Mine – Quarry Planning

Bill Hissem

QUARRY ACADEMY

Improving Processes. Instilling Expertise.

DYNO
Dyno Nobel

SANDVIK

Mine – Quarry Planning

Mines are not quarries

and quarries are not mines.

BUT;

They share a lot in common and have a lot to offer each other.

For the quarry industry;

1) How much and what kind of planning should be done?

2) Who should be involved and responsible for the plan?

3) How do you implement in today's working environment?

QUARRY ACADEMY

Mine – Quarry Planning

Elements of a Mine Plan:

- Creation and maintenance of a production plan
- Right material (ore/stone spec.)
- Delivered at right time (scheduling)
- At lowest possible cost per unit of product (process)
- Fullfill the business targets of the company (ROI)

QUARRY ACADEMY

Mine – Quarry Planning

For the quarry industry;

1) How much and what kind of planning should be done?

No more, nor less then that which is now required to achieve the safety and profit outcomes required by the "new normal".

QUARRY ACADEMY

Mine – Quarry Planning

The “New Normal”….

What is it demanding of us?

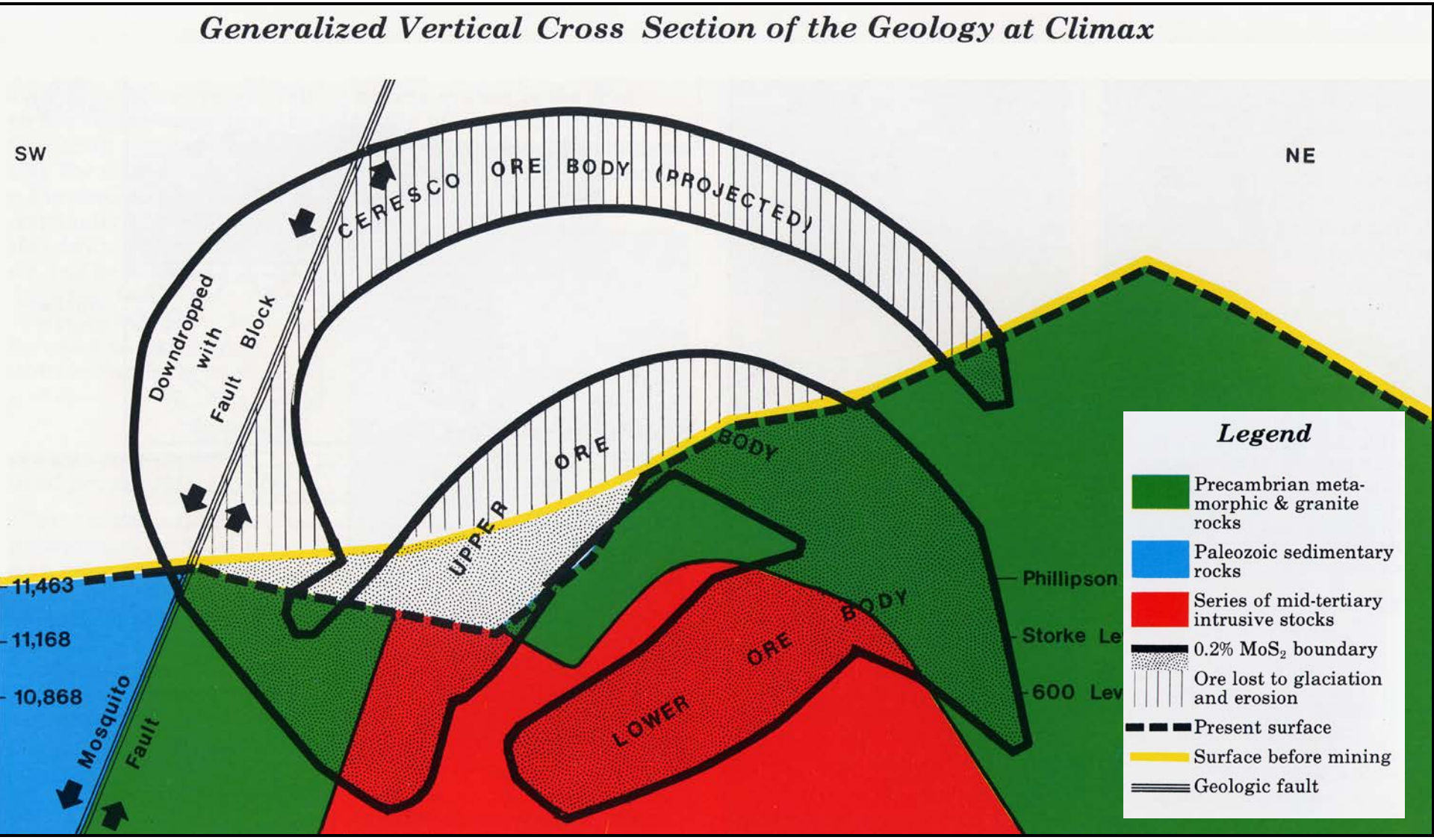
Flawless Execution to an new economic standard.

