

The Phu Kham (PKM) Minesched Journey



GEOVIA Users Conference – August 4 2016



PHU BIA MINING

PanAust Limited Company overview

- PanAust Limited (PNA) is an Australian incorporated copper and gold mining company with:
 - Two operational mines in Lao PDR – Phu Kham Copper-Gold Operation and Ban Houayxai Gold-Silver Operation
 - A world-class, large resource growth project in Papua New Guinea – Frieda River Copper-Gold Project
 - Ongoing exploration activities and interests in Southeast Asia and South America
 - A logistics and supply network in Vietnam and Thailand
- PNA is a wholly owned subsidiary of Guandong Rising Assets Management (GRAM), a Chinese state-owned enterprise.
- PNA's Lao-registered subsidiary, Phu Bia Mining is 90% owned by PanAust and 10% owned by the Government of Lao PDR.
- PNA was fully acquired by GRAM in mid-2015 and subsequently delisted from the ASX. GRAM had been a cornerstone investor in PNA since 2009. The acquisition was smooth and completed without interruption to the business. GRAM is very supportive of PNA's vision, values, and operational and growth objectives.



Our Lao Operations

Phu Kham Mine:

- Extracts copper metal along with gold and silver by-product credits from a sulfide orebody
- Utilises conventional open-pit truck shovel operational mining methods
- The largest open-pit mine in Lao PDR
- The process plant Concentrator upgrades the metals into a saleable product ie +0.5% copper in ground concentrated up to 23% copper in concentrate by floating and recovering the valuable metals
- The concentrate is hauled by semi trailer to ports in Vietnam (80%) and Thailand (20%) for subsequent shipment to smelters around the world

Ban Houayxai Mine:

- Produces gold doré bars along containing a silver by-product credit
- Utilises conventional open-pit truck excavator operational mining methods
- The process plant using the conventional Carbon-in-Leach extraction technique
- A signatory to the ICMI International Cyanide Management Code



Mine locations



Resources

- Cost effective and plentiful water, power, and personnel resources
- Good site access road
- Both mines located close to each other enables sharing and aids in minimising duplication of services, equipment and inventory
- Lao situated near major industrial bases in Southeast Asia
- Well-established and proven business unit



PKM Operations – what we do

Mining Open Pit

- Owner operator fleet moving 55 million tonnes per annum using:
 - 53 x CAT777D 100t trucks,
 - loaded by 5 primary loading units; 3 x PC3000, 2 RH90 and 2 PC 2000 excavators
 - Fleet of ancillary gear CAT D10T, 16M, ADT 740s, drills DM45s/L7s
- Real time fleet dispatch system (Jigsaw) from central mine and process control room
- Owner maintenance model, fleet and component rebuild facilities saving \$1m / month
- Advanced geotechnical and hydrological services on site, including real time radar



