

Where Are We Going In This Hand Basket?

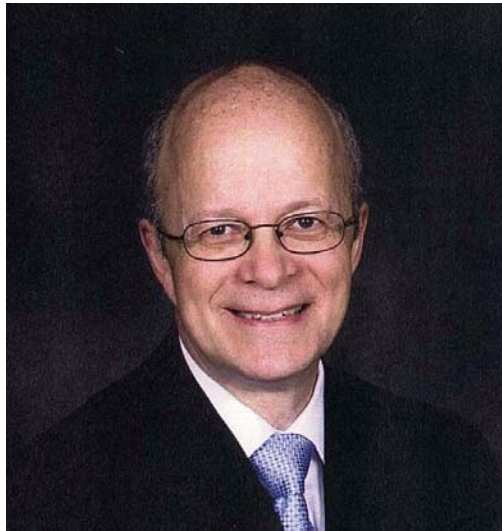
Where are we going in this hand basket?

Where Are We Going In This Hand Basket?



Lawrence Devon Smith

Where are we going in this hand basket?



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Lawrence Devon Smith (Larry) is Principal Consultant at LDSA and has been Director of Project Evaluations for Barrick Gold, Vale-Inco, and Rio Algom as well as SNC-Lavalin.

Larry is a mining engineer with over 35 years' experience in project economic evaluations including scoping and optimization studies, pre-feasibility and feasibility studies, risk assessment, and due diligence and has published a number of papers on these topics. He is on the executive of MES and CIM Toronto.

Larry teaches Mineral Economics as an adjunct professor at the University of Toronto, the Pontificia Universidad Catolica de Valparaiso in Chile and Schulich Business School at York University.



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?

The Hand Basket



What is a Failed Project?

Where are we going in this hand basket?

For mining projects, some key indicators of a “failed” project are:

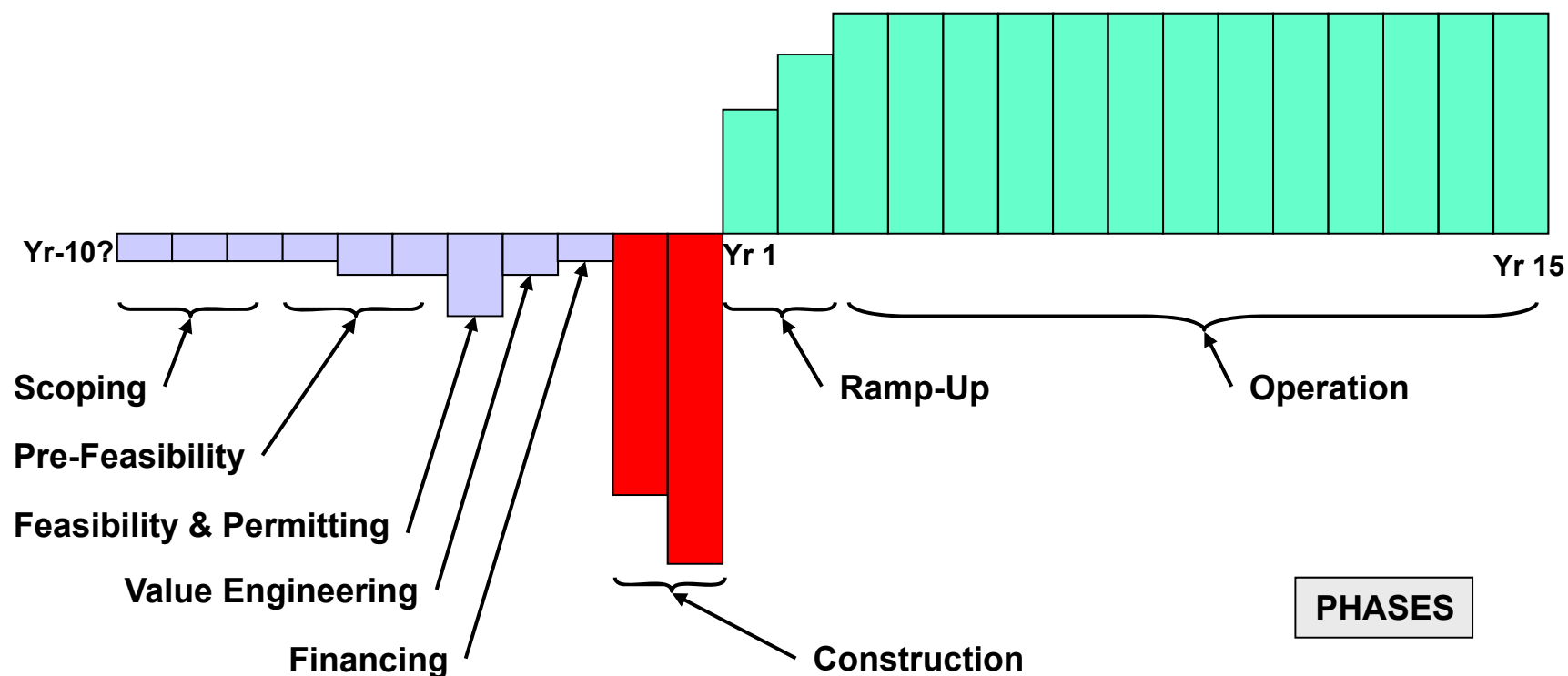
- Cost
 - It cost more than it should have (particularly capital)
- Schedule
 - It takes longer to build than expected
 - It takes longer to ramp-up than expected
- It does not do what it is supposed to do
 - Poor performance; output, product specifications;
 - Low revenue
 - High costs
- No one is happy about it:
 - Management, Shareholders, Bankers
- Does a project fail if it does not meet expectations that were unrealistic and unattainable?
- Caution: Failure may not become evident until years later



Mining Project Life Cycle Phases of Development

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Where are we going in this hand basket?

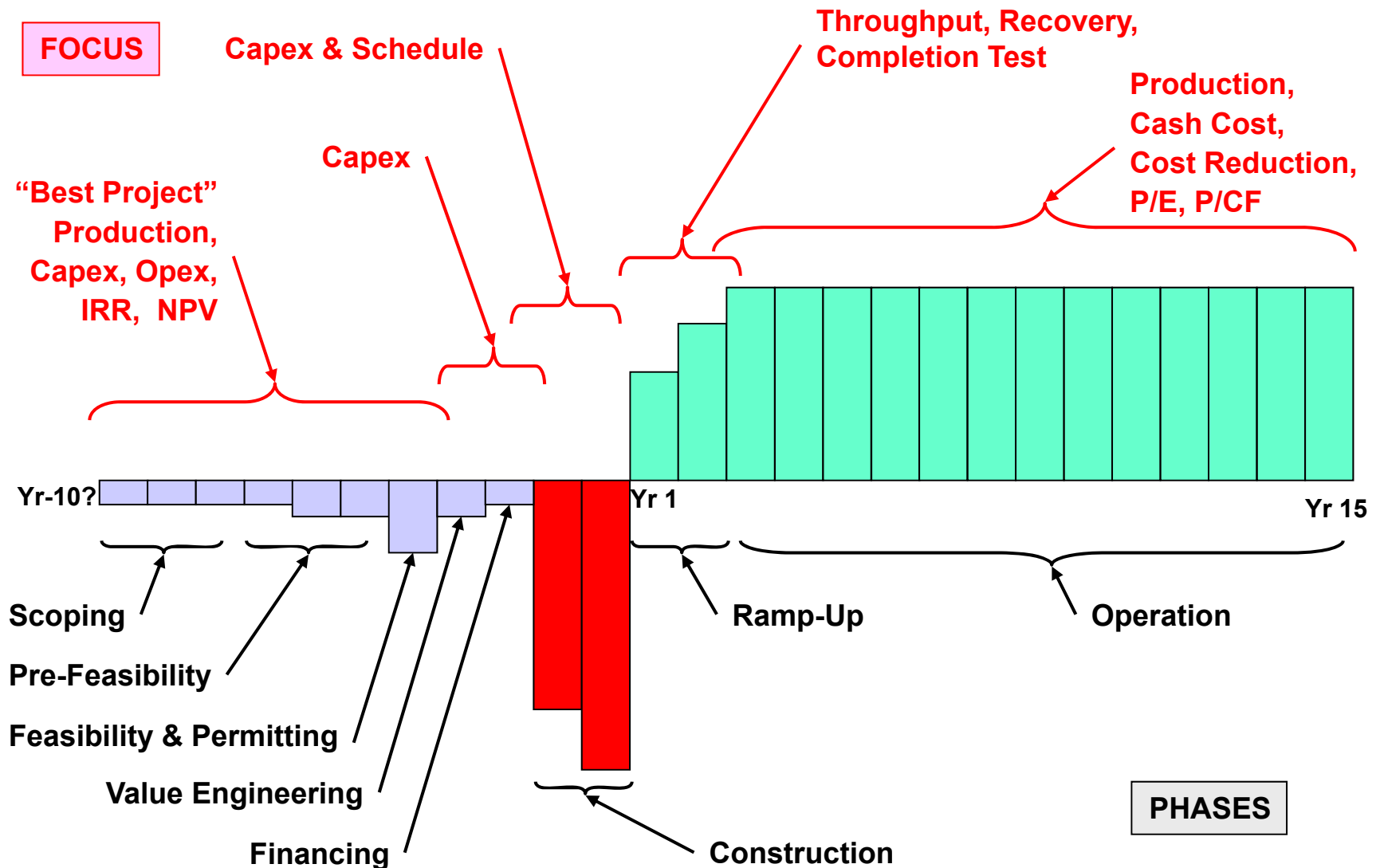


Mining Project Life Cycle

Primary Focus Changes Over Time

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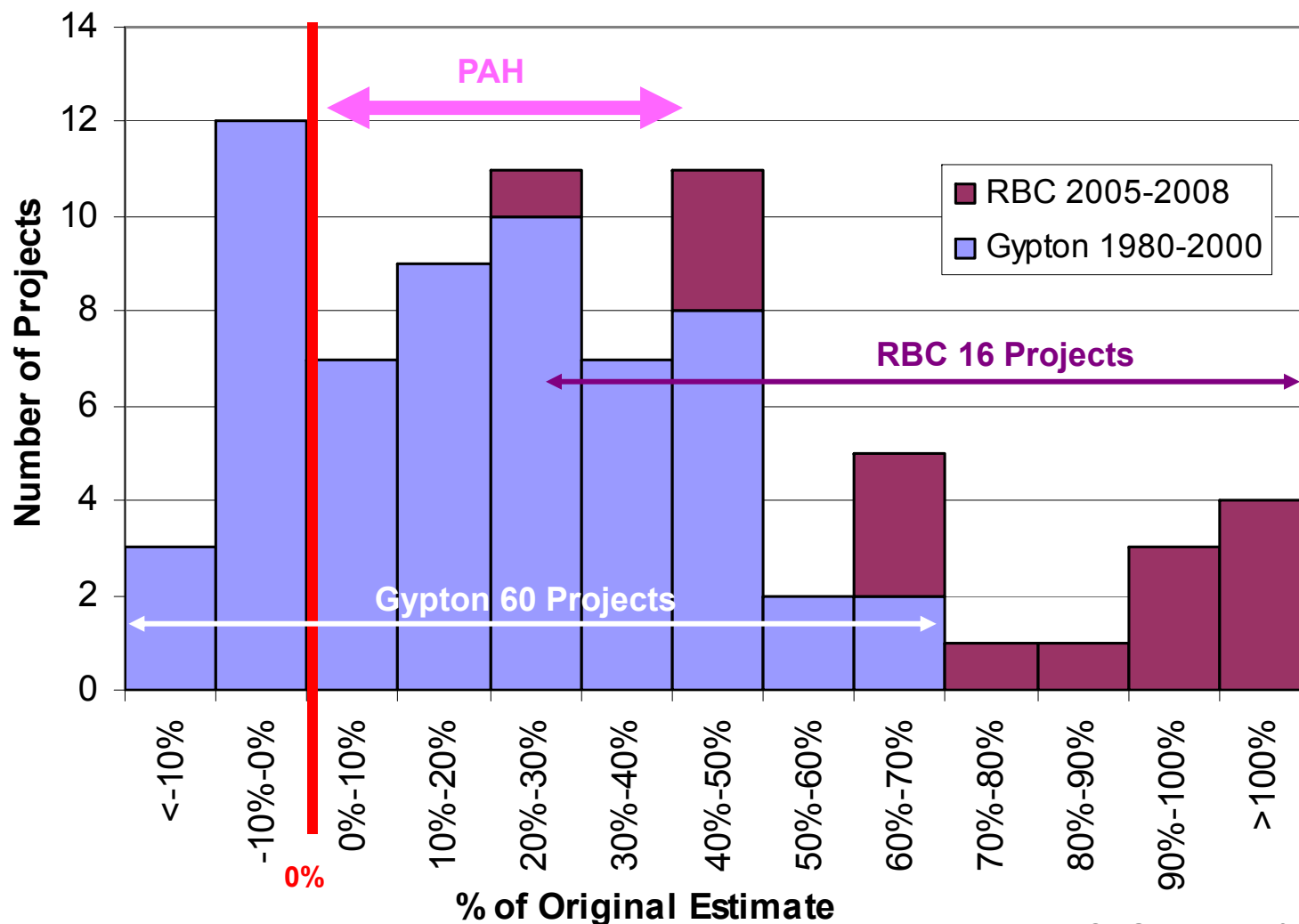


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How Have We Done?