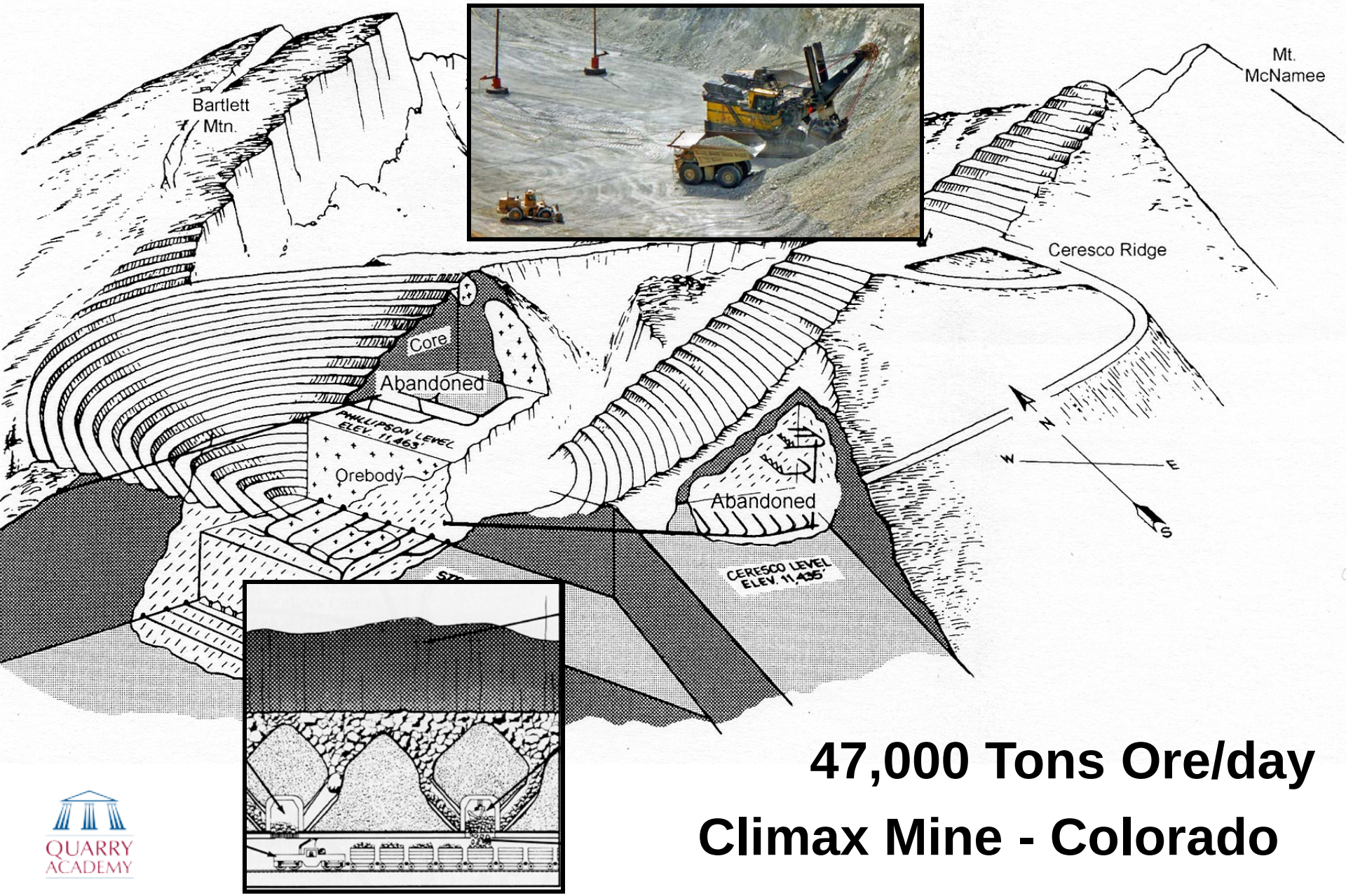
QUARRY ACADEMY

QUARRY ACADEMY

Climax Mine - Colorado


Climax Mine - Colorado



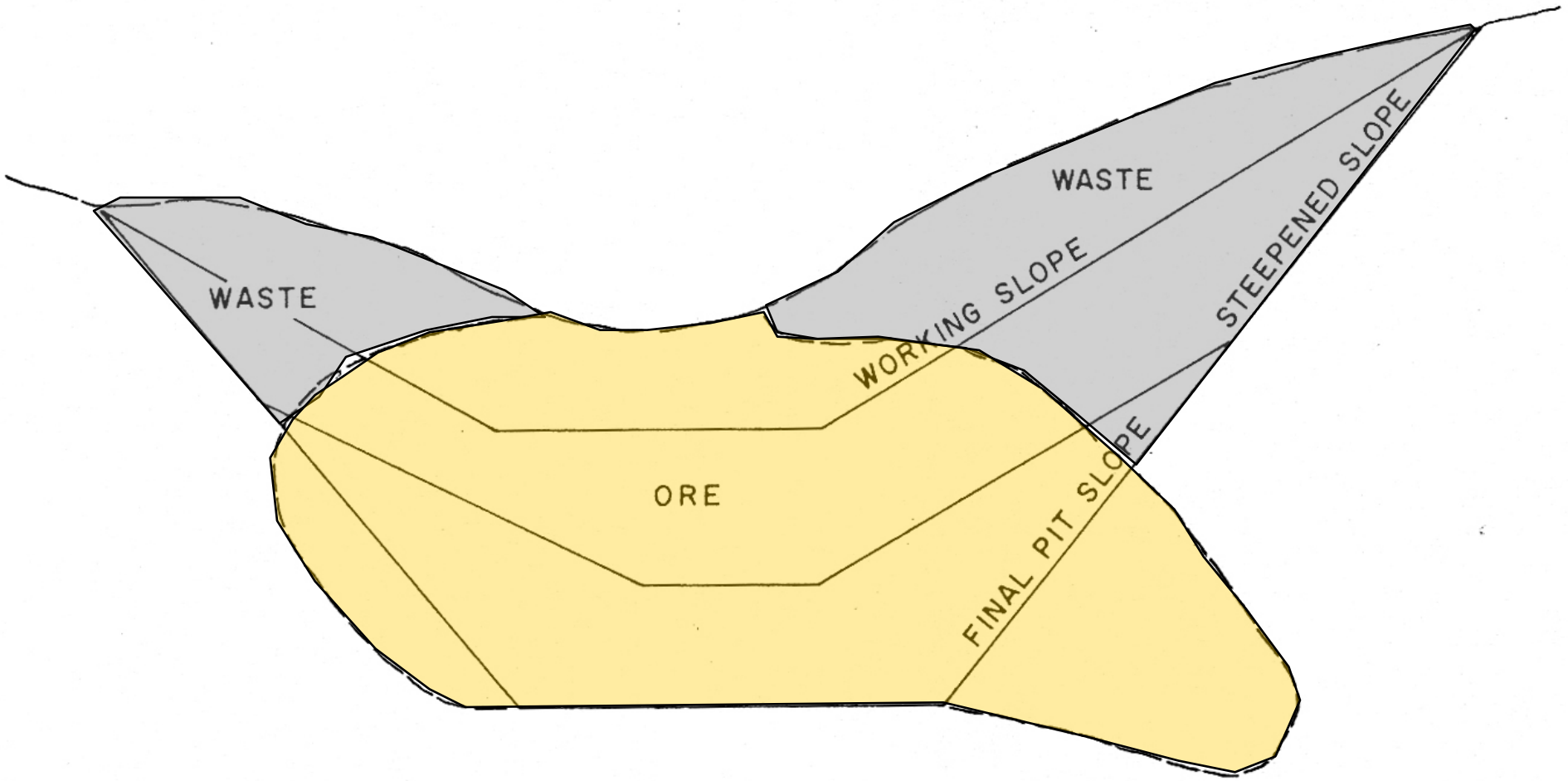


47,000 Tons Ore/day

Climax Mine - Colorado

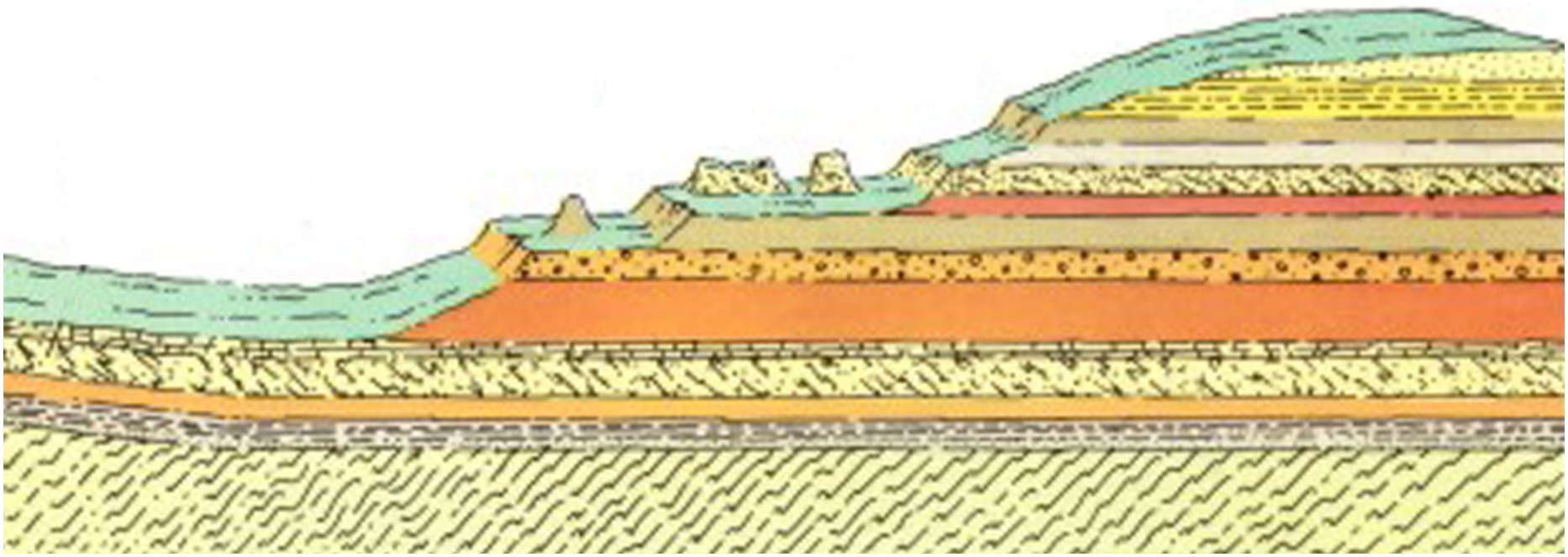
QUARRY ACADEMY

With mines, waste is a physical material quantity to be measured and handled.



QUARRY ACADEMY

With quarries, with the exception of soil overburden, the entire deposit is product.



QUARRY ACADEMY

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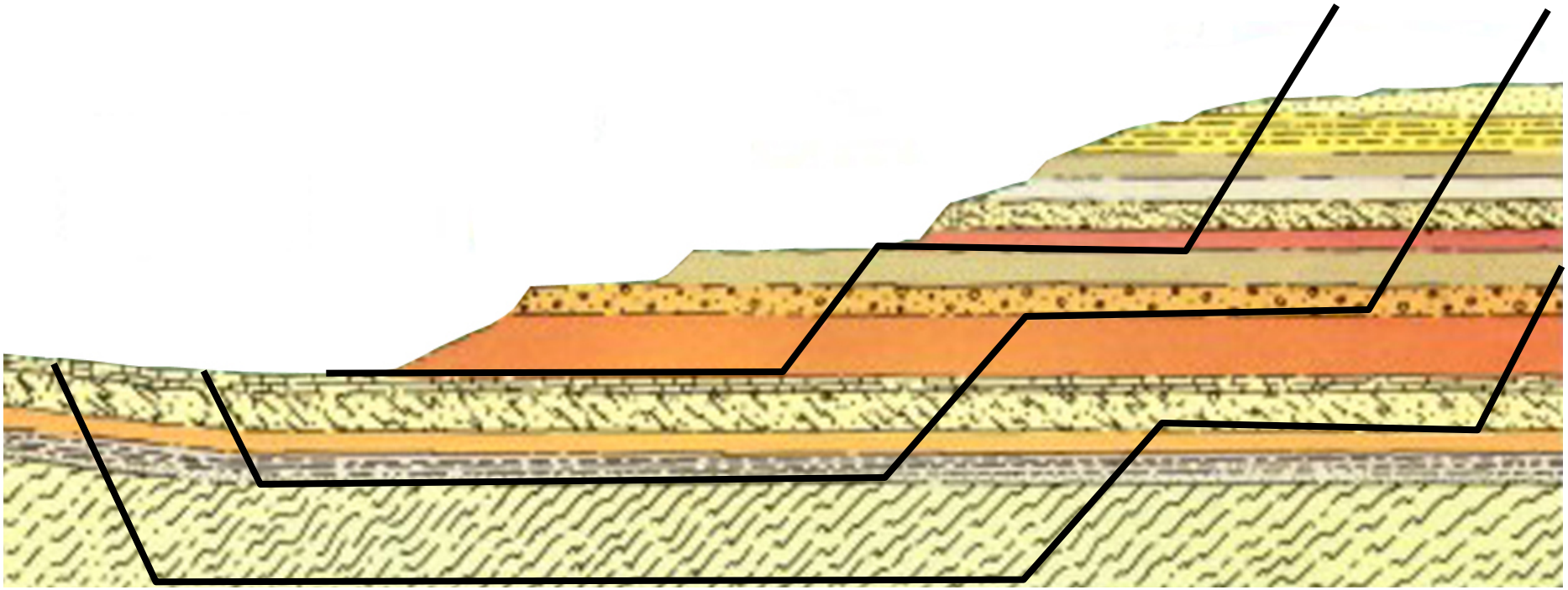

For quarries, waste is more a by-product of production, not so much a component of extraction.

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Mine – Quarry Planning

Planning, especially long term combines:

- Objective issues of physical resources
  - Deposit location, size, shape, structure, quality
  - Manpower & equipment
  - Mining & operations management methods

- Subjective issues of company standards and culture
  - Working assumptions
  - Safety standards
  - ROI and site deposit life
  - Social contract/franchise obligations

QUARRY ACADEMY

Mine – Quarry Planning

Profit

Product Transformation Value Creation Events

1 2 3 4