BHX Operations – what we do

Mining Open Pit

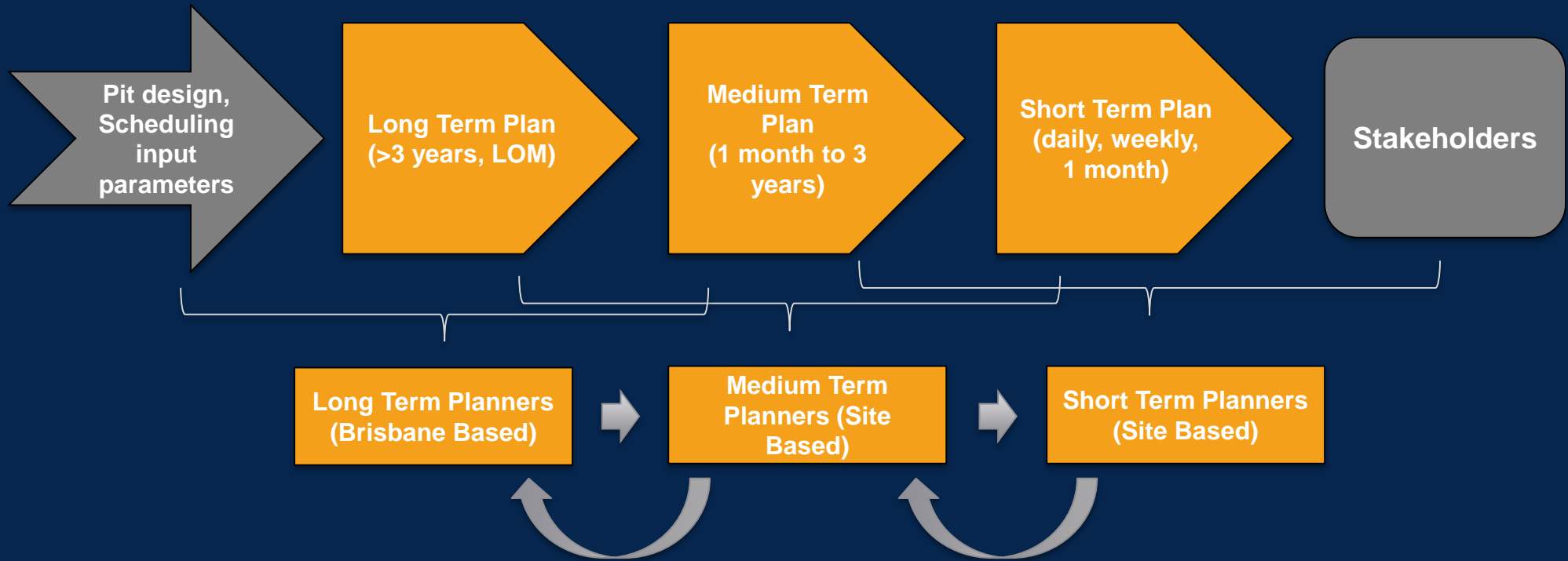
- Conventional open-pit truck and excavator
- 3 X PC1250 Komatsu excavators and 7 X Cat 777D haul truck

Process plant

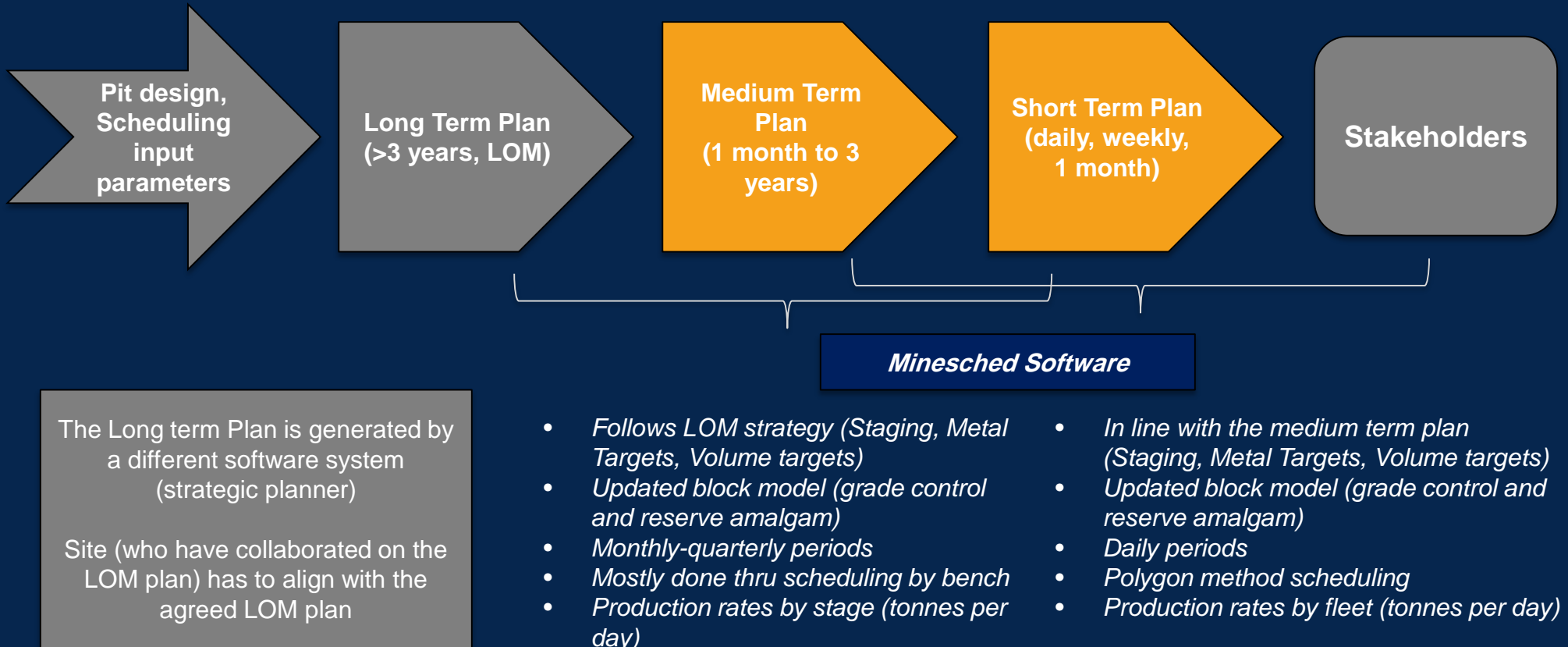
- Carbon-in-Leach process plant
- Certified and accredited to International Cyanide Management Code



