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*Innovative Solutions
for Sustainability*



Management decisions and informed WCF choice

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Management and informed choice

Decisions on **HOW** to carry out well construction are based on the previous experience and available information of:

- The formation
- Equipment and fluid performance (technical suitability)
- Cost and available resources (investment decision)

To make **informed choices**, the decision should include consideration of:

- Overall **operational consequences** of a choice (time, additional processes, waste, HSE consequences)
- Cover the **lifespan of the well** (i.e. include pre-operation work and the handover to production process)
- The **risk potential** of the choice



A financial approach to cost consideration of operational choices

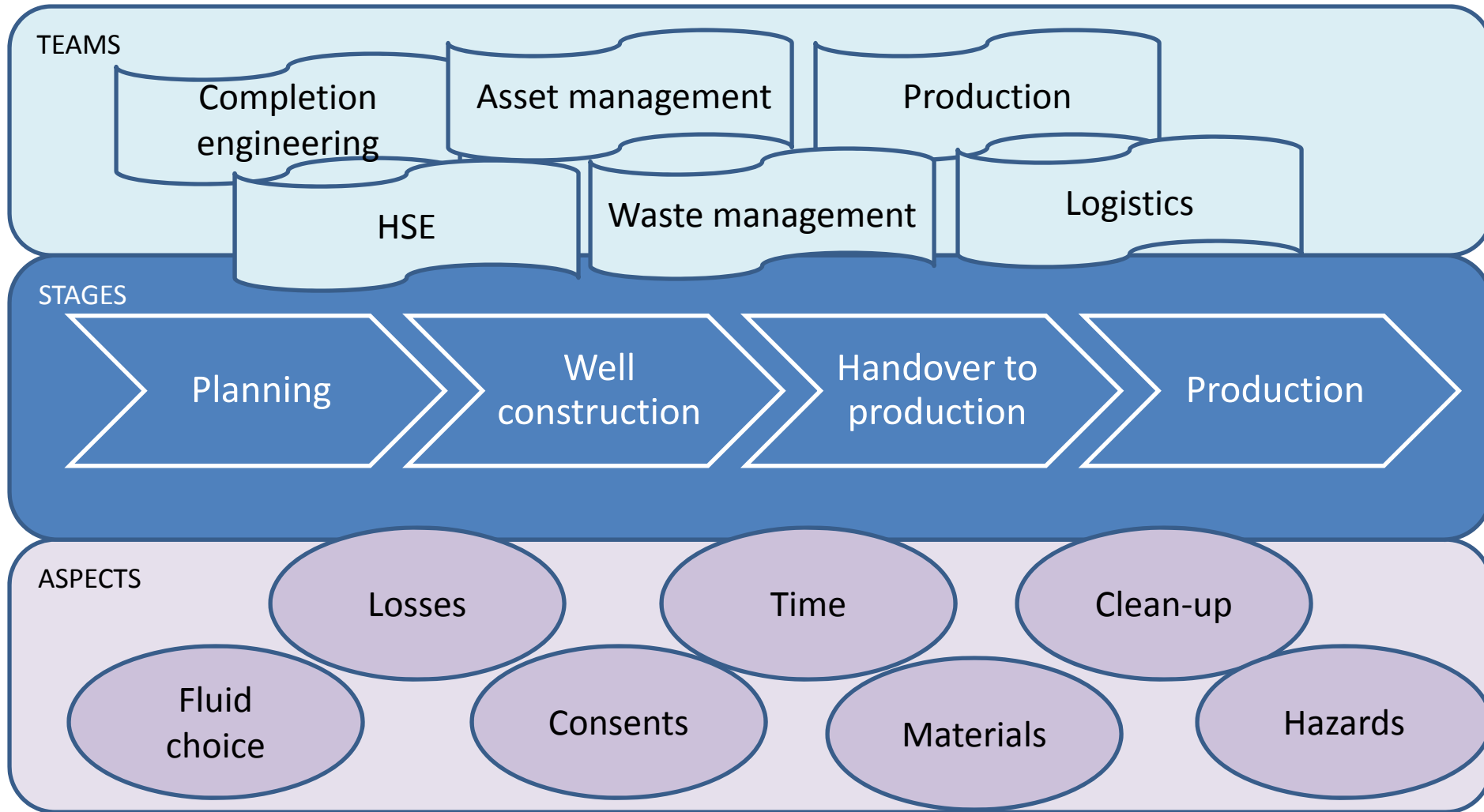
Consideration of comparative **operational expenditure (OPEX)** of choices is a **standard approach** to financial analysis (e.g. Williams et al. 2006).

Understanding the **overall operational costs** and uncertainties or **cost of risk** are both in the very core of making informed decisions (e.g. Teale et al 2003).

