Applied Technology Workshop - ATW
Key Technologies To Create More Value From Mature Fields

Session 1

Key Success Factors When Selecting Technologies for Mature Fields: Navigation Guidelines for a Moving Target

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Key Success Factors When Selecting Technologies for Mature Fields: Navigation Guidelines for a Moving Target

Outline

- Mature Fields Introduction
- Mature Fields: Socio-technical Systems?
- Fields Lifecycle – The Mature Phase Implications
- Technology Trends
- Risk and Reliability
- A Systemic View of a Mature Field
- Navigation Guidelines
- An Integration Tool for This ATW

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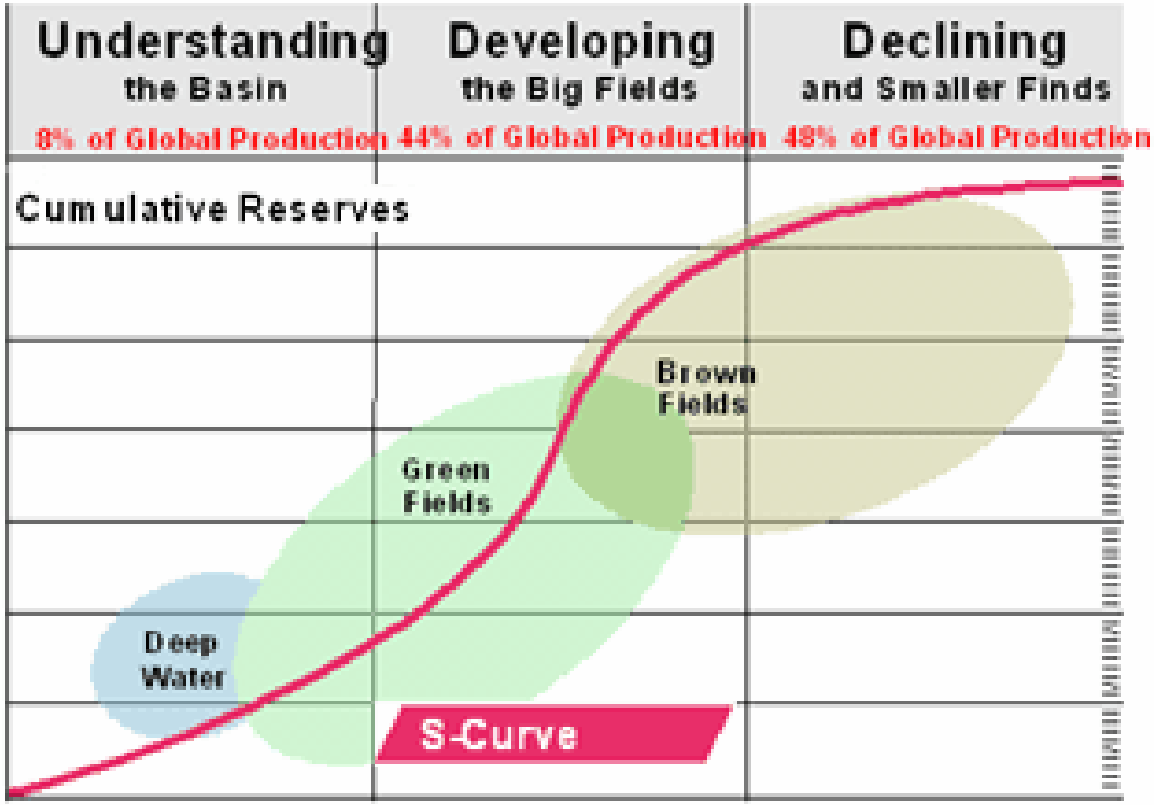
Global Mature Field

48% of Global Production In Declining and Smaller Finds

We are becoming a Global Mature Province – A Big Global Mature Field



Source: WEO IEA

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Distribution of World Oil Fields by Size

Estimated Ultimate Recovery (million barrels)	Size	United States	World Total
50,000+	Megagiant	None	2
5,000 - 50,000	Supergiant	2	40
500 - 5,000	Giant	46	328
100 - 500	Major	240	961
50 - 100	Large	327	895
25 - 50	Medium	356	1109
10 - 25	Small	761	2128
1 - 10	Very small	4599	7112
0.1 - 1	Tiny	9533	10849
0 - 0.1	Insignificant	11021	11751
0 - 0.5	Other tiny	4500	5989
		31385	41164

Source: L.F. Ivanhoe and G.G. Leckie, "Global Oil, Gas Fields, Sizes Tallied, Analyzed", Oil & Gas Journal, February 15, 1993, pp 87-91

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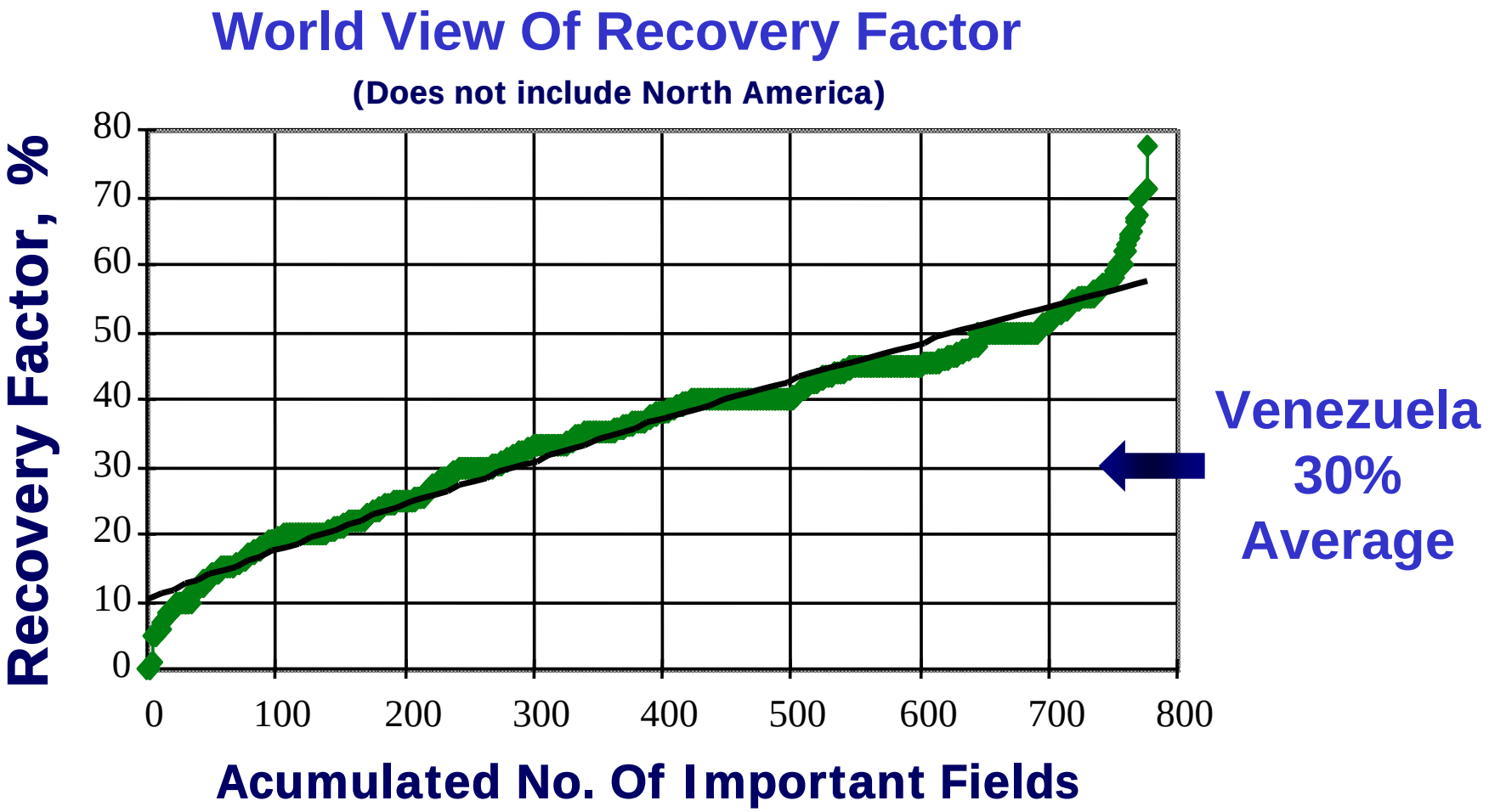
Recovery Factor



