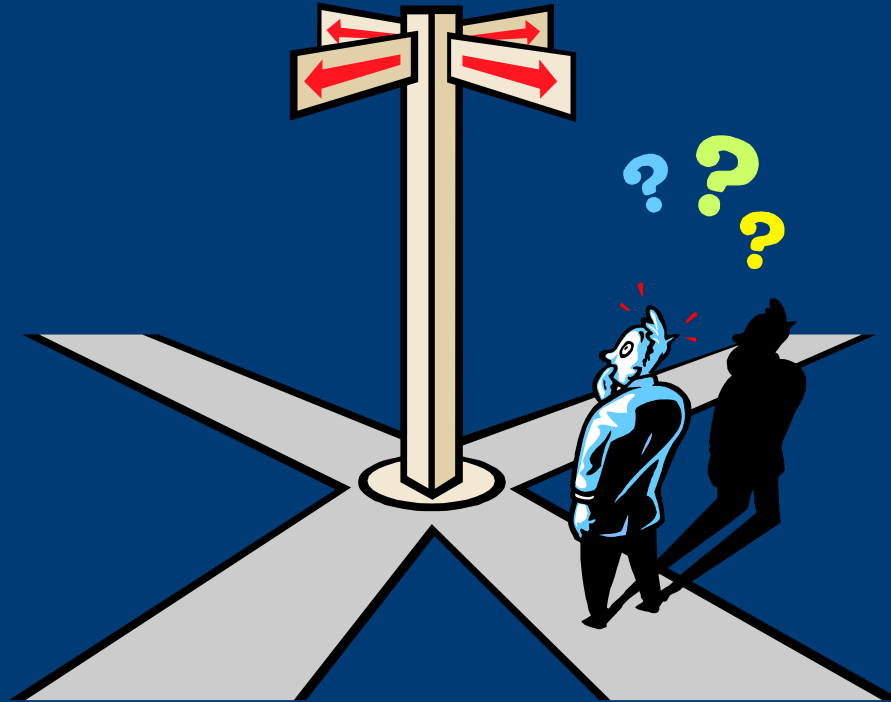


A Prescriptive View of Risk

2004-5 SPE Distinguished Lecture

Peter Cockcroft

Apologies to Yogi
Berra



When you come to a fork in the road
- take it!!

- What is risk?
- What is risk management?
- Why bother with it?
- Different perspectives of Risk
- A suggested process
 - Identify
 - Quantify (assess)
 - Response
 - Avoid (Terminate)
 - Transfer
 - Mitigate (Treat)
 - Accept (Take)
 - Monitoring and Review

Risk and Uncertainty Contrasted

The MIT dictionary of modern economics (1992) definitions:

- **Uncertainty**

"A situation in which the likelihood of an event occurring is not known at all. That is, no probability distribution can be attached to the outcomes..."

- **Risk**

"A context in which an event occurs with some probability or where the size of the event has a probability distribution..."

Risk \neq Uncertainty

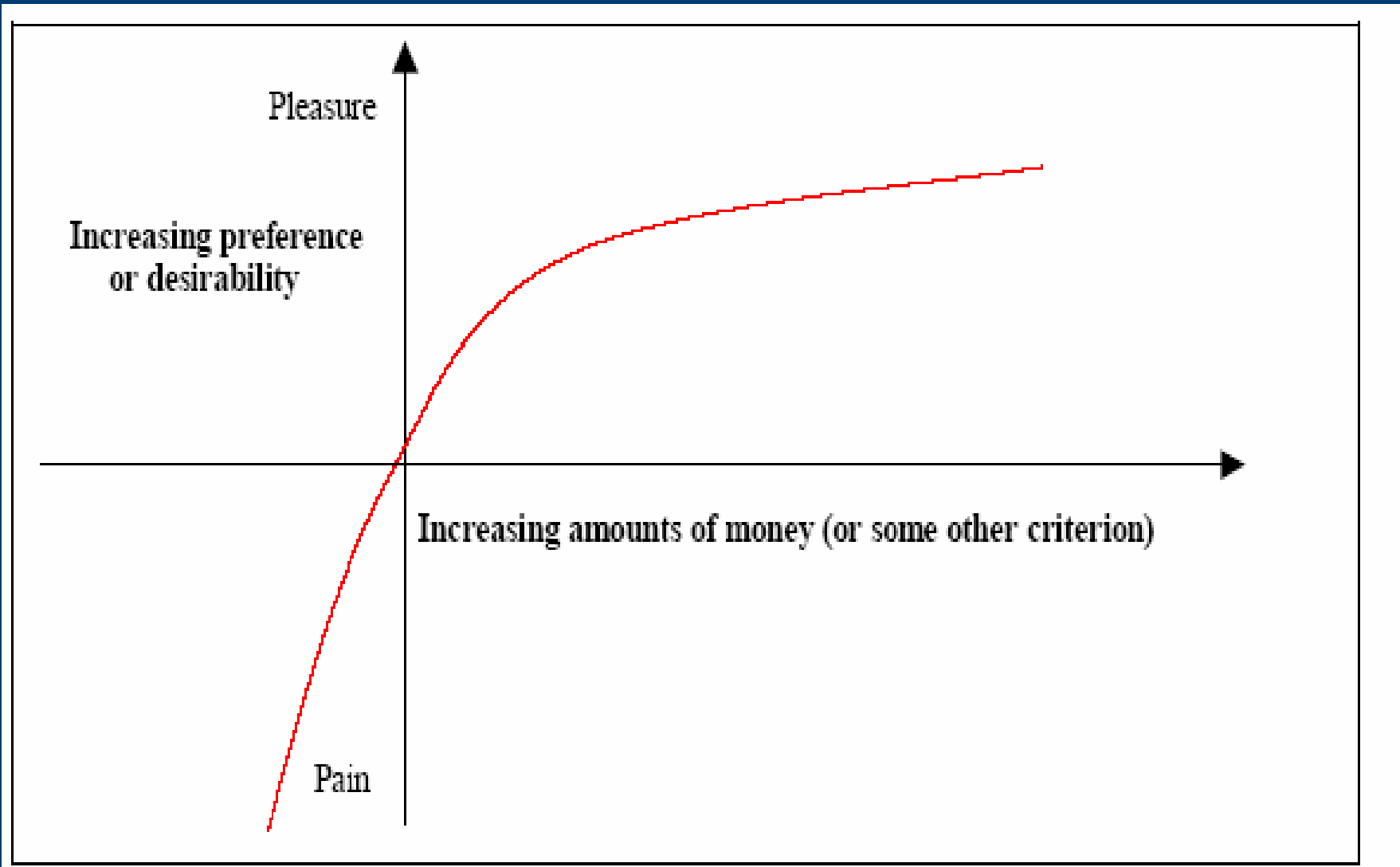


Risks are those factors which could influence the achievement of business objectives. This definition includes both the 'upside' opportunity and the 'downside' hazard.

It is important to identify, assess and determine appropriate ways of responding to upside risks in pursuit of opportunity and value. It is also important to identify, assess and determine appropriate ways of responding to downside risks which could hinder performance or result in losses.

The pleasure (utility) associated with winning is generally less than the displeasure of losing the same amount - it hurts more to lose than it feels good to win.

People will take a greater chance to avoid a loss than to make a gain of the same amount.



WHAT IS RISK AND RISK MANAGEMENT?