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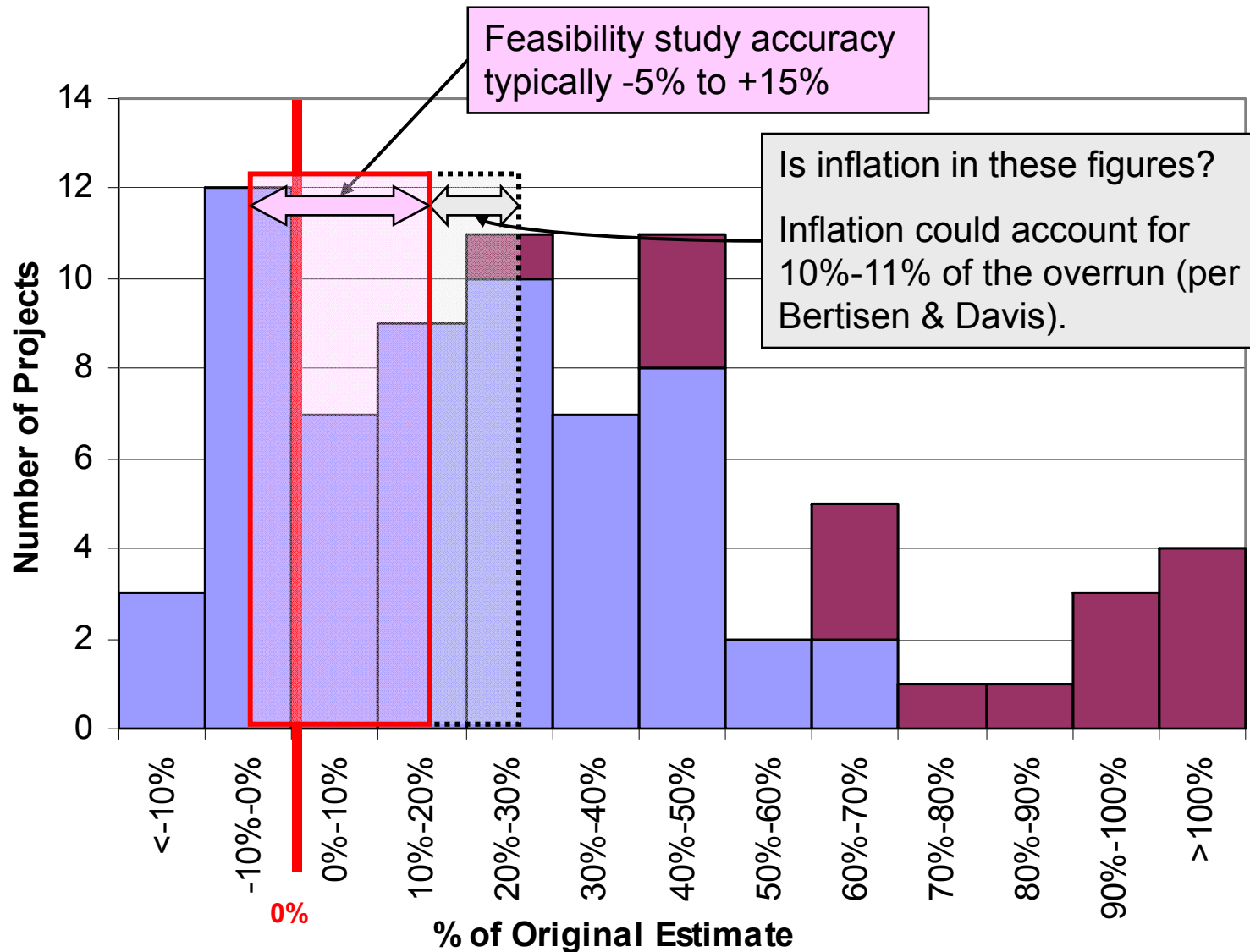


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How Have We Done?

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Where are we going in this hand basket?



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How Have We Done?

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Where are we going in this hand basket?

- Owner Project Management: Gaps in project team experience and skills, insufficient owner participation, and unqualified personnel;
- Estimating: Errors and omissions, untested or faulty assumptions in critical areas, and unqualified personnel;
- Logistics: Inadequate assessment of how to supply the project during development and operations.
- Construction Management: Inadequate or inappropriate staffing levels and unqualified personnel; and
- Site Investigations & Basic Engineering: Inadequate or incomplete investigation, evaluation and interpretation of critical site-specific conditions;
- Limited resources, specifically:
 - limited risk capital
 - limited qualified personnel.
- Limited time:
 - always pressure to produce the study as quickly as possible.
 - artificial deadlines, such as board meetings and presentations to bankers or analysts.



Top 10 Strategic Business Risks in Mining & Metals

Where are we going in this hand basket?

2009-2010

1. Cost containment
2. Industry consolidation
3. Access to capital
4. Maintaining social license to operate
5. Climate change concerns
6. Skills shortage could delay projects
7. Infrastructure access creating bottlenecks
8. Access to secure energy
9. Resource nationalism
10. Pipeline shrinkage (lack of new discoveries)

2011-2012

1. Resource nationalism
2. Skills shortage
3. Infrastructure access (to markets)
4. Maintaining social license to operate
5. Capital Project Execution
6. Price & Currency Volatility
7. Capital Allocation
8. Cost Management
9. Interruptions to Supply (Natural Disasters)
10. Fraud and Corruption, Sovereign Risk

2013-2014

1. Capital allocation
2. Margin protection & productivity improvement
3. Resource nationalism
4. Social license to operate
5. Skills shortage
6. Price and currency volatility
7. Capital project execution
8. Sharing the benefits
9. Infrastructure access
10. Threat of substitutes



Why Building A Mine On Budget Is Rare

Where are we going in this hand basket?

No association or weak association with percentage capital cost overruns

- ✗ Financing
- ✗ Company size
- ✗ Project size
- ✗ Mining method
- ✗ Infrastructure requirements
- ✗ Power requirements
- ✗ Project location
- ✗ Primary commodity
- ✗ Processing method
- ✗ Project history

Strong association with percentage capital cost overruns

- ✓ Commodity market “heat” at beginning of construction
- ✓ Integrated design/build teams
- ✓ Project “quality” (IRR, NPV)



Why Building A Mine On Budget Is Rare

Where are we going in this hand basket?

- Strong association between capital cost overruns and the following project characteristics:
 - ✓ **Commodity market “heat” at beginning of construction** (as measured by a ratio of trailing commodity basket prices)
 - Hotter markets = larger overruns
 - Cooler markets = smaller overruns
 - ✓ **Integrated design/build teams**
 - Feasibility author same as build (EPCM) team = smaller overruns
 - Feasibility author independent from build (EPCM) team = larger overruns
 - ✓ **Project “quality”** (as measured by feasibility IRR or NPV:CAPEX ratio)
 - Marginal projects = larger overruns
 - Stronger projects = smaller overruns



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Engineering Cost Estimates

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Where are we going in this hand basket?



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Cost Estimates

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Where are we going in this hand basket?

- Remoteness:
 - High elevation, Arctic, Third world
 - Suggest adding up to 50% to costs and schedule.
- Unconventionality:
 - “Serial #001”, new process, new construction, new engineering concepts
 - Problems with ramp-up and reaching full capacity.
 - Suggest adding up to 50% to costs and schedule.
- Earthwork:
 - “The devil is in the dirt.”
 - Suggest adding up to 100% to earthwork capital budget.
- Schedule:
 - Suggest adding ~ 10% to the schedule (and increase the capital cost to reflect this delay) in addition to the effects noted above



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Where are we going in this hand basket?

- To secure a project, bidders often make overly optimistic assumptions about costs and revenues.

“Overdue & over budget” – The Economist June 9, 2005

- Everyone expects the other bidders are reducing their estimates to be competitive and obtain financing so they do it too.
- “Bidders” are not just external
 - Internal projects compete for corporate funds and essentially “bid” against each other for management attention and approval

DEFINITIONS:

- Bid: A wild guess carried out to two decimal points.
- Bid Opening: A poker game in which the losing hand wins.
- Low Bidder: A contractor who is wondering what he left out.



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“Value Engineering” – Reducing Costs on Paper

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Where are we going in this hand basket?

- Cost Savings:
 - Used equipment (5% is a typical suggestion)
 - Penny wise & pound foolish



For want of a handful of strategically place bolts, hurricanes have blow off whole roofs, resulting in costly law suits. (FM Global ad)

- Schedule:
 - Reduce schedule to reduce costs
 - “The bearing of a child takes nine months no matter how many women are assigned.” (Fredrick Brooks in *The Mythical Man Month*)
- Scope:
 - Reduce scope to reduce costs



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Scope Changes: Original Contract & Change Orders

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Where are we going in this hand basket?



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Project Costs and Schedule Overruns

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Where are we going in this hand basket?

- **Remoteness**
 - High elevation (usually accompanied by severe weather)
 - Arctic (with severe weather conditions)
 - Third world (accompanied by poor infrastructure and political instability)
 - **Suggest adding up to 50% to costs and schedule.**
- **Unconventionality**
 - New process, construction or engineering concepts.
 - Problems with ramp-up and reaching full capacity.
 - **Suggest adding up to 50% to costs and schedule.**
- **Earthwork**
 - “The devil is in the dirt.”
 - **Suggest adding up to 100% to earthwork capital budget.**
- **Schedule**
 - **Suggest adding ~ 10% to the schedule and increase capital cost by 1% of total project capital for each month of delay (in addition to the effects noted above)**



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A Great Deal of Time and Money

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Where are we going in this hand basket?



Antamina Feasibility Study (29 Volumes)
Plus Update Study (11 Volumes in foreground)



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A Great Deal of Time and Money . . . BUT

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Where are we going in this hand basket?



Delivering Smarter Solutions

ISSUE NO. 57 — August 2004

***Feasibility Study Does Not
Necessarily Mean Feasible***

Sometimes the answer is NO!



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Large Projects: “The Bigger They Come . . .”

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Where are we going in this hand basket?