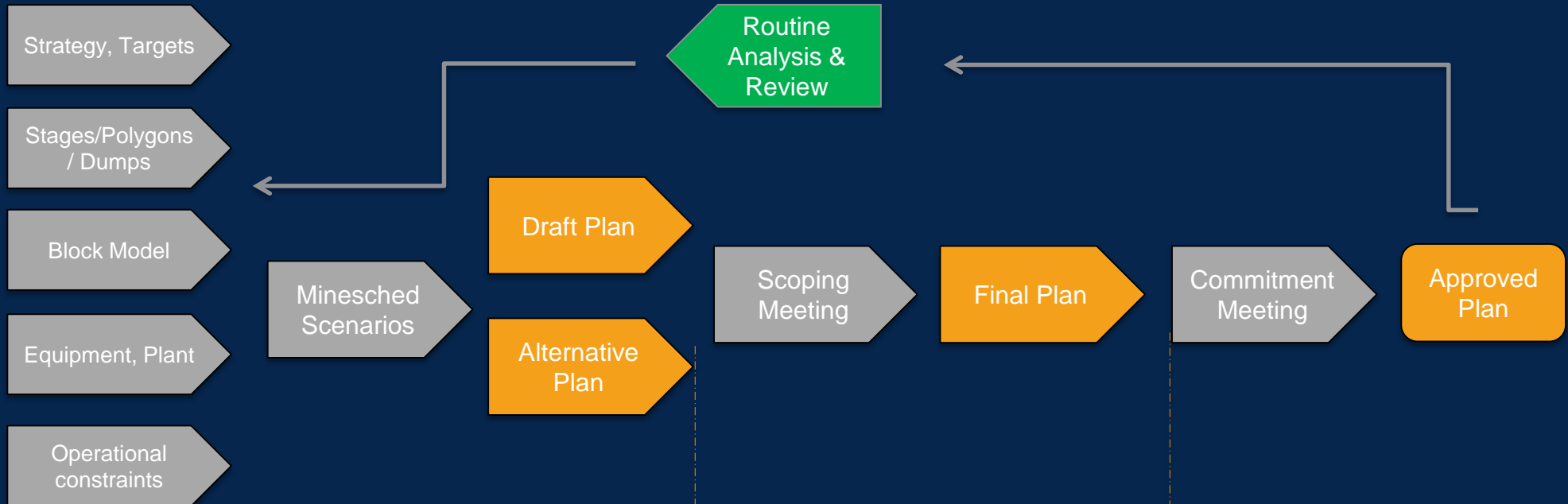
PBM mine planning system/process



PBM Minesched



PBM mine scheduling process



Everyone is involved

- Strategies and targets are driven by long/medium term plans
- Stages, polygons and block models are engineering, geotech and geology inputs
- Equipment inputs are provided by maintenance sections
- Operational constraints are captured during pit tours, discussion with pit supervisors and actions from previous performance reviews