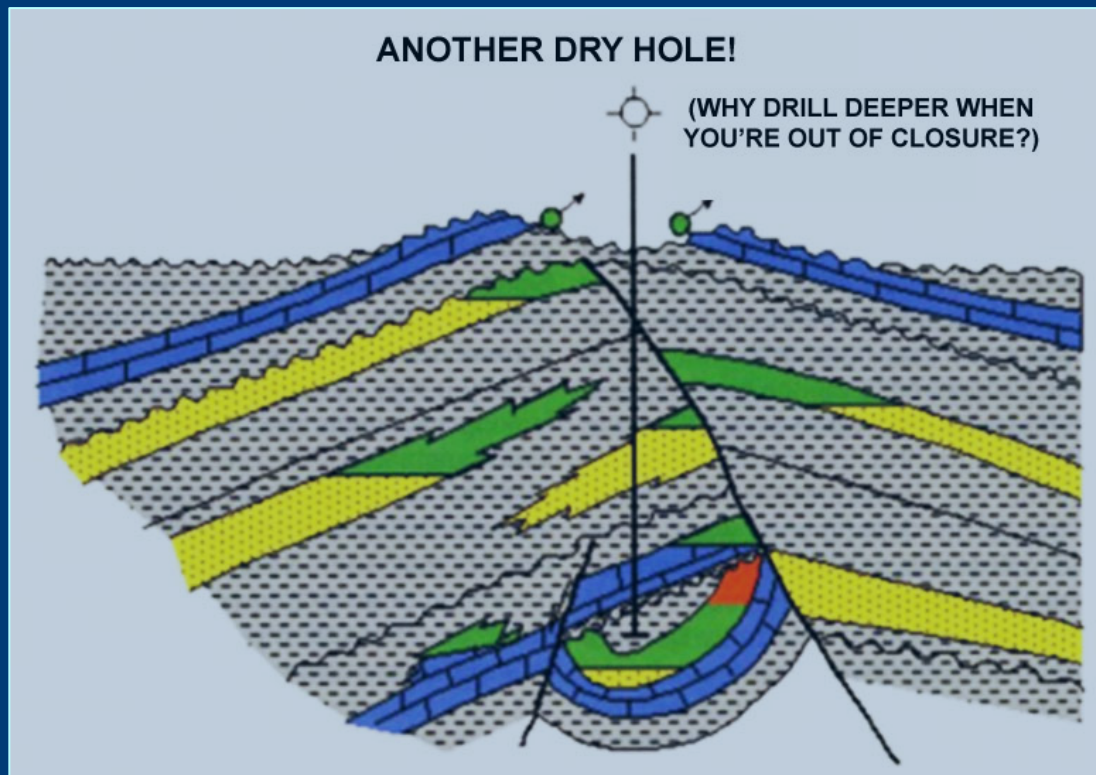
Exploration Risk

- They may be looking in the wrong place



Geological Risk

- The Geological Interpretation may be wrong



Contract Risk

- The lawyers did a bad job



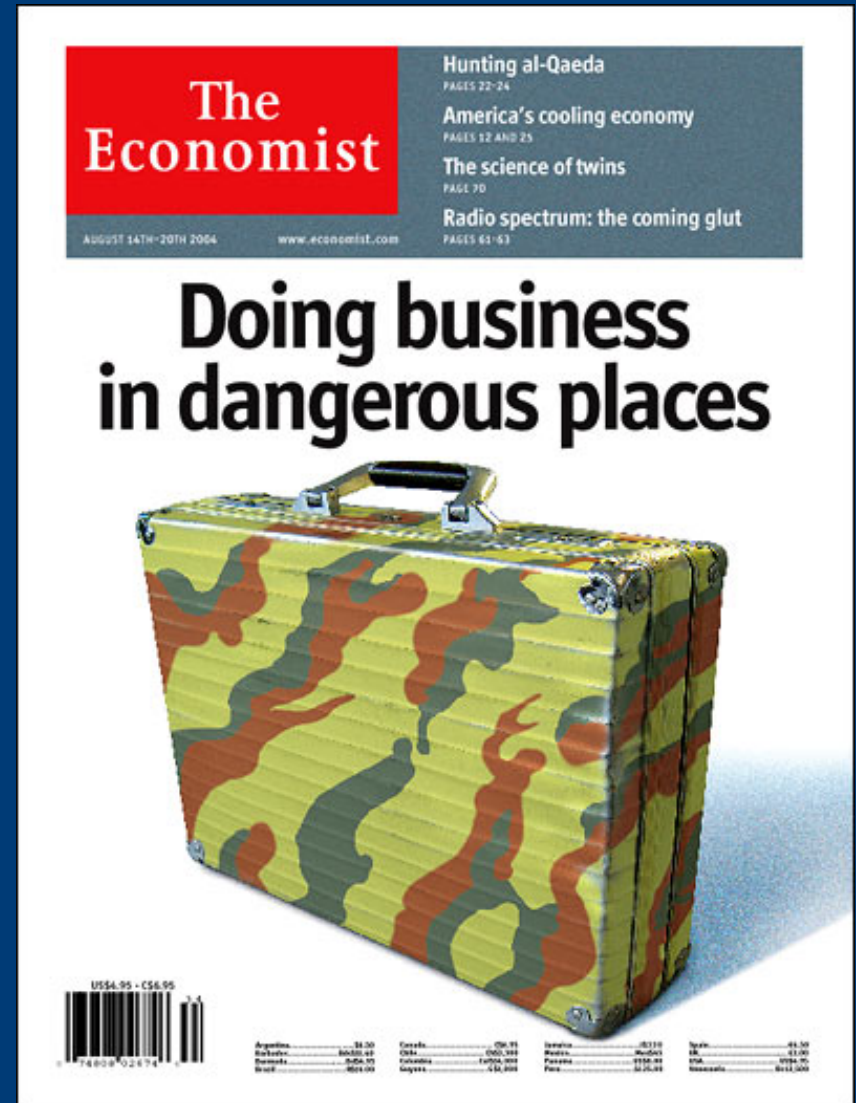
Government Risk

- The fiscal terms may be changed

Political Risk

○ War

○ Nationalisation



Development Risk

- The engineers get it wrong



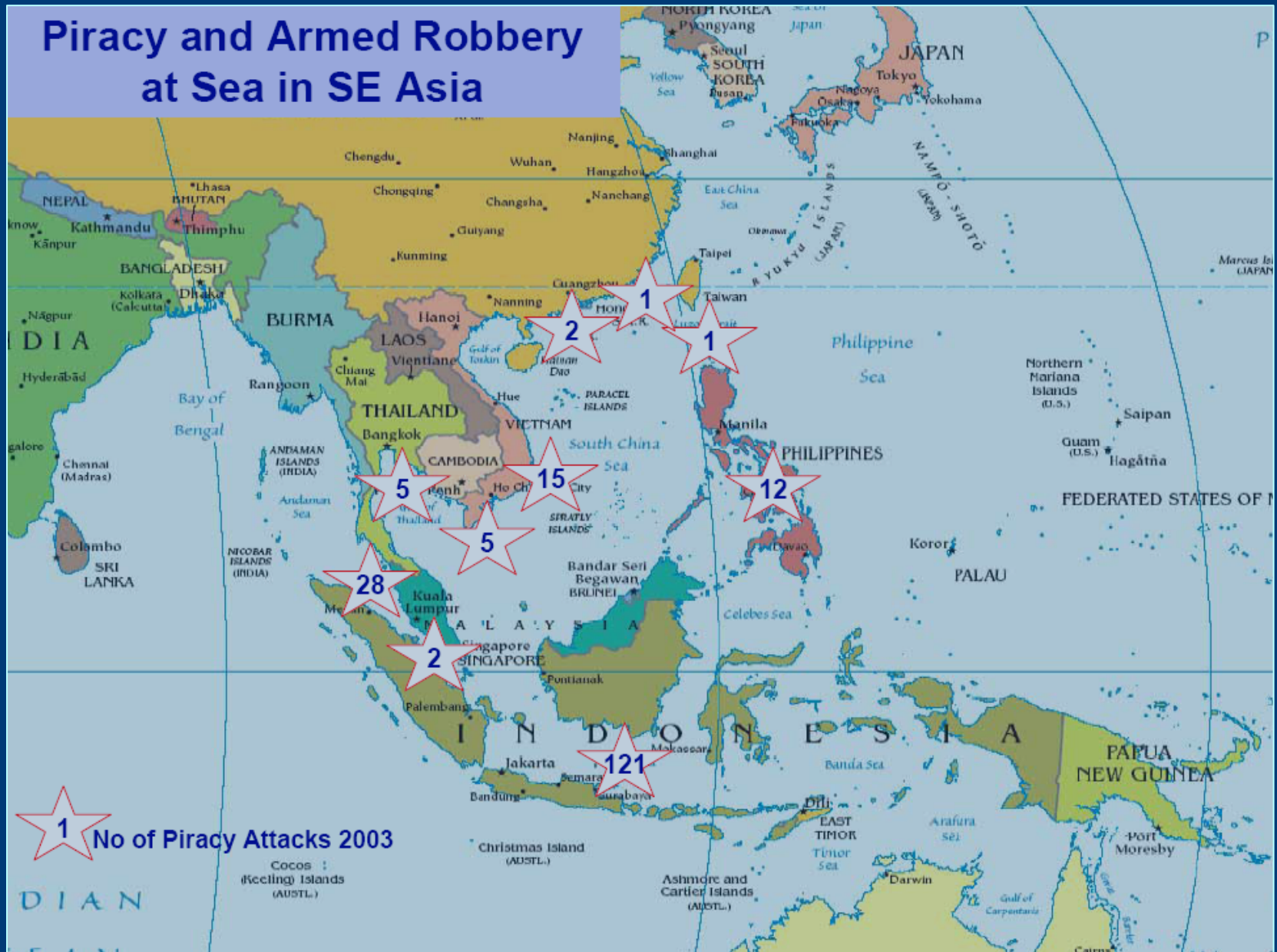
Natural Risk

- The "hundred year" wave



Terrorist Risk

Piracy and Armed Robbery at Sea in SE Asia



Environment Risk

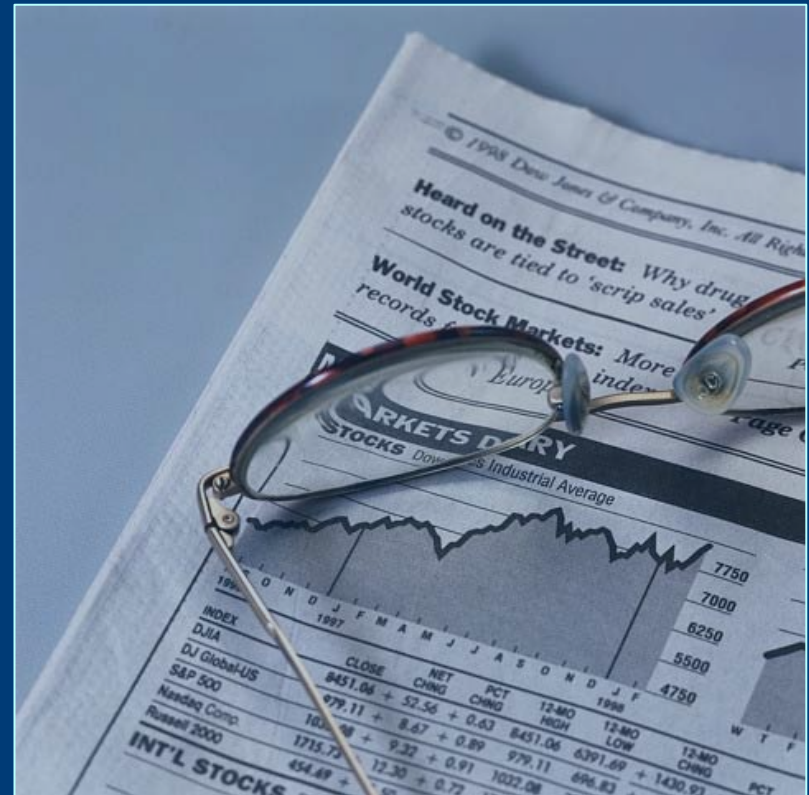


Operational Risk

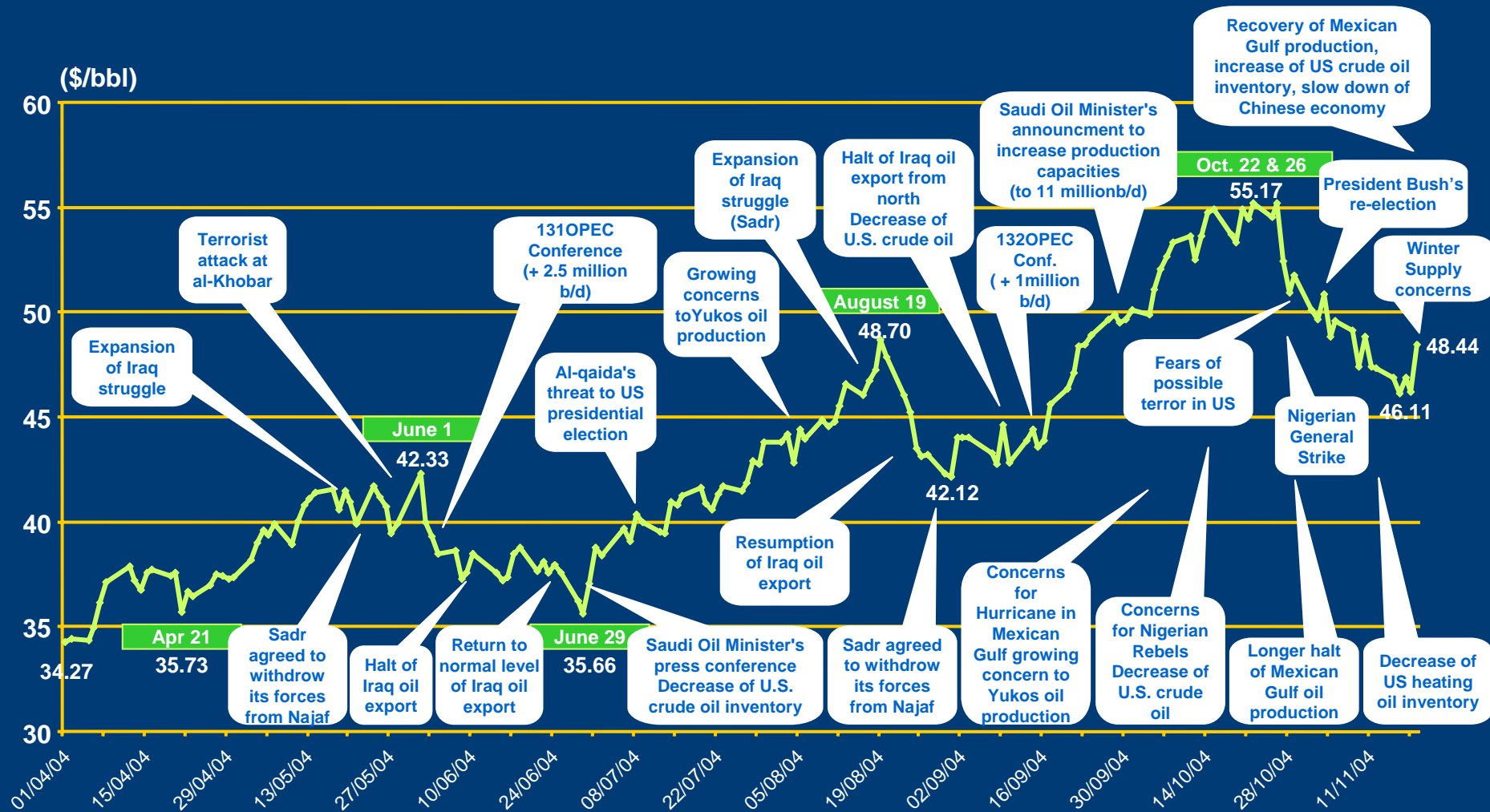


Corporate Risk

- Their stock suffers, or they are subject to a takeover bid



Commercial Risk



2004 Oil price movements

Labor Risk

- The workers go on strike



What is Risk and Risk Management?

Risk can be defined as exposure to the consequences of uncertainty. This includes the possibility of economic or financial loss or gain, physical damage, injury to people, delay or non-achievement of planned objectives, as a consequence of uncertainty about the future. Risk thus has two elements:

- the likelihood of something happening,
- the consequences or impacts if it were to happen.

Risk management is the systematic application of management policies, processes and procedures to the tasks of identifying, analyzing, assessing, treating and monitoring risk.

WHY BOTHER WITH
RISK MANAGEMENT?

Events can go wrong.....



Image courtesy of Reuters

.....or better than expected



Risk Management ...

- So whether you are
 - Operating an airline
 - Running a bank
 - Transporting crude oil
 - Managing a cancer smear programme
 - Operating a production platform
 - Waiting for a train at a Station
- You need to understand the risks and have confidence in the controls and responses you employ
- You need to understand and accept any residual risk

The past
is certain....