Understanding and analysing the different direct and indirect cost elements triggered by fluid use is a prerequisite for **informed and cost efficient WCF choices**.



A challenge: the myriad of viewpoints



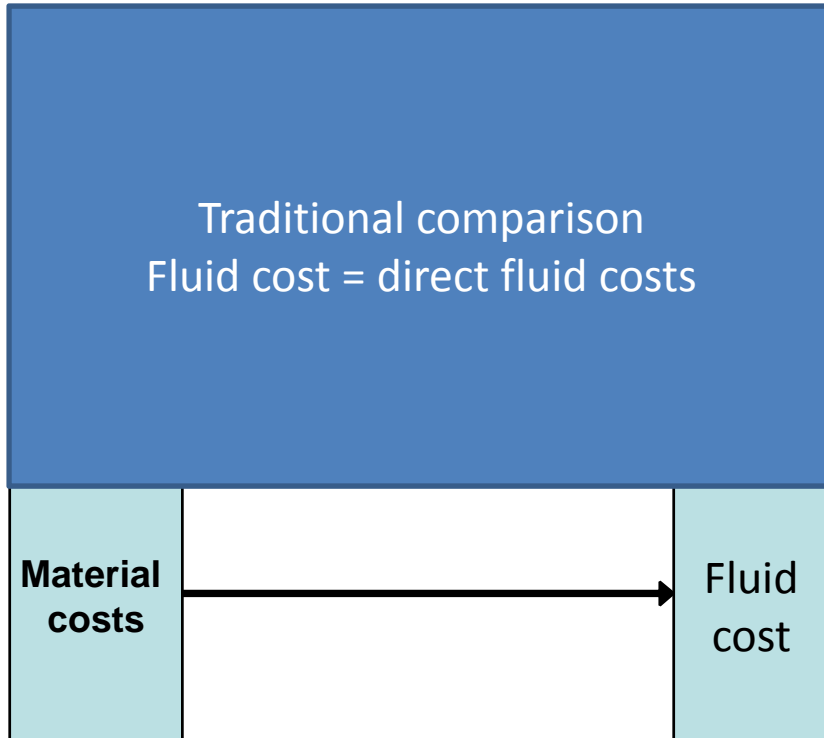
The theory: Activity Based Costing (ABC)

ABC from WCF perspective

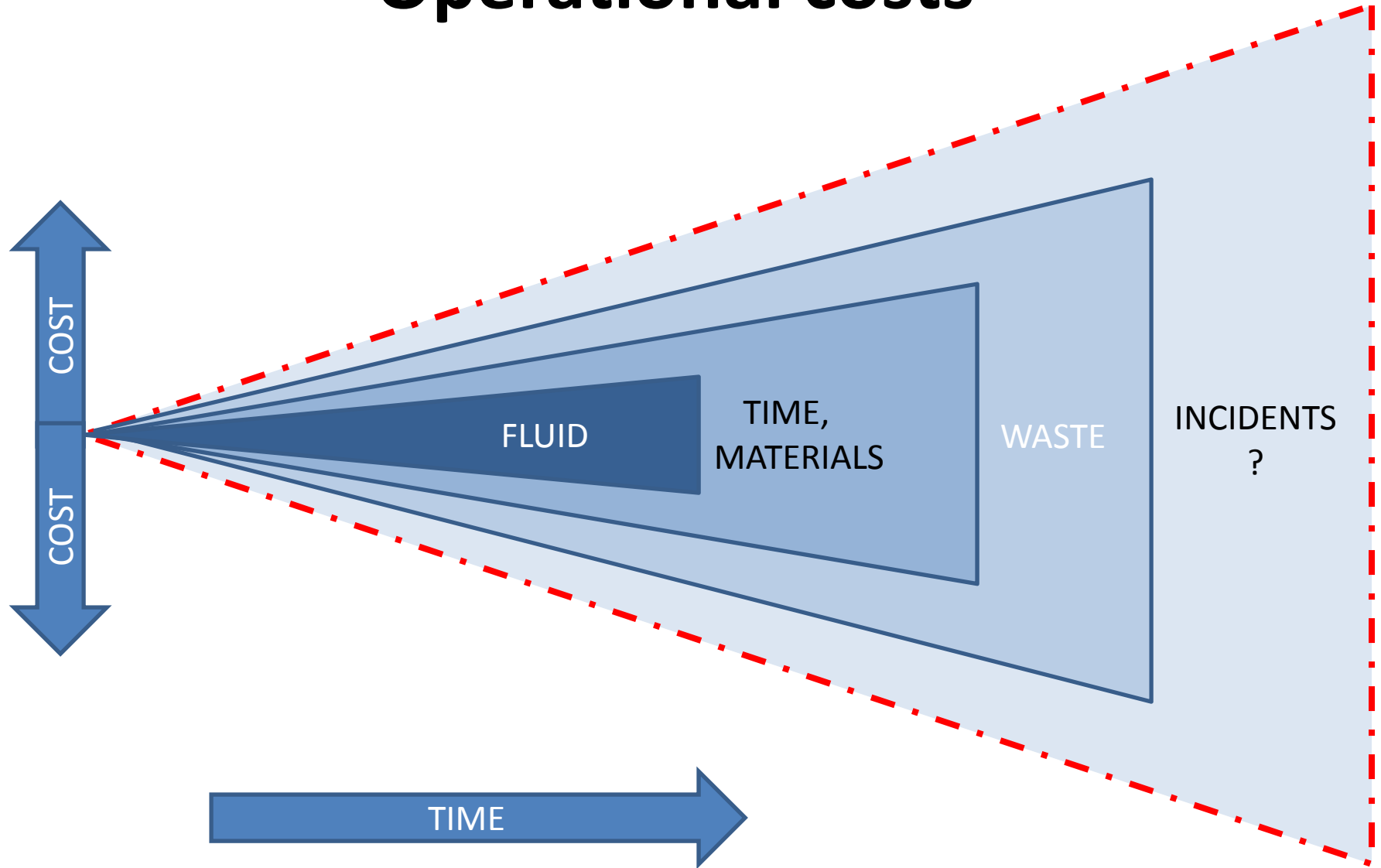
This would include activities such as:

