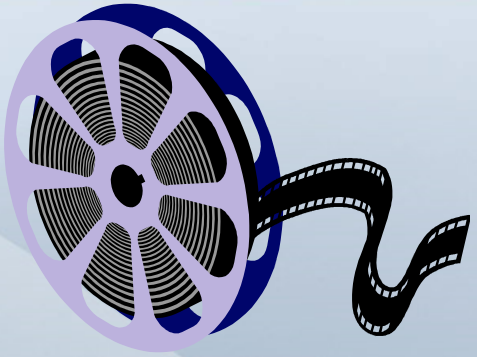


- Results documented:
  - Mine A: Increased from 6500m² to 10700m² in 9 months
  - Mine B: Improved from 10500m² to 16000m² in 6 months
  - Mine C: Improved from 9500m² to 14000m² in 9 months, then improved to 16000m² in another 4 month exercise
  - Mine D: Increased Production from 150kt/m to 200kt/m

What follows is essentially their story

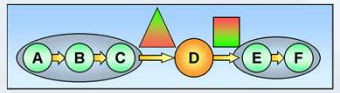
Leeukloof Mine Story





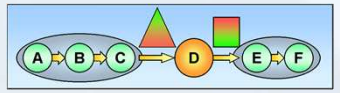
- Gradual reduction in output
- Average ore grade going down – mining on extremities of ore body (6 km)
- Leadership style: Dominating autocracy, “The more the pressure, the better the performance”
- Culture of Finger pointing, Fire fighting, Blame shifting
- Low morale
- **Average for previous year 9500 m^2**

Initial Engagement



- TOC proven “Recipe for Success”
- Initial Senior Team training in TOC
- **Stoping constraint(s) identified**
  - Available Face Time
  - 65 Crews
- Many actions identified
- Implemented Daily War Room
  - Went through motions but virtually no effect
- Manager approach: “They don’t want to”
  - Long hours (06:00 – 18:00)

Example - Solution Design: Stoping Constraint



Development
Trigger
Pay Face Length
Structural info
Q
Panels
Panels Blasted per day
70%
Equipped Panels
Ventilation
Compressed Air
Total Water
Stoping Panels
Panel Crew
Panel Crew
11 days
8 days
70% Blasts/day
6,0 hours
4,5 h
Daily Routine 1,5 hr Buffer
Skills Buffer
Trigger
Fully Functional Team
U/G Stores
Trigger
Shaft Stores
Other
Timber
Material
Critical Equipment & Machines
Empty Gullies
Stope Boxes
Men & Material
Reef
Tramming
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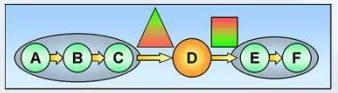
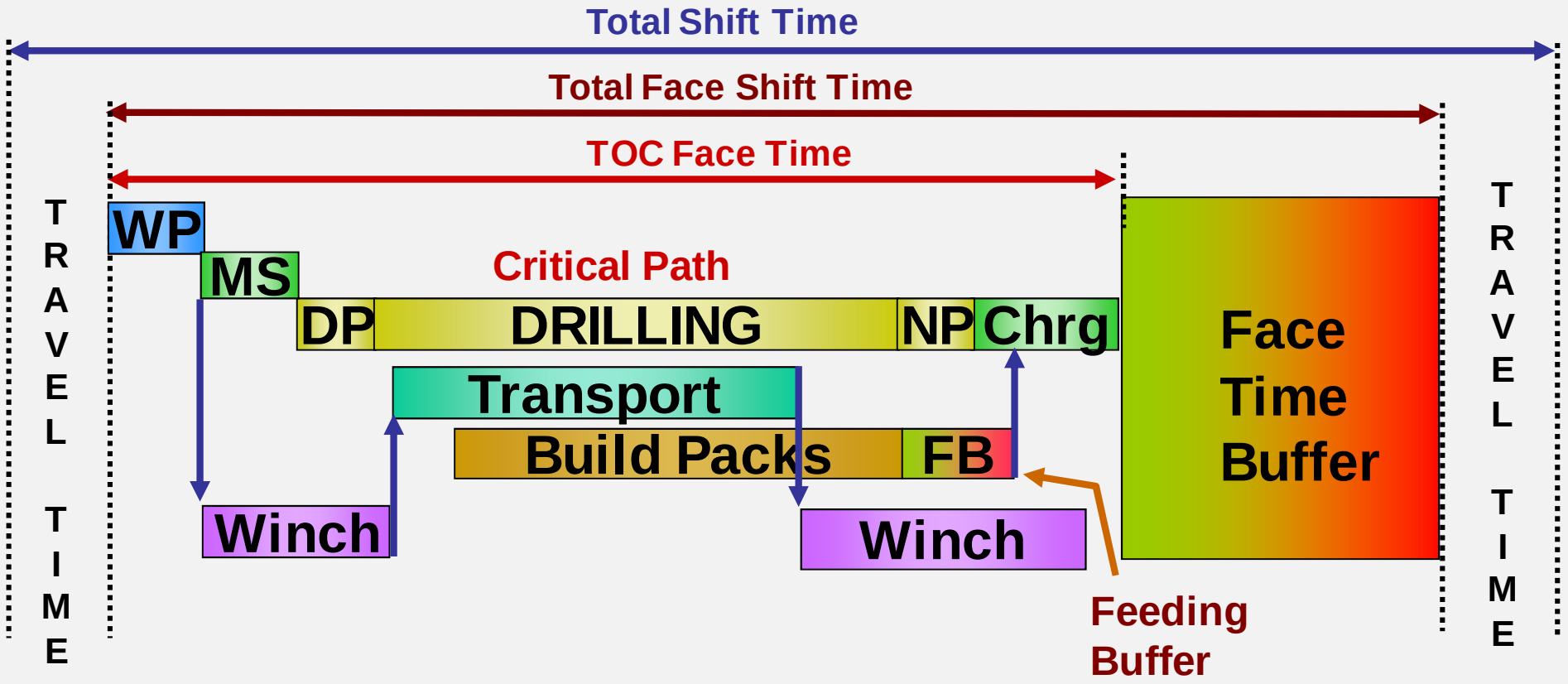
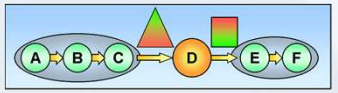
Development Ends
Tramming
Sub#
Waste