- The industry is moving into larger and larger projects.
- Large projects are not just a bigger version of a small project
- Large projects take on a life of their own.
- “Managing projects is managing interfaces”
- The ideal project has about 10 interfaces
 - The number of interfaces grows exponentially as the project size increases.
 - Therefore larger projects need more management & skilled people
 - But no one wants to staff up to that level of personnel
 - Result is that large projects are understaffed and control is reduced
 - Large projects last longer. It is difficult to keep a good team together over a long period of time, especially in a “hot” market.
- Project Manager: The conductor of an orchestra where all of the musicians are in a different union

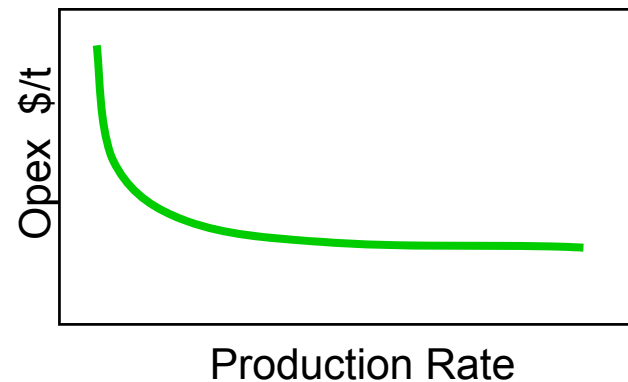
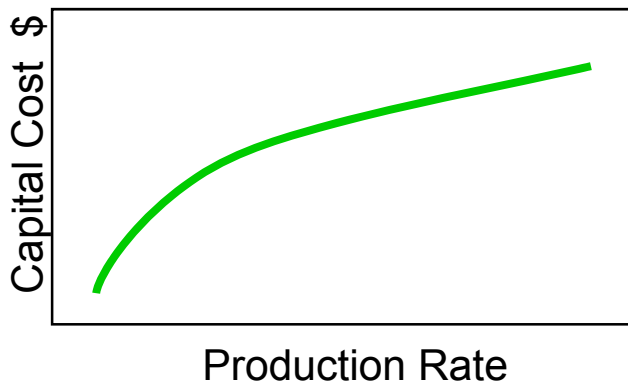


Market Expectations Obsession With Size

22

Where are we going in this hand basket?

- World's largest producer – “size matters”
 - Axiom - Bigger is better
 - Axiom - Bigger will make costs lower
 - Axiom - Economy of scale
 - Result - Crank up mining rate to unrealistic levels to meet economic hurdles (on paper)

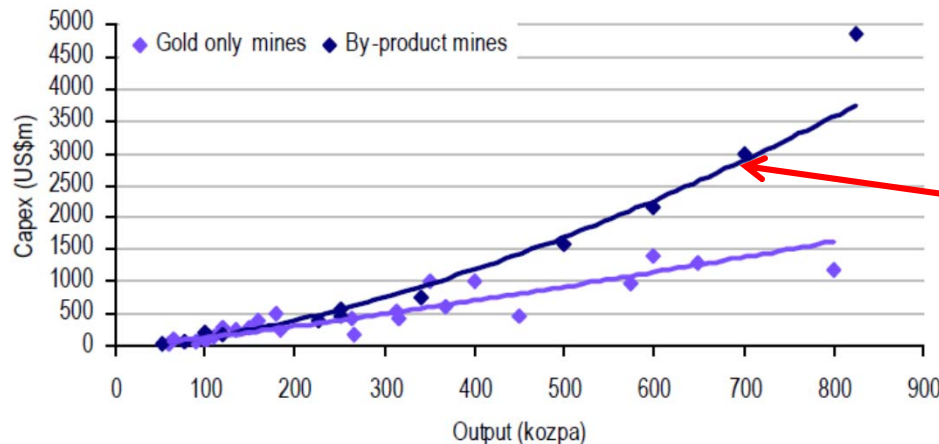
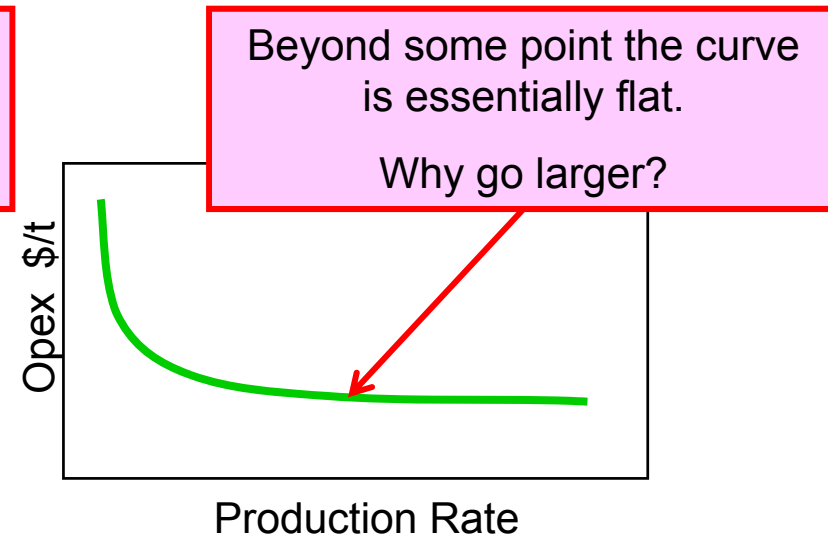
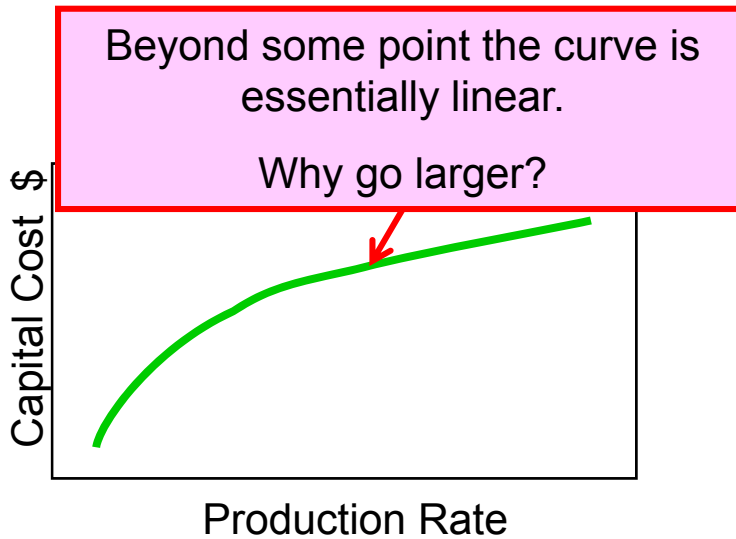


Market Expectations

Obsession With Size – Let's Look Closer

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Where are we going in this hand basket?



Recent UBS report suggests the old axiom may not be holding up.
Why go larger?

Why try to be the world's biggest or cheapest producer?

Why not be the world's **most profitable** producer?



Market Expectations

Obsession With Cash Operating Costs

Where are we going in this hand basket?

- **Cut costs at all costs**
- \$/lb or \$/oz
 - The metric that appears to matter once in production
 - Anything to get the cash cost down
- “Moving down the cost curve”
 - Ignores the capital cost to do this
- Budgeting by cost (as opposed to profit)
 - Example 1: Cut \$.10/lb but decrease revenue by \$.12/lb
 - Shows up as decrease in cash cost
 - Example 2: Spend \$.10/lb to increase revenue \$.12/lb
 - Shows up as increase in cash cost
- Should consider more meaningful metrics:
 - Net Cash Flow versus Cost
 - CF/oz or CF/lb
 - NPV/oz or NPV/lb



Management

“The New CEO” Effect

Where are we going in this hand basket?

- “CEO turnover hits new high”
 - 1341 CEOs left their companies in 2014 (US only?) (*mainstreet.com*)
 - Why the turnover?
 - Where will we find this many qualified CEOs to replace them?
- New CEO has 16 months to prove themselves:
 - 4 months to assess and set a path
 - 12 months to move the organization into the new path
- Example:
 - New CEO proves his/her worth by reducing headcount by 10%
 - Factory worker example is cut
 - Former worker is hired back as a contractor at 2X his original salary



Management

“Too Close For Comfort” Effect

Where are we going in this hand basket?

- The closer you are to the decision makers the more difficult it is to say no.
- Project decisions are dictated by people to whom you cannot say “No”
 - Budgets
 - Schedules
- Projects become a “sacred cow” and cannot be criticized or killed
 - Refusal to acknowledge that a disaster is approaching
- “Not Invented Here” syndrome
 - Typical of companies that have had successful research activities in the past
 - 10’s or 100’s of millions are spent to “defend the cause”
 - A simpler and cheaper solution may be available “off the shelf”, but it is from someone else’s shelf



Management

“Edge Of The Empire” Effect

Where are we going in this hand basket?

- The further the decision maker is from the task, the simpler the solution appears to be.

“Edge Of The Empire” Effect

- It is easier when you are no “up close and personal”
- Cost cutting measures dictated from head office:
 - No hiring
 - No contractors
- Example: Apply these criteria to a remote site with small truck fleet:
 - 2 truck operators fired for alcohol abuse
 - No new hires so cannot replace
 - Maintenance contract stopped to cut costs
 - The few remaining trucks eventually stopped working
 - Result is no production



Management

Arbitrary Deadlines & Dysfunctional Rewards

Where are we going in this hand basket?

- Quarterly Reports; Four big problems:
 - March 31, June 30, September 30, December 31
- Dysfunctional Reward Systems
 - “. . . both owners and managers need to think through what is the right way to assess performance and then reward or punish it. Part of the problem is public markets’ obsession with quarterly results, which presses managers to pursue meaningless targets rather than think about what is best for the company”
 - “Ownership matters”, The Economist March 11, 2006, p10
- Strategy / Tactics:
 - Use rewards to encourage a longer term view.
 - Follow the banker’s example – Completion Tests
 - Compensation only comes when the project performs as planned
 - Tie executive compensation to the long term results of their decisions.
 - Reward with options that vest 3-5 years in the future.



Management

Numeric Petrification - The Issue

Where are we going in this hand basket?

Process by which numbers become carved in stone

- Symptoms:
 - CEO = Chief Estimating Officer
 - CEO = Chief Euphoria Officer
 - Appears to manifest itself Quarterly
- Stages
 - Premature articulation
 - Followed almost immediately by a press release
 - Often accompanied by Rectal-Cranial Inversion
- Prognosis
 - CEO starts to believe the numbers
 - Personnel start to believe the numbers
 - Company acts on the numbers as if they are real



Management

Numeric Petrification - The Press Release

Where are we going in this hand basket?

The Facts:

On the back of a photograph of Remus Starr, showing him standing on the gallows, are the words:

"Remus Starr: Horse thief, sent to Montana Territorial Prison, 1885. Escaped 1887, robbed the Montana Flyer six times. Caught by Pinkerton detectives, convicted and hanged, 1889."



Management

Numeric Petrification - The Press Release

Where are we going in this hand basket?

The Facts:

On the back of a photograph of Remus Starr, showing him standing on the gallows, are the words:

"Remus Starr: Horse thief, sent to Montana Territorial Prison, 1885. Escaped 1887, robbed the Montana Flyer six times. Caught by Pinkerton detectives, convicted and hanged, 1889."

The Press Release:

"Remus Starr was a famous cowboy in the Montana Territory. His business empire grew to include acquisition of valuable equestrian assets and intimate dealings with the Montana railroad. Beginning in 1885, he devoted several years of his life to service at a government facility, finally taking leave to resume his dealings with the railroad. In 1887, he was a key player in a vital investigation run by the renowned Pinkerton Detective Agency. In 1889, Remus passed away during an important civic function held in his honor when the platform upon which he was standing collapsed."

 **Danger: Your own people may start believing the press release.**



Management

Numeric Petrification - Rectal-Cranial Inversion

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Where are we going in this hand basket?



Bad Case:

Where are you getting your estimates from?

Worse Case:

You start believing your own numbers.

Worst case:

Your organization believes your numbers and is acting on them.



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?

Reality Check



Reality Check Risk Assessment

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Where are we going in this hand basket?