Source: Jean Laherrere, Petroconsultants

Mature Field Reservoir Management Today

- Episodic and reactive.
- Experts with a functional vision
- Well and surface infrastructure management separated from subsurface management.
- Automation infrastructure poorly exploited.
- Environmental and safety risks not monitored properly (poor risk prediction capabilities).
- Available information disperse and episodic.

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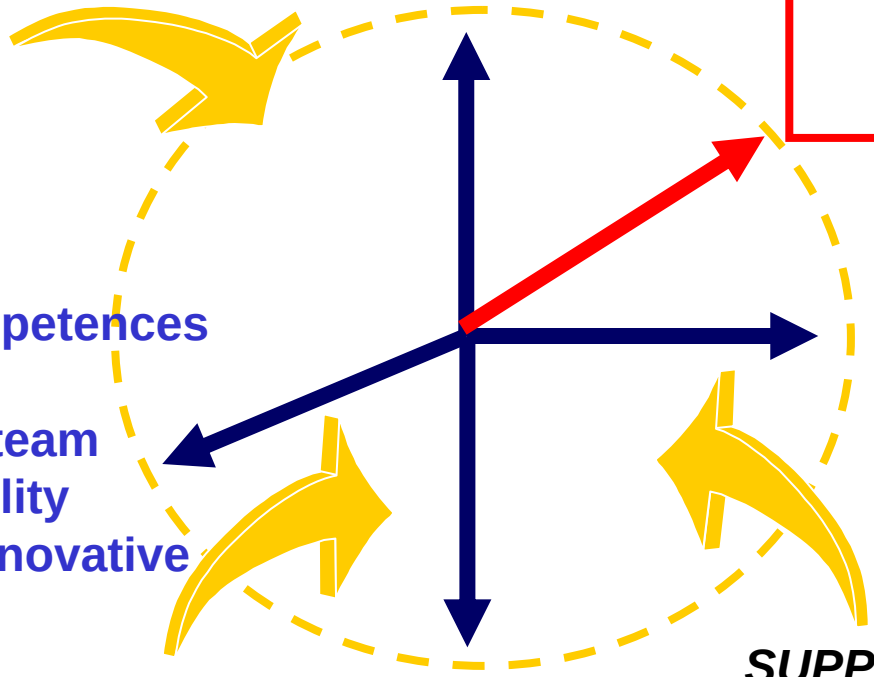
Socio Technical Systems: Multiple Dimensions and Drivers

Integrated Risk Management of Assets
- ***Risk and reliability***
- ***Data and information***
- ***Reservoir Life Cycle Total Cost***

TECHNOLOGY (I&D=>APPLICATION)
- **Methodologies**
- **Tools & Equipment**

PRODUCTIVITY OF A SOCIO TECHNICAL SYSTEM (MORE VALUE LESS COSTS)



PEOPLE
- **Quantity& Competences**
- **Communities**
- **Individual and team learning capability**
- **Creative and innovative**

PROCESSES
- **Organizational Capacity**
- **Work flow**
- **Cycle Time**

Knowledge Management
- ***Learning while doing, result oriented, fit for purpose just in time methodologies***

ENVIRONMENT
- **Biodiversity**
- **Natural resources**
- **Air, Water, Land**

SUPPLY CHAIN
- ***Goods and services***
- ***Use of supplier´s intellectual capital***

