Asset, Ageing & Risk Management

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Using well information & knowledge bases to inform decision-making for well management

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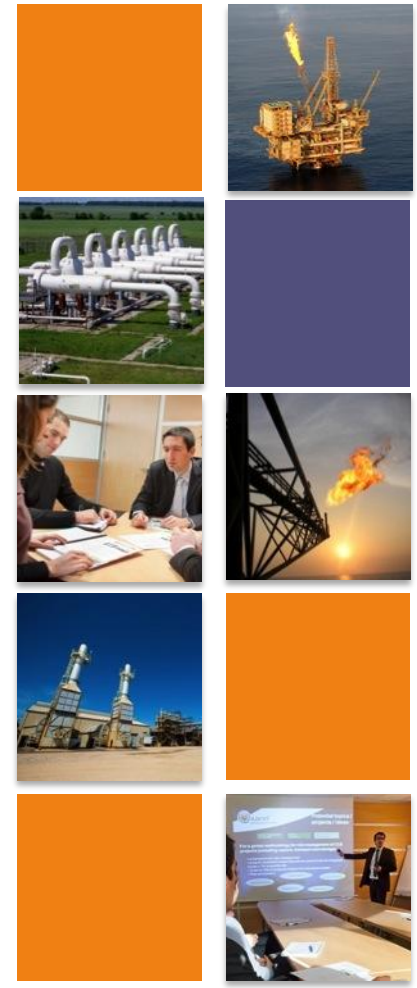
with Simeo™

Oxand
Asset, Ageing & Risk Management

Presentation Overview



- ➜ **Introducing Oxand**
- ➜ **Asset management & data management**
- ➜ **Oxand's approach to well asset management**
- ➜ **Oxand's solution: SIMEO™ WellBase**

Introducing Oxand

- ➜ **Independent international engineering consultancy firm specialised in asset & risk management**
- ➜ **Focus on life cycle optimisation of high risk capital intensive assets**
- ➜ **UK business is centred on Oil & Gas and Nuclear Energy**

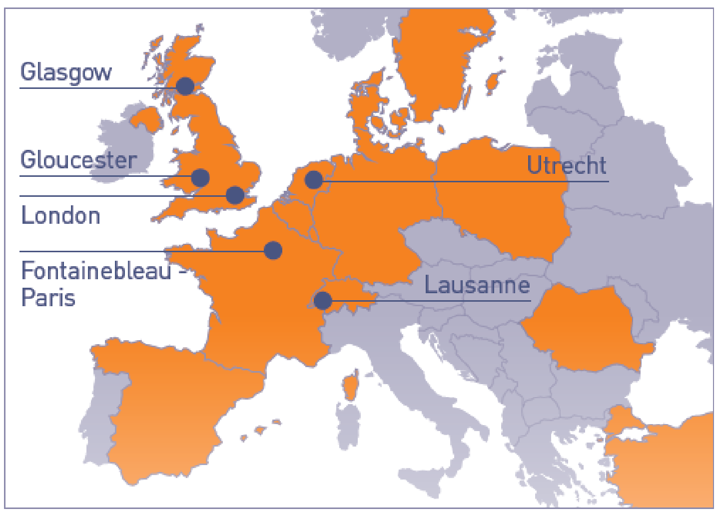
- > **£ 1000bn** OF CAPEX CAPITALISED IN ***SIMEO***™
- > **150** PERMANENT CONSULTANTS
- > **£ 12m** REVENUE

ENERGY (Oil & Gas, Nuclear, Hydro…)

TRANSPORT (Roads, Railways, Ports…)

Introducing Oxand

OVER **800 PROJECTS** THROUGHOUT THE WORLD, IN THE MAJOR INDUSTRY SECTORS



OUR SECTORS

ENERGY
NUCLEAR
OIL & GAS
RENEWABLES (HYDRO & WIND)

TRANSPORT
RAILWAY
PORT / WATERWAY
AIRPORT / SPATIAL
ROAD / HIGHWAY

SPECIFIC LARGE ASSETS
DEFENCE
INDUSTRIES
PUBLIC AUTHORITIES

Over 150 consultants specialised in Physical Asset Performance Management

Asset Management & Data Management

➜ **Important:**

- Asset management ≠ Data management
- Asset management ≠ "looking after your assets"

Asset management = creating value from your assets

➜ **Data management should support asset management by informing decision-making. For example:**

- Repair/replace?
- Expand/consolidate?
- Invest now/later?