- Transport and storage
- Use
- Waste handling and disposal
- Handover to production ...

..and of course the material cost =
fluid cost (per bbl)



Operational costs



A few challenges

1. Data identification (**WHAT SHOULD BE ASSESSED ?**)
2. Data collation (**FROM WHERE ?**)
3. Process ownership (**BY WHOM?**)
4. Procedures for data exchange (**HOW ?**)
5. All performance measures comparable (**WHAT DOES IT MEAN?**)
6. Presentation of results (**DECISION CRITERIA!**)

... and the time to do it all!



Activities, Data Providers and Process Ownership

1. Completion team:

- Fluid choice and other activities that trigger costs during displacement, completion and flow back to rig. Include material compatibility, losses and rig time.

2. Logistics team:

- Cost and availability of transport of fluids and waste onshore and to offshore sites.

3. Production team:

- Activities include treating and disposing of produced water, hydrocarbon stream clean up operations (e.g. desalting) on platform or in refinery.

4. Waste management team:

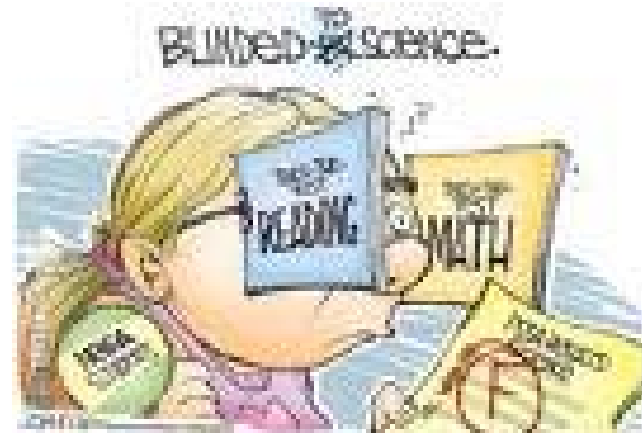
- Activities include treatment on the rig and / or the production facility, such as separators, and disposal of wastes.