- Beware of a single point estimate
- Gives no quantification of risk



Estimated Value (\$, \$/oz, NPV, IRR, etc)

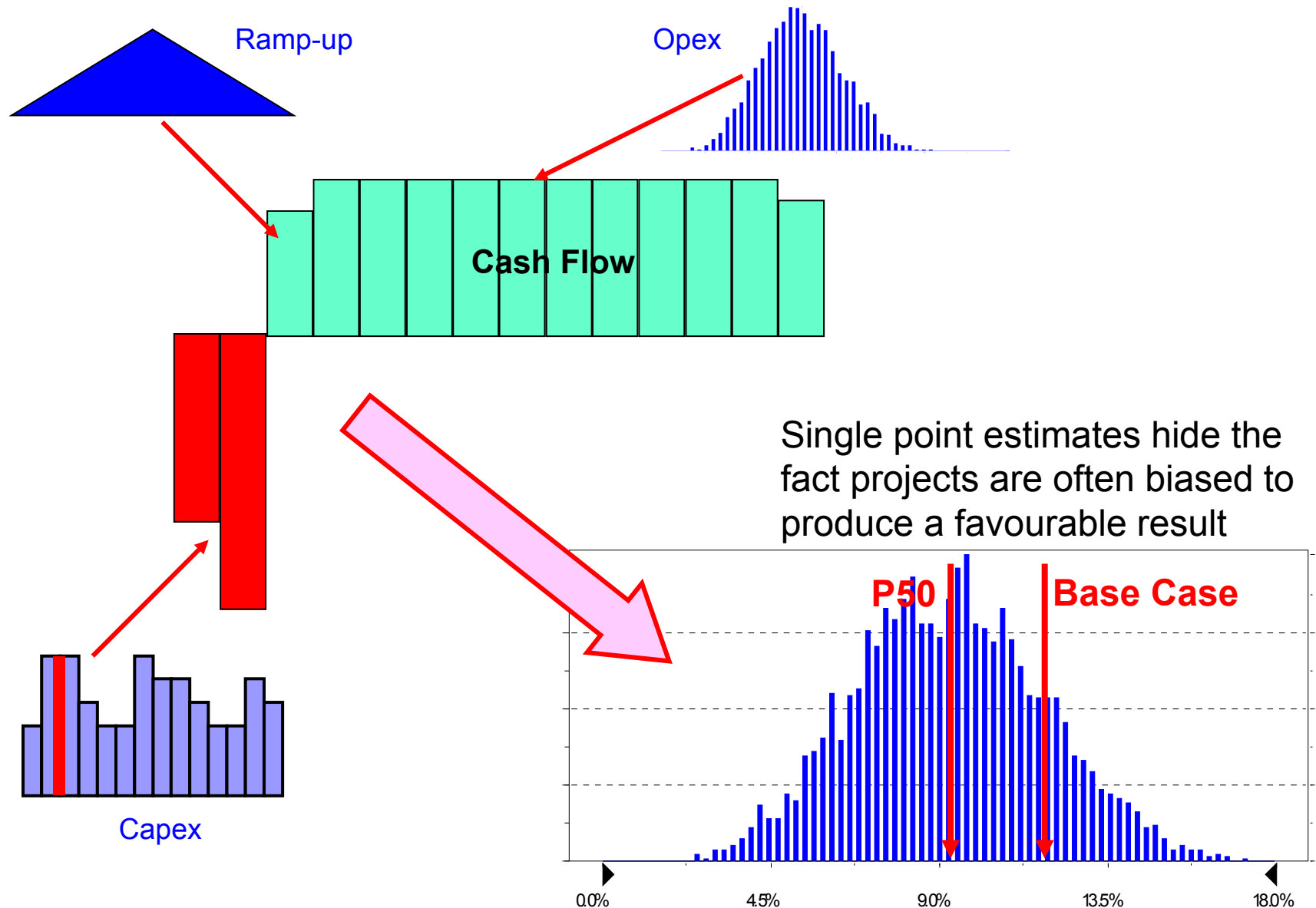


Reality Check

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Risk Assessment – Every Variable Has A Range

Where are we going in this hand basket?



Reality Check

Risk Assessment – Due Diligence

Where are we going in this hand basket?

- Select excellent people
- Build the right team
- Make sure they will tell you “No.”
- Listen to their advice
- Act on their recommendations



Grumpy



Grumpy



Grumpy



Dopey



Happy



Doc



**Number
Cruncher**



Reality Check

The T Shirt

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Where are we going in this hand basket?



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?

Where Are We Going? The Mine Of The Future



Disclaimer

Where are we going in this hand basket?



Please read all instructions and warnings before use. Must be 18 years of age or older to proceed further. Enter at your own risk. Do not enter. Speed limit - 28.8 or higher. Stop here on red. Hostess will seat you. Trucks over 4 tons excluded. Void where prohibited by law. Some assembly required. This is a test of the emergency broadcast system - this is ONLY A TEST! List each check separately by bank number. Batteries not included. Contents may settle during shipment. Any resemblance to persons living or dead is purely coincidental. Use only as directed. For indoor or outdoor use only. Wearing of this garment does not enable you to fly. We make no other warranties, expressed or implied. Do not use while operating a motor vehicle or heavy equipment. Postage will be paid by addressee. Postal service will not deliver mail without postage. No postage necessary if mailed in the United States. Subject to CAB approval. This is not an offer to sell securities. May be too intense for some viewers. See other side for additional listings. This product is meant for educational purposes only. For recreational use only. For office use only. For entertainment purposes only. Only 1 winner per household. Do not disturb. All models are over 18 years of age. Apply only to infected areas. If condition persists, consult your physician. Take two of these and call me in the morning. An apple a day keeps the doctor away. Now with new plastic applicator. High altitude directions-increase cook time by 10 minutes. This is not an attorney advertisement or referral service. No user-serviceable parts inside. Website contains small parts and is not intended for use by children under the age of eighteen. This compact disc was originally recorded on analog equipment. Freshest if eaten before date on carton. Times are approximate. Do not disturb. Simulated picture. Please remain seated until the ride comes to a complete stop. Return your seatback and tray table to their normal upright position. Your seat cushion can be used as a flotation device. In the event of decreased air pressure, oxygen masks will pop out of the top of your monitor. The call you have made requires a 20 cent deposit. Breaking seal constitutes acceptance of agreement. For off-road use only. Do not block intersection. No trespassing. No stopping or standing. Don't even think about parking here. No parking when road is snow covered. As seen on TV. One size fits all. Product will be hot after heating. Do not iron clothes on body. Remove clothing before distributing in washing machine. Do not use while sleeping. Do not use on food. Many suitcases look alike. Contains a substantial amount of non-Tobacco ingredients. Colours may fade. Insert this end first. We have sent the forms which seem right for you. This page made from 100% recycled electrons. Slippery when wet. No substitutions allowed. For a limited time only. Void where prohibited, taxed, or otherwise restricted. Caveat emptor. Provided "as-is" without warranty. Reader assumes full responsibility. We are an equal opportunity employer. No shoes, no shirt, no service. Quantities are limited while supplies last. If any defects are discovered, do not attempt to fix them yourself, but return to an authorized service centre. Read at your own risk. Parental advisory - explicit lyrics. Text may contain explicit materials some readers may find objectionable, parental guidance is advised. Keep away from sunlight. Keep away from pets and small children. Limit one per family please. No money down. No purchase necessary. Not affiliated with the American Red Cross. Drop in any mailbox. Edited for television. Keep cool. Process promptly. Return to sender, no forwarding order on file, unable to forward. Not responsible for direct, indirect, incidental or consequential damages resulting from any defect, error or failure to perform. Webmaster is also not responsible for items left, lost or stolen. At participating locations only. Sold by weight, not by volume. Penalty for private use. See label for sequence. This web site rated 'R' for Mature audiences. Do not take with alcohol. Sealed for your protection - do not use if safety seal is broken. Substantial penalty for early withdrawal. Do not write below this line. Falling rock. Use seatbelts even with airbags. Do not stop on railroad tracks. Lost ticket pays maximum rate. Your cancelled check is your receipt. Add toner. Place stamp here. Avoid contact with skin. Sanitized for your protection. Employees must wash hands before returning to work. Caution, coffee is served HOT. Be sure each item is properly endorsed. Sign here without admitting guilt. Slightly higher west of the Mississippi. Employees and their families are not eligible. Beware of dog. Contestants have been briefed on some questions before the show. Filmed in front of a live, studio audience. Call now to ensure prompt delivery. Leave off the last S for savings. Calls may be monitored for quality assurance or training purposes. Please make your selections from the following menu. All representatives are still busy assisting other callers. Please stay on the line and a representative will be with you when they feel the need. Please call back during our normal business hours. You must be present to win. Winners need not be present to win. No passes accepted for this engagement. This space () intentionally left blank. Do not use this product with a petroleum based lubricant. No animals were harmed in the preparation of this web site; only humans. This web page contains no CFCs. Discontinue use if nausea or dizziness occurs. Shading within a garment may occur. Use only in a well-ventilated area. Keep away from fire or flames. No soliciting. Bridge freezes before road surface. Stop, get ticket. Right lane must turn right. Left lane must turn left. Middle lane must make up their damn minds. This site runs on unleaded fuel only. Objects in mirror may be closer than they appear. Buses and carpools with two or more people only. No hitchhiking. Components may be hot. Silica gel - do not eat. Not to be used in conjunction with any other offer. Details on reverse side. Shoplifters will be prosecuted to the fullest extent of the law. We reserve the right to check all bags, coats & personal belongings upon exiting this page. Recycle. Fragile - handle with care. This side up. No jumping or diving. No running by the pool. Register has less than \$50 after dark. Driver does not carry cash. No swimming unless lifeguard is present. Swim at your own risk! Please do not wade in fountain. Guaranteed low prices. Not transferable. Actual size not shown. Contents under pressure. Do not intentionally inhale vapours. Replace with same type. Approved for veterans. Please be kind, rewind. Booths for two or more. Check here if tax deductible. Action figures sold separately. No preservatives added. Some equipment shown is optional. Price does not include tax. Do not remove any HTML tags under penalty of law. Hand wash only - tumble dry on low heat. No Canadian coins. Short circuit may cause fire. No more than 3 transactions per car. Not recommended for small children. Pre-recorded for this time zone. Reproduction strictly prohibited. No alcohol, dogs or horses. Not for resale. List at least two alternate dates. Blackout dates may apply. Viewing by pregnant women may result in fetal injury, premature birth and low birth weight. First pull up, then pull down. Insert Tab A into Slot B. Call toll free number before digging. Some of the trademarks mentioned in this product appear for identification purposes only. Record additional transactions on back of previous stub. Unix is a registered trademark of AT&T. Do not fold, spindle or mutilate. No transfers issued until the bus comes to a complete stop. Doors do not rebound or bounce back. Your mileage may vary. This article does not reflect the thoughts or opinions of either myself, my company, my friends, or my cat. Don't quote me on that. Don't quote me on anything. All rights reserved. Patent pending. For external use only. Avoid extreme temperatures. Avoid contact with eyes and skin. Do not puncture, incinerate, or store above 120 degrees Fahrenheit. Do not place near a magnetic source. Smoking could be hazardous to your health. Cigarette Smoke Contains Carbon Monoxide. Smoking Causes Lung Cancer, Heart Disease, Emphysema. The best safeguard, second only to abstinence, is the use of a condom. No salt, MSG, artificial colour or flavouring added. If ingested, induce vomiting. Ribbed for her pleasure. Offer valid only at participating locations. Slightly higher west of the Rockies. Allow four to six weeks for delivery. You may distribute this article freely, but may not make a profit from it. 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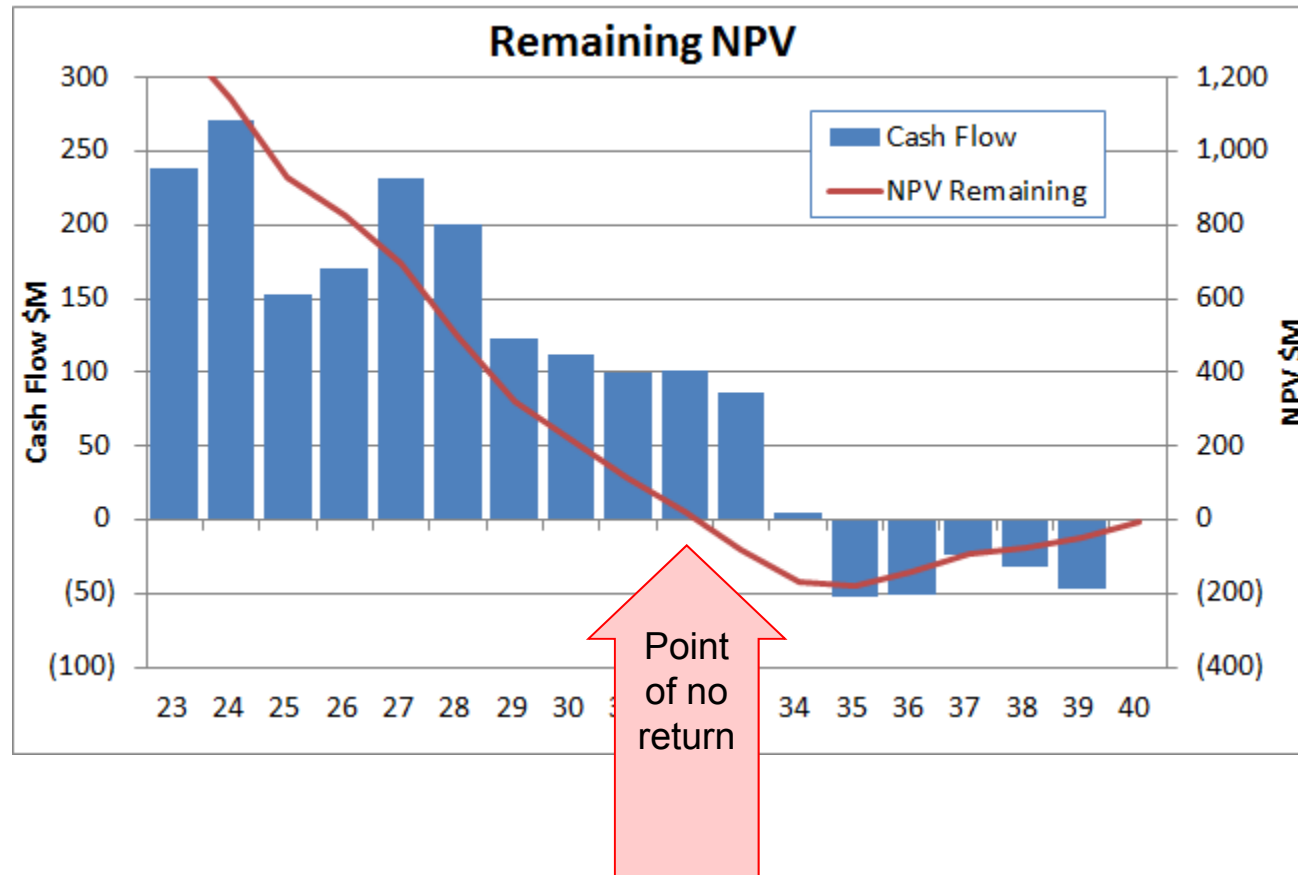
The Mine Of The Future Closure