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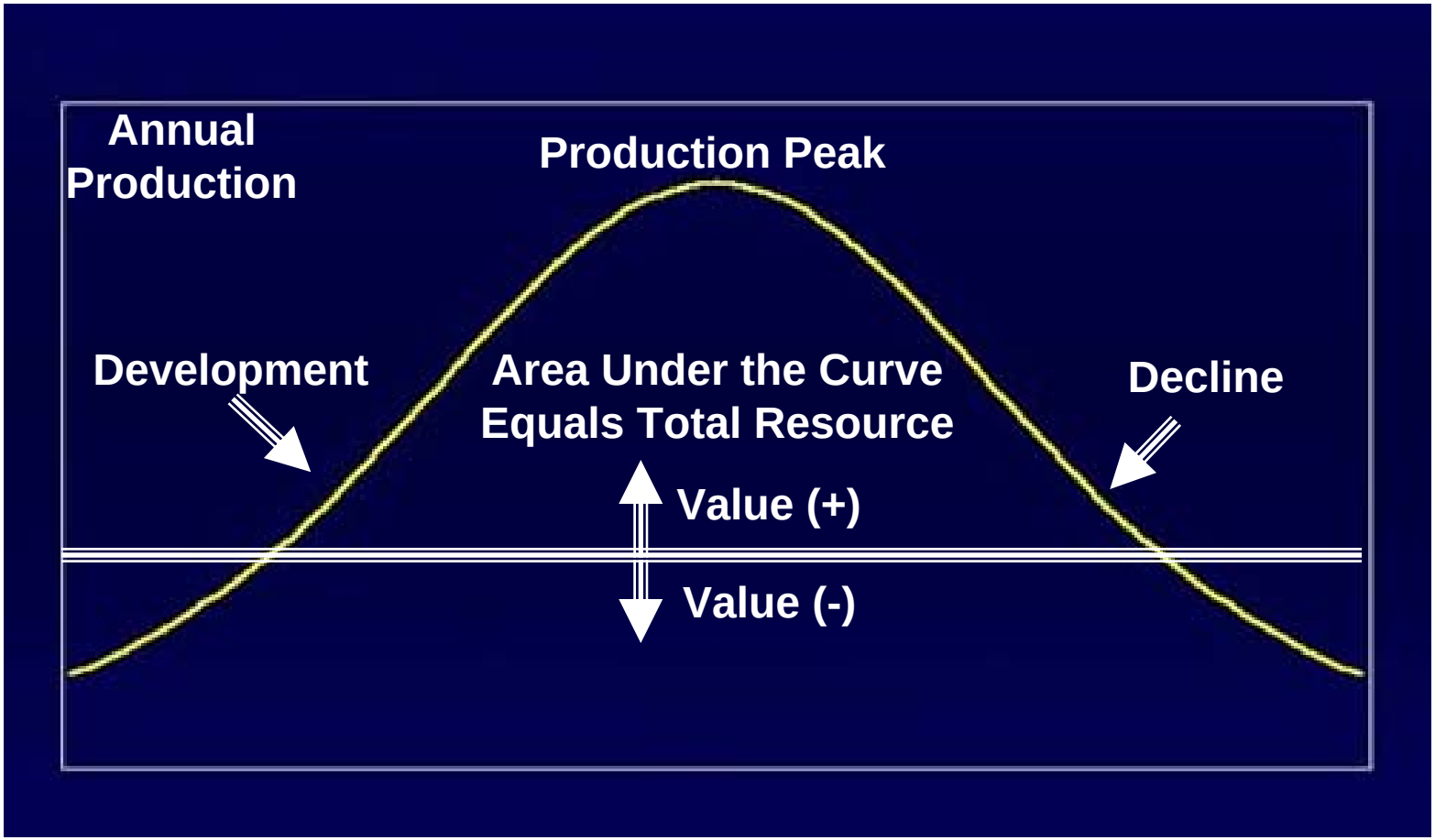
HC Reservoirs Lifecycle: A Non-Renewable Shrinking Resource



Cost Control emphasis on Design-Construction

Cost Control emphasis on Operation-Maintenance

Source: World Resouces Institute

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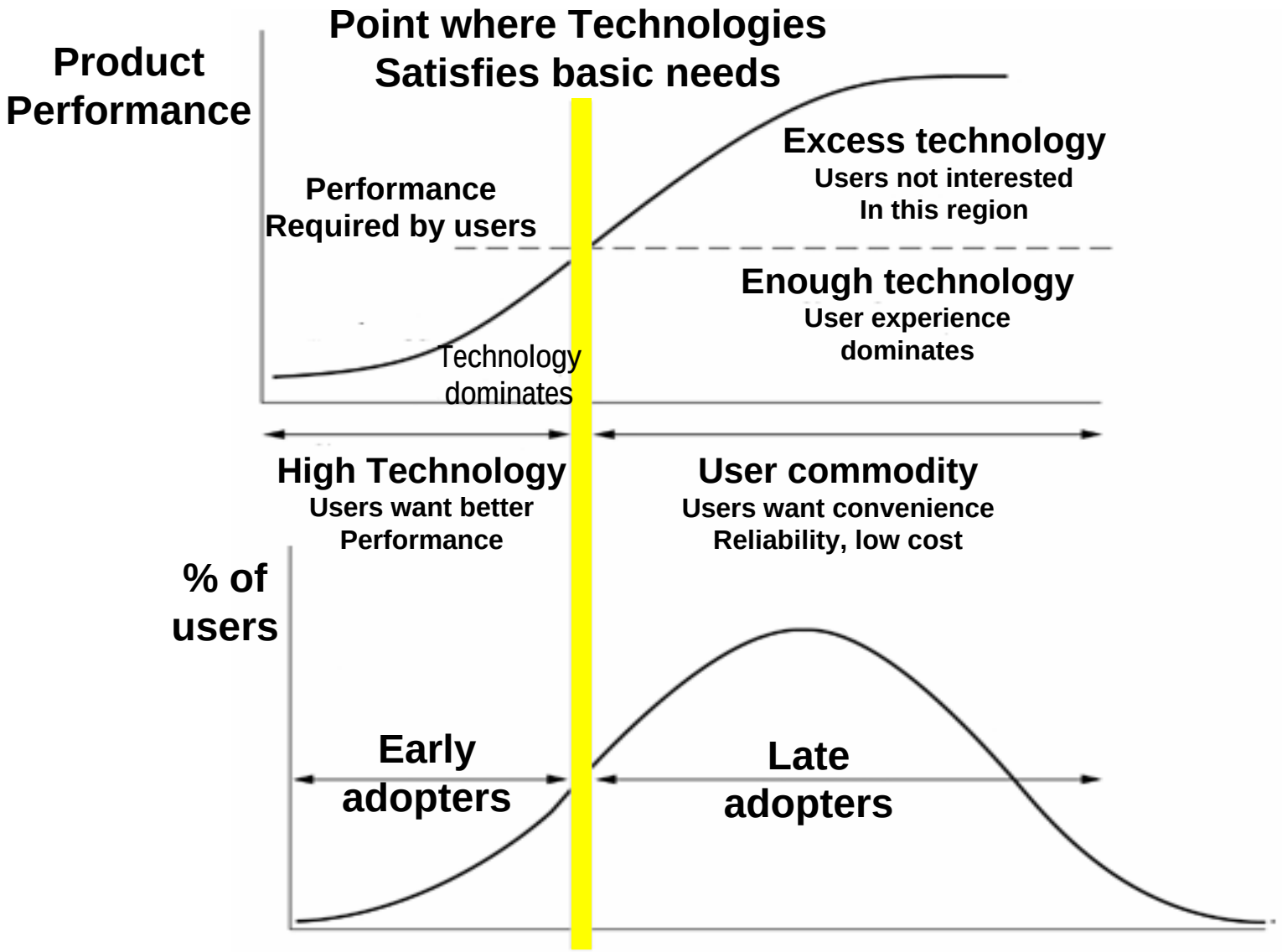
Technology-driven to human-centered