Buffer Management in a Stope, Day Shift



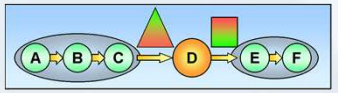


Insights



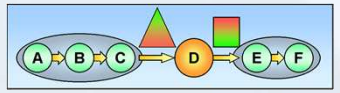
- Dealing with Symptoms
  - Stoping = **Perceived** Constraint
- Deeply entrenched Local Optima
  - System driven restrictions (e.g. Budget controls)
- Logistics of People and Materials
- Hindsight: **Leadership "Constraint"**
  - Lack of good leadership
  - Lost the will to perform
- **More of a people issue than the physical reality**
  - Mental Models, Behaviour

Turning Point: People Intervention 1

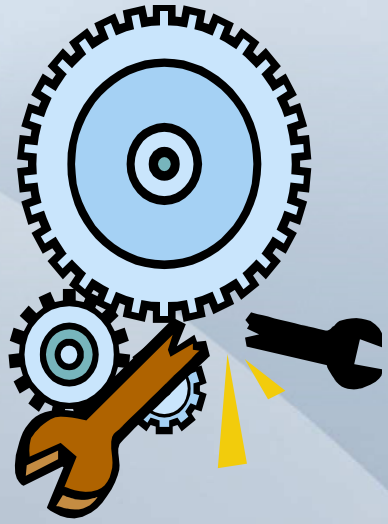


- **Senior Team development activity:**
  - **2 Days off site**
  - **Experience own behaviours in "game"**
  - **Mine Overseers marginalised**
- Working together as a team
  - "Our shaft" (took full ownership)
- Focused efforts:
  - Daily War Room
  - Operational deployment focus
  - Reporting each stope's performance
  - Stand-by Rock Drill Operators and Winch Drivers
  - Rock drill replenishment system

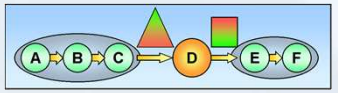
Second Engagement: Constraints Tramming & Available materials

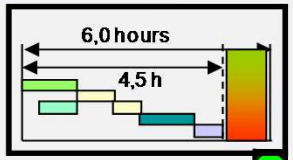


- **Long travelling distances (Tramming)**
  - **Available face time 3,5 hours**
  - **Man Carriages to working places**
- **Tramming shuttles**
  - "Double Handling"
- Level stores & Working place stores
- Winch repair workshop underground
- Batteries replacement
- Hopper repair shop on surface
- Crew sizes adjustments (out of box)
  - Achieved 754m² vs standard of 420m²