Closure Costs

Point of No Return

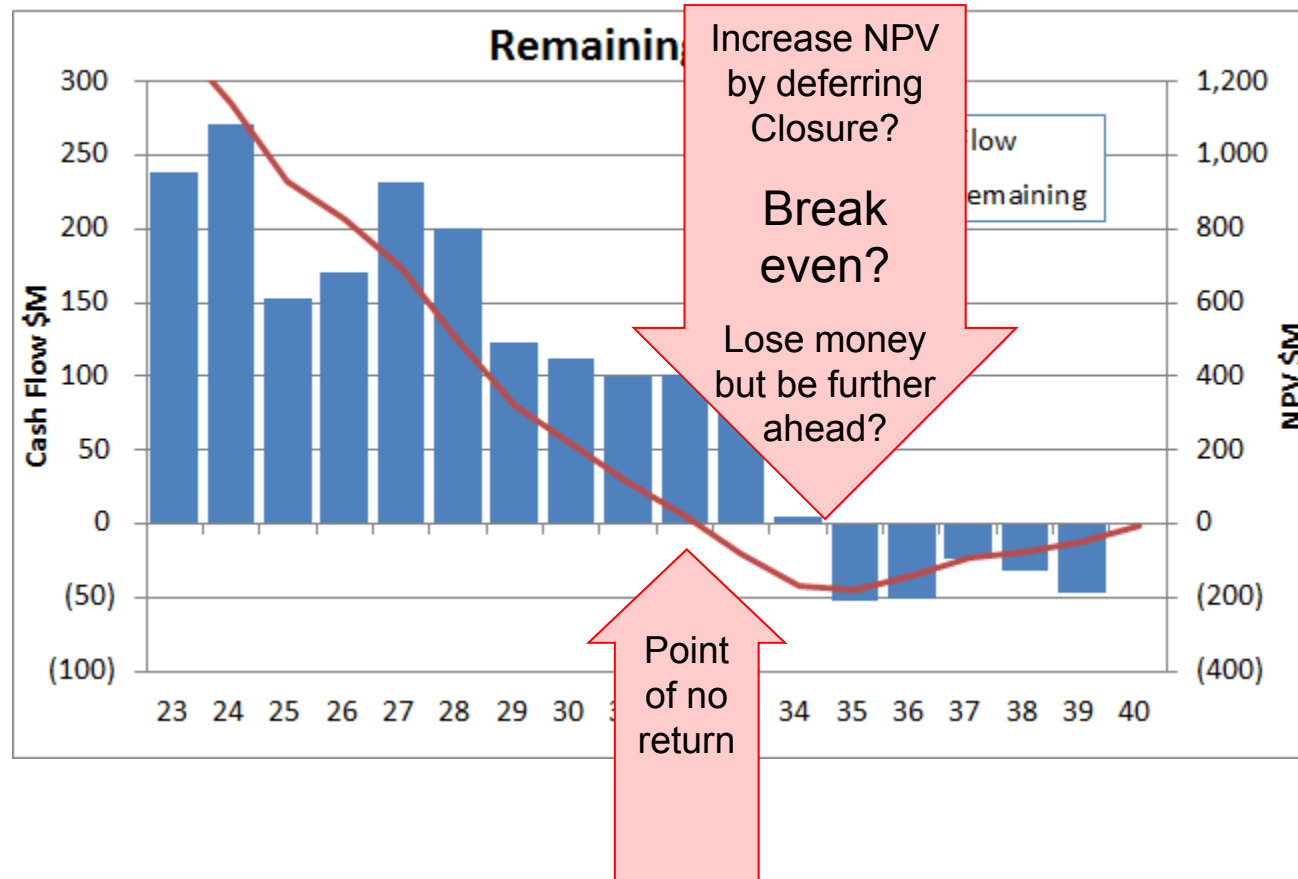
Where are we going in this hand basket?



Closure Costs

Is there Value in Deferring Closure?

Where are we going in this hand basket?



Closure Costs

Accumulation of Long Term Liabilities

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Where are we going in this hand basket?



Closure Costs

Accumulation of Long Term Liabilities

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Where are we going in this hand basket?



Closure Costs

Accumulation of Long Term Liabilities

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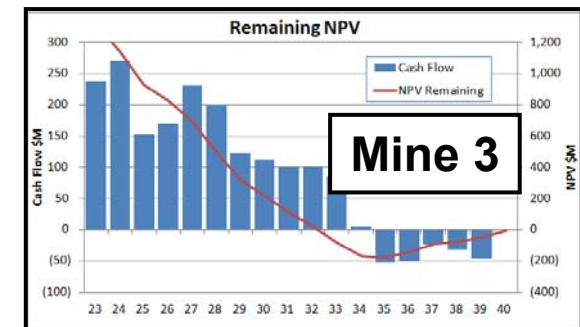
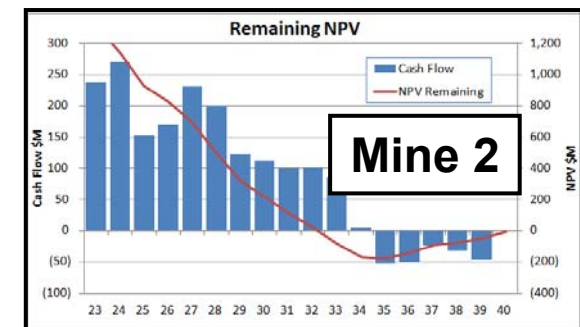
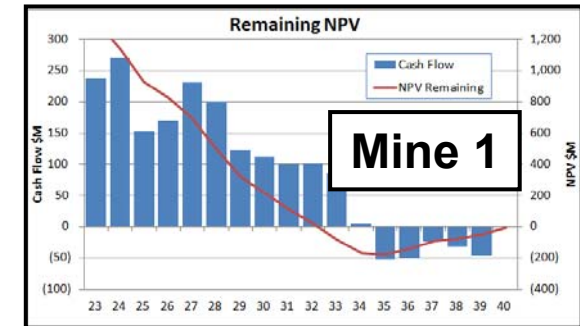


Closure Costs

Accumulation of Long Term Liabilities

Where are we going in this hand basket?

- As companies move through their mines' lives, more and more operations will be closed.
- The cost of closure has been increasing with increasing regulations and will likely to continue to do so.
- At some point the obligations of closure and long term monitoring will exceed the value of the remaining operations.
- What are the company's options at that point?
- Is bankruptcy the likely outcome.
- Can the liability ever be removed by selling the property?
- Can the liability be transferred to specialized closure entity such as an insurance company?



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?

The Mine Of The Future Social & Environmental



Top 10 Strategic Business Risks in Mining & Metals

Where are we going in this hand basket?

2009-2010

1. Cost containment
2. Industry consolidation
3. Access to capital
4. **Maintaining social license to operate**
5. Climate change concerns
6. Skills shortage could delay projects
7. Infrastructure access creating bottlenecks
8. Access to secure energy
9. **Resource nationalism**
10. Pipeline shrinkage (lack of new discoveries)

2011-2012

1. **Resource nationalism**
2. Skills shortage
3. Infrastructure access (to markets)
4. **Maintaining social license to operate**
5. Capital Project Execution
6. Price & Currency Volatility
7. Capital Allocation
8. Cost Management
9. Interruptions to Supply (Natural Disasters)
10. Fraud and Corruption, Sovereign Risk

2013-2014

1. Capital allocation
2. Margin protection & productivity improvement
3. **Resource nationalism**
4. **Social license to operate**
5. Skills shortage
6. Price and currency volatility
7. Capital project execution
8. Sharing the benefits
9. Infrastructure access
10. Threat of substitutes



Social and Environmental Costs and Schedules

Where are we going in this hand basket?