Source: Don Norman (1998: The Invisible Computer) - *http://www.jnd.org*

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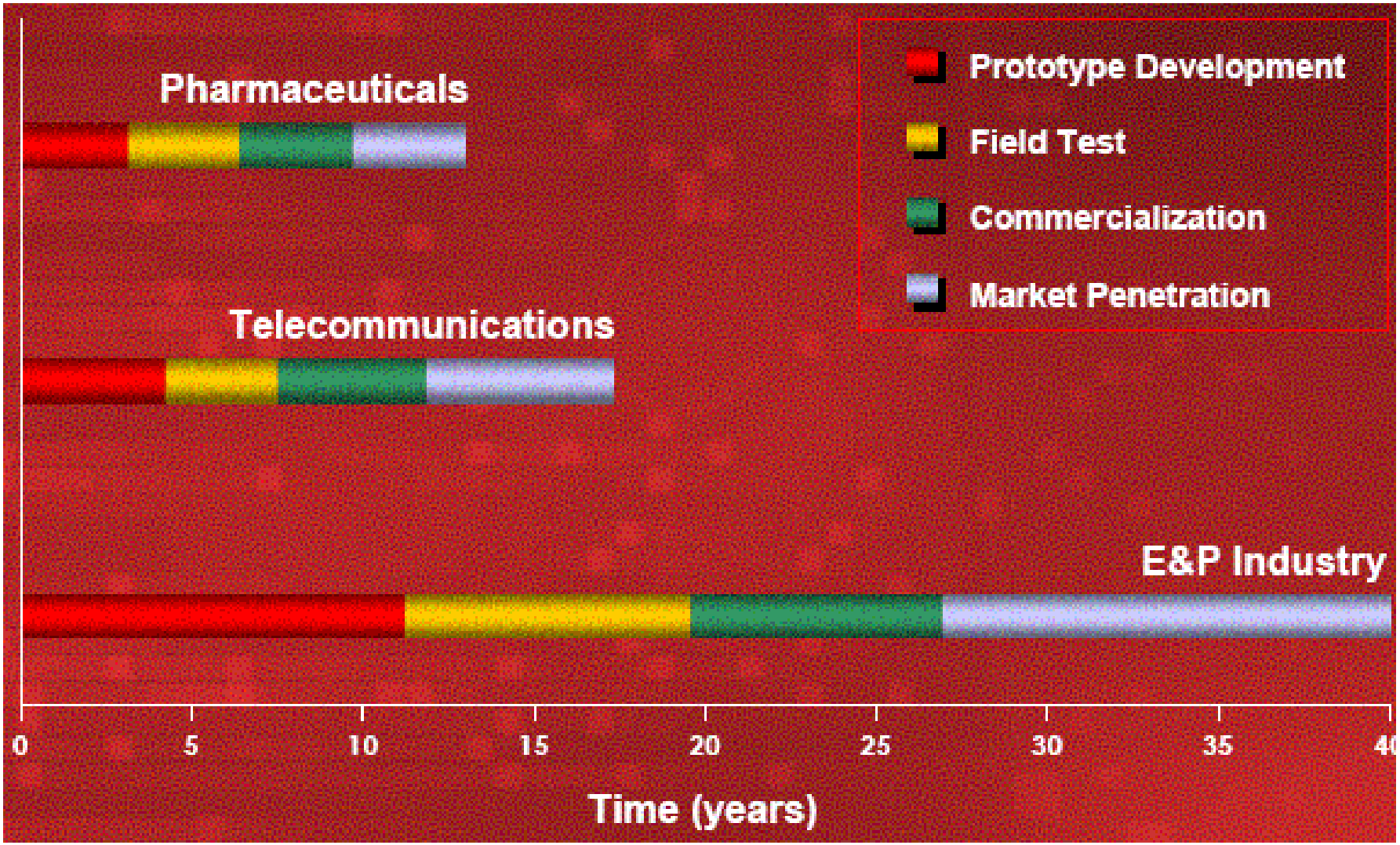
E&P Slow Technology Cycle Development



Source: McKinsey

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Technology Trends

(IOR – Improved Oil Recovery)

Drainage Area Improvement

- ✓ Workovers
- ✓ Infill drilling
- ✓ Step-out drilling
- ✓ Deepening
- ✓ Recompletions

Production Enhancement

- ✓ Increase well productivity
- ✓ Alternative lift methods
- ✓ Gas lift optimization
- ✓ Changes in completion strategies
- ✓ Iddle wells reactivation
- ✓ Surface infrastructure debottlenecking
- ✓ Upgrading facilities
- ✓ Process automation

Secondary Recovery

- ✓ Water flooding
- ✓ Gas flooding (immiscible)

Enhanced Oil Recovery

- ✓ Gas flooding - CO2, HC rich gas
- ✓ Water alternating gas (WAG)
- ✓ Microbial (MEOR)
- ✓ Dilute surfactant/chemical
- ✓ Polymer
- ✓ Thermal
- ✓ Pressure pulsing techniques (PPT)
- ✓ Cold heavy oil production (CHOPS)
- ✓ Gravity Assisted Drainage (GAD)
- ✓ Inert Gas Injection (IGI)
- ✓ Steam assisted gravity drainage (SAGD)
- ✓ Vapor assisted petroleum extraction (VAPEX)

Source: Adapted from Improved Oil Recovery - Meeting the Challenge
Jon Chadwick - Shell Malaysia SPE International IOR Conference
Kuala Lumpur, 20 October 2003

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Technology Trends

- Microseismic monitoring for reservoir management
- Supercomputers, visualization applied to reservoir to point of sales integrated simulation
- Drilling and completion systems with online 3D seismic interpretation – assisted with robots and artificial intelligence
- Intelligent fields – Total closed loop from subsurface to surface