Stripping → Drilling → Blasting → Loading → Hauling → Crushing → Screening

$S $D $B $L $H $C $S

Safety Safety Safety Safety Safety Safety Safety

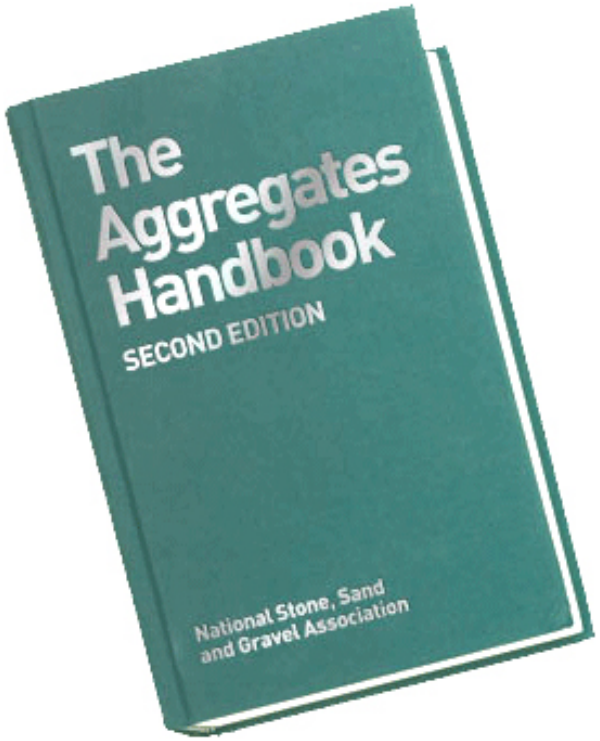
Safety

QUARRY ACADEMY

second drill rod must be considered when purchasing the less expensive drill having the shorter mast.

Drill Hole Size: The size of the holes drilled for blasting in surface quarries are typically 3 to 7 in. in diameter. Many operators begin production using one size hole and, over a period of time, change to a different size hole as varying geologic conditions are encountered and different types of explosives are employed. Usually, larger diameter holes result in less total drilling and blasting costs. Lower overall costs can result from an increase in the size of drill hole with a resultant decrease in the number of holes required. The larger holes contain a greater quantity of blasting agent and cause fragmentation of a greater tonnage of rock. The most cost-effective choice of hole diameter and blasting agent is determined only by experimentation in the field. For this reason, drilling contractors are often employed in the early phases of development to allow experimentation with drill types and hole sizes before equipment is purchased.