Environmental

- Most of our environmental obligations are “known”:
 - Existing legislation
 - International standards
 - They may be expensive but the limits are known
 - They will continue to evolve
- Allow time for baseline studies and permitting
 - The schedules may be long but they are “known”
 - They will continue to evolve

Social

- Much of our social obligation is not known:
 - Little legislation or international standards or examples as guidelines
 - The costs seem to have no limit
- Negotiations are time consuming and highly political
- The new “resource nationalism”



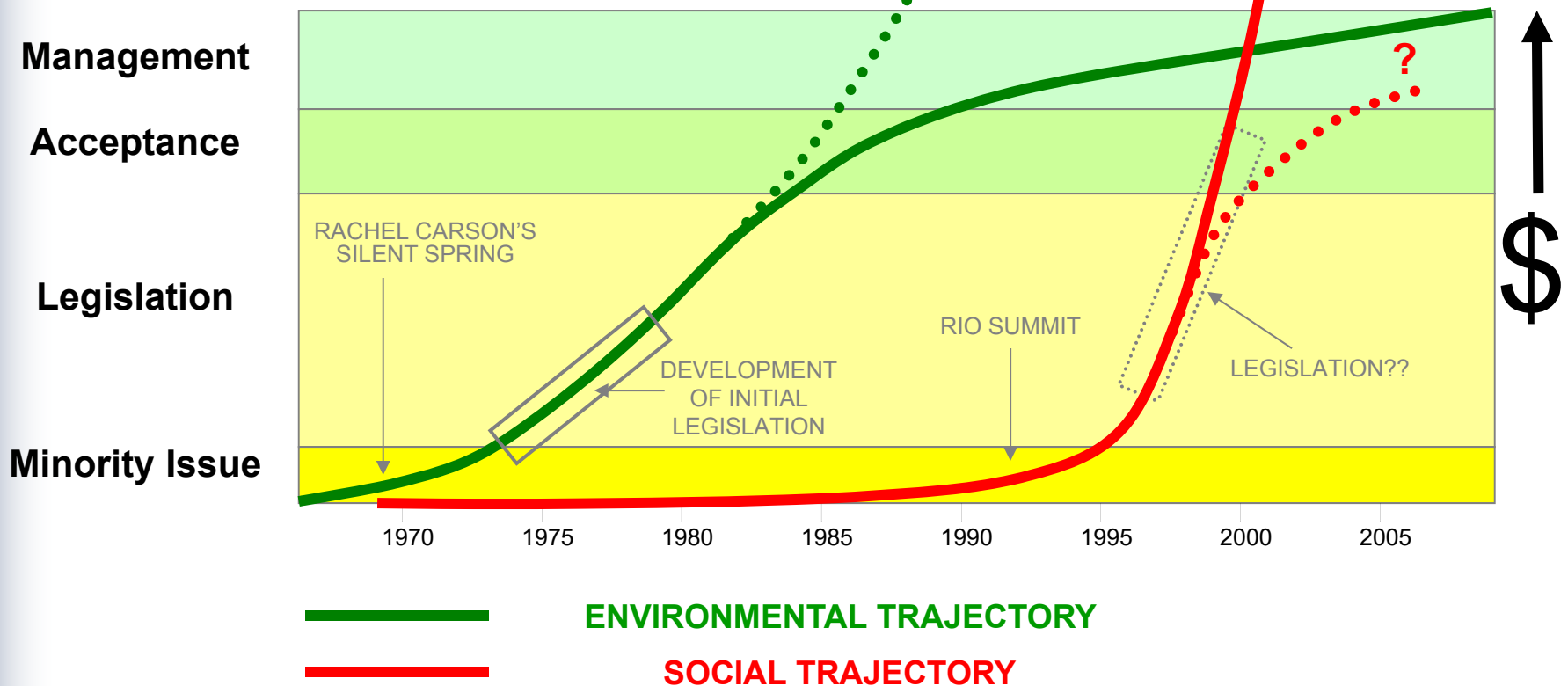
Social Issues Cost Money

Is There A Limit?

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Where are we going in this hand basket?

Environmental and Social Acceptance Timeline
Process of Acceptance by Corporate Cultures



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?

The Mine of The Future The Next New Thing



Where Are We Going In This Hand Basket?

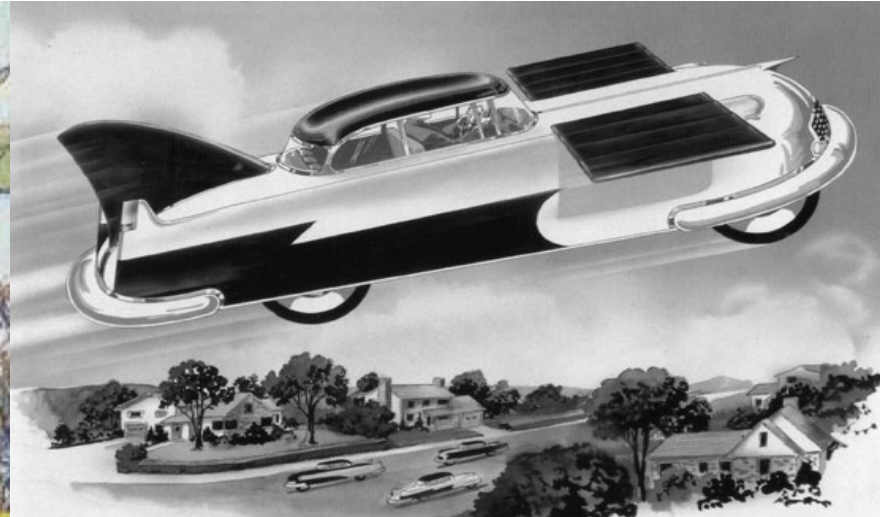
Where are we going in this hand basket?

***The future
is not what it used to be!***



Remember When The Future Looked Like This?

Where are we going in this hand basket?



What Will the Mine of the Future Look Like?

Where are we going in this hand basket?



What have we learned about the future?

Where are we going in this hand basket?

Don Mills

- The modern suburb in 1955
- Curved streets and cul-de-sacs to limit traffic volume
- Model copied all over North America
- Depends on cars and cheap gas
- Poor access for transit



New modern city planning

- Trending towards simple grid system running off of a commercial “high street”
- Easy walking access.
- Simplified infrastructure.
- Very easy access for transit.
- Pompeii



What Will the Mine of the Future Look Like?

Where are we going in this hand basket?

- Remote control operations?
 - You can't move maintenance off-site.
- Amazing new technology?
 - Truckless haulage?
 - Rail-veyors?
 - Dirigibles?
 - Robots and automation?
- Some visions are probably fanciful:



The Mine Of The Future

Where are we going in this hand basket?

- Mines and Mining:
 - Lower grades (and larger deposits)
 - Increasingly remote locations
 - “Deeper is cheaper” at existing operations
 - Underground mining to avoid ARD and waste footprint
- Increased focus on waste products and closure obligations
 - Transparent costs, expressed as cash and NPV
 - Trust funds with true cash costs (not bonds or accounting accruals)
 - Increased costs
 - Longer post-closure commitment
- Longer Schedules
 - Longer permitting and approval processes
 - More scrutiny by more parties



The Mine Of The Future

Where are we going in this hand basket?

- More Technical Partners
 - Equipment suppliers (mining equipment, camps, shipping companies)
 - Infrastructure suppliers (power lines, roads, pipelines)
 - Commodity suppliers (power, water, oxygen, gas)
- More social & environmental issues at greater cost
 - More NGOs
 - More social media
 - More anti-mining emotion and less facts
 - More government, community & first nation “partners”
 - The new “resource nationalism”
 - More and more compliance and transparency legislation
 - More charges and punishment
 - More supporting and embracing local cultures and customs
 - Why isn’t bribery recognized as a local custom?



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?



Questions?



Where Are We Going In This Hand Basket?

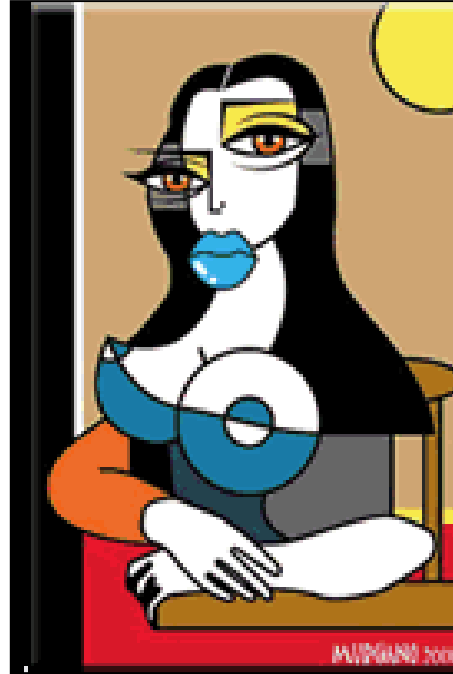
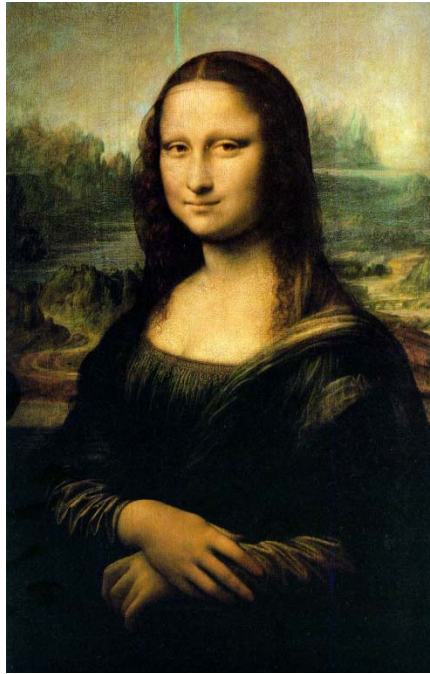
Notes

Where are we going in this hand basket?



Oldies But Goodies

- Some of the illustrations are older, but classic
- The new versions are not always as good.



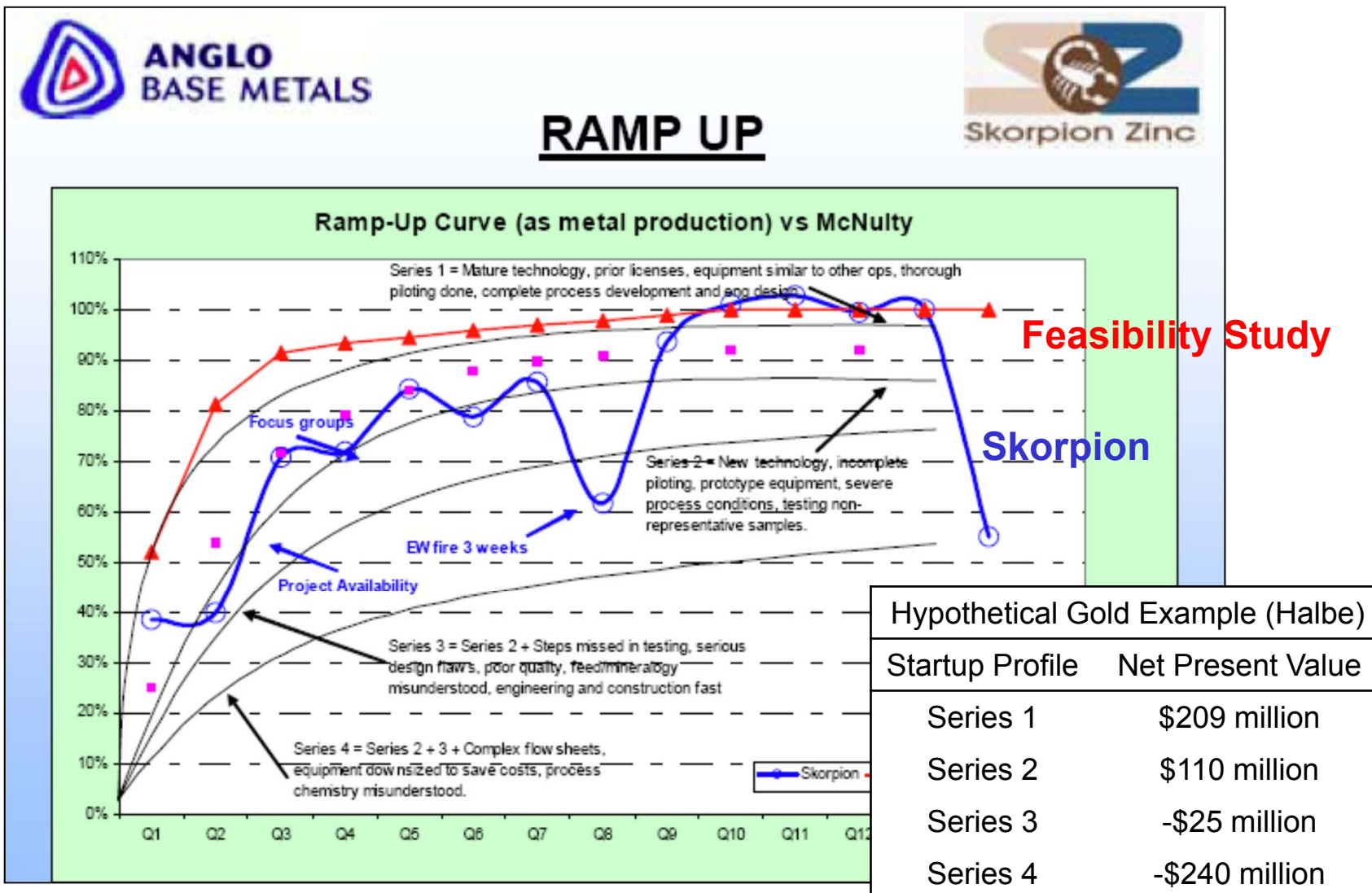
Where are we going in this hand basket?