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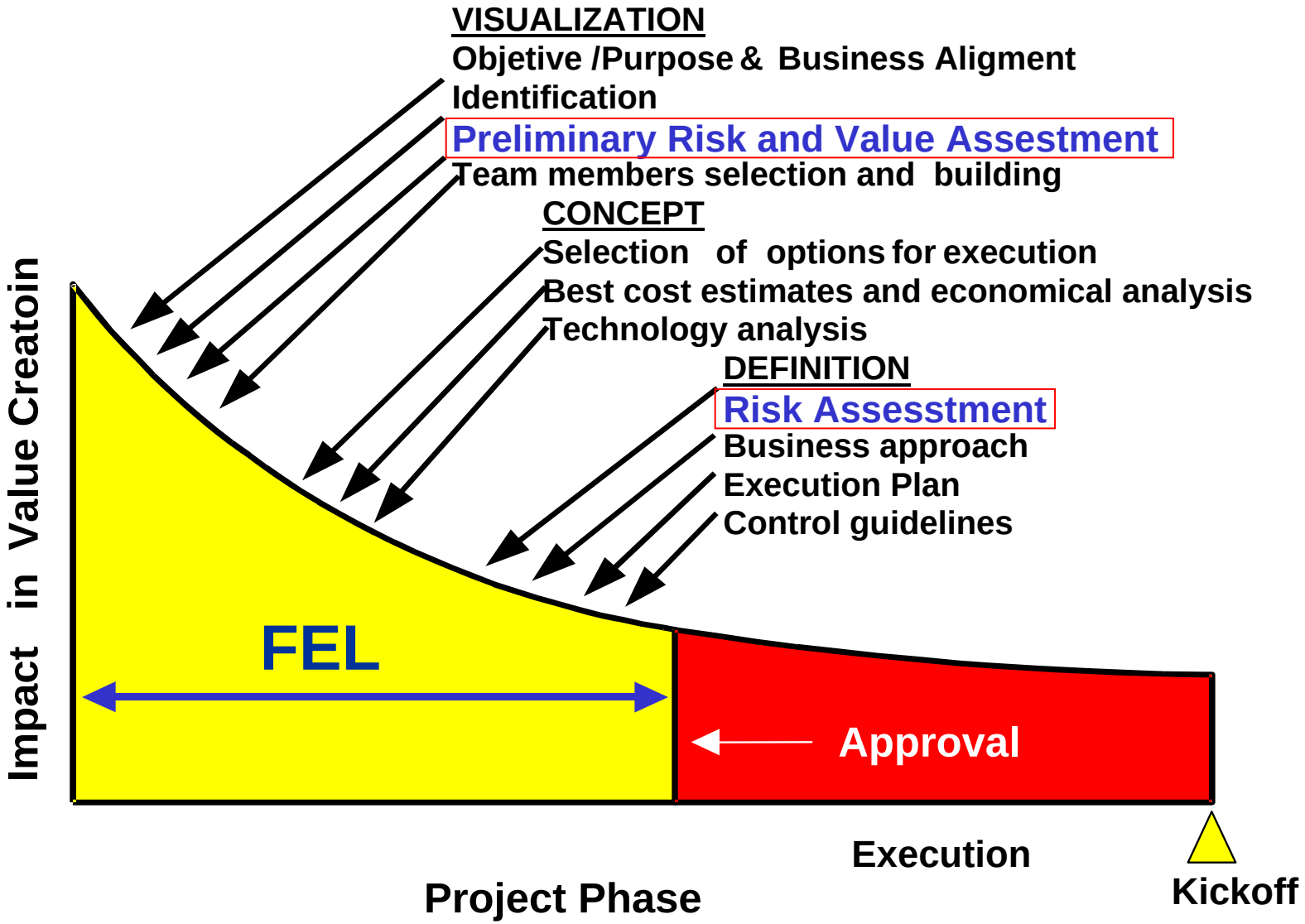
Front End Loading (FEL): Integrating Disciplines to Maximize Value



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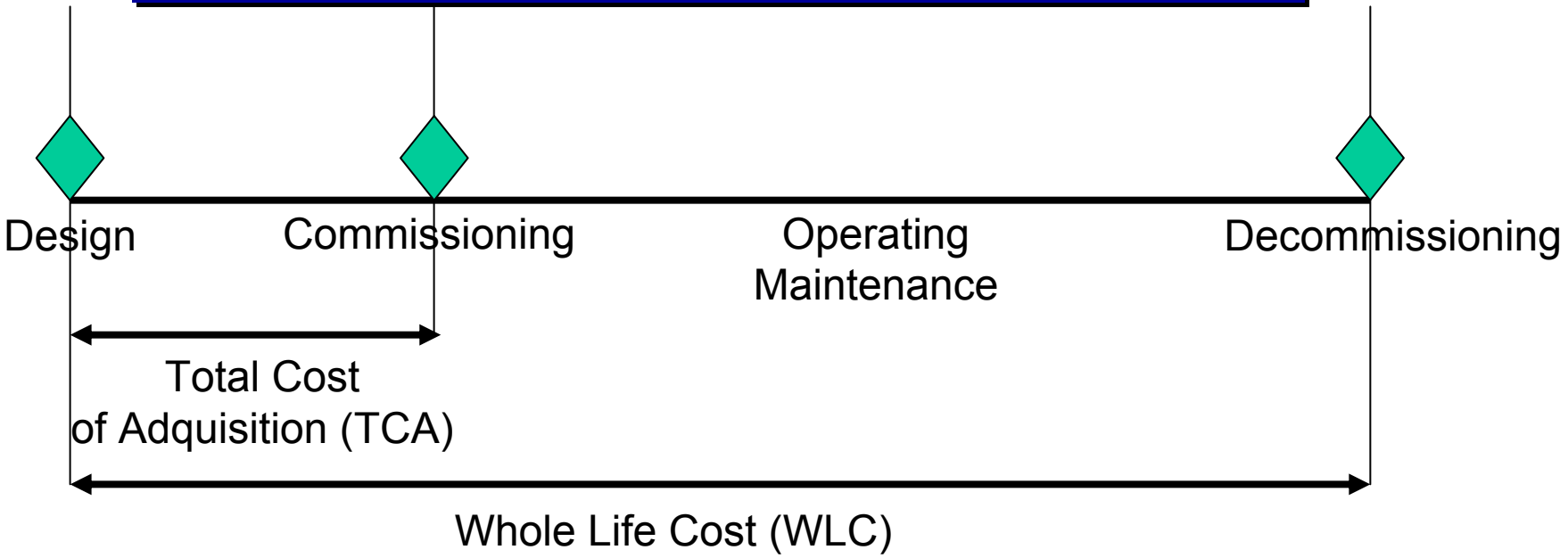
Life Cycle Costing (LCC)

Total Cost of Adquisition (TCA) Vs. Whole Life Cost (WLC)



TCA - what we see
The total cost of acquiring an asset or service. Comprises all stages from design to commissioning.

WLC - what the we really need
The total cost of an asset or service. Comprises all stages from acquisition, operating, maintenance and decommissioning. Increasingly used to ensure high level of purchasing decisions.