5. HSE experts:

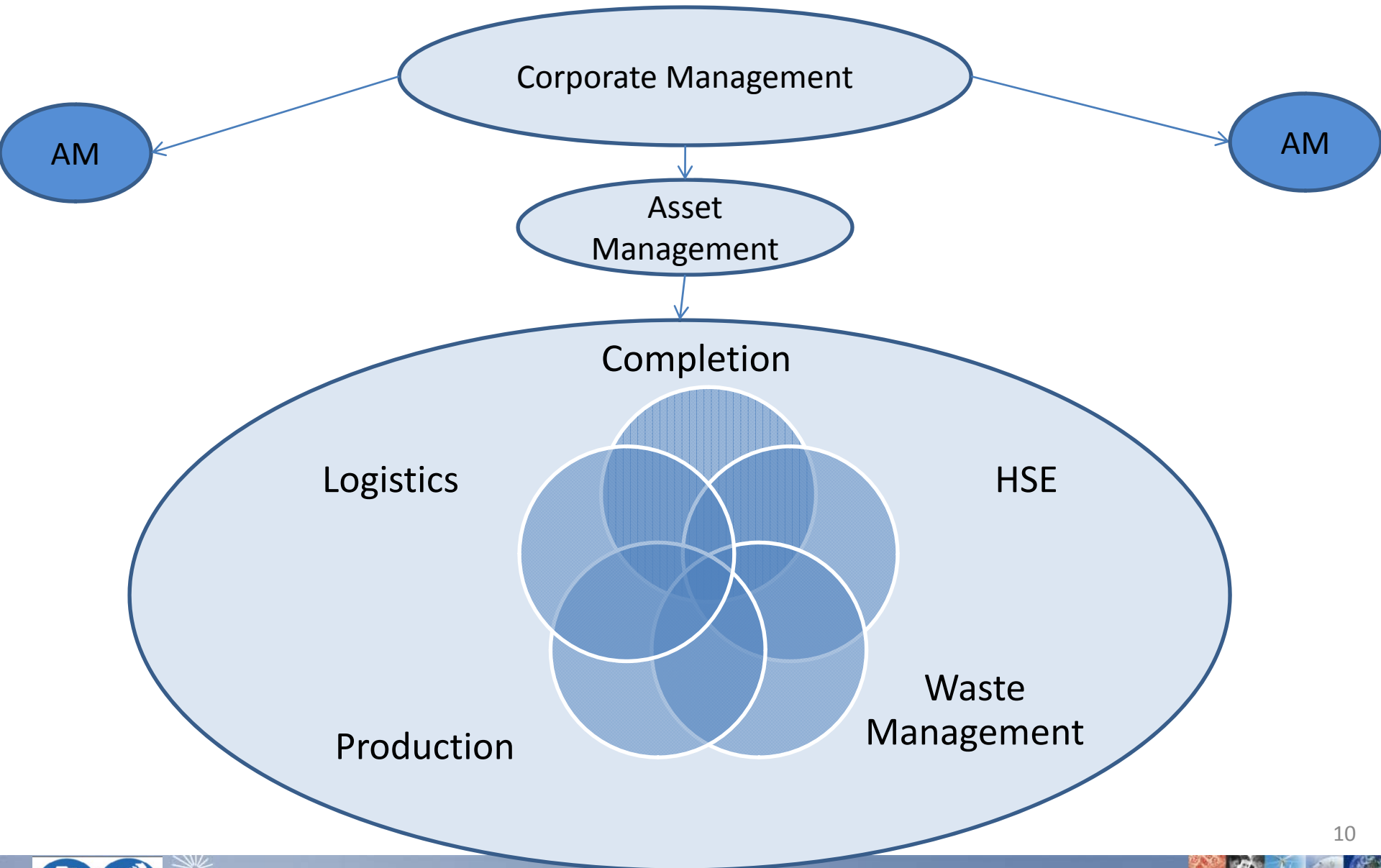
- Activities that trigger HSE costs span the entire operational process.



Blinkered & compartmentalised?



Open cross-departmental decisions?



A tool to make it easier

The calculations of overall operational cost and assessing cost of risk requires **multiple interdependent calculations**.

Aim when developing the tool was to provide a **structured environment** to capture all cost points

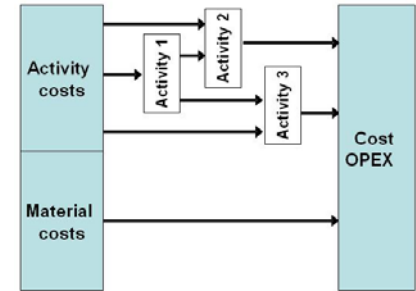
- From different budgets
- For different tasks (activities)
- From different stages of the operation (pre, during and post)

The results from the calculations are presented as:

- **Opex** associated with fluid choice for the well (=cost to run fluid)
- Cost of **HSE risk** and
- **Average predicted fluid cost** per well