Optimizing Blasting: Initial selection of a combination of drill and explosive may be most cost-effectively accomplished utilizing the expertise and computer programs available from drill and explosive manufacturers and suppliers. These programs estimate the overall cost of various alternatives at accuracy levels approximately proportionate to the reliability of the geological data available. The software used in this type of analysis is generally the property of the blasting or explosive company and is normally not for sale but can be obtained by hiring the company on a contract basis. The benefits derived from use of these programs are normally part of the total blasting service. Companies that have blasting computer programs include the follow-

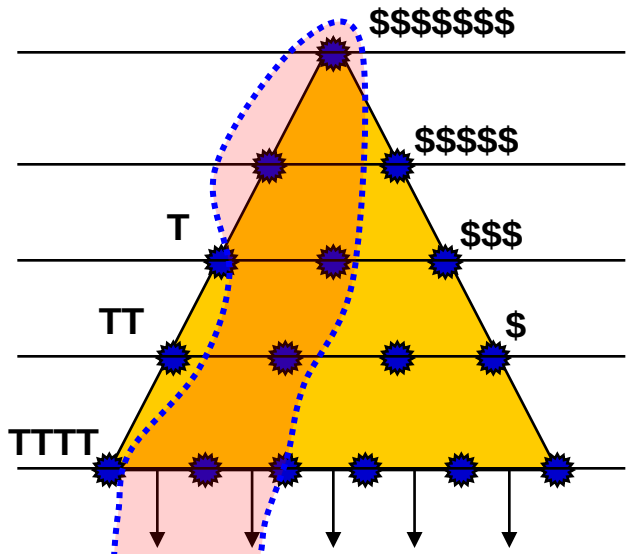


An important concept to remember is that fragmentation of rock by primary blasting is more cost effective than fragmentation by mechanical crushing or secondary breaking.

of rock fragmentation with a minimum amount of vibration. For example, the blast hole drill pattern can be held constant for several blasts using several different types of explosives. The overall cost, rock fragmentation results, and vibration levels are monitored until the most efficient explosive is found for the existing condition. Alternately, the same explosive might be used, but the spacing of the drill pattern varied until the cost as a function of quantity of fragmentation is optimized. *An important concept to remember is that fragmentation of rock by primary blasting is more cost effective than fragmentation by mechanical crushing or secondary breaking.*

New types of explosives, drill bits, drills, and other innovations should be evaluated as they become available. Many excellent references are available on drilling and blasting concepts.[2,3,4,5] The ex-

Primary Focus Structure



CEO — 5 – 10 yr

VP — Year

District Mgrs — Quarter

Foremen — Week

Operations — Day

Sense of responsibility point of reference

T = Tons of Production

$ = Money - Profit

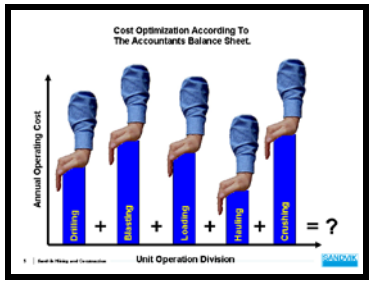
Product Transformation
Value Creation Events

1 Stripping → Drilling → Blasting → 2 Loading → Hauling → 3 Crushing → 4 Screening → Profit

Department Focus

Old Normal

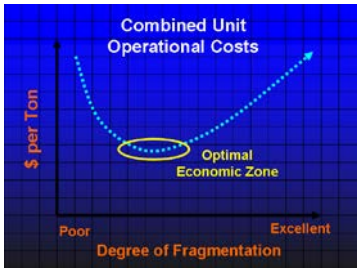
Invoice Minimization



Rubbliizes the Bench

VS.

Process Improvement



Enables Chemical Crushing

New Normal

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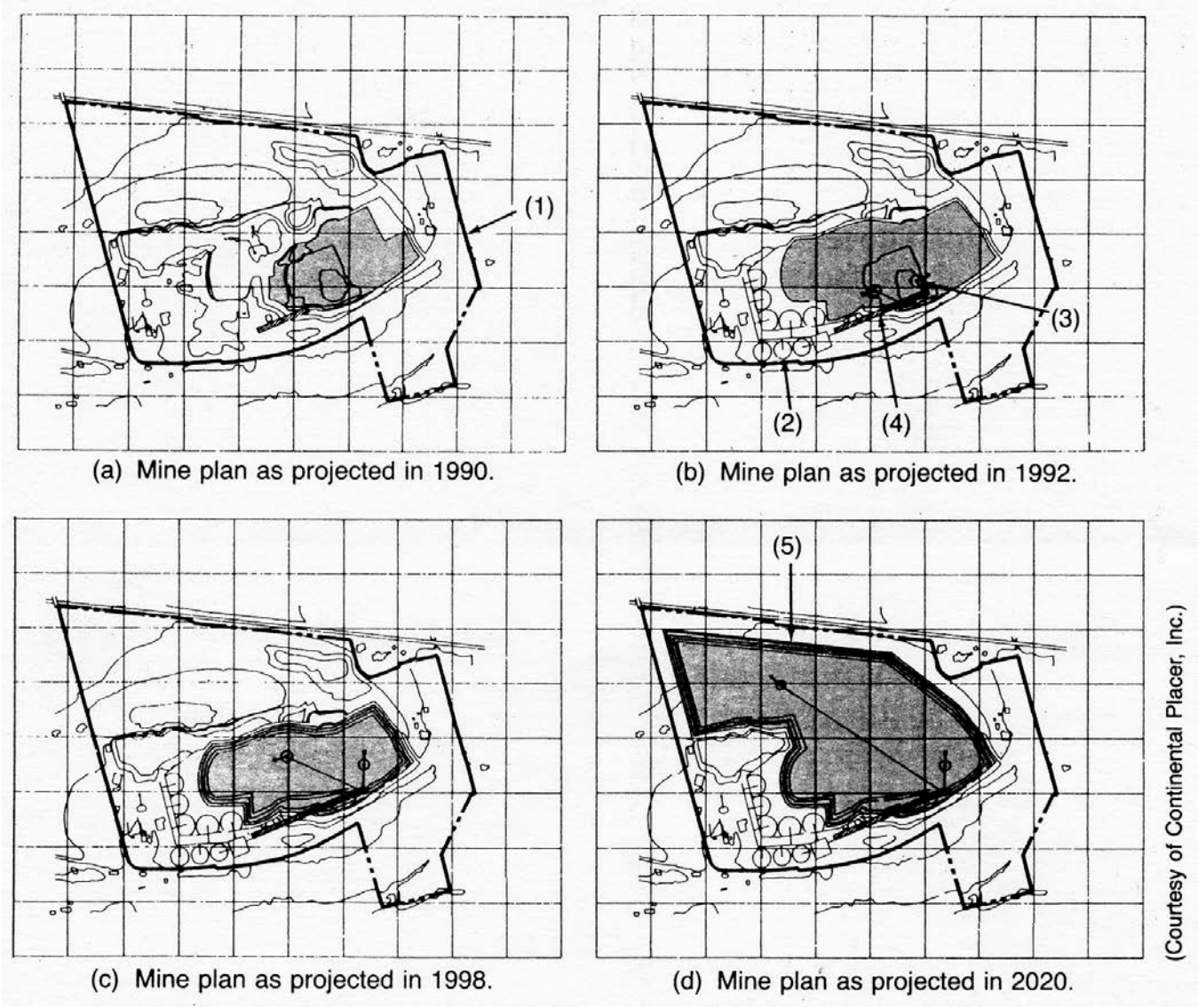
Partitioned tasking and responsibility inevitability leads to disconnected realities and behavior in the absence of process awareness.