.... But the future is uncertain



Can we predict the future?



Image courtesy of World Energy.

Unfortunately our predictions are often wrong!



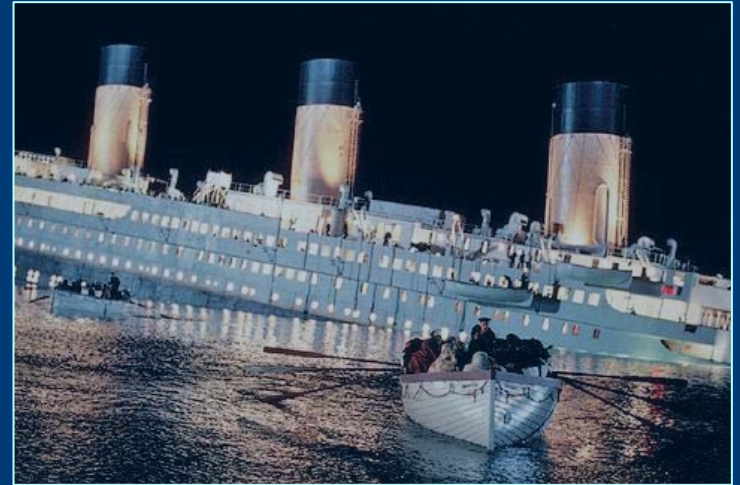
We woz wrong

Newspapers are quick to crow about their predictive triumphs. But what about when they are wrong? The editor of The Economist owns up to our recent, er, disappointments and explains why forecasts are so often wrong

Can experience help?

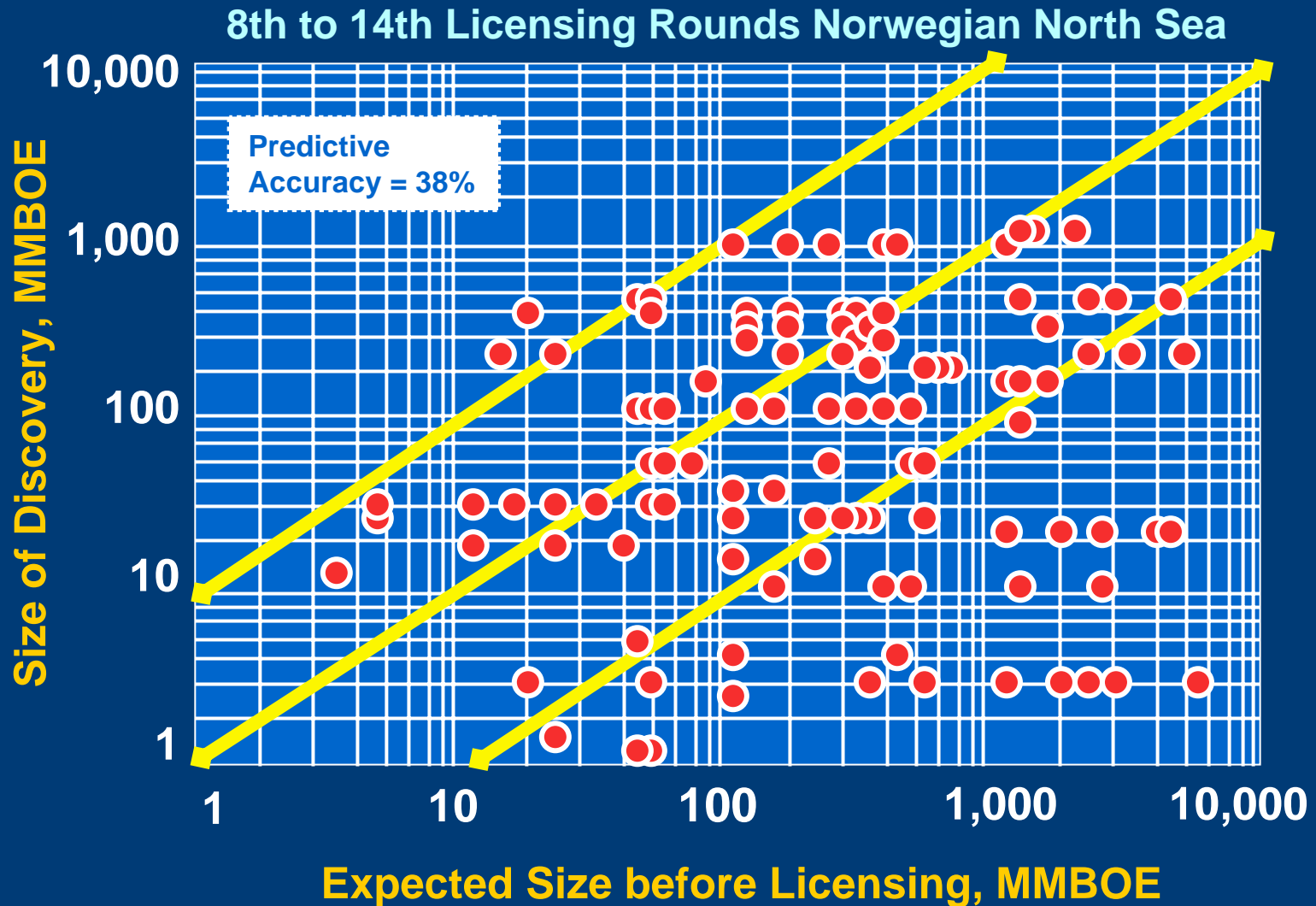
"When anyone asks me how I can describe my experience of nearly forty years at sea, I merely say uneventful. In all my experience, I have never been in an accident of any sort worth speaking about.

I have seen but one vessel in distress in all my years at sea ...I never saw a wreck and have never been wrecked, nor was I ever in any predicament that threatened to end in disaster of any sort."

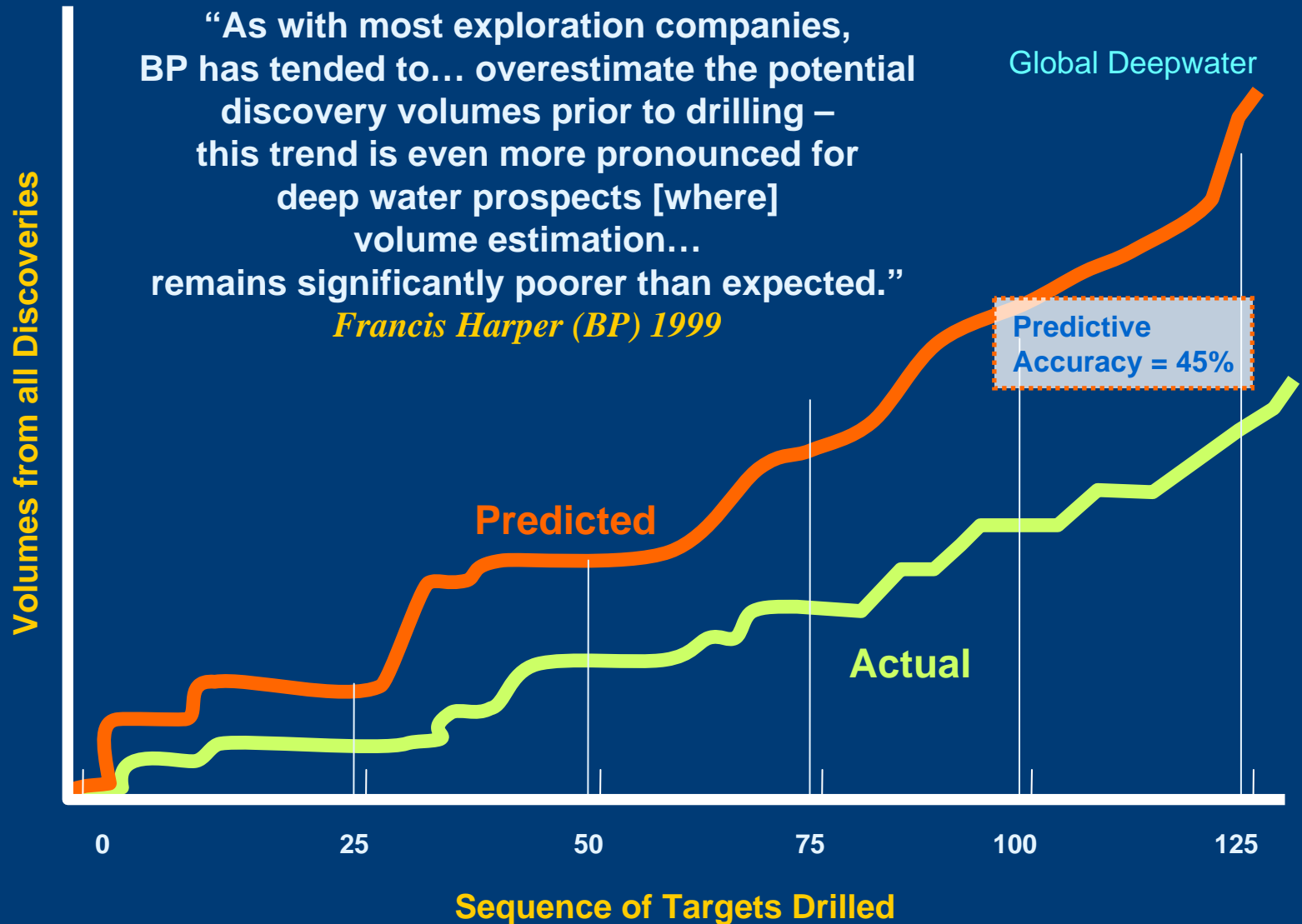


*From a paper presented in 1907
by EJ Smith,
first captain of RMS Titanic,
April 1912*