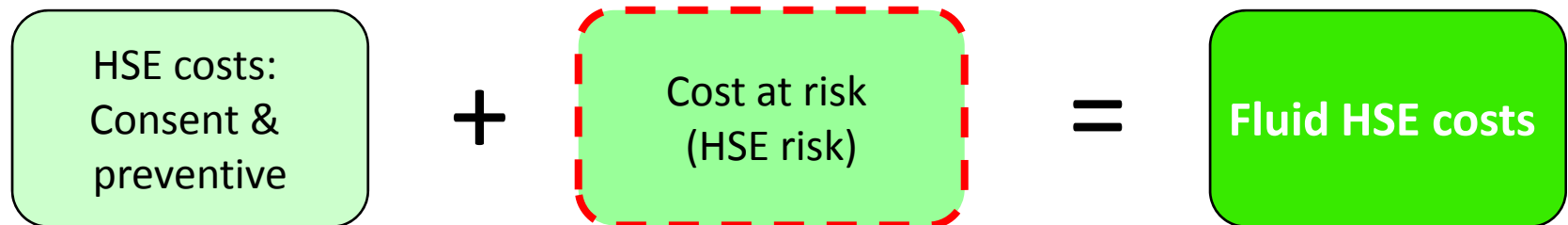
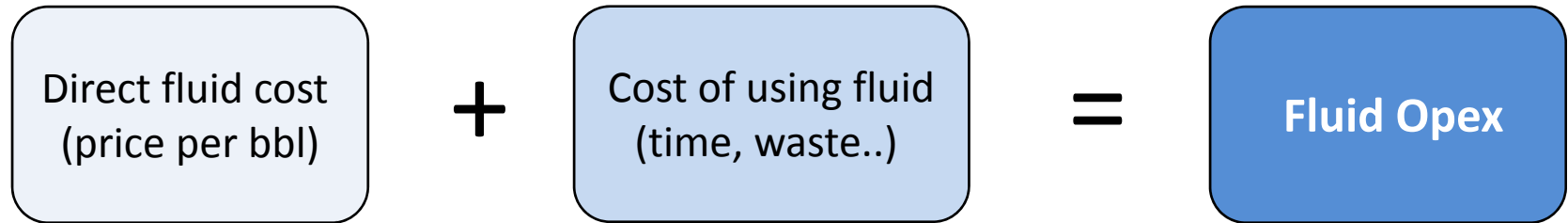
ABC and the developed tool



1. Direct costs for the fluids = **Material costs**
 - Fluid cost (different pricing models)
 - Losses
 - Other materials (e.g. tubing material choice)
2. **Activities** that trigger indirect operational costs:
 - Systematic & covers all development phases.
 - When used in early planning, can leave blanks
3. **HSE risk potential:**
 - Risk potential related to fluid hazard
 - Cost of incidents over all operational stages (cost at risk)



From direct costs to overall cost: base case mathematics



ABC activities, Opex and the tool results*

FLUID AND OPERATIONAL COSTS	Cesium Formate	Zinc Bromide	Currency
Cost of fluid (before losses)	701 250	417 600	US\$
Cost of lost fluids	1 170 000	312 000	US\$
Onshore transport	3 744	3 931	US\$
Shipping	71 311	78 442	US\$
Personal protection	0	20 000	US\$
Suboptimal rig time	125 000	958 333	US\$
Delay in production	8	59	US\$
Fluid related other operational costs	400 000	1 000 000	US\$
Total waste fluids, ship to shore	0	107 982	US\$
Produced water treatment on rig	0	0	US\$
Waste disposal	0	350 000	US\$
Cost of brine, contaminated production stream	10	20 000	US\$
Other, please specify			US\$
Other, please specify			US\$
Total operational costs	2 471 322	3 268 347	US\$