Mine – Quarry Planning



(a) Mine plan as projected in 1990.

(b) Mine plan as projected in 1992.

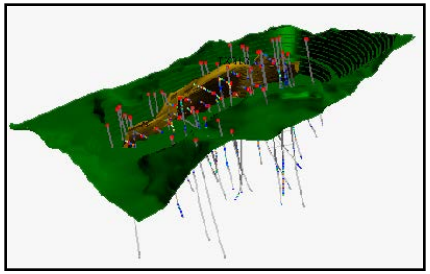
(c) Mine plan as projected in 1998.

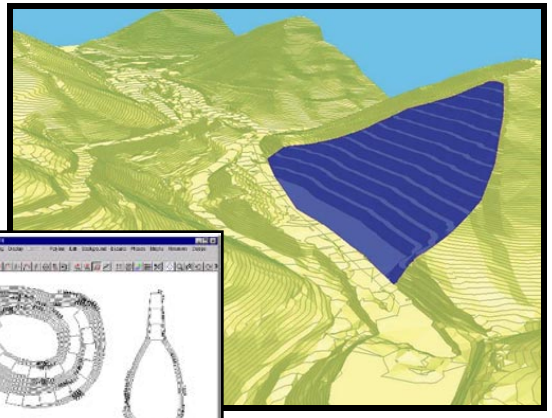
(d) Mine plan as projected in 2020.

(Courtesy of Continental Placer, Inc.)

QUARRY ACADEMY

Mine – Quarry Planning



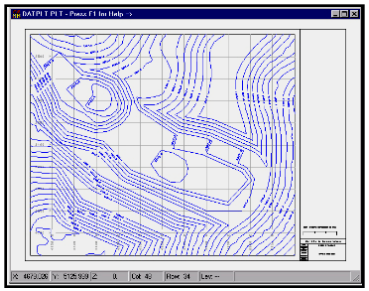


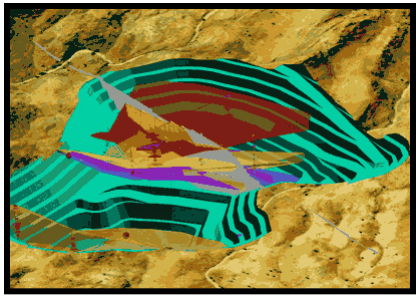
Design:

Pencil - pen & paper

vs.

AutoCad Civil/Gemcom-Surpac/Maptek-Vulcan 3D, etc.

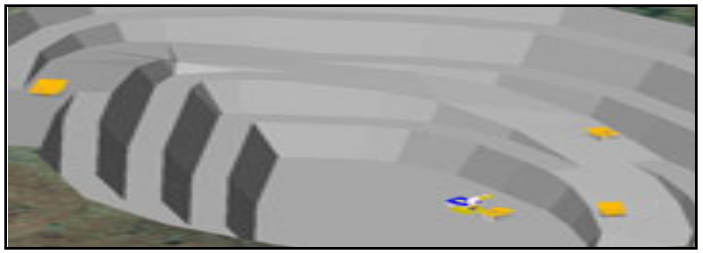




Scheduling:

Spreadsheets

Solvit – RKM Mining – MineMax, etc.



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Mine – Quarry Planning

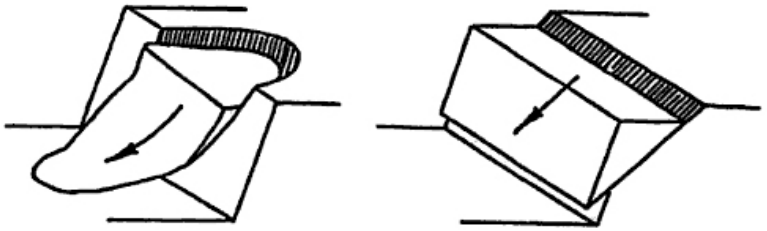
Understand, quantify, and work with your geology.

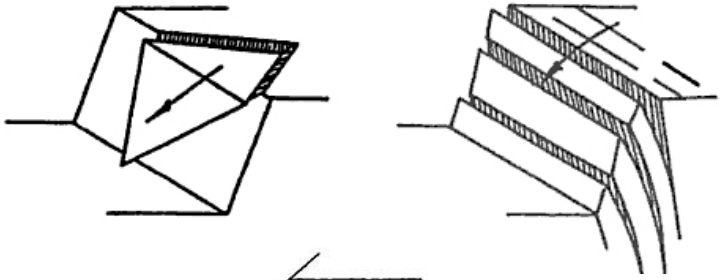
Slope Stability

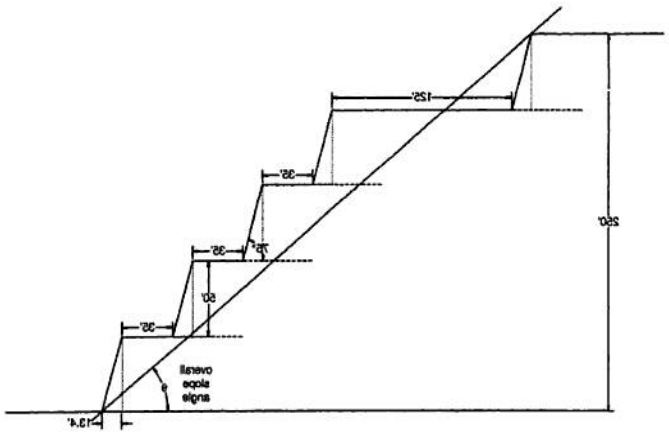
Pit Expansion

Blasting Direction

Maximize reserve recovery at the pit limits.







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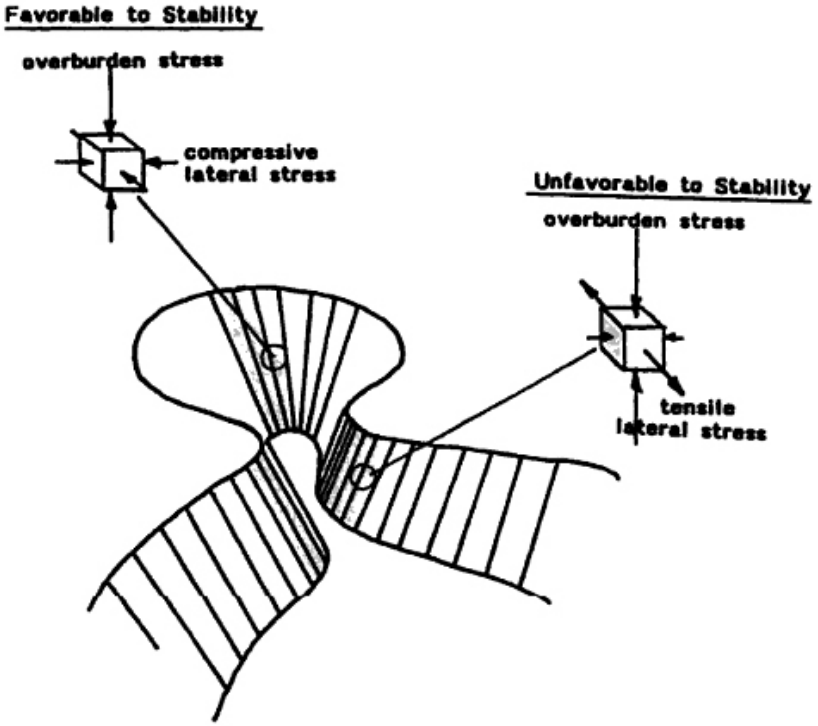
Mine – Quarry Planning

Project and observe current excavation in light of geometry effect as pit goes back and deeper. Avoid irregular and tight pit bottoms.