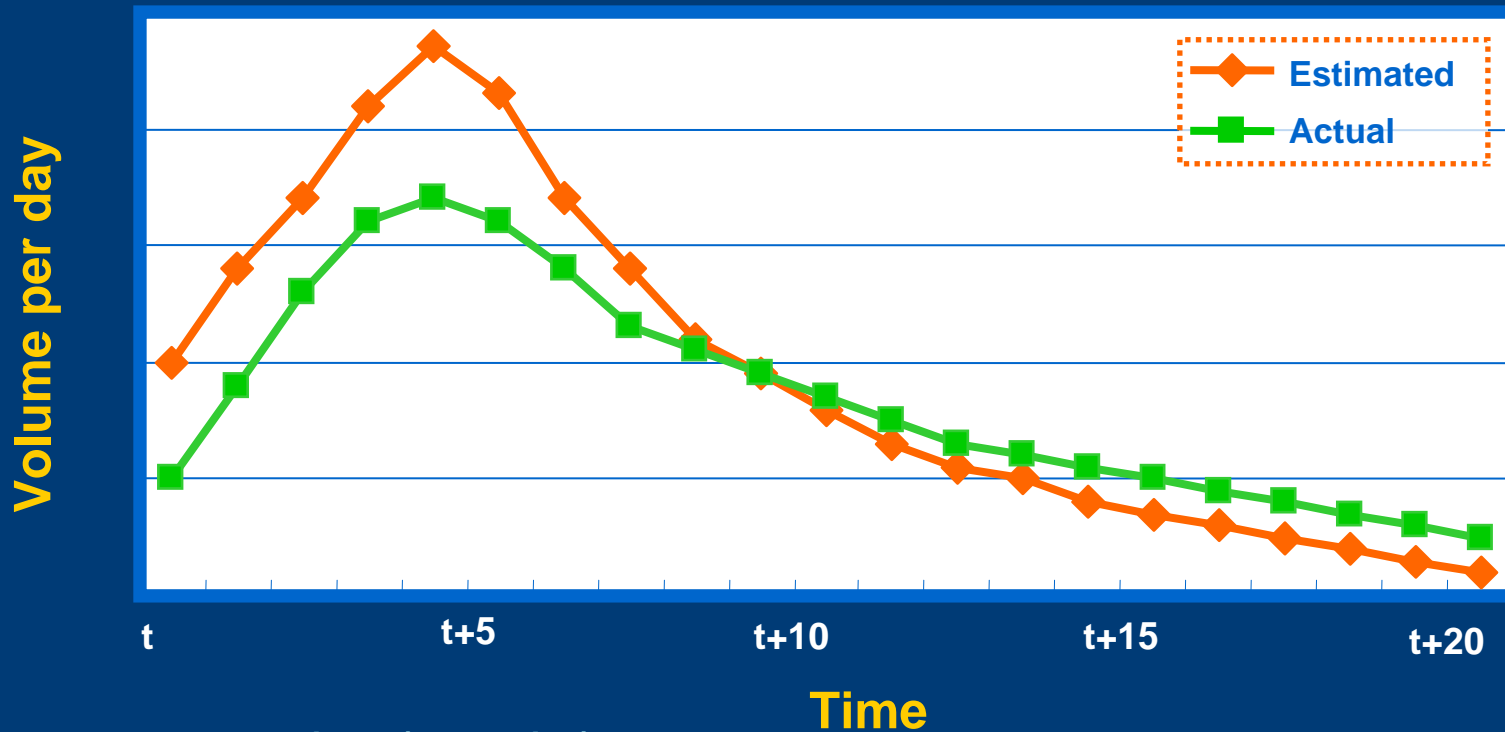
Habitual Under-Delivery



Habitual Under-Delivery



Errors in Production Volume Estimates



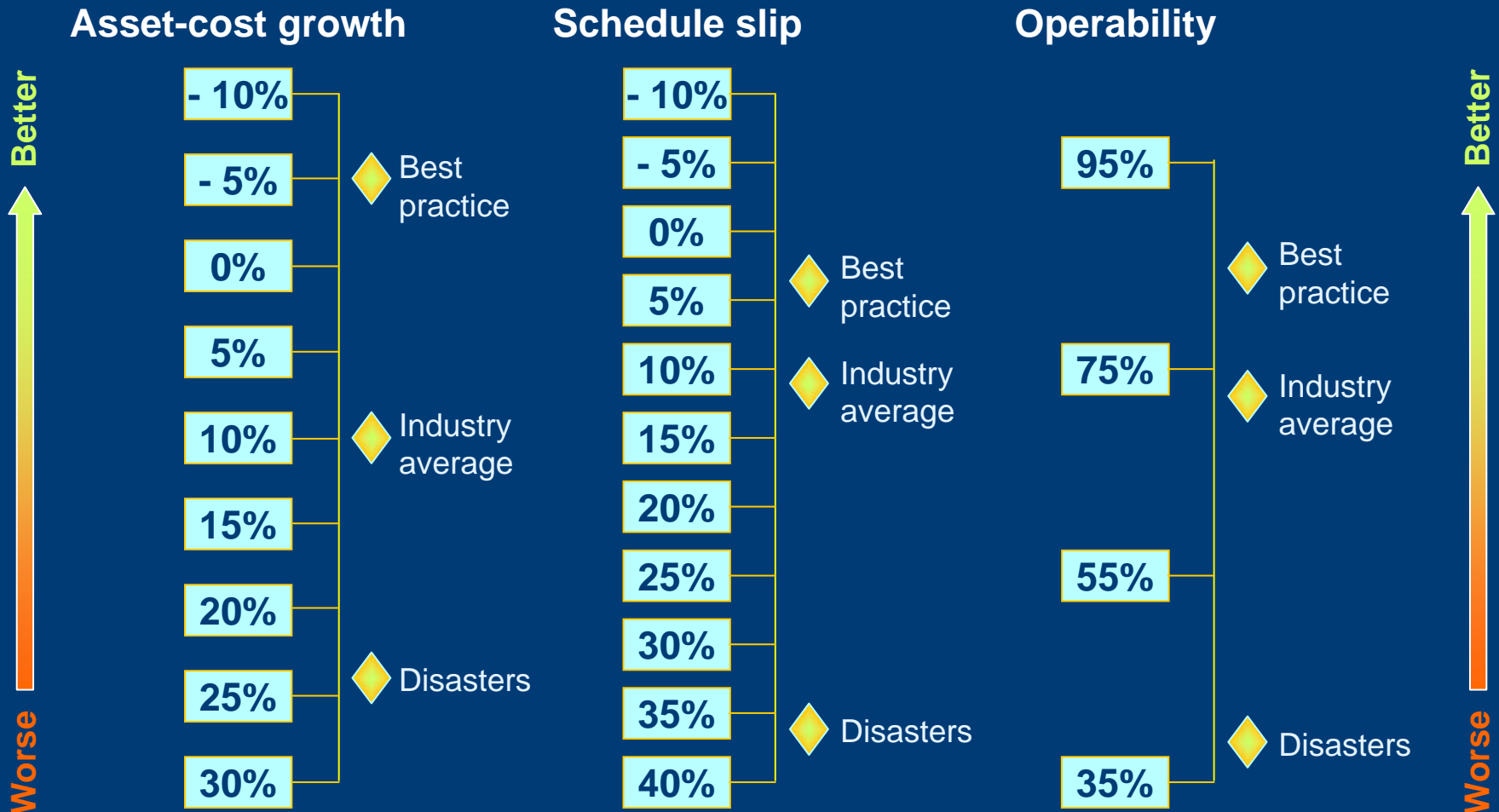
n = 160 projects (worldwide)

Campbell (2001)

For 159 of 160 (99.5%) projects, actual production was less than estimated production

Industry Performance on Development Projects

(after Merrow, IPA, 2003)



Different Perspectives of Risk

Market

Demand, alternatives, competition, transport distances, access to reliable export routes

Economic

Product prices, strength of local currency, inflation, cost of capital, availability of capital

Fiscal

Tax stability, regressive system, withholding/import taxes, respect of contract

Political

Government stability, ethnic tension, corruption, national energy policy, bureaucracy, monopolies

Safety

Process reliability, proximity to habitation, labour intensity & skills age of plant, corrosion, cultural attitude

Sub-surface

Reserves, depth, product flow rates, geological uncertainty, compartmentalisation

Corporate

Shareholder opinion, investor appetite, regulatory, remuneration

Technological

Process engineering, unproved technology, deep water

Drilling

time uncertainty = cost uncertainty, Risks = twist-off, stuck pipe, kick, punch-through, etc

Quality

High contaminant content (CO₂, H₂S, H₂O), process efficiency

Cost

Capital expenditure, project management, operations & maintenance

Staff

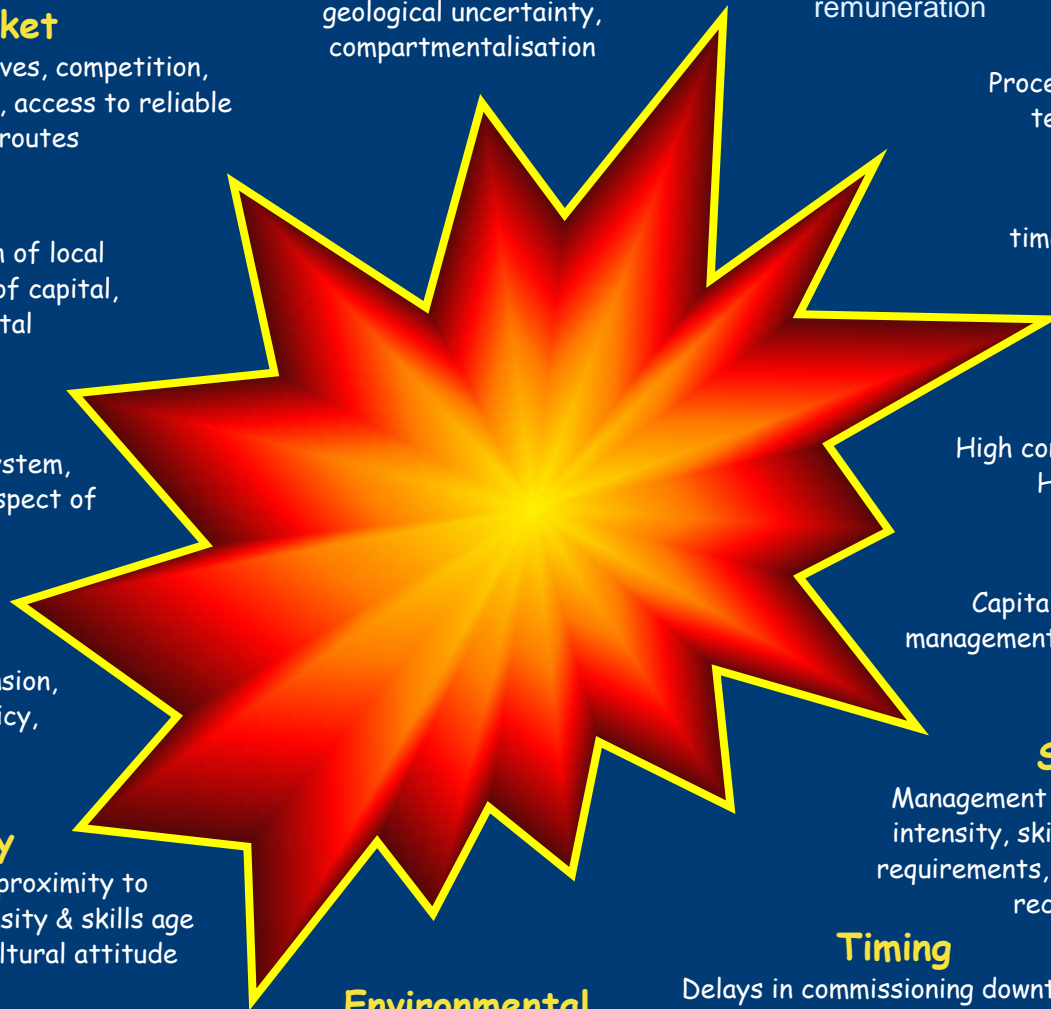
Management experience, labour intensity, skill levels relative to requirements, industrial relations, recruitment

Timing

Delays in commissioning downtime, efficiency, project management, force majeure

Environmental

Planning approvals, waste disposal, emissions, decommissioning



Do we work together??







PHASES OF RISK MANAGEMENT

Step **1**

Establish the Context: Understand The Business

What is the Business, and the Environment in which it operates?

Step **2**

Identify Risks

What are the uncertainties associated with achieving the objectives?

Step **3**

Analyse Risks

Utilise consistent analytical methods

Step **4**

Assess Risks

Which risks are most significant?

Step **5**

Respond to Risks

What do you choose to do about risks?

ESTABLISHING THE CONTEXT

- Environment
- Business Objectives
- Stakeholder Analysis
- Critical Success Factors

RISK IDENTIFICATION

Identify Risks: Areas of Risks

- Country
- Operations
- People
- Technology
- Systems
- Asset Integrity
- Stakeholders & Partners
- Reputation
- Authorisation
- Management
- Customers
- Financial
- Confusion
- Natural Events
- Fraud
- Group Interaction
- Communication
- Strategy & Decision Making
- Information
- Knowledge
- HSE
- Competition
- Organisation
- Markets
- Change

Risk Identification Tools and Techniques

- Documentation Reviews
- Information Gathering Techniques
 - Brainstorming
 - Delphi Technique
 - Interviewing
 - Root cause identification
 - SWOT analysis
- Checklist Analysis
- Assumptions Analysis
- Diagramming Techniques
 - Cause and Effect (Fishbone) diagrams
 - System or process flow charts
 - Influence diagrams
 - Stakeholder Identification and mapping

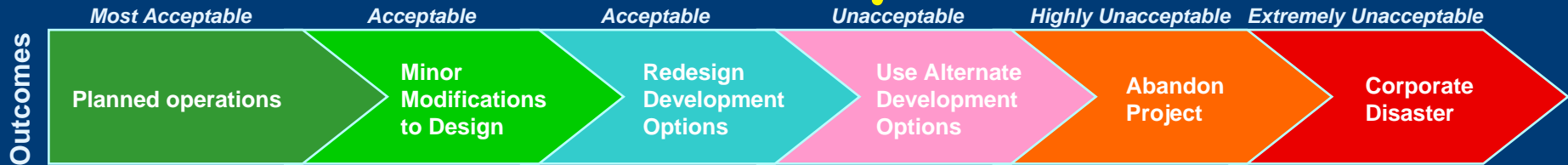
Community Perception of Risks

We all make judgments about risks according to our perceptions and beliefs. We undertake risk studies in a structured way, making use of information, judgments and experience from a range of sources, so we can have a degree of confidence in our conclusions.