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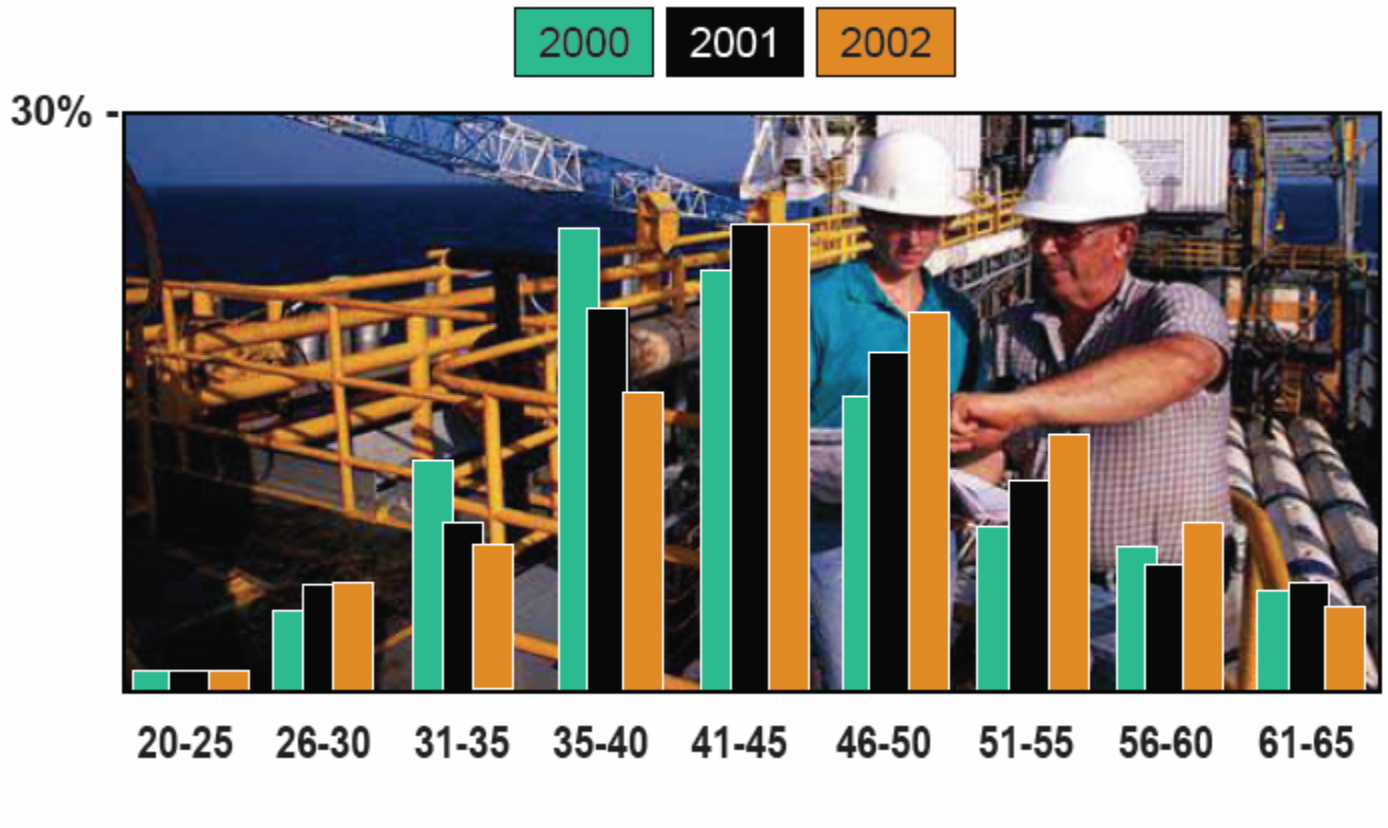
People

How to prepare future generations of professionals to deal with mature fields?



Source: Adapted from Pierce Riemer - The World Petroleum Congress - Calgary SPE HSE - 2004

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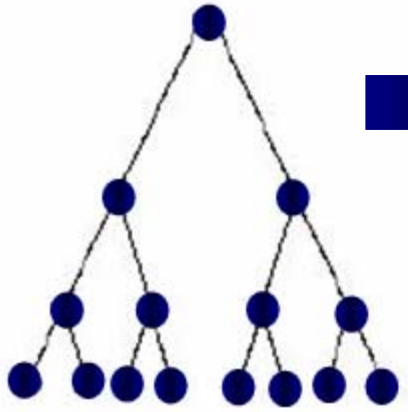
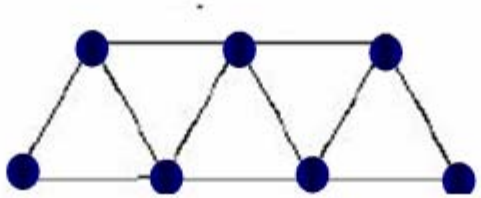
How the future organization will look like?

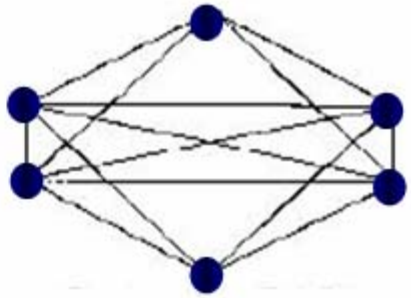
Alternative types of task allocation leading To different types of organization structures



One person / one task generates a single structure of hierarchical levels



Each person has a Overlapping Competence with other members, provides the conditions for a matrix organization. In this case each person is capable of carrying out 2 to 4 tasks



Each person / all tasks Provides the conditions for a composite autonomous group, and allows any structure of work relationships to be utilized

Source: David (P.G.) Herbst - Alternatives to Hierarchies

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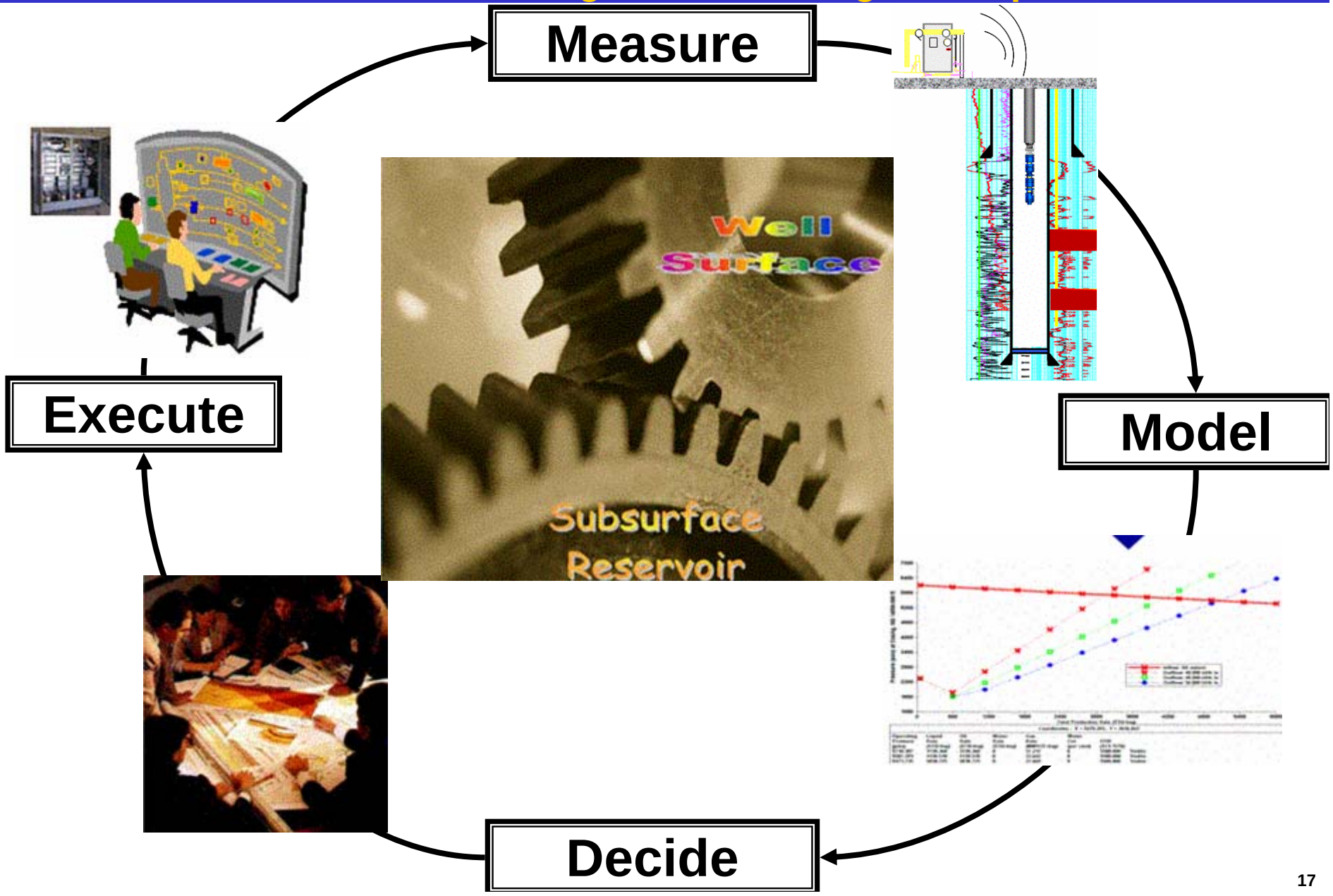
Subsurface-Surface Process Integration - Closing the loop