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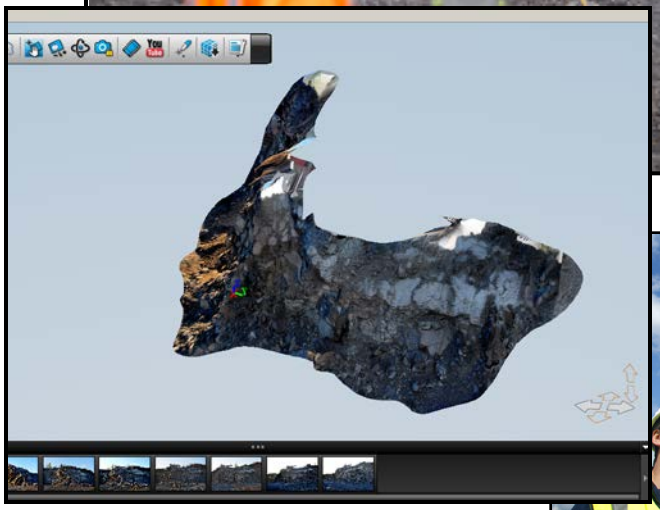
Mine – Quarry Planning

Survey Control – use it!



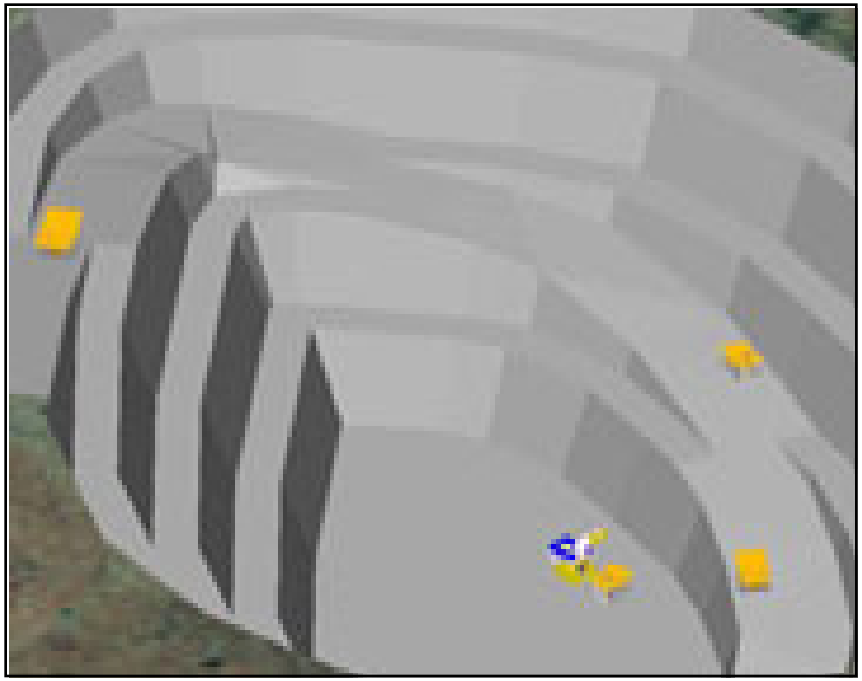
QUARRY ACADEMY

Mine – Quarry Planning

Design your pit to maximize benefit for loading and haulage efficiency and safety.

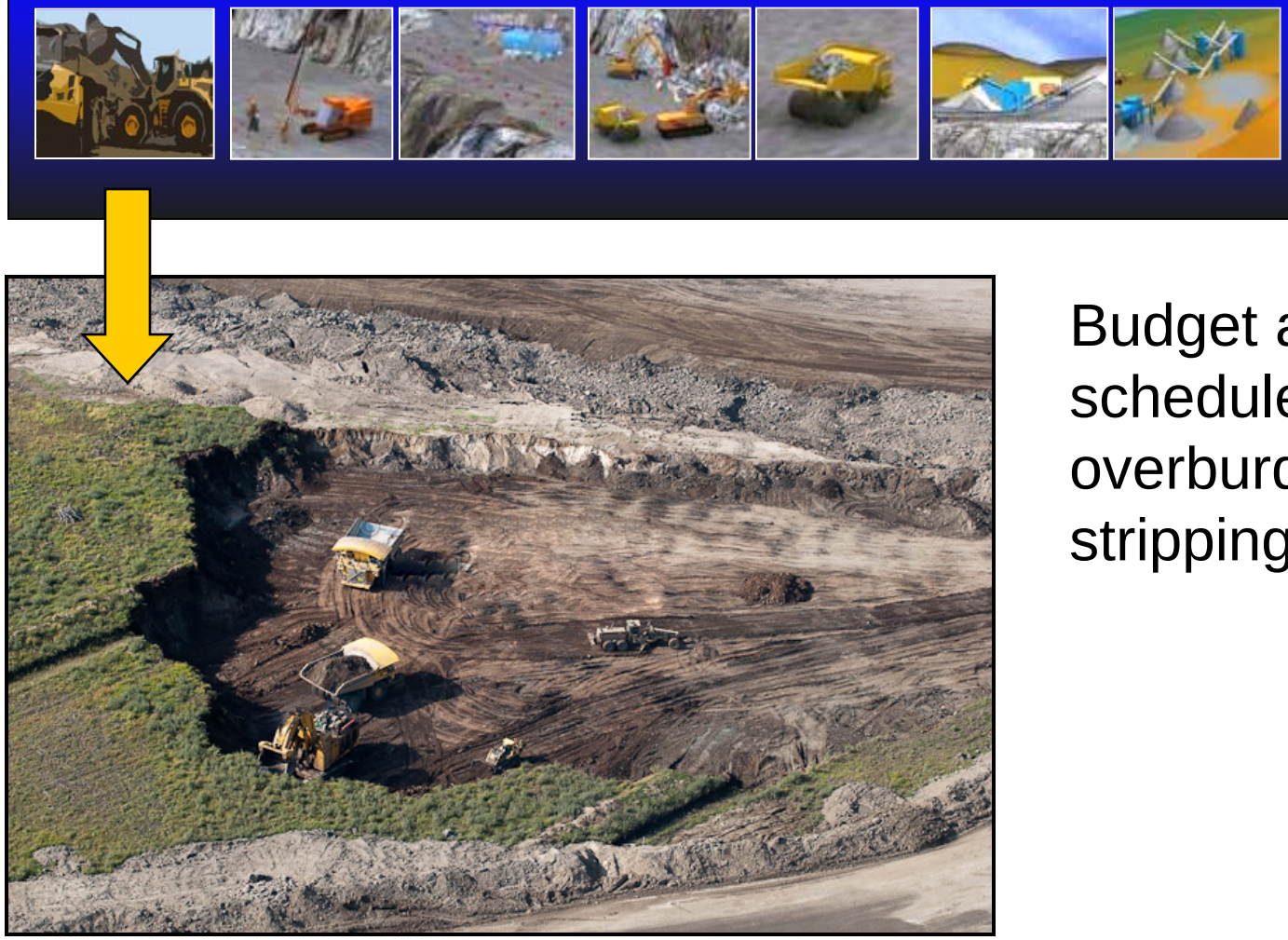
Maintain even floor elevation & haul road smoothness.