Example - Solution Design: Tramming Constraint





Daily Routine
1,5 hr Buffer

Material & Explosives

U/G Stores

People

Buffer of available skills

Buffer Loco Drivers

Tramming Crews

Stoping Panels

Stope Boxes

Timber Cycle

Timber Cars on Surface

Timber

Rate t/d

Shaft Schedule

Shaft Stores

Reef

Timber

People

Material

Waste

Man Carriages

Development Cycle

Drill

Blast

Clean

Tramming Bottleneck

Tons Trammed

Maint Skills

Spares

Hoppers

Locos

Engineering

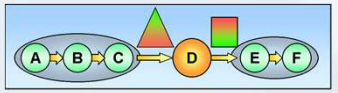
Regular Services

Preventive Maintenance

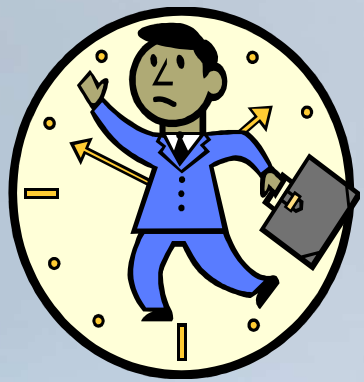
Haulage Conditions

Rail Maintenance Crews

Man Carriages (Trains)

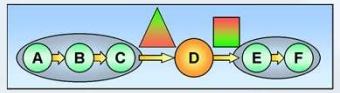


- Refurbished man carriages
- Fixed the rails, switches, tramming schedules
- Embarking and disembarking
- Every crew delivered to their working cross cut and collected in afternoon, every day
- Increased face time by up to 1,5 hours



Performance up to 12500m²

People Intervention 2



- One day Production Supervisors exercise
  - Tracking metaphor (Flow & Interdependence)
- Coaching on Dialogue (How we talk)
- Lists of actions to be taken
- Training of low performance crews
  - ICU Crews: Stores, mock-up training
- **Coffee shop "interview" with MO**
  - **P/S's "listened in"**
- Next level of performance

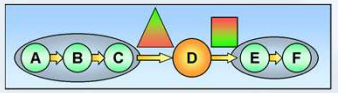
Performance up to 14000m²

Project 16000

- Visionary project to improve further
- Pillar Mining Workshop – 2 days
- 1,5 Hour meeting every week for 2 months
  - Each Head of Department one slide, 5 Points
  - SMART Goals
  - No standard job description stuff
  - Thinking beyond the normal
- After 3 weeks, “real” contributions started:
  - Ventilation full review
  - Accurate prediction of m² from daily hoisted tons

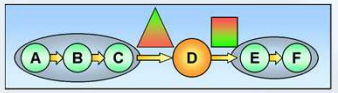
Achieved 16000 m² before official launch

Rewards for Excellence

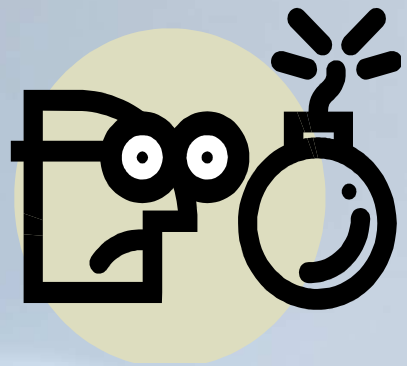


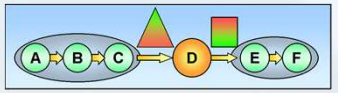
- Best performing shaft for 2 years
- Internal promotions of P/S's to MO
- Rewards in the group
  - Safety, productivity, profitability, etc
- Top Executives visit:
  - War Room, Underground stores, Man Carriages, Winch repair workshop
  - Turned a blind eye towards crew size
  - No interference from Executives
- **Lights off at 15:30**

Sad Ending



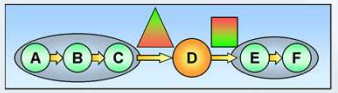
- Manager and MO's promoted
- New manager arrived.
- Day 1: **"I will teach you how to mine MY way"**
  - Closed all underground stores
  - Introduced strict Cost & Budget controls
  - Stopped tramming shuttles
  - Cut crew sizes to "standard"
- Within only a few months, the production dropped to below 7000 m²





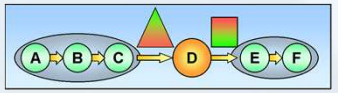
Lessons from Success Stories

Characteristics of Success: Operations



- Effective Reframing from Balanced Capacity towards Optimised Flow principles
- Constraints identified and very well managed
- Everybody focused on the FLOW of the whole
- Buffering everything that can hamper the flow
- Protective capacity - very well protected against Murphy
- Constructive framework of regular meetings
  - Technical Planning, War Room, Weekly Tactical, Reflection
- Very clear distinction on the cost of not producing vs expenditure
- Local cost focus is only done to satisfy the bigger system