Everyone reviews

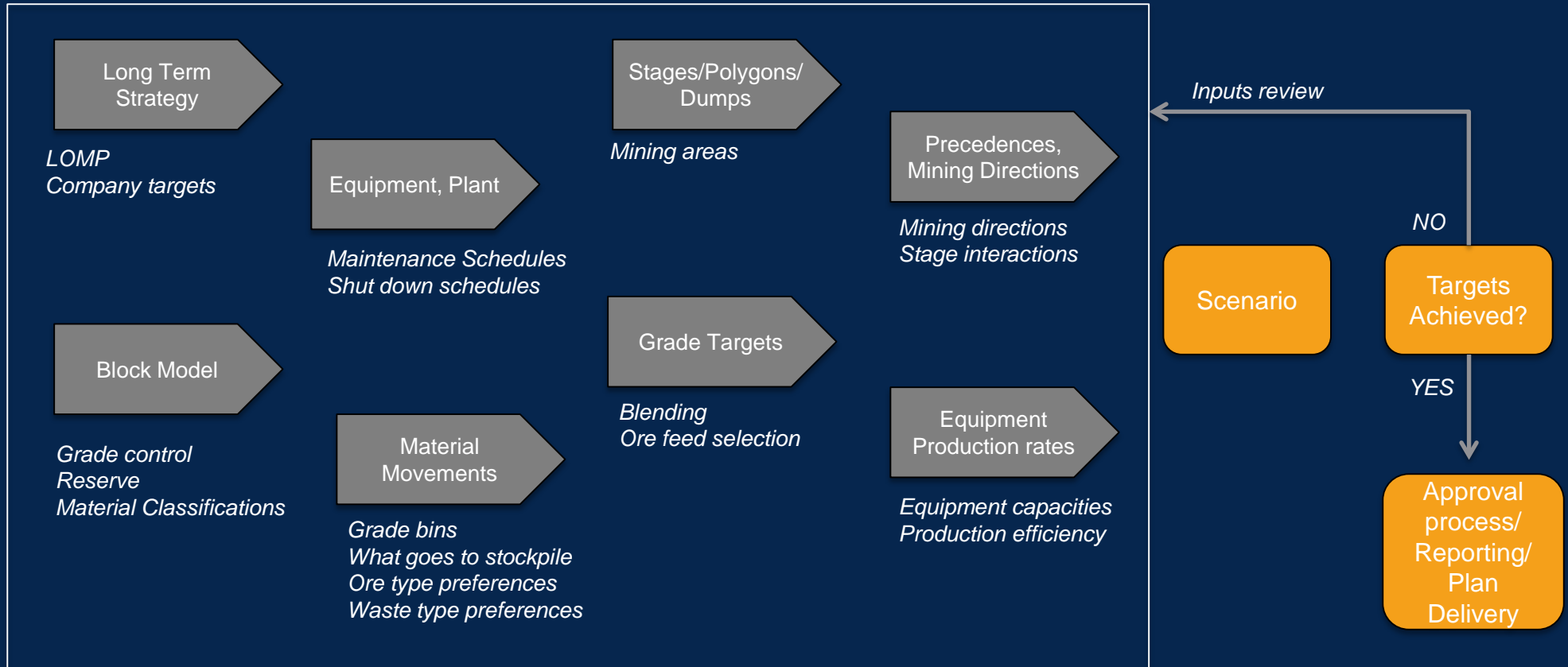
- Confirming target is achieved
- Review of inputs
- Review of resulting plan
- Discussion of risk and opportunities
- Actions if required

Everyone commits

- Plan signoff
- Acceptance of KPIs



Typical Minesched scenario inputs



Minesched scenario results

Physicals

Tonnages

Grades

KPI targets

Other material attributes

Mining Locations

Pit faces

Dump and stockpile

Movement and timing

Development sequence

Production targets per stage

Material routes

Risks and opportunities

Grade spikes

Vertical rate of advance



Two different mine sites One scheduling software

Phu Kham

Bulk Mining Operations Copper - Gold

PKM Minesched

- 10m benches
- Ore blending (commonly copper and arsenic)
- 6-7 shovel/excavator fleet
- 51 Trucks CAT 777
- 2-3 waste dumps
- 2-3 stockpiles