However, not everyone can apply the same level of skills and resources as we have available. In particular, people in the broad community in which we operate must frequently make judgments about risks on the basis of far more limited information and analysis. In addition, and despite our best intentions, their aims and objectives are often different from ours.

All this means that the community's perceptions of the risks associated with our activities may not correspond to ours, and we may meet unexpected opposition or resistance to our plans. We must be aware of this and incorporate community aims and objectives into our risk assessments.

Definition of Outcomes of Unfavorable Publicity



- ✓ Development options as planned
- ✓ No adverse publicity
- ✓ No restrictions on freedom

- ✓ Minor modifications
- ✓ Approximately 10% increase in cost
- ✓ Minor restrictions, negligible Corporate Cost

- ✓ Major design modifications
- ✓ Cost of deferred gas due to delays
- ✓ Corporate costs for managing negative publicity

- ✓ Development option abandoned
- ✓ All expenditure lost
- ✓ Cost of new option & Abandonment cost
- ✓ High corporate cost for managing negative publicity
- ✓ Impact on share value

- ✓ Project abandoned
- ✓ All expenditure and potential profit lost
- ✓ Large corporate cost to manage negative publicity
- ✓ Significant fall in share price

- ✓ Project abandoned
- ✓ Negative publicity threatens the existence of company
- ✓ All expenditure and potential profit lost
- ✓ Corporate cost equals total corporate value

RISK ANALYSIS

Risk analysis is the process of estimating the likelihood that things may turn out different and potential consequences for the objectives and critical success factors of the project.

The risk identification stage has generated a list of the risks that might impact on the project. Often the list will be extensive, and you will need to separate the important items from the less important ones. Risk analysis generates initial risk levels, a precursor to risk assessment and priority setting.

What Methods do we use to predict the future events?

- **Guess**

Some call this intuition, or experienced-based hunches

- **Deterministic**

- **Probabilistic**

- **Scenarios**

Initial Situation

Decision



Iteration

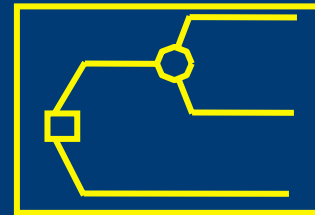
Decision Hierarchy



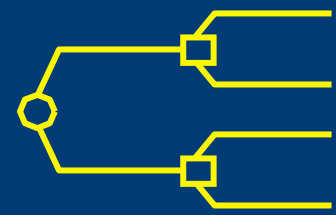
Spreadsheet Model

	A	B	C
1			
2			
3			

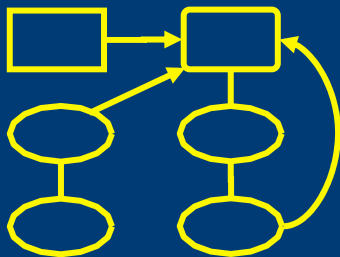
Decision Tree



Value of Information



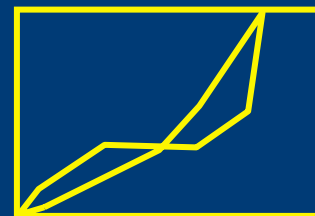
Influence Diagram



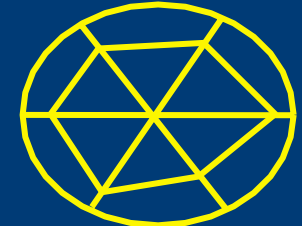
Deterministic Sensitivity



Probability Distributions



Decision Quality



Scenarios

A scenario is a description of how a risk might arise, the effect of controls, the responses that might be implemented and their consequences.

It is a way of describing the processes by which risks might occur and be dealt with, in a more wide-ranging and less structured approach than that described above.

Scenarios can be very useful for analyzing future events or events outside the usual experience, like changed economic circumstances, new industry structures or revised technological or environmental trends, and developing responses to them.

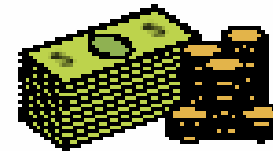
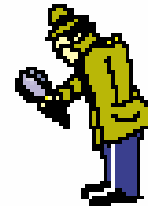
High Oil Prices: Sustainable or a Speculative Bubble?

The Answer Depends on the Lens Used to Evaluate Price

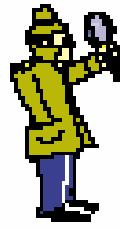
Four Lenses



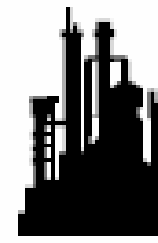
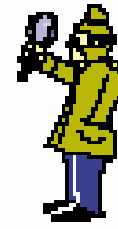
Inventory Levels



Value of the Dollar
and Inflation



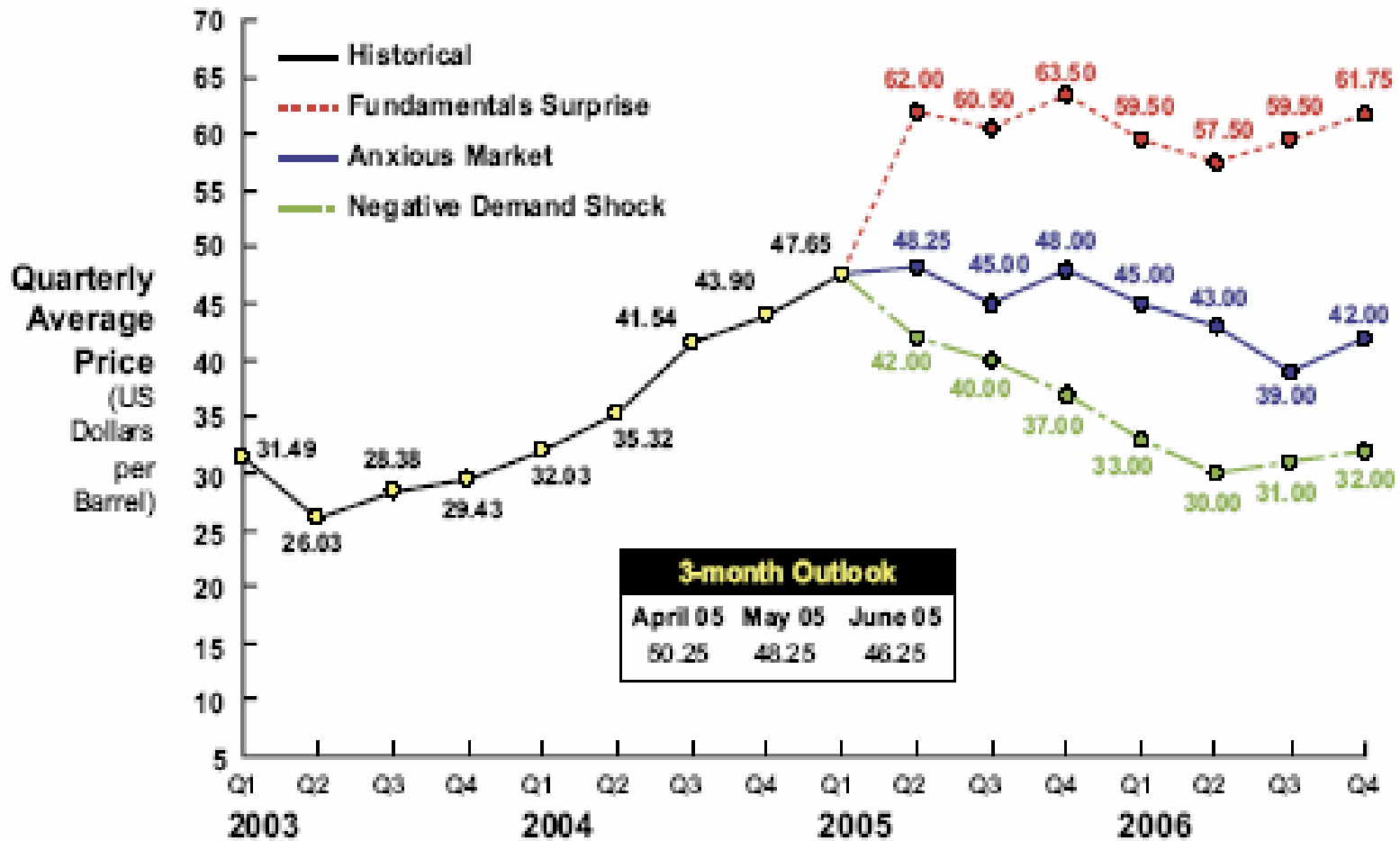
Spare Production
Capacity



Refining Margins

Source: Cambridge Energy Research Associates.
60005-1

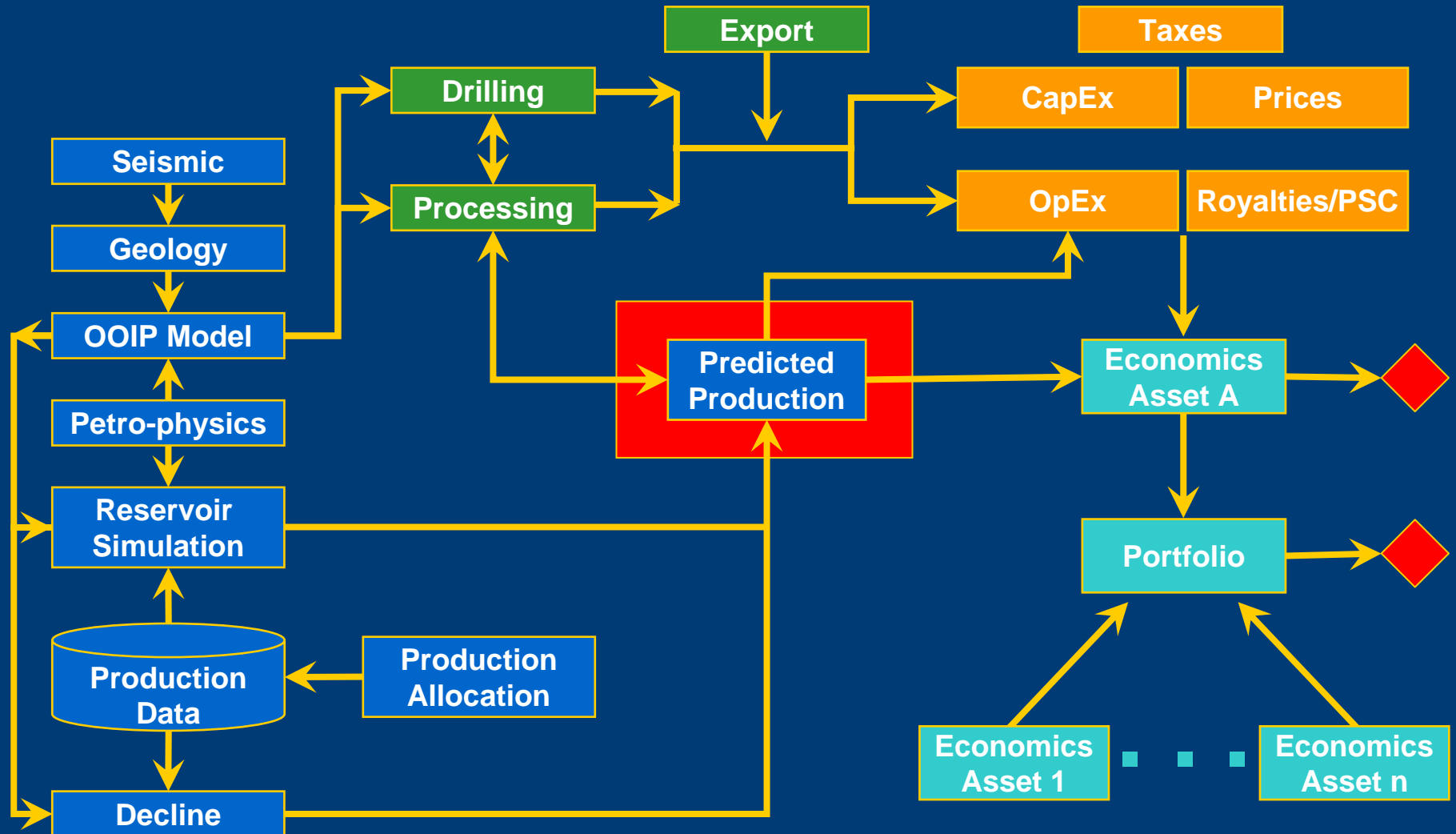
2003–06 Oil Price Environment: Dated Brent