Characteristics of Success: People



- Daily War Room activity, in a good spirit, all the relevant departments involved – Making good decisions
- Cooperation between departments and individuals (No silos)
- Culture of making it easier for people to perform
- Mutual respect and a spirit of calmness is evident
- Positive, winning spirit that is almost tangible
- Open Dialogue observed in most meetings and interactions
- Regular Reflection: Culture of Learning together, Mutual caring, Honesty and Openness
- Team work: Creating an improved environment together
- Constantly work with the bigger picture, longer term view

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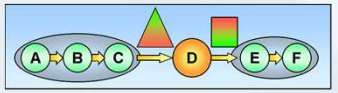
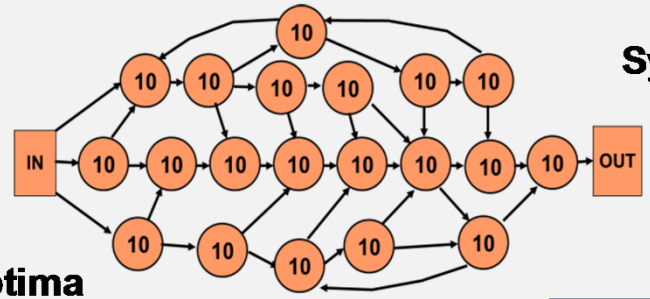
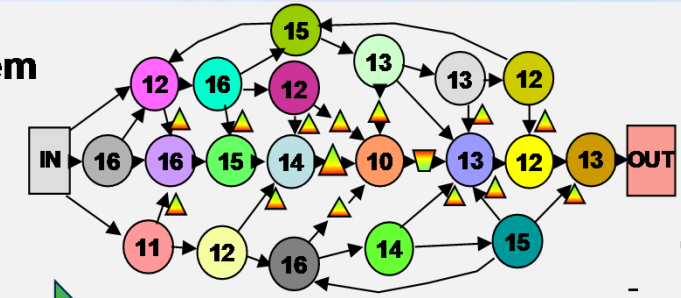
Strategic Intent with TOC Initiative





System

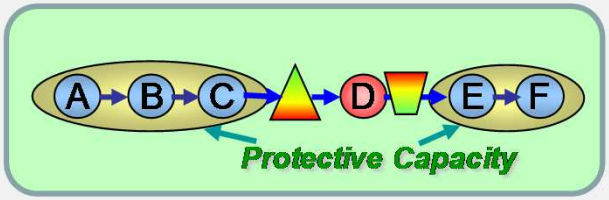


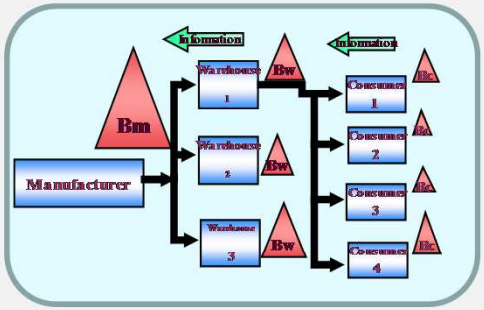
World of Local Optima

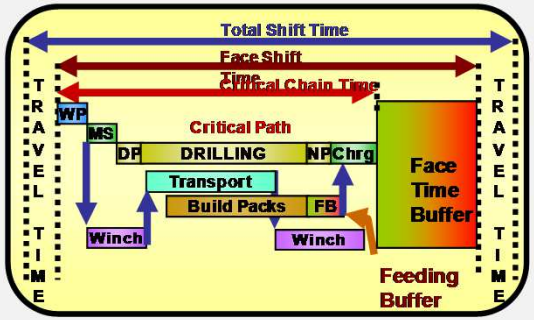
- Efficiency
- Statistics & Formulas
- Simple rules
- Physical

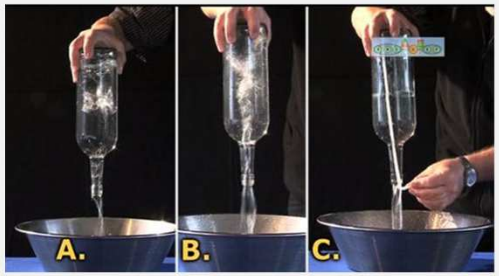
World of Optimised Flow

- Flow
- Bottlenecks & Buffers
- Interdependence
- Logistics & People









3 Bottles

War ROOM (Daily management system)

- Focus on Immediate Future
- Good Visibility
- Pro-active / Creative
- Behaviour / Culture