*Different scheduling styles
Different block models
Different users*

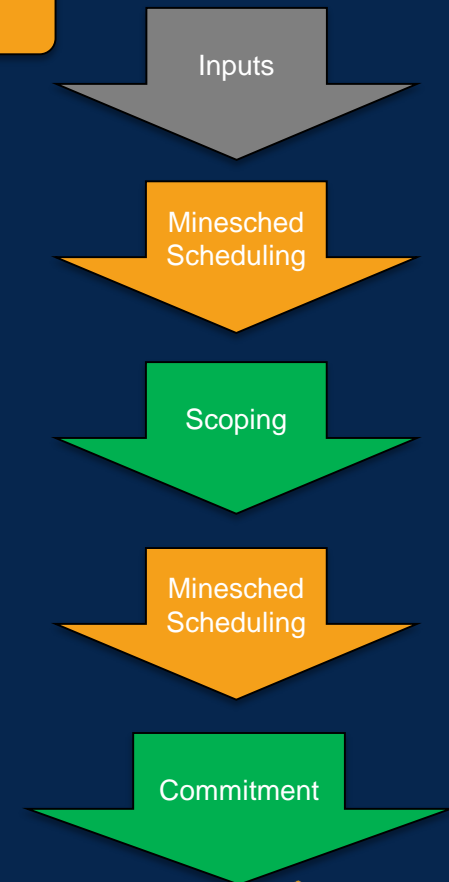
*Similar mine planning process flow
One Production Management System
Similar Management Summary Reports
Common goal*

Ban Houayxai

Selective Mining Gold - Silver

BHX Minesched

- 3.25-3.5m flitches
- Strict ore blending (gold and hardness)
- 3 excavator fleet
- 7 trucks CAT 777
- 1 waste dump
- 2 stockpiles



From short term scheduler to >5year budget scheduler

HOW PBM SUCCESSFULLY USED MINESCHED AS LONG TERM SCHEDULER?



- *Good understanding of the medium term and long term strategy*
- *Good relationship and collaboration of short, medium and long term planners*
- *Compliance checks are done (weekly, monthly, budget) to regulate deviation from the long term strategies*
- *Proper use of software's strengths and weaknesses*

WHY MINESCHED?

- *The mine planner has maximum control of the scheduler (location scheduler vs strategic scheduler)*
- *Plan detailing - smaller scheduling periods, more defined scheduling sequence*
- *Allows to incorporate short to medium term opportunities*
- *Software consistency – Geovia (Surpac) environment*

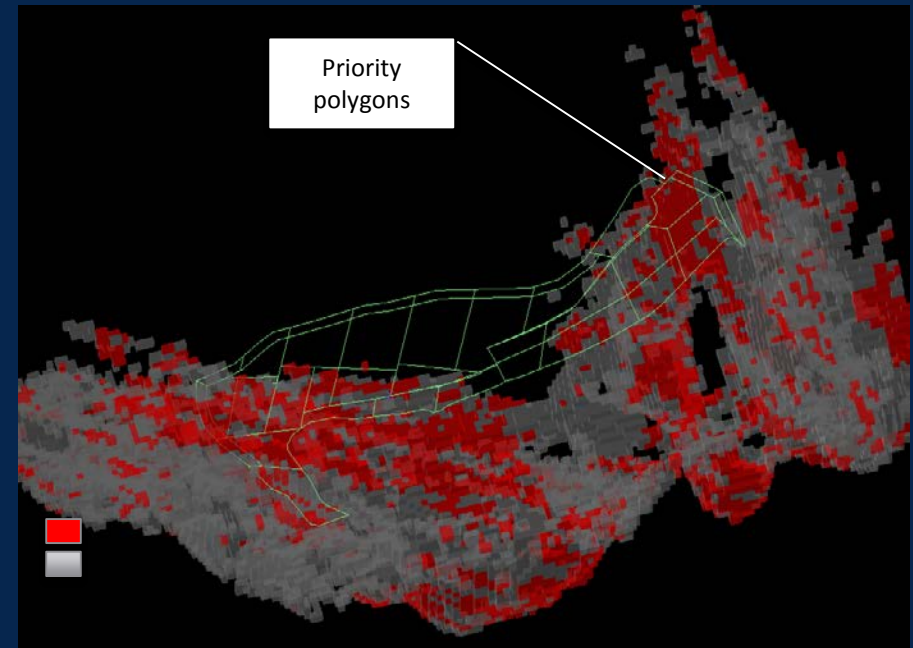
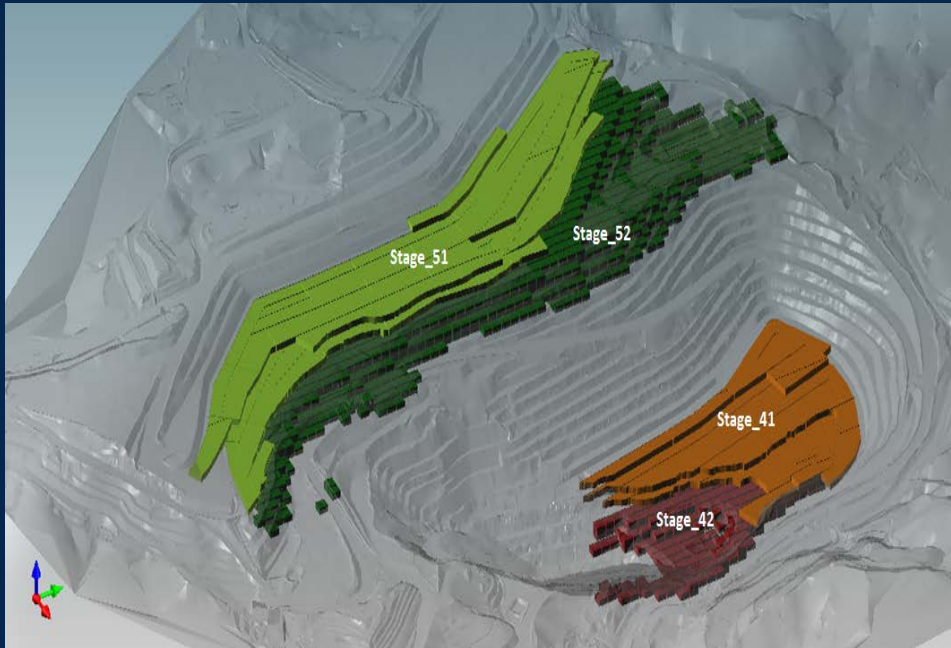