Feasibility Studies & Capital Performance Ramp-Up

62

Where are we going in this hand basket?



D. Halbe - Business aspects and future technical outlook for hydrometallurgy - 2003

Skorpion Zinc - Association Of Mine Managers of South Africa - 26Oct06



Where Are We Going In This Hand Basket?

Where are we going in this hand basket?

Take Aways



Take Away Tactics and Strategies

Where are we going in this hand basket?

Tactics:

- Staff up to manage the interfaces
 - Seek out the best possible personnel
 - In the short term, grit your teeth and pay the salaries you must to get the right people
 - Lessons Learned: Record the problems (and solutions) honestly and thoroughly for future review.
 - Know where you are
 - 3 Ways to be Lost:
 - You don't know where you are going.
 - You don't know where you are.
 - You don't know how to get from where you are to where you are going.
- ☠ Biggest Danger: You may not know you are lost.



Take Away Tactics and Strategies

Where are we going in this hand basket?

Strategies:

- Develop long term perspectives (beyond quarterly results; beyond director meetings; beyond metal price downturns)
- Develop value (as opposed to size)
- Develop reliable databases of problems, risks, issues, and solutions
 - Support a forum where we can share the knowledge
- Develop training and mentoring to create your own excellent people
- Develop appropriate metrics (focus on profit, not just reduced costs)
- Develop functional reward systems (as opposed to “take the cash and run”)
- Develop reality checks:
 - Understand your risks
 - Challenge numbers and assumptions
 - Reward people who tell you the truth

Remember: Sometimes the answer is “NO!”



Why Do Projects Fail?

Where are we going in this hand basket?

- WHAT IS FAILURE?
 - More than 10% over budget
 - More than 3 months late to start-up
 - More than 1 year late full production
- Overseas Projects
 - Different Design Approaches
 - Different Contracting Approaches
 - Different Social + Cultural Issues
- Western Study:
 - Over 1000 major project failures studied
 - 89 Factors identified for failure
 - Only one significant factor - the quality of the project manager.



Feasibility Studies & Capital Performance

How Have We Done?

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Where are we going in this hand basket?

- The average operating company:
 - often has limited experience in developing projects
 - often have cut back or eliminated corporate engineering staffs
 - Often do not involve the EPCM contractor from early concept through start-up even though EPCM contractor has typically been involved in the construction of more mines than the owners
- No apparent difference between:
 - Junior or major company
 - Large of small projects
 - Location
 - In-house or “blue chip” consultants



How Have We Done?

Feasibility Performance Since 1980

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Where are we going in this hand basket?

Managerial Deficiencies

- *Owner Project Management*: Gaps in project team experience and skills, insufficient owner participation, and unqualified personnel;
- *Estimating*: Errors and omissions, untested or faulty assumptions in critical areas, and unqualified personnel;
- *Logistics*: Inadequate assessment of how to supply the project during development and operations.
- *Construction Management*: Inadequate or inappropriate staffing levels and unqualified personnel; and
- *Financial Management*: Inadequate plan to fund the project, misevaluation or omission of the time required to raise financing, and omission of financing costs.

Technical Deficiencies

- *Site Investigations*: Inadequate or incomplete investigation of critical site-specific conditions; and
- *Basic Engineering*: Inadequate or incomplete evaluation and interpretation of the site-specific data.



How Have We Done?

Feasibility Performance Since 1980

69

Where are we going in this hand basket?

Other

- Acts of God;
- Changes in legislation;
- Civil disturbance, war, terrorism, etc.;
- Non-governmental entity interference;
- miscellaneous forms of bad luck.

The following conditions were apparent:

- There was no correlation between overrunning the estimate and who compiled it (either in-house or “blue chip” consultants)
- Upper-tier operators did not perform any better than “juniors;”
- Neither project size nor location appeared to have much influence on the likelihood of an overrun.



How Have We Done?

Feasibility Performance Since 1980

Where are we going in this hand basket?

The following factors work against producing a reliable study:

- Limited resources: limited risk capital
- Limited resources: qualified personnel.
- Limited time - always the pressure to produce the study as quickly as possible.
- Artificial deadlines, such as board meetings and presentations to bankers.
- The highly site-specific nature of the projects makes direct comparison very subjective.
- The cyclical nature of the mining industry.
- Long project development times.
- The average operating company often has limited experience in developing projects.
- Operating companies have cut back or completely eliminated corporate engineering staffs.
- The typical design engineer or the Engineer-Procure-Construction Management (EPCM) contractor has been involved in the construction of more mines than the owners, but is rarely involved with a project from early concept through start-up. Therefore, their ability to help assess risks or shortcomings in feasibility engineering can be severely limited.
- Published comparisons of expectations (feasibility) versus actual performance are almost non-existent. Owners are reluctant to air their problems.

How Have We Done? Feasibility Performance Since 1980

Chris Gypton, E&MJ Jan 1/02



Why Building A Mine On Budget Is Rare

Where are we going in this hand basket?

- No association or weak association between capital cost overruns and the following project characteristics:
 - ✗ **Financing** (external vs. internal sources)
 - ✗ **Company size** (as measured by market cap at feasibility and market cap at construction)
 - ✗ **Project size** (as measured by estimated capex, actual capex, and processing capacity)
 - ✗ **Mining method**, infrastructure requirements, and power requirements
 - ✗ **Project location** (by continent)
 - ✗ **Primary commodity**
 - ✗ **Processing method**
 - ✗ **Project history** (greenfield vs. brownfield)



Capital Projects

How Have We Done?

Where are we going in this hand basket?

- Mining projects are often in remote sites and have unique logistical and environmental issues.
- Resources are often seen as national legacies with attendant political, legal and socio-economic considerations.
- Improved metal prices and/or extraction technologies may lead to reacquisition of abandoned mining properties that have unforeseen environmental legacies and regulatory implications.
- Volatility in metal prices have led to abrupt study deferrals and resumptions causing problems such as ambiguous mining rates, skipped study steps and an unrealistic study schedule.
- Feasibility studies may tend to focus on technical issues at the expense of business and project delivery issues (e.g., execution strategy and planning deliverables).



Capital Projects

How Have We Done?

Where are we going in this hand basket?

- In addition to the degree of project definition, estimate accuracy is also driven by other systemic risks such as:
- Level of non-familiar or first of a kind technology in the project.
- Complexity of the project.
- Quality of reference cost estimating data.
- Quality of assumptions used in preparing the estimate.
- Experience and skill level of the estimator in the mining and ore processing industries
- Estimating techniques employed.
- Time and level of effort budgeted to prepare the estimate.
- The accuracy of the geotechnical data.
- Remote nature of project locations and the lack of benchmark data for these remote locations.
- Political, environmental, and other regulatory circumstances.
- Project-specific risks (e.g. risk events) also drive the accuracy range.



Why do projects fail?

Failure Factors

Where are we going in this hand basket?

- Poor (no) project phasing
 - Late equipment information.....
 - Late input of permit conditions.....
 - New team member inputs.....
 - Late test work results.....
 - Late resource data.....
- No team continuity..... 63%
- Turn-key fixed price..... 42%
- Major new technology..... 50%
- Front end issues
 - Budget cuts without scope cuts.....
 - Scope changes generally.....
 - Key data ignored (pilot plants or geology)
- **All failures had multiple factors**



Feasibility Studies & Capital Performance

Large Projects: “The Bigger They Come . . .”

75

Where are we going in this hand basket?

- Large projects need more of the right people
 - “The right people for the right job.”
 - “You get what you pay for.”
 - Large projects last longer. It is difficult to keep a good team together over a long period of time, especially in a “hot” market.
- Large projects need excellent planning and communication
 - Time spent on design, planning, inspection does not get in the way of real work, it is the real work.
 - In larger projects it is more difficult to keep the team up to date on progress, changes, issues, especially if working in many different locations.
- Strategy / Tactic
 - Large projects need a different kind of managing.
 - Large projects need to be broken down into manageable sizes



Things Can Always Get Worse

Where are we going in this hand basket?



The Pipeline Problem

The Issues

Where are we going in this hand basket?

- May have reached “peak gold” production in around 2000
- One new multi-million ounce mine every year just to replace output
- Impact: *(Mineweb 29Mar10)*
 - 10 largest gold mining companies (\$152 billion Market Cap)
 - 2007-9 3 year operating cash flow = \$24.5 billion
 - 2007-9 3 year free cash flow = **-\$13.5 billion**
 - Striving to maintain or enhance their resource positions
- Explore:
 - Budgets are low; Success is low
- Acquire:
 - Does not create new production only moves ownership around
- Expand existing operations:
 - Solves today’s problem
 - Shortens the life of the operation