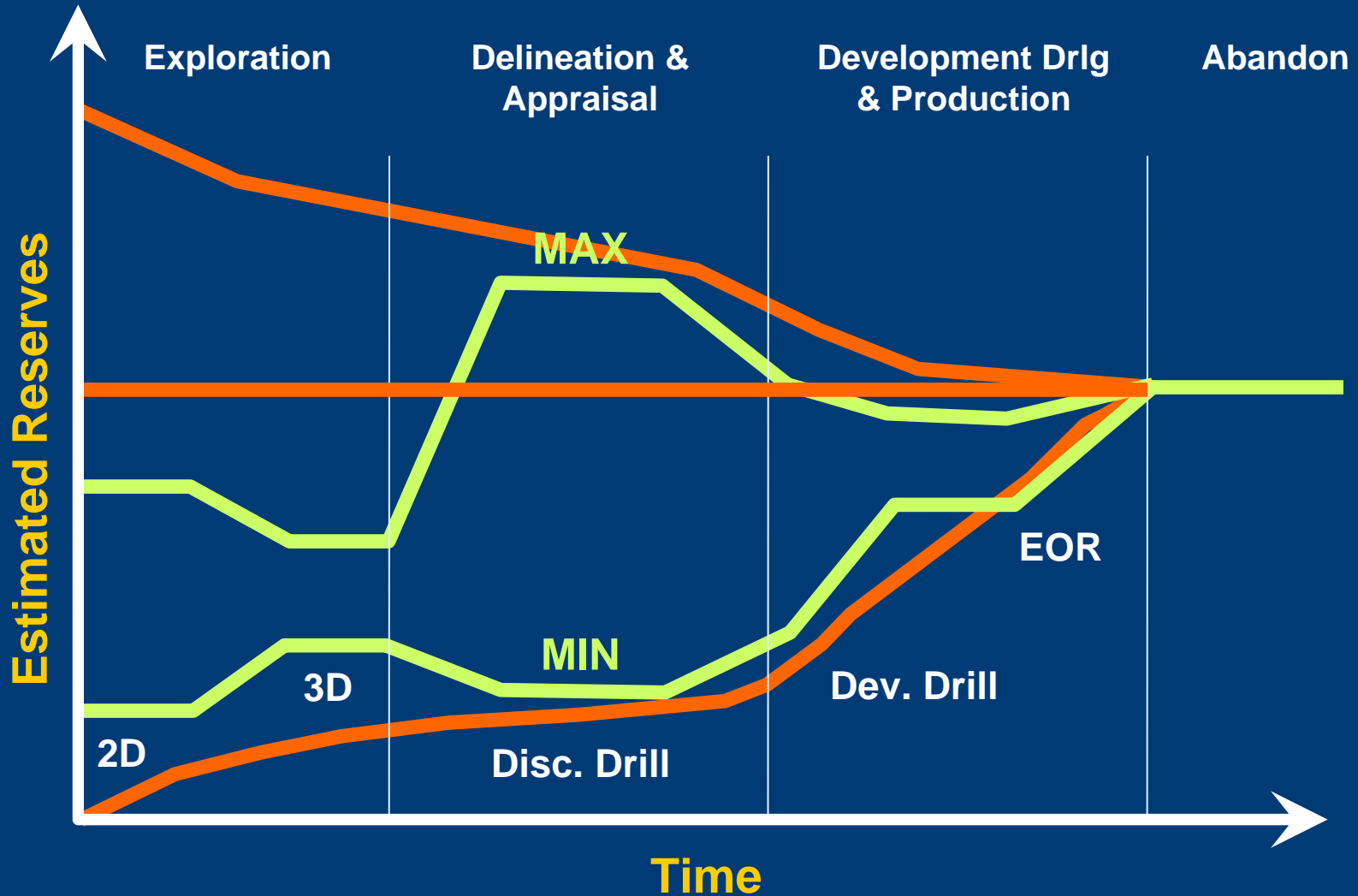
Source: Cambridge Energy Research Associates.
40914-7_031705

RISK ASSESSMENT AND PRIORITY SETTING

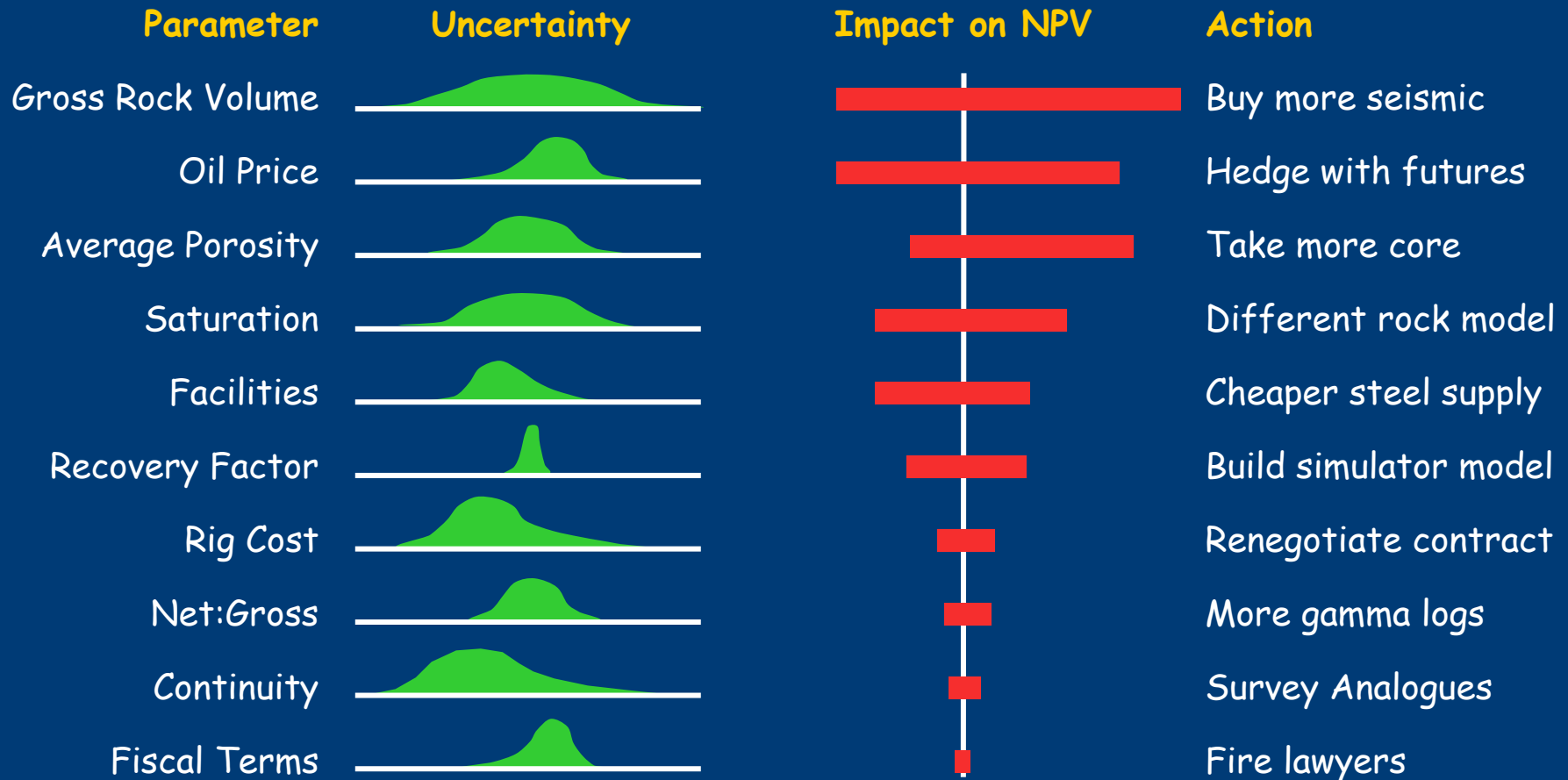
Uncertainties and dependencies are everywhere...



...are frequently under-estimated



...and we spend a lot of money without always knowing which ones really matter



Likelihoods and Consequences

Risk analysis is based on the two components of risk; the likelihood or probability of the risk arising and its consequences. The forms of analysis may range from simple qualitative methods to highly quantitative approaches.

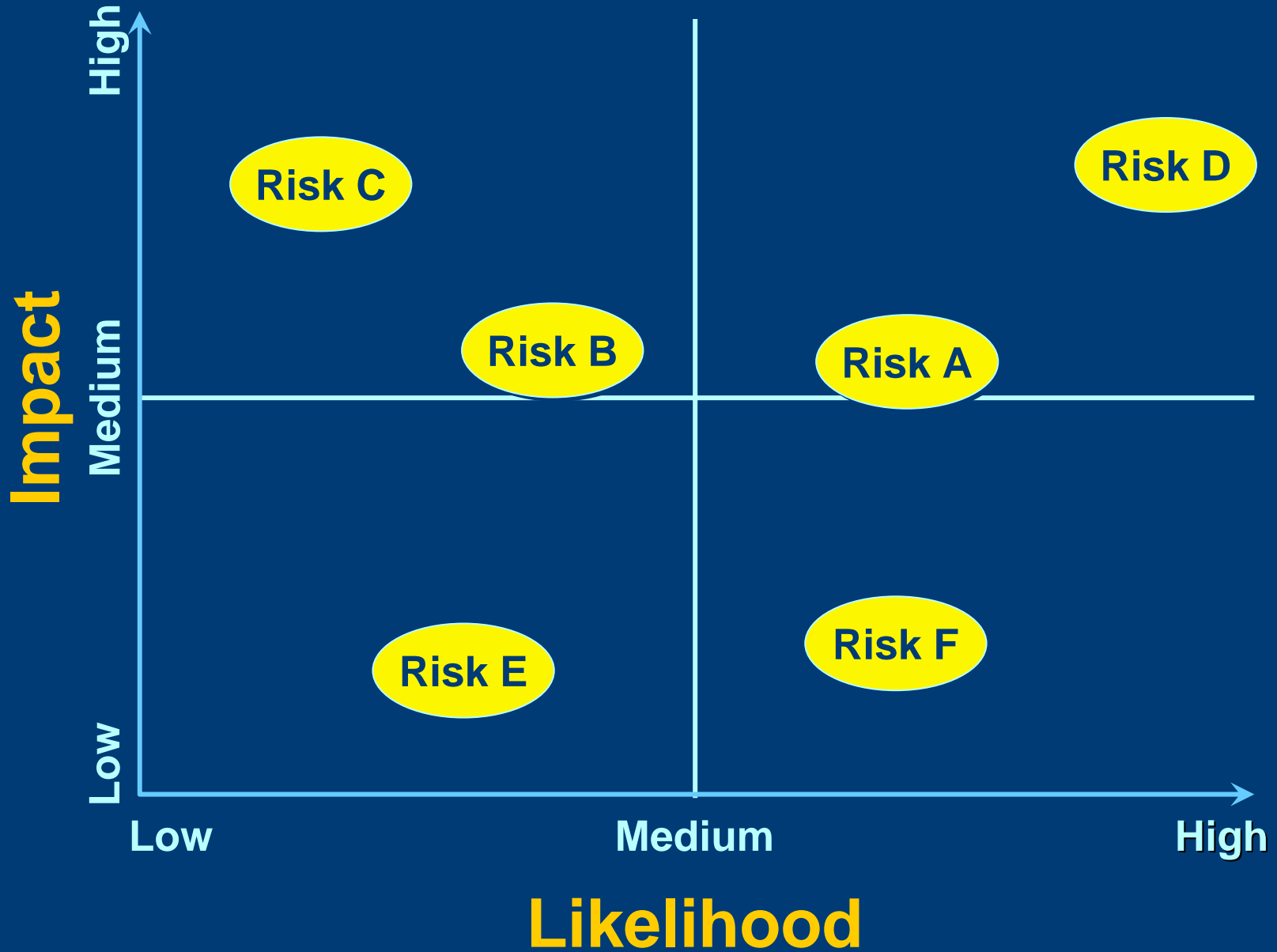
Likelihoods are difficult for many people to estimate, since few use them in their everyday activities, and consequences may not be easily quantified in the early stages of a procurement. Alternative approaches use indicators or indirect measures instead of direct likelihood or consequence estimates.