FLUID COST

PPE

WASTE

PRODUCTION

TRANSPORT

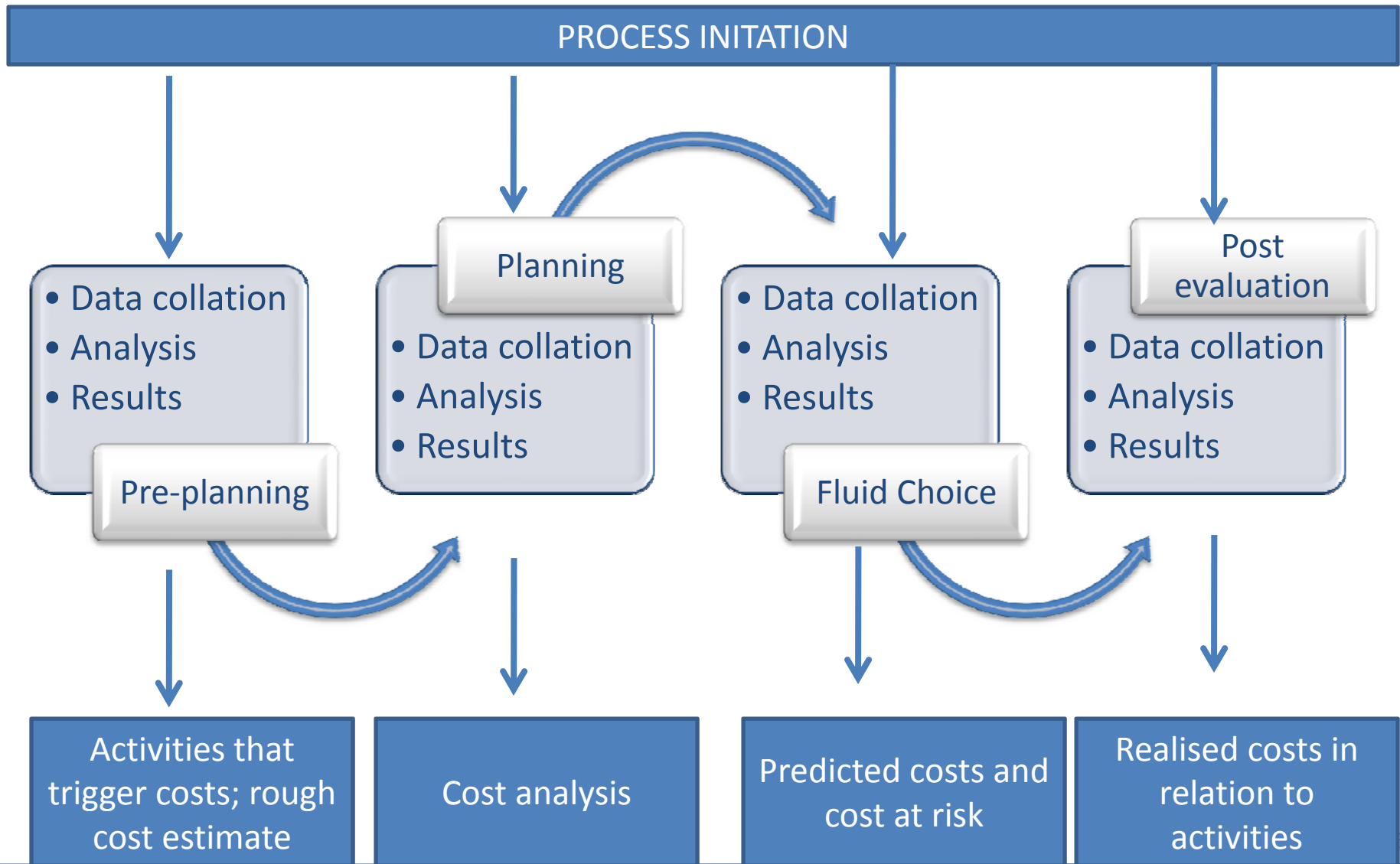
RIG TIME

PRODUCED
WATER

DELAYS



Planning cycle and analysis



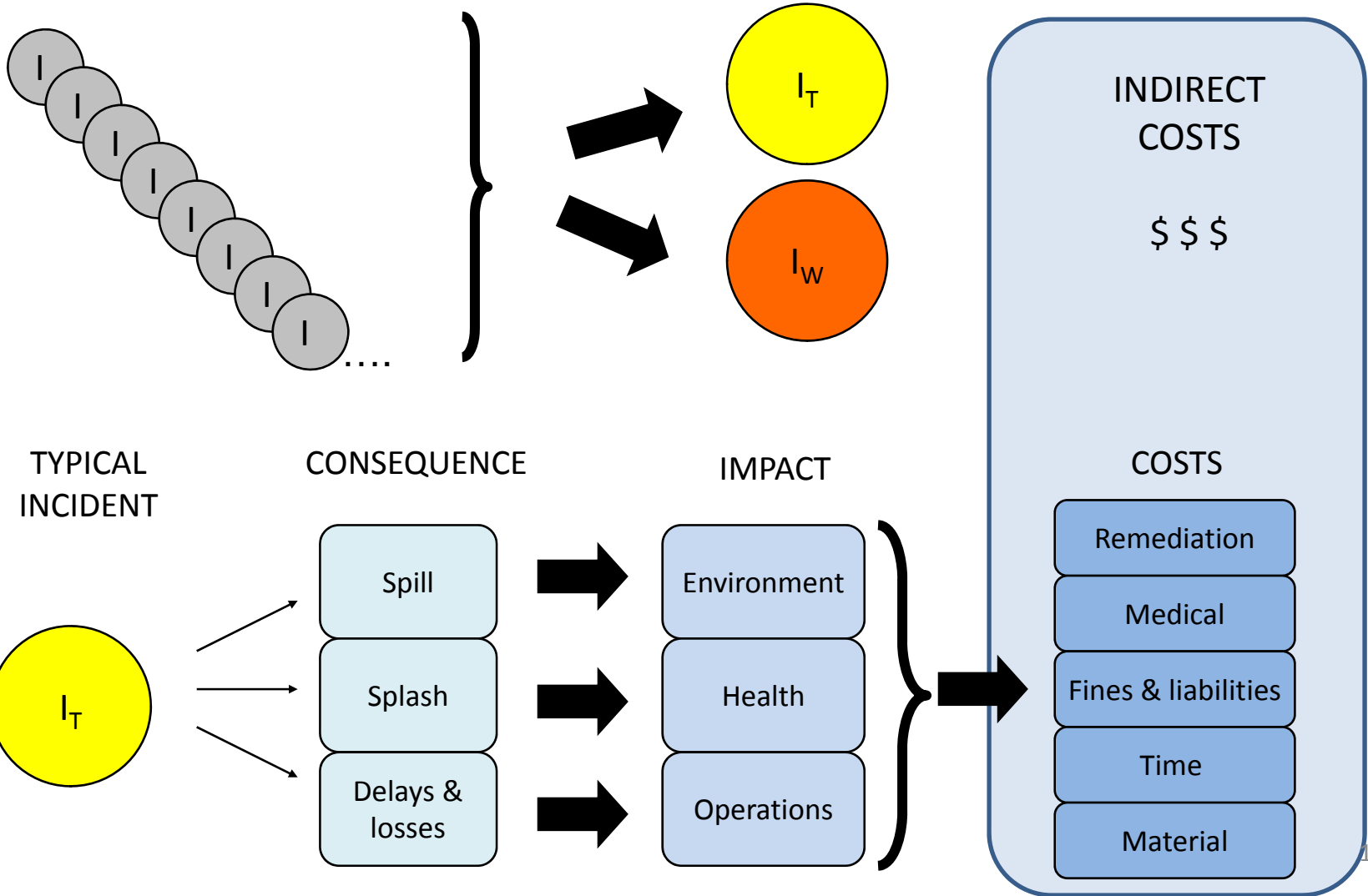
Risk = Cost

“We must, above all, shift from a culture of reaction to a culture of prevention. Prevention is not only more humane than cure, it is also much cheaper.”