Design your ramp grade and haulage distances – optimize the gear ratio/rimpull of your trucks.



QUARRY ACADEMY

Stripping Drilling Blasting Loading Hauling Crushing Sizing



Budget and schedule for overburden stripping.

QUARRY ACADEMY

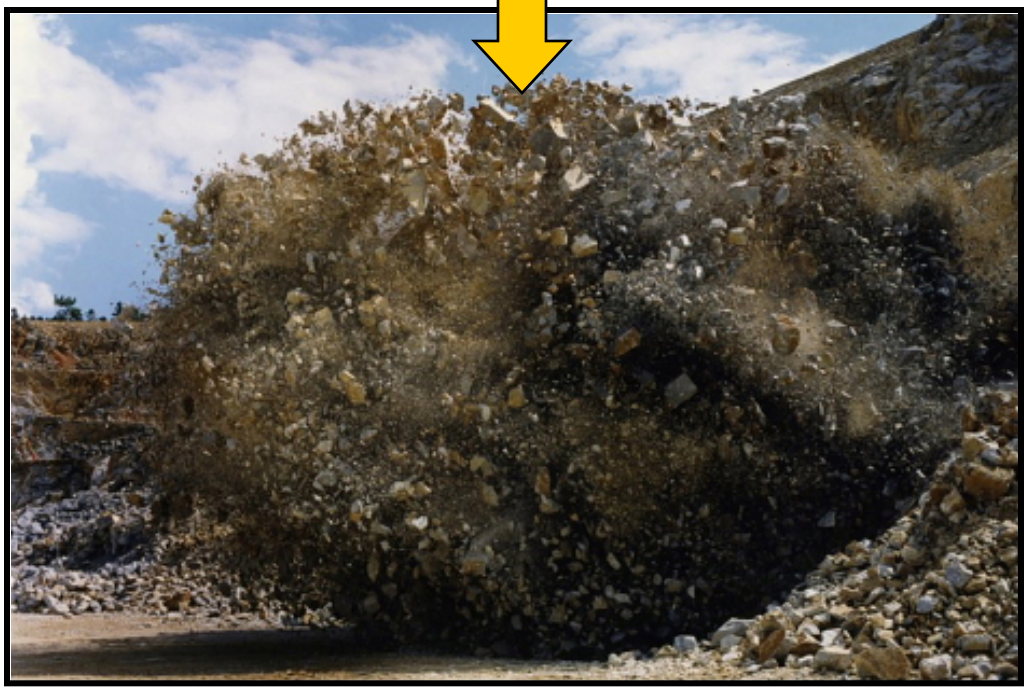
Stripping Drilling Blasting Loading Hauling Crushing Sizing

Select the drill and hole size to handle the geologic rock conditions and support optimal energy distribution.

Balance production capacity with site conditions to maximize safety and total process economy.

QUARRY ACADEMY

Stripping Drilling Blasting Loading Hauling Crushing Sizing



Balance safety, production, and offsite vibration issues with fragmentation influence on productivity and total economy.

“Value” Moment 1

QUARRY ACADEMY

Stripping Drilling Blasting Loading Hauling Crushing Sizing

Optimize loader/truck sizing.

Design & manage pit geometry to maximize equipment efficiency.

QUARRY ACADEMY

Stripping Drilling Blasting Loading Hauling Crushing Sizing

Optimization of design to maximize flexibility, throughput efficiency, and power minimization while achieving requsite product quality.

“Value” Moment 2 3 4

QUARRY ACADEMY

Mine – Quarry Planning

•The “New Normal” market demands suggest that a combination of old standards and methods, combined with new tools and daily operations practice based on metrics will be needed increasingly for economic success.

•Operations will need to be responsible not only for production, but also economic efficiency to secure sufficient profit for the organization.

•The pit and the plant will need to be brought together to assure that optimal profit is achieved in the product stockpile.

QUARRY ACADEMY

Mine – Quarry Planning

For the Quarry Industry;

How much and what kind of planning should be done?

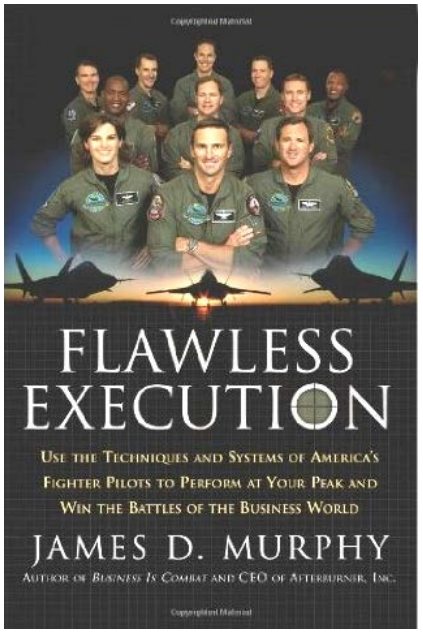
Enough to insure that profit is built into production.

2) Who should be involved and responsible for the plan?

Operations and management.

3) How do you implement in today's working environment?

Process focus with metrics and cost accounting that tracks and demonstrates production dynamics.



"Flawless Execution"

Retired F-15 Fighter Pilot &
Business Consultant James Murphy

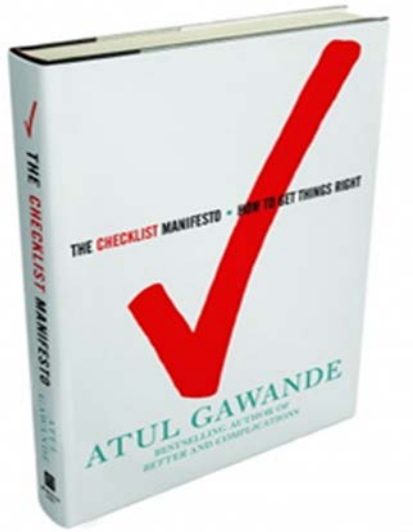
Mission success requires planning.

How to get the most out of your group:

1) Training never stops, even in combat.
2) Rank should never get in the way of mission success.

The principals in this book show why the USAF is the best in the world and how your organization can pattern itself after it's success.

QUARRY ACADEMY



"Checklist Manifesto: How to Get Things Right"

Surgeon and journalist, Atul Gawande

Checklists require planning.