Risk Assessment Matrix

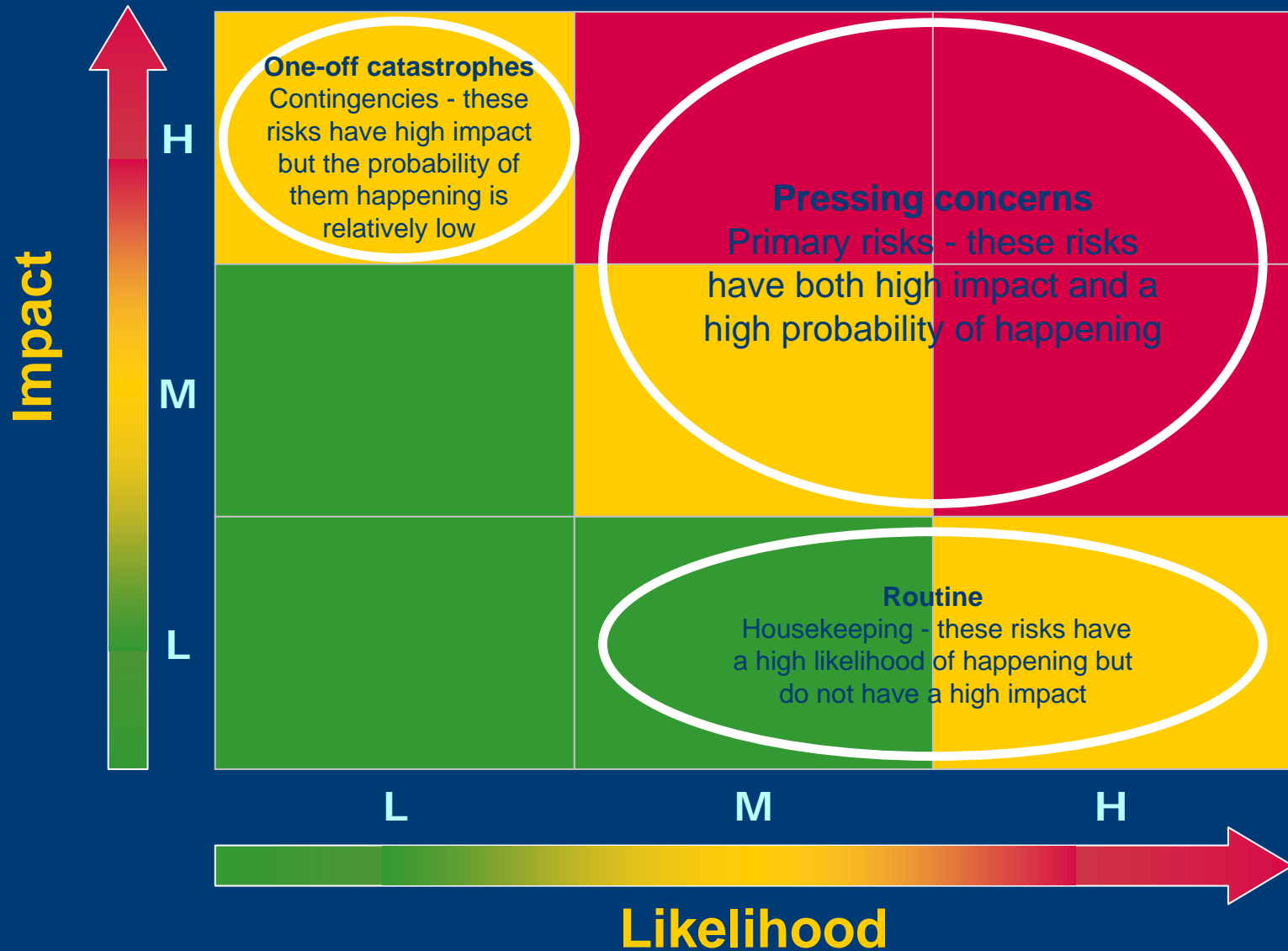
To enable a prioritisation of the risks to objectives, it is necessary to consider two key factors - **likelihood and impact (or consequence)**. This is a qualitative rather than a objective assessment.

The priority given to the risk will ultimately determine the amount of effort and resources we put into managing it.

When rating the risk consider the 'current residual risk' ie after taking account of the current controls in place. We must first agree a consistent way of ranking the risks.....



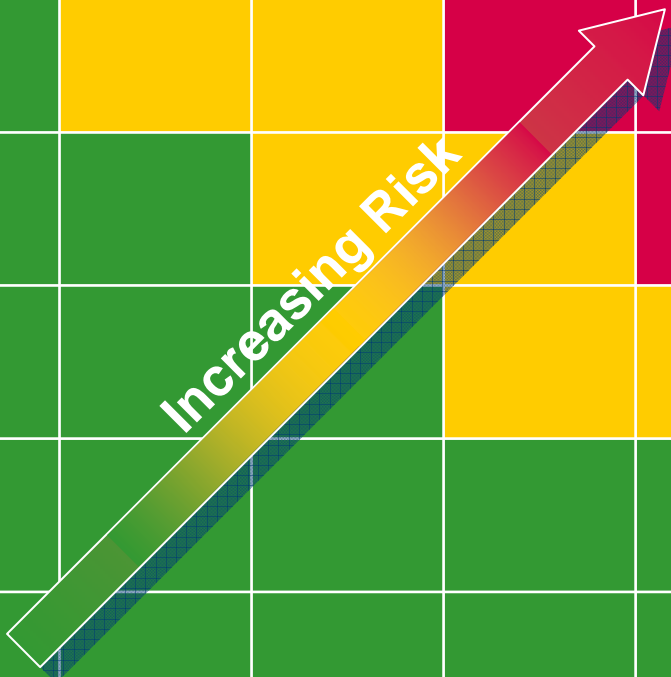
Risk Matrix



Risk assessment determines the risks that should be accorded the highest priority in developing responses for risk treatment.

The risk analysis process generates a set of risk levels or risk factors that are used to set priorities. The aim of risk assessment is to partition key elements and their associated risks into three groups that determine the level of management response and effort.

Severity	Consequences				Increasing Likelihood				
					A	B	C	D	E
	People	Assets	Reputation	Environment	Never heard of industry	Heard of industry	Incident has occurred in our company	Happens several times a year in our company	Happens several times a year in a location
5	Multiple fatalities	Extensive damage	International impact	Massive effect					
4	1-3 fatalities	Major damage	National impact	Major effect					
3	Major health effect or injury	Localised damage	Large impact	Localised effect					High Risk
2	Minor health effect or injury	Minor damage	Minor impact	Minor effect					Medium Risk
1	Slight health effect or injury	Slight damage	Slight impact	Slight effect					Low Risk
0	No health effect / or injury	No damage	No impact	No effect					



Consequences

Likelihood

Source: Shell

Setting Priorities

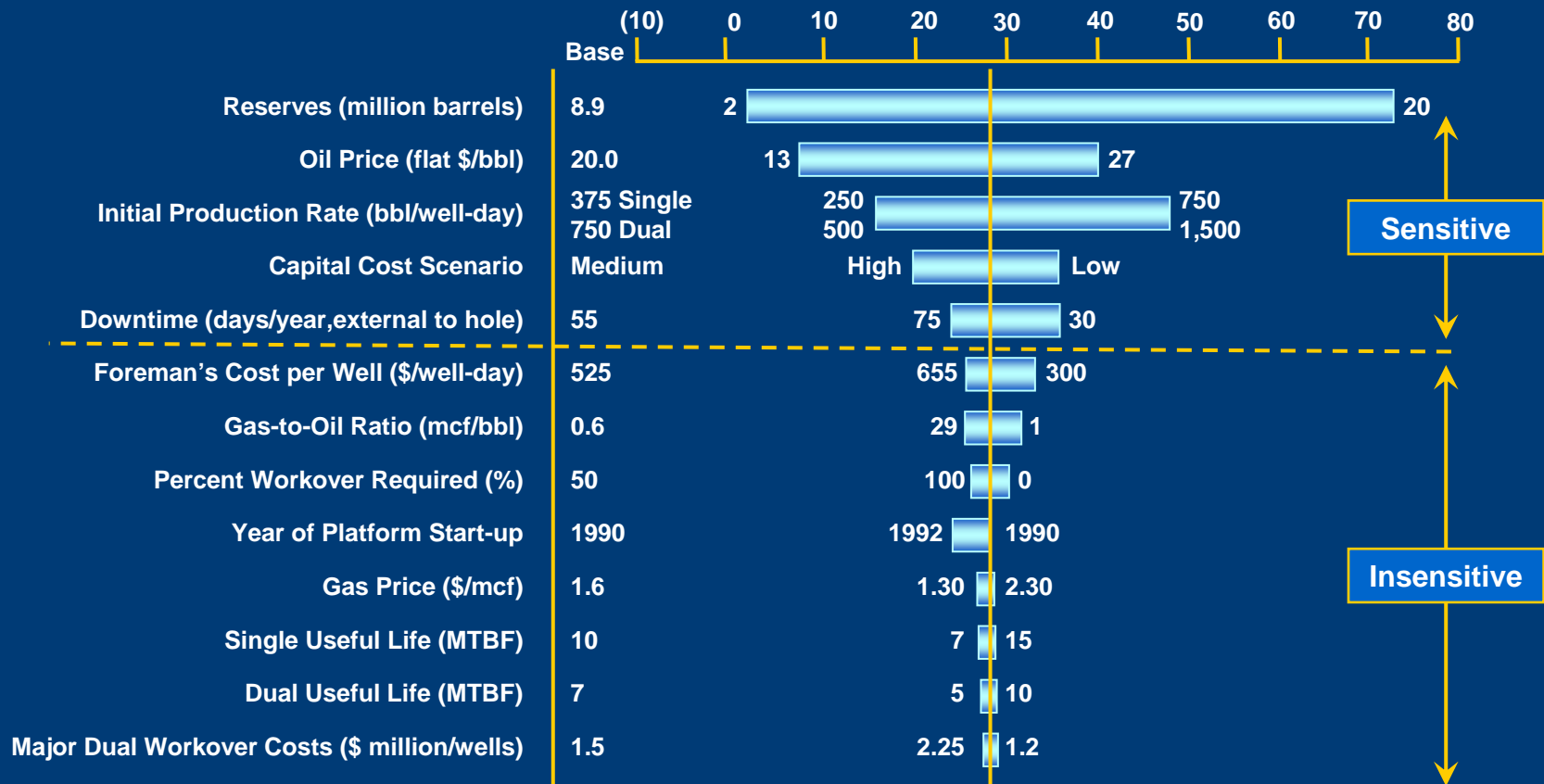
Risk factors and the initial ranking in the risk profile can only be a guide to priorities for management attention, due to the constraints and limitations of the procedures used to generate them.

Accordingly, a two-stage process is commonly used to set priorities.

1. Sequence risks in decreasing order of risk factors and set cut-off levels to provide an initial indication of priorities. You may choose cut-off levels based on absolute criteria (for example, if safety issues are involved), pragmatic criteria related to the resources available for managing high-risk elements, or on more sophisticated trade-offs between the costs of developing detailed Risk Action Plans for major risks and the benefits of doing so.
2. Examine each risk in the sequenced list to determine whether it has been classified correctly, and modify the classification accordingly. In this stage, you may group similar risks to be managed together.

As we might expect, most of the uncertainty in the NPV comes from reserves, prices, and production rates

Project NPV (US\$MM)



Base Value = \$29 million

Ranking of Risks



RISK RESPONSE AND HANDLING

© 1991, 1994 S DNEY HARRIS



“‘Be Careful’! All you can tell me is ‘Be Careful’?”