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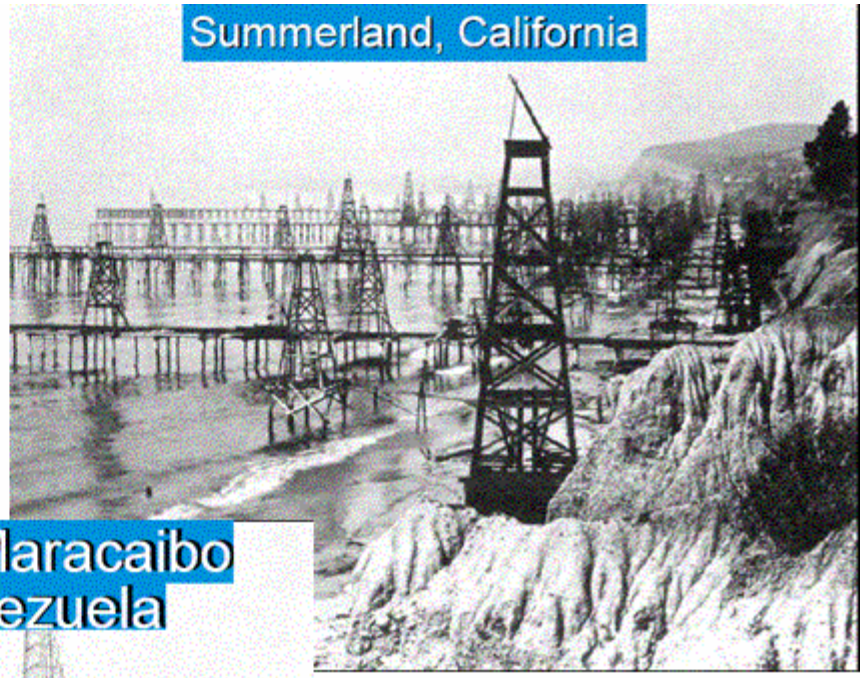
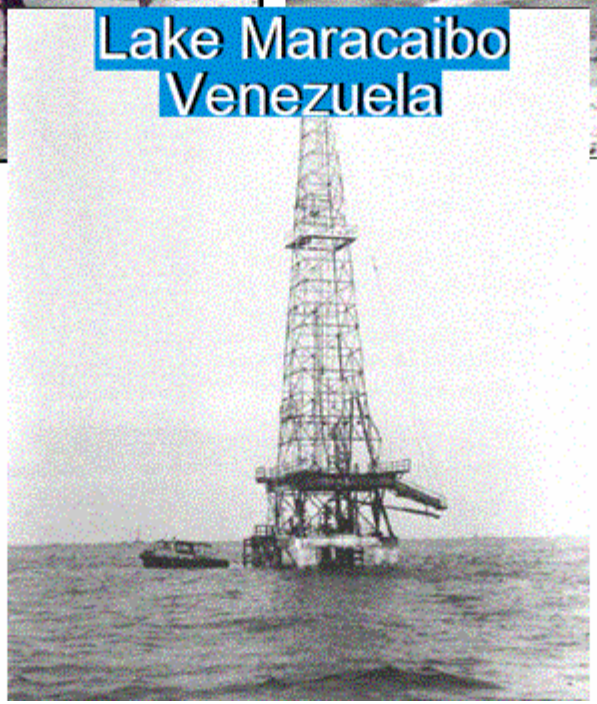
Environmental impact of HC production operations





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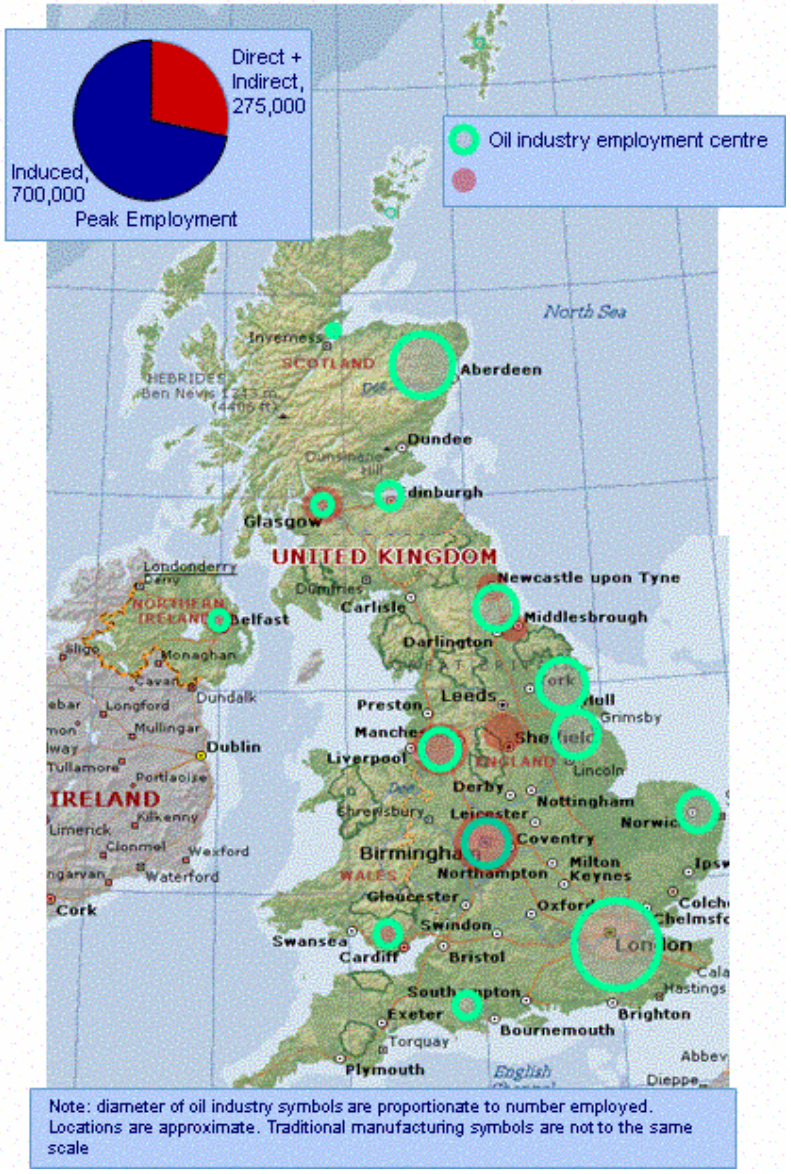
Social effects of Oil and Gas Industry: What happens at mature phase?