There are 2 types of errors:

1) Ignorance (mistakes we make because we don't know enough),

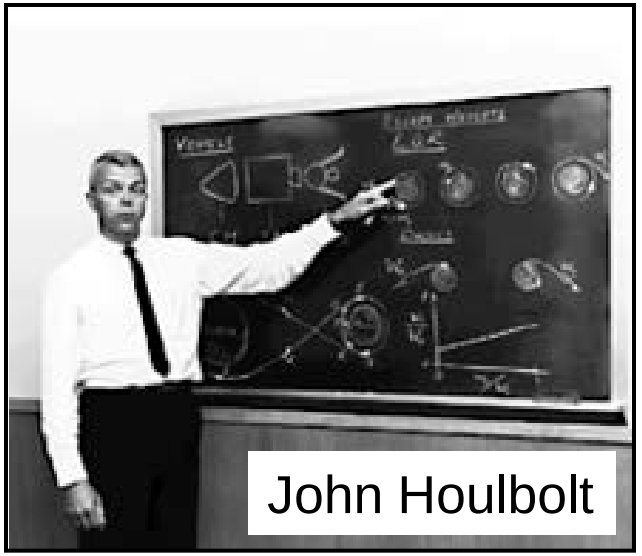
2) Ineptitude (mistakes we make because we don't make proper use of what we know).

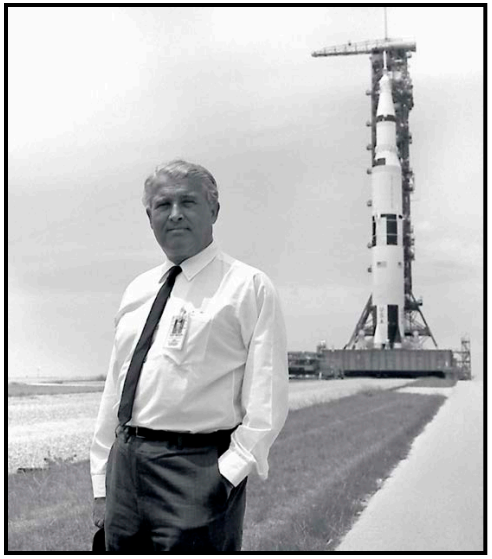
Failure in the modern world, he writes, is really about the second of these errors.

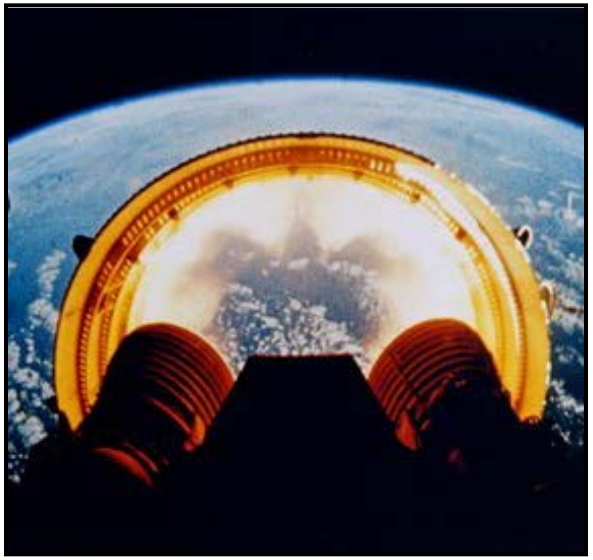
QUARRY ACADEMY

Planning and going to the moon:

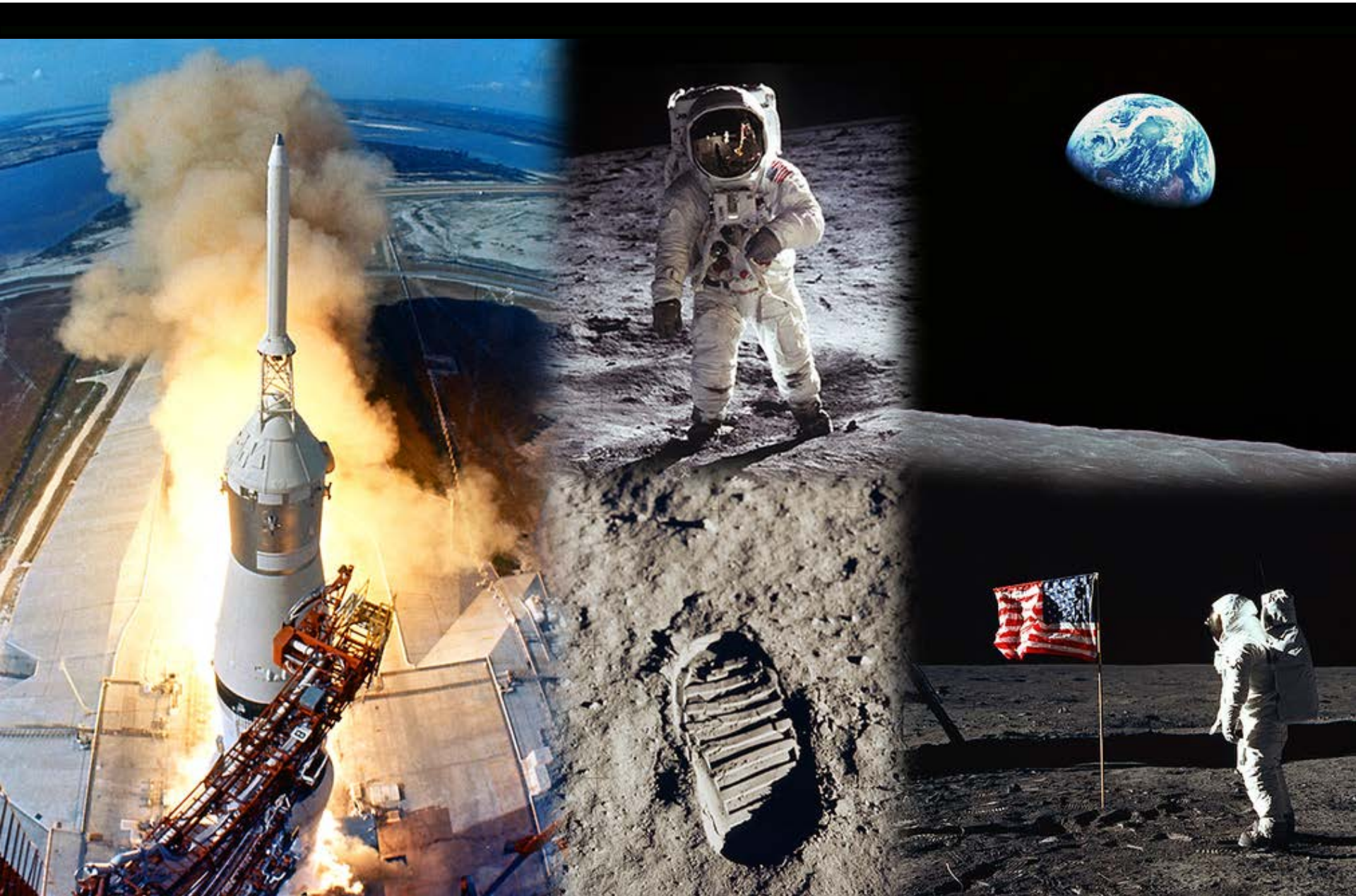

Dr. Wernher Von Braun
& President Kennedy


John Houlbolt





Planning and going to the moon:



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