Mine scheduling in a changing environment PKM cases

In late 2014 and 2015, PKM has required a very specific mine development to produce more copper and compensate for the falling metal prices

Solution:

- Used mining polygons to schedule the full year forecast (polygon scheduling allows to selectively mine high grade blocks or more mining emphasis in ore areas)
- Short term schedule complying to forecast
- Mining operations complying to plan



Mine scheduling in a changing environment PKM cases

A couple of days late 2013 and early 2014, the mine has encountered significantly hard ore in short periods (hour to a shift production) which slowed down mill throughputs by 25%

Solution:

- ✓ Used ore hardness attribute to determine mill hours per tonne
- ✓ Used mill hours to schedule instead of the usual process tonnes feed
- ✓ Using mill hours in the schedule has resulted to more realistic forecasting and enabled to schedule high grade ore feeds during events of low mill throughputs

The process plant circuit overflows when fed with too much copper (>16 tph cu)

Solution:

- ✓ During prolonged high grade events, scheduling focuses on cutph (cu tonne per hour) instead of cu% as target
- ✓ Cutph is added as an attribute in the block model
- ✓ Using cutph as attribute provides more control in changing throughput rates -- [hard ore (low throughput) + high grade = soft ore (low throughput) + low grade]

Arsenic and sulphur grades has to be controlled from time to time (for better recovery and concentrate grade)

Solution:

- ✓ Used other grade attributes as target instead of the usual Cu%



Mine scheduling in a changing environment PKM cases

More copper required, overflowing ore supply

Solution:

- ✓ Marginal grade ores were not fed to the plant from time to time (stockpiled for emergency or future use)
- ✓ Material movement has on/off switch when to allow marginal grades to the process
- ✓ Stockpile management

Different reporting styles of different minesched users

Opportunity:

- Used custom reporting in 2013 (previously set up), then report preparations thru scripts in 2014 (one engineer is very good in scripting at that time), reports now uses lookups from minesched raw data (PMS agreed format)
- Reporting styles can adapt to the skill set of the user – easier management and debugging

Comfortable schedule, flexibility is allowed (many exposed ore, good recovery, good equipment and plant conditions)