➜ **Data collection needs to be targeted and data must be transformed into information, i.e;: analysed**

Data – Information – Decision

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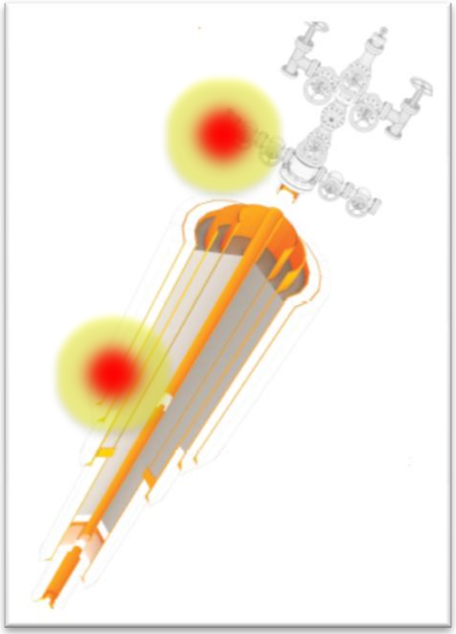
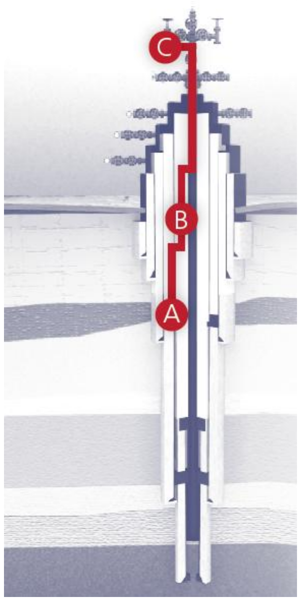
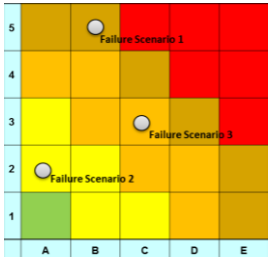
Data
- Definition
- Collection
- Treatment

Information
- Analysis
- Assessment
- Interpretation

Decision
- Problem
- Solution
- Action







Well Failure Criticality

		Platform Wells			Subsea Wells		
		Platform Well Type 1	Platform Well Type 2	Platform Well Type 3	Subsea Well Type 1	Subsea Well Type 2	Subsea Well Type 3
Single Surface failures	Single Surface Failure 1	3	2	4	1	1	1
	Single Surface Failure 2	3	5	3	3	5	5
	Single Surface Failure 3	2	2	2	2	2	2
Multiple Surface failures	Multiple Surface Failure 1	3	3	3	2	1	1
	Multiple Surface Failure 2	4	4	5	2	2	2
	Multiple Surface Failure 3	3	3	3	2	2	2
Sub-Surface failures	Subsurface Failure 1	4	5	4	4	4	2
	Subsurface Failure 2	5	5	5	5	4	4
	Subsurface Failure 3	4	4	5	4	3	3