UK Industrial Centres 1970

Oil industry centres 1980



Note: diameter of oil industry symbols are proportionate to number employed. Locations are approximate. Traditional manufacturing symbols are not to the same scale

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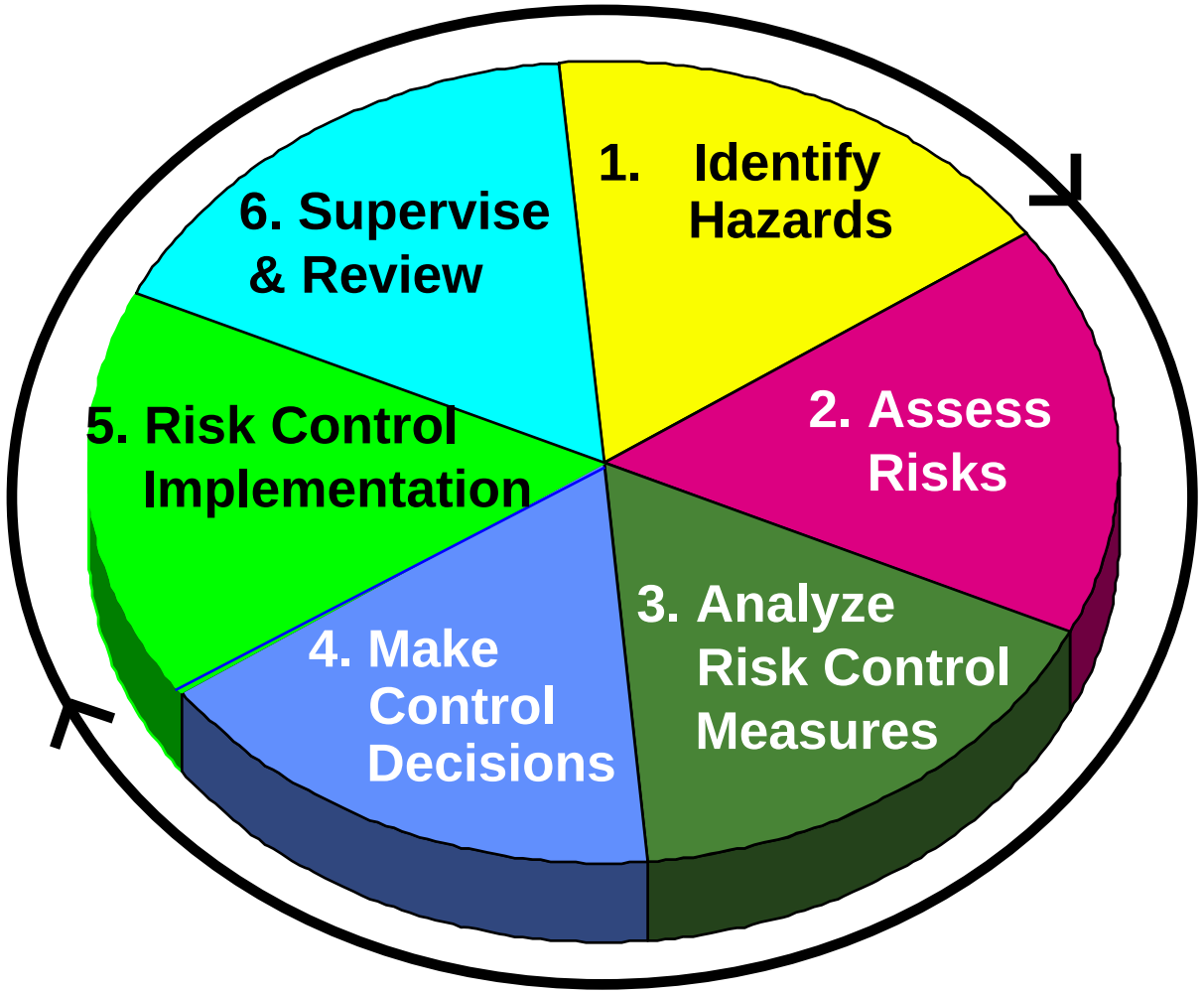
Technology Projects: Operational Risk Assesstment



Technology Project Preparation

1. Expert team selection.
2. Data, documents, reports selection.
3. Tools, equipment, software and methodology selection and training.
4. On site visits, interviews and workshops.
5. Asset team selection.
6. Reporting format and mechanism.
7. Project preparation workshop.

Closing remarks

- Total cost of HC production technologies = technical cost + social cost
- Long term social vision of reserves production should balance short term economic vision
- Regional and local capabilities (technology services, infrastructure, educated workforce) must be developed to get low cost and long term stable conditions to get high recovery factors in oil and gas projects

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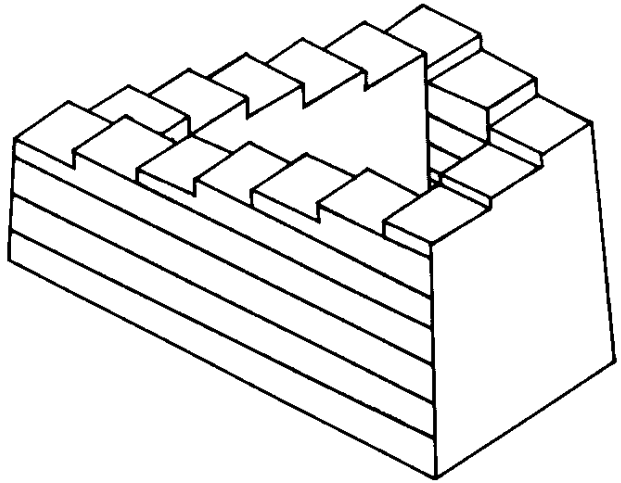
Challenge for this ATW: At the End of this ATW We Will Map…

- How the Mature Field of the Future Looks Like?
- Creating our own vision integrating technologies, people, processes and the territories where these fields are located...
- What are the key technologies that will allow value creation from the Mature Field of the Future…..?
- A Technology Risk Assesstment Matrix that helps to integrate the results of this ATW

Closing remark

"There is nothing so inefficient as very efficiently doing the wrong things"



"No hay nada mas ineficiente que hacer las cosas incorrectas eficientemente"

Peter Drucker