Opportunity

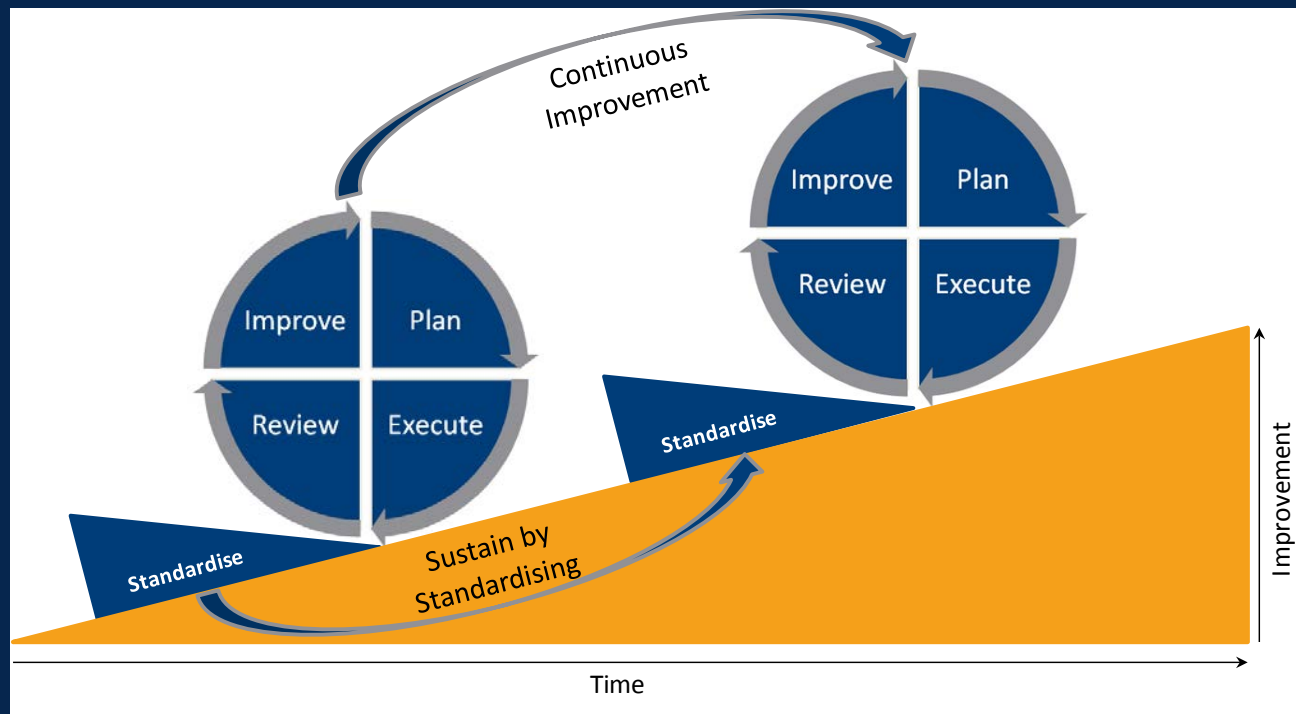
- Forecasting and monthly scheduling reverts back to bench by bench scheduling
- Allows short term plans to dictate movement – adds more practicality
- Less engineering time required