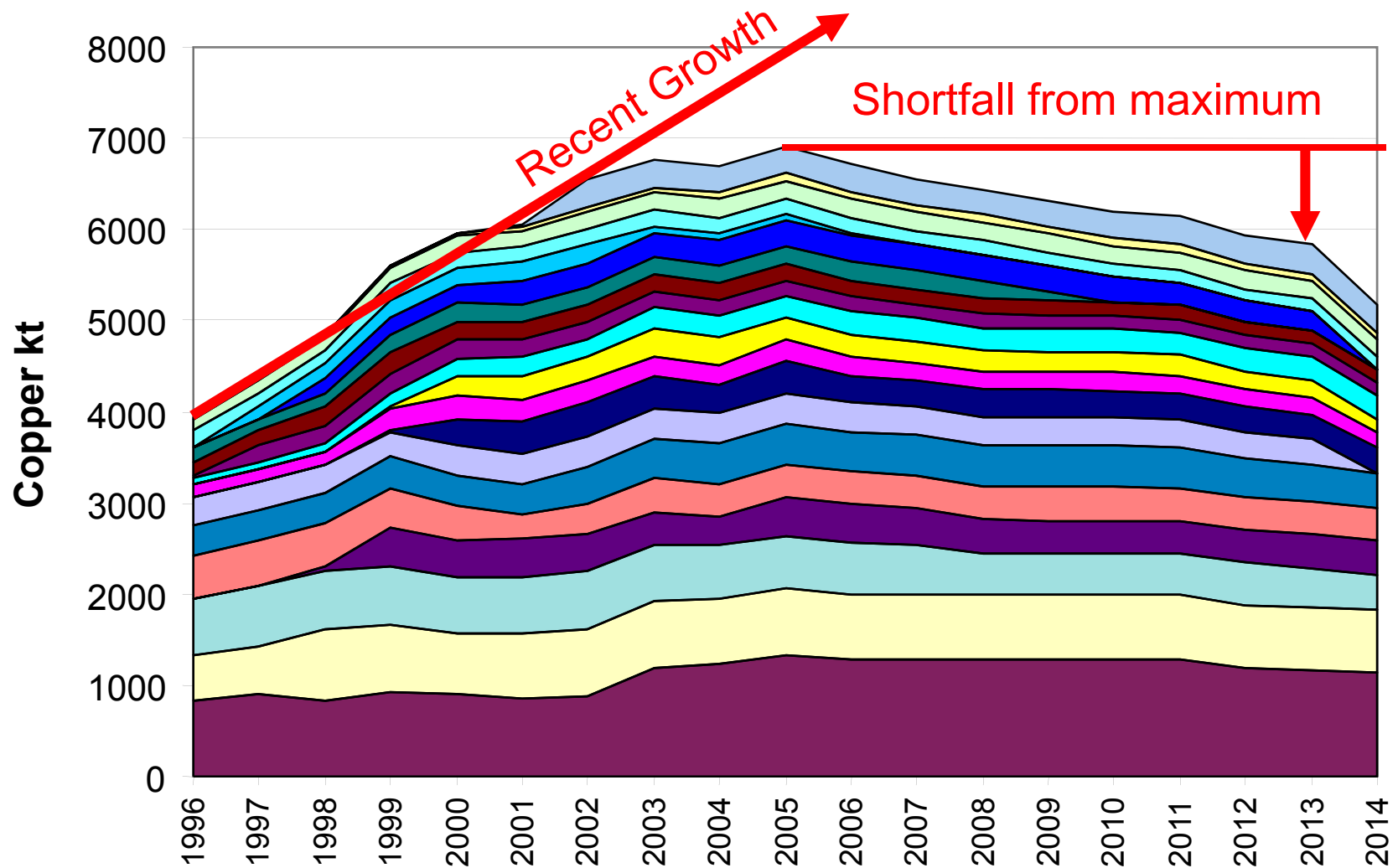


The Pipeline Problem

The Picture

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Where are we going in this hand basket?



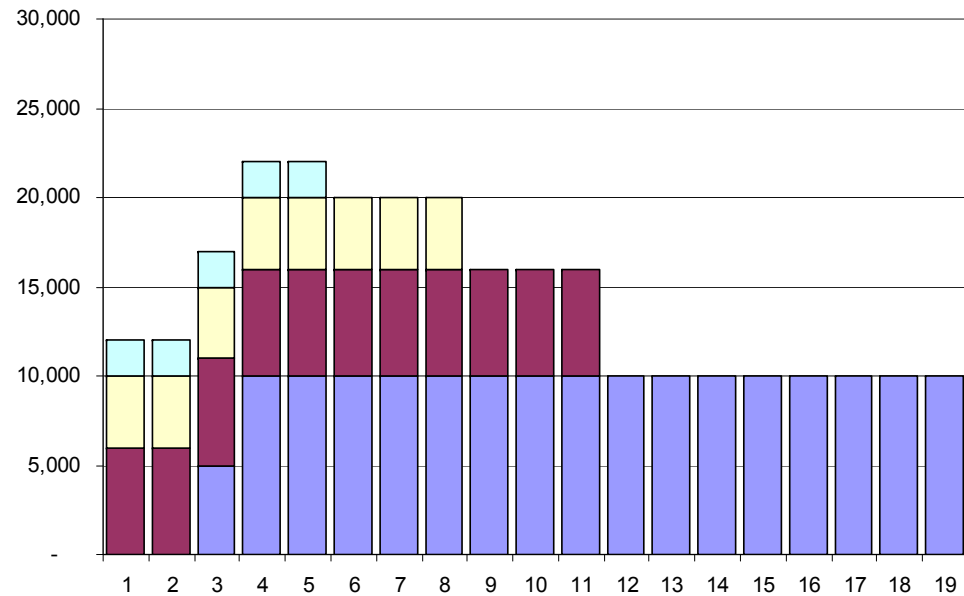
The Pipeline Problem

Expanding Existing Operations

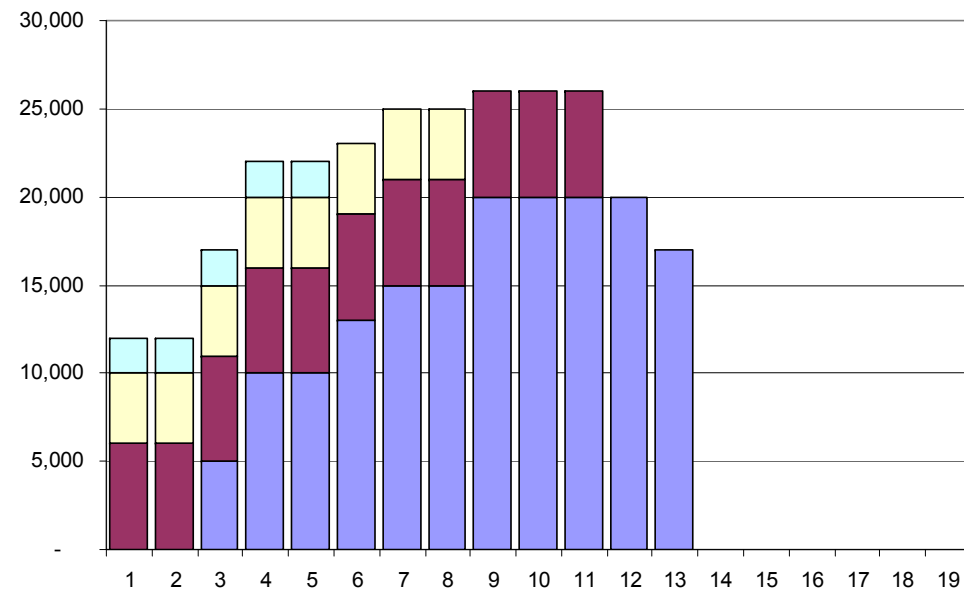
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Where are we going in this hand basket?

Pipeline Problem
“As Is”



Pipeline Problem
“Solution”



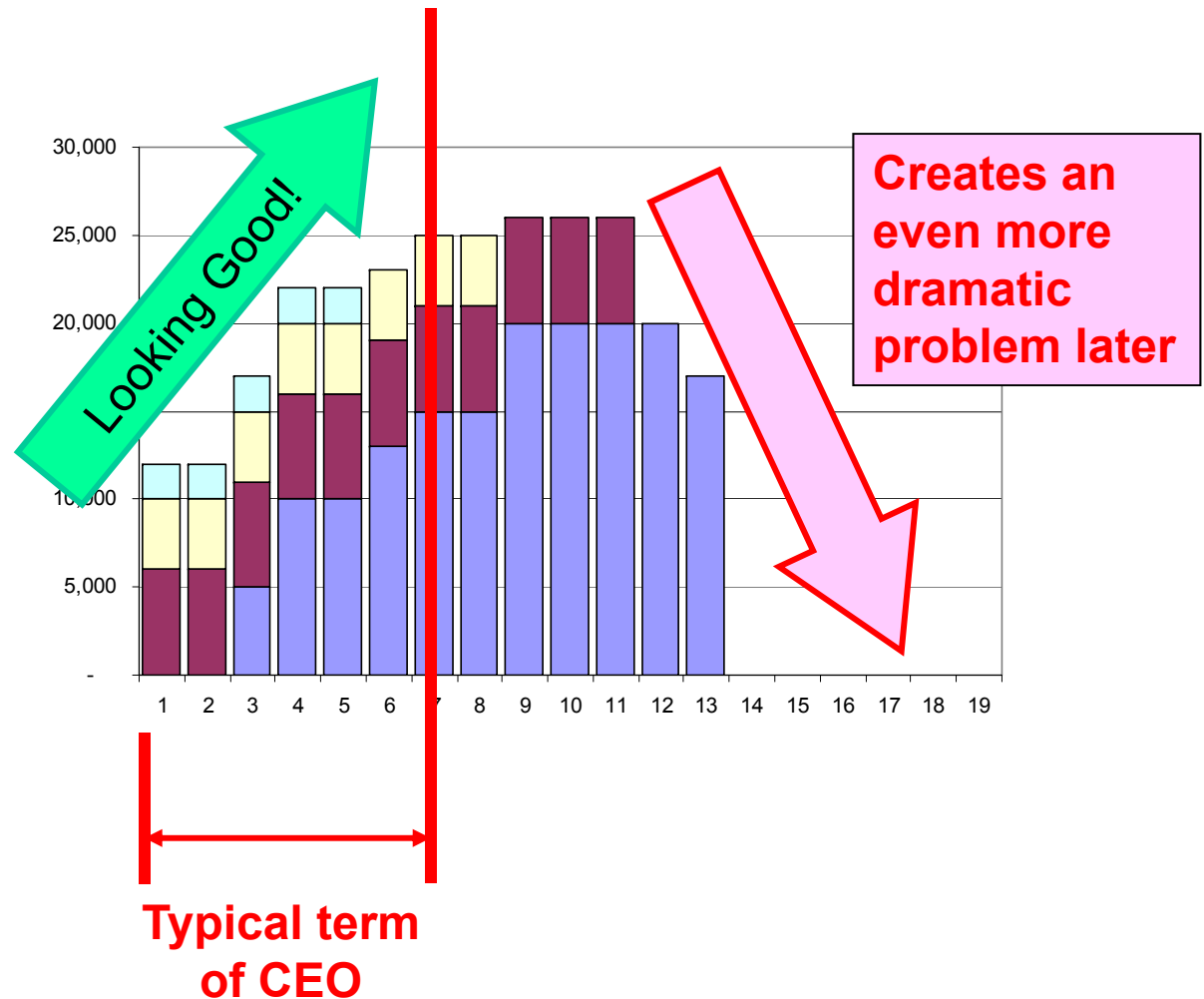
The Pipeline Problem

Expanding Existing Operations

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Where are we going in this hand basket?

Pipeline Problem
“Solution”



Case Study

Where are we going in this hand basket?



Premature articulation



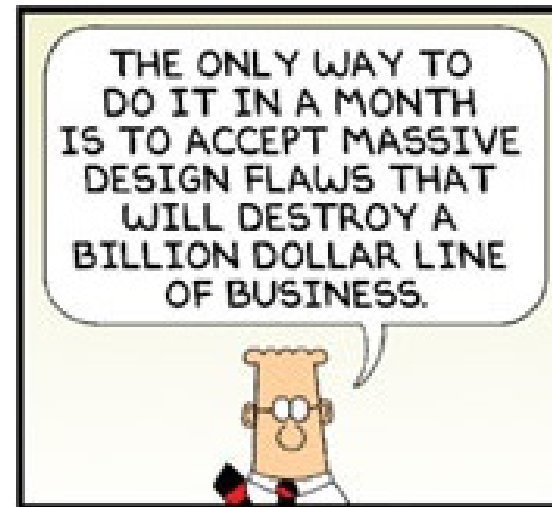
Unrealistic deadlines



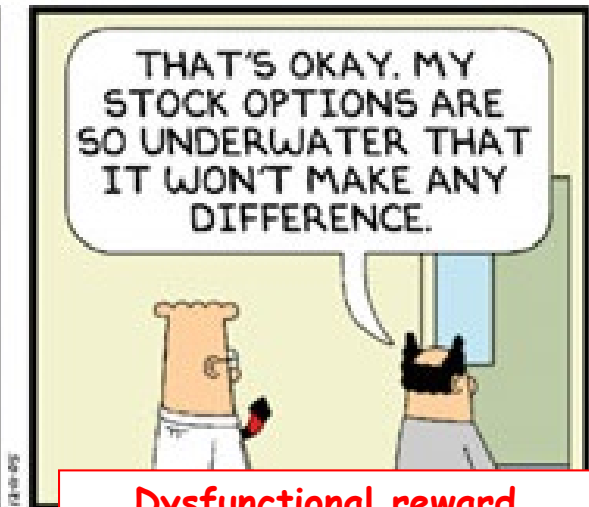
Don't contradict the CEO



Numeric petrification



Dysfunctional reward systems



Red Flags



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Where are we going in this hand basket?