- Kofi Annan, ex-Secretary-General of United Nations



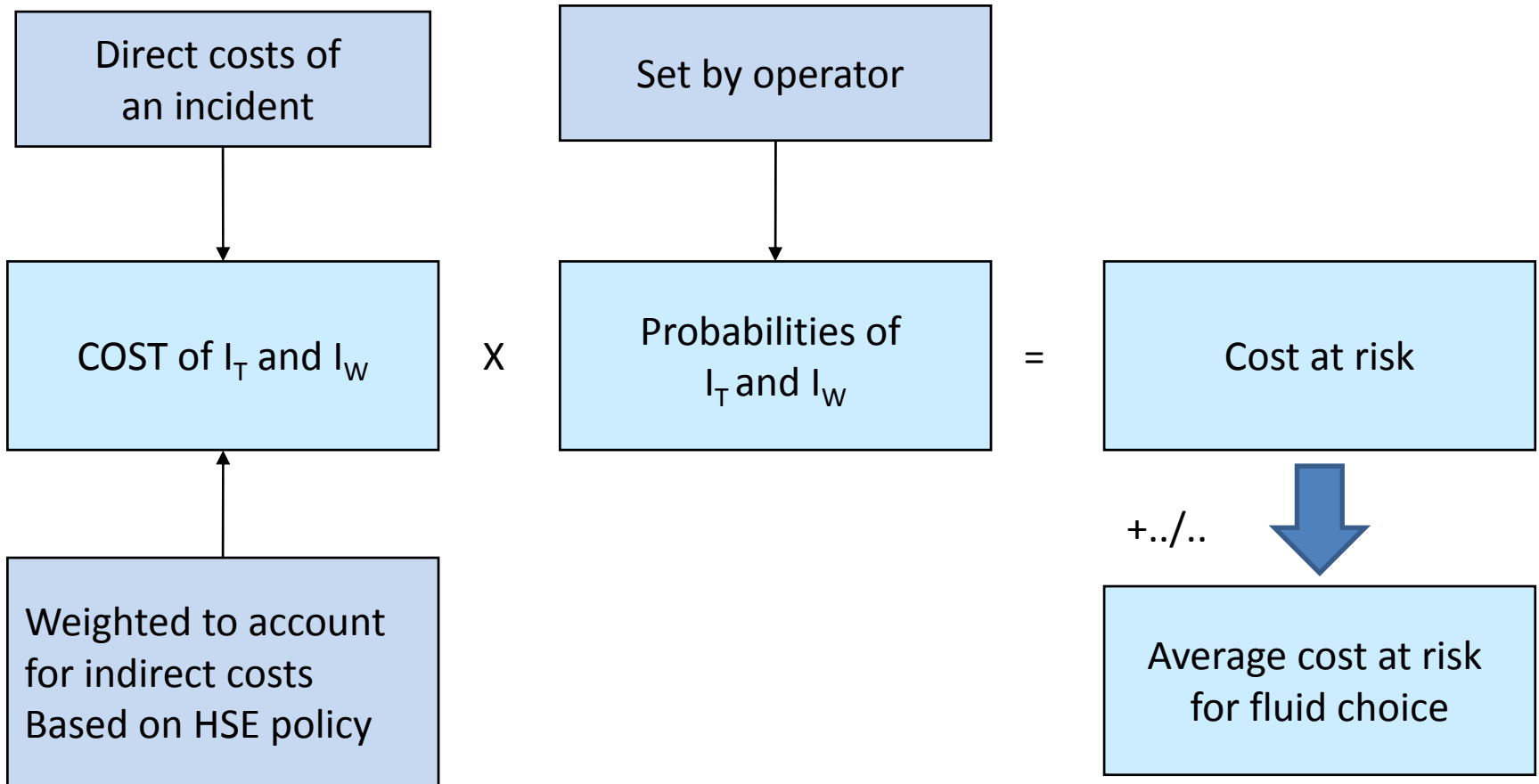
Cost of risk*



* See also SPE 120531

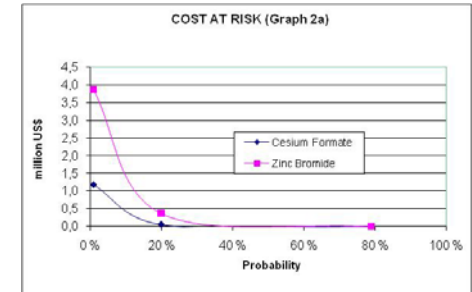
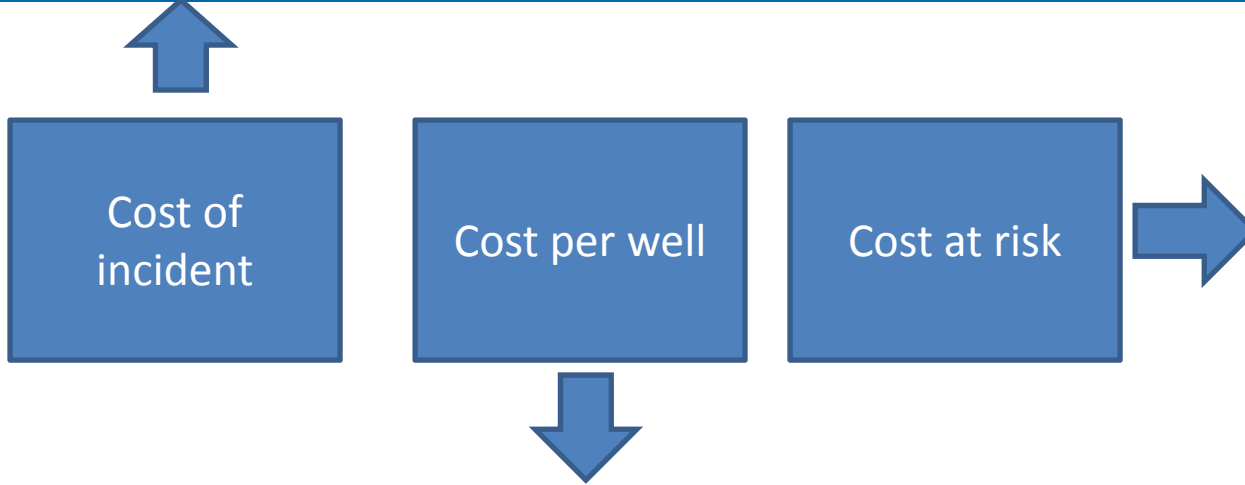


From incident to cost at risk



Cost analysis summaries

COST OF RISK	Included in comparison	Cesium Formate		Zinc Bromide		Currency
		20 %	1 %	20 %	1 %	
Scenario 1 type incidents (ROAD)	Yes	13 350	517 344	390 815	3 977 856	US\$
Scenario 2 type incidents (STORAGE)	Yes	13 284	871 575	363 805	6 160 700	US\$
Scenario 3 type incidents (SHIPPING)	Yes	33 600	334 000	359 315	2 332 575	US\$
Scenario 4 type incidents (RIG)	Yes	156 600	3 034 000	392 115	3 052 575	US\$
Average cost of incident consequences		54 209	1 189 230	376 513	3 880 927	US\$



Average cost per well	2 494 056	3 382 459	US\$
Additional cost, which is at risk to occur during WC (with small to average incident confidence 20 %)	54 209	376 513	US\$
Additional cost, which is at risk to occur during WC (with larger than average incident confidence 1 %)	1 189 230	3 880 927	US\$

Summary

To make informed decisions, you need information on overall costs and consequences

To do this in practice, you need tools

The developed tool enables overall comparisons of fluid choices

- Automatic comparison of cost points (ABC)
- Inclusion of cost at risk

Enables HSE to be taken into account early in the planning cycle

→ To evaluate the variety of costs triggered by different activities requires a well defined process and management support.



Conclusions

- ✓ BrineWise™ provides an accessible and cohesive structure for overall cost review
- ✓ Integrates HSE into the evaluation process
- ✓ Results form a structured input to management decisions
- ✓ Enhances communication
- ✓ **Integrating the approach into the well planning cycle has a significant potential to enhance overall well construction project economics and reduce HSE hazard**

- Requires adaptation for other fluids
- Requires policy decisions
- Does not directly quantify technical risk





Thank you

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