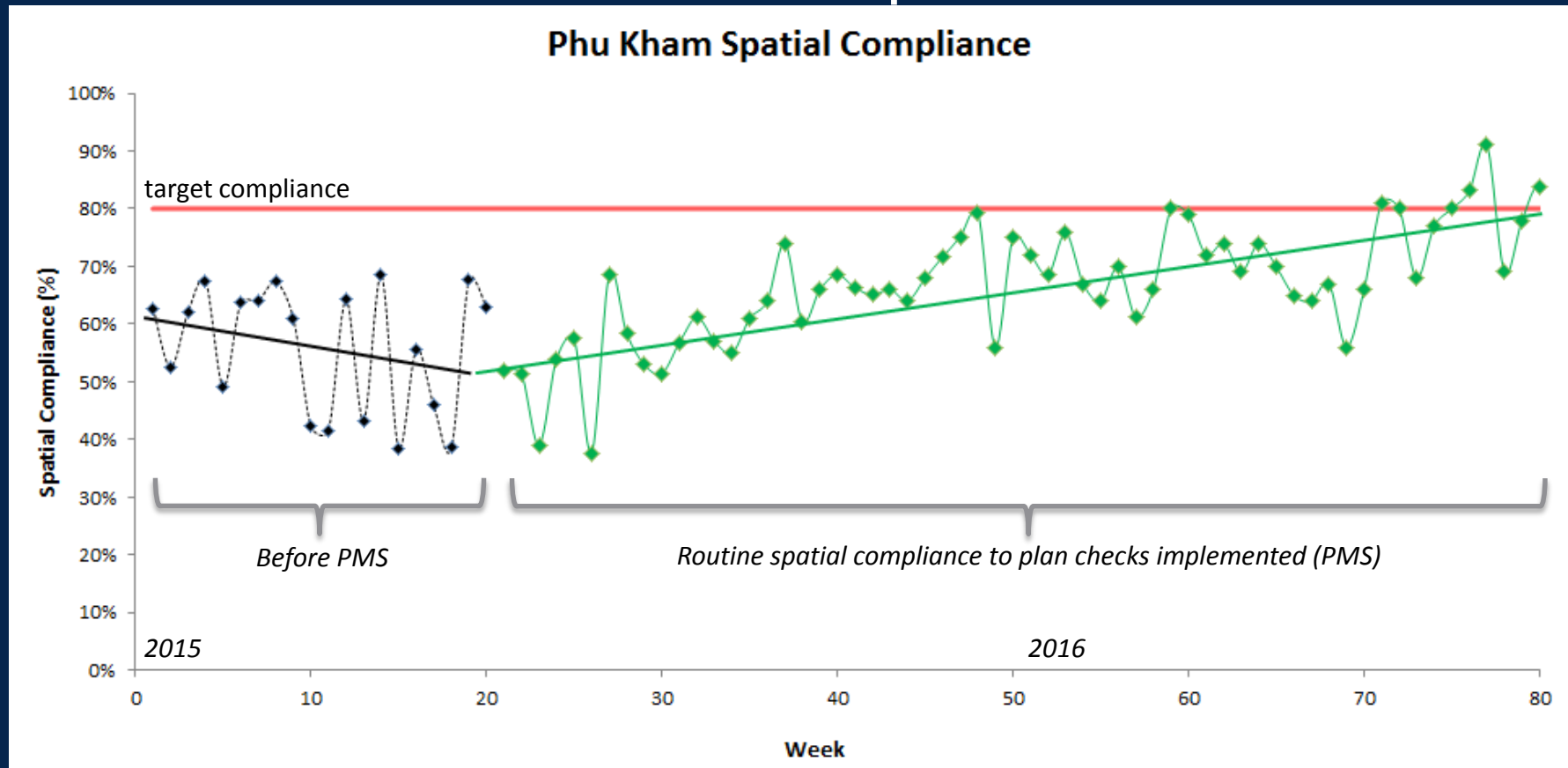
Production Management System (PMS)

Improved compliance of daily and monthly production plans was a result of linking all planning time horizons from life of mine to shift, and standardising the reporting and communication of long term and short term schedules at Phu Kham.

Developing and adopting a Production Management System (PMS) built around a continuous improvement cycle (Plan-Execute-Review-Improve), provided the framework for the new standards.



Plan review, Plan compliance



- ✓ Consistent week-on-week improvement in spatial compliance demonstrates improved planning and execution of the plan
- ✓ Better plan compliance = better forecast (since plans are done with projected starting faces)

Keys to success

- ✓ Good understanding of the software (strengths and weaknesses)
- ✓ Knowing the existing engineering skill sets
- ✓ A working mine planning process (Production Management System)
- ✓ Awareness of the long term mining strategy
- ✓ Understanding stakeholder requirements
- ✓ Strong operations support



Future works/ongoing works

- Waste Dump detailing works
 - Minesched was used to determine how the waste dump is being built up but not regularly
 - Requires computer memory
 - Requires waste dump staging and polygons
- Minesched linked to Haulage simulation software (Haul Infinity)
 - To link the Minesched blocks (source and destination) raw data to the haul infinity raw data
 - Has proven to work in the 1-yr plan and will implement this exercise to all schedules
- To include compliance to plan as Minesched attribute (compliance to LOMP, compliance to budget)
- To run partial percentages in medium term and long term schedules