Risk Response Strategies

TAKE



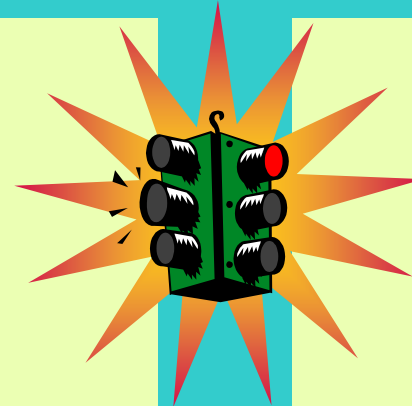
TREAT



TRANSFER



TERMINATE



Source: INSEAD

Take

- intentionally pursue fully accept
- set reward/loss targets and tolerance levels
- establish and monitor key risk indicators
- charge premium price
- build in contingencies
- develop recovery plans
- investigate and take follow-up action
- develop fall-back arrangements
- finance the consequences

Risk acceptance occurs when risks cannot be avoided, reduced or transferred, or the costs of doing so would be high.

Nevertheless risk prevention, reduction, and impact mitigation measures and monitoring are usually recommended.

Transfer

- insure
- share (joint ventures, alliances, partnerships)
- contract out (outsource, assign)
- diversify/spread
- Hedge

Risk transfer shifts responsibility for a risk to another party, who ultimately bears the consequences if the risk arises.

Insurance and joint ventures are well-known risk transfer strategies.

Transferring a risk to another party will usually result in a cost (such as an insurance premium) or a reduced return.

SCOPE OF WORK INFORMATION	very little	partial			complete
UNCERTAINTY	high	moderate			low
DEGREE OF RISK	high	medium			low
SUGGESTED RISK ALLOCATION					
CONTRACT TYPES	CPPF	CPIF	CPFF	FPPI	FFP

CPPF - Cost Plus Percentage Fee

CPIF - Cost Plus Incentive Fee

CPFF - Cost Plus Fixed Fee

FPPI - Fixed Price Plus Incentive

FFP - Firm Fixed Price

Terminate

- cease activity
- pull out of market, divest
- redesign (e.g. business processes, systems, tools)

Treat

- Risk reduction (likelihood)
- Risk mitigation (consequences)
- change or recalibrate objective
- redesign (e.g. business processes, systems, tools)
- reduce scale

Risk reduction

- Risk reduction is directed to eliminating sources of risk or substantially reducing the likelihood of their occurrence.
- Examples include more detailed planning, careful selection of partners, involvement of multi-lateral agencies, choice of alternative approaches, design changes, quality assurance procedures, operations reviews, regular inspections, additional effort in design and engineering, training, market research, preventive maintenance and contract terms.

Impact mitigation

- Impact mitigation is directed to minimising the consequences of risks. Some risks, such as those associated with market variations or changes in Government policy, cannot be avoided, and although risk prevention may reduce the likelihood of them arising they may still occur. Risk management must then be directed to coping with their impacts.
- Impact reduction strategies include contingency planning, quality assurance, contract terms and conditions, regular audits to detect technical compliance or security breaches, and crisis management and disaster recovery programs.

IMPLEMENTING AND MONITORING RISK TREATMENT

Monitoring and Review

For most projects and major business initiatives, the nature of risks will change as the project or activity moves through different phases from concept to completion. Risk Action Plans can be developed for the higher priority moderate risks as resources become available for more detailed analysis or as the timing becomes more critical.

The RMP is not a static document. It should reflect the current analysis and thinking about risk in the project, and it will change as the project progresses and the risks change, are resolved or become more urgent.

Example of Risk Action Plan

- **Recommend actions**
 - Summary
 - Impact
- **Risk identification and assessment**
 - Activity description
 - Risk identification
- **Responses to risks**
 - Risk treatment options
 - Benefits and costs of options
- **Implementation**
 - Proposed actions
 - Responsibilities
 - Resource requirements
 - Timing
 - Reporting



Typical Contents of a Risk Management Plan

○ Recommend actions

- Summary
- Impact

○ Risk treatment

- Major risks : Summary of risk action plans
- Moderate risks : Summary of treatment approaches
- Minor risks : List of risks

○ Risk identification, analysis and assessment

- List of risks
- Table of likelihoods, consequences and risk factors
- Priority list of major, moderate and minor risks

○ Implementation and monitoring

- The risk management organisation
- Functions and responsibilities
- Reporting structures
- Implementation and monitoring plan
- Review and evaluation plan

Step **1**

Establish the Context: Understand The Business

What is the Business, and the Environment in which it operates?

Step **2**

Identify Risks

What are the uncertainties associated with achieving the objectives?

Step **3**

Analyse Risks

Utilise consistent analytical methods

Step **4**

Assess Risks

Which risks are most significant?

Step **5**

Respond to Risks

What do you choose to do about risks?

Risk Response Strategies

TAKE



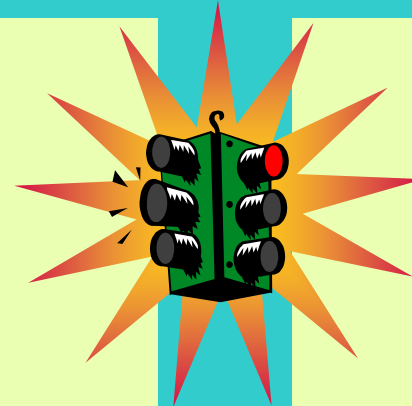
TREAT



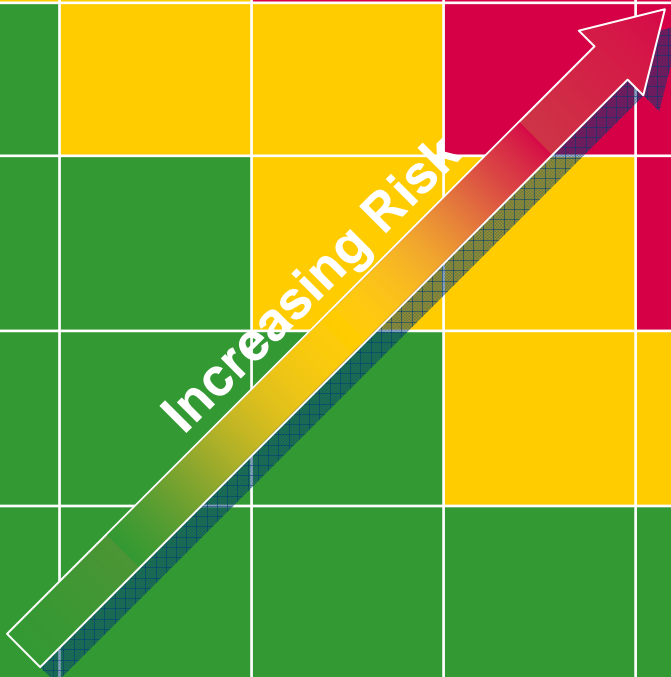
TRANSFER



TERMINATE



Severity	Consequences				Increasing Likelihood				
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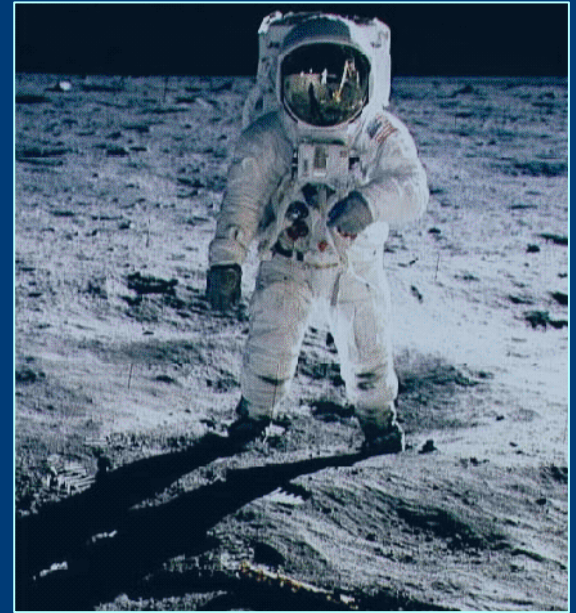
Consequences

Likelihood

Dealing with the Real World

"You want a valve that doesn't leak and you try everything possible to develop one. But the real world provides you with a leaky valve. You have to determine how much leaking you can tolerate"

*NASA Scientist from
Columbia project*



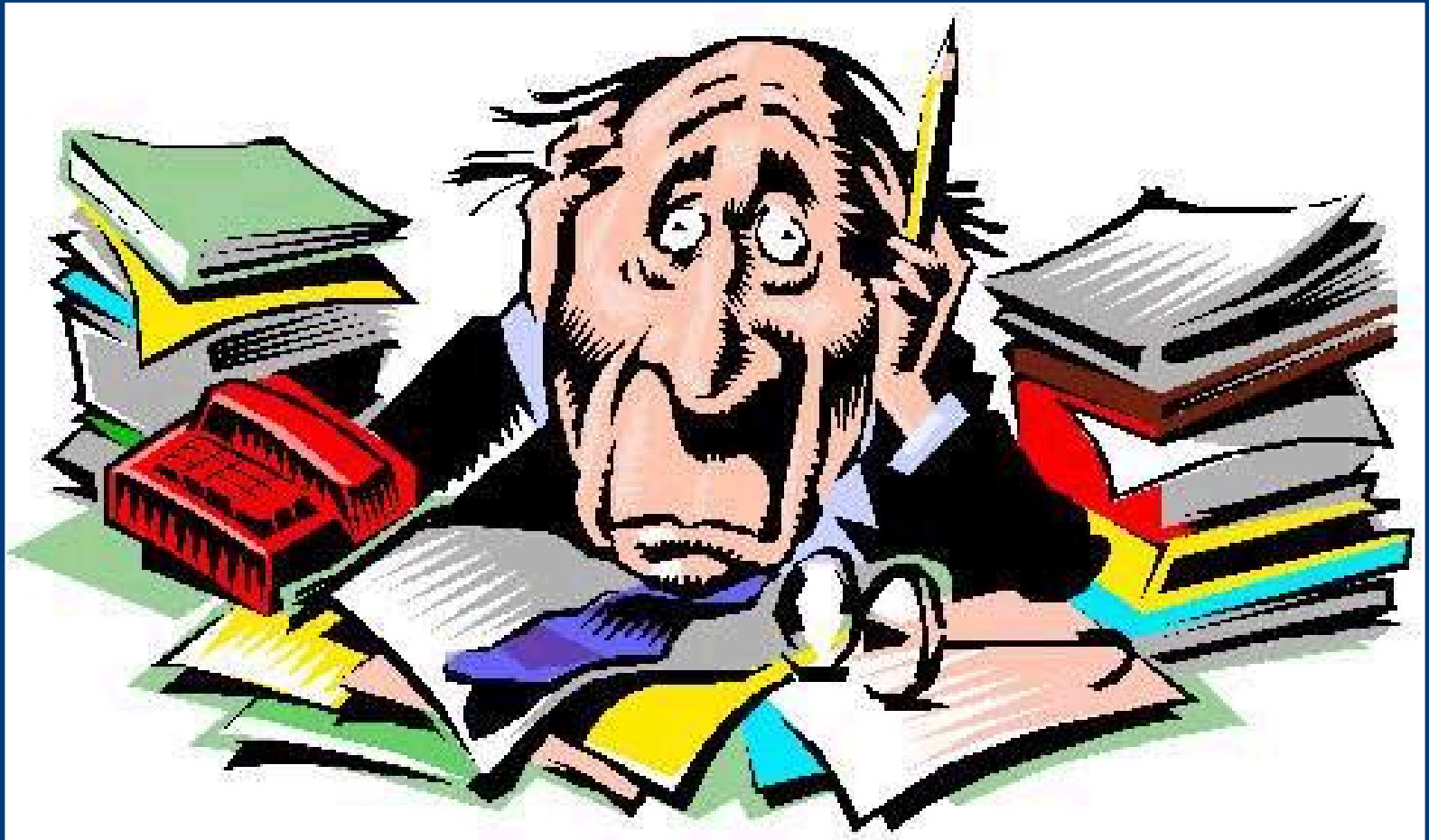


"There are risks and costs to a program of action.

But they are far less than the long-range risks and costs of comfortable inaction".

John F Kennedy

Paralysis by Analysis



Extinction by Intuition



What - me worry?

Famous “Mad” magazine comic strip character

Merci