→ **What is the optimum well design?**

→ **How urgently should we repair?**

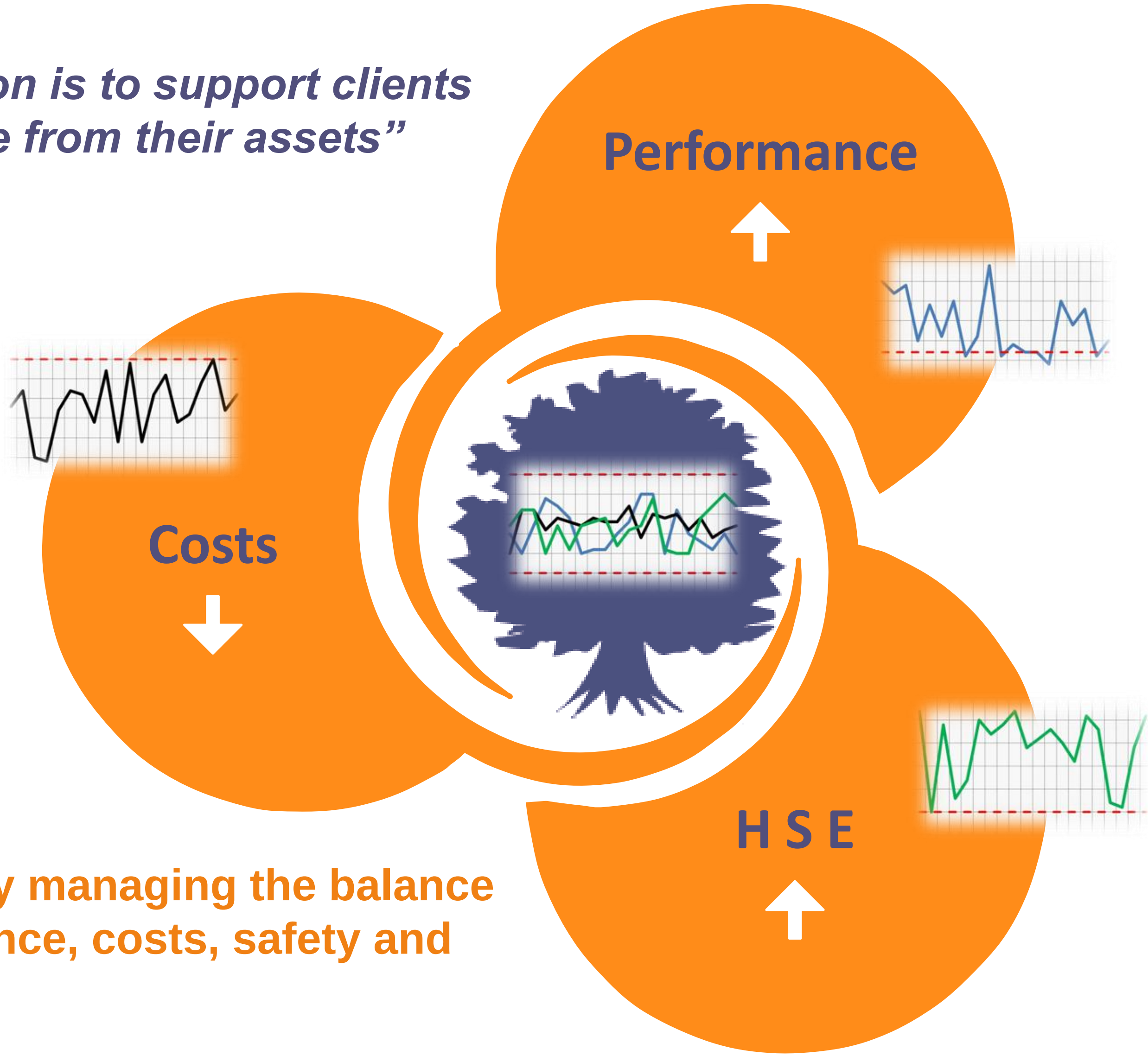
→ **How often should we inspect?**

→ **How to safely extend operational life?**

→ **What is best abandonment plan?**

Asset Management & Oxand's Approach

"Oxand's mission is to support clients in creating value from their assets"



This is achieved by managing the balance between performance, costs, safety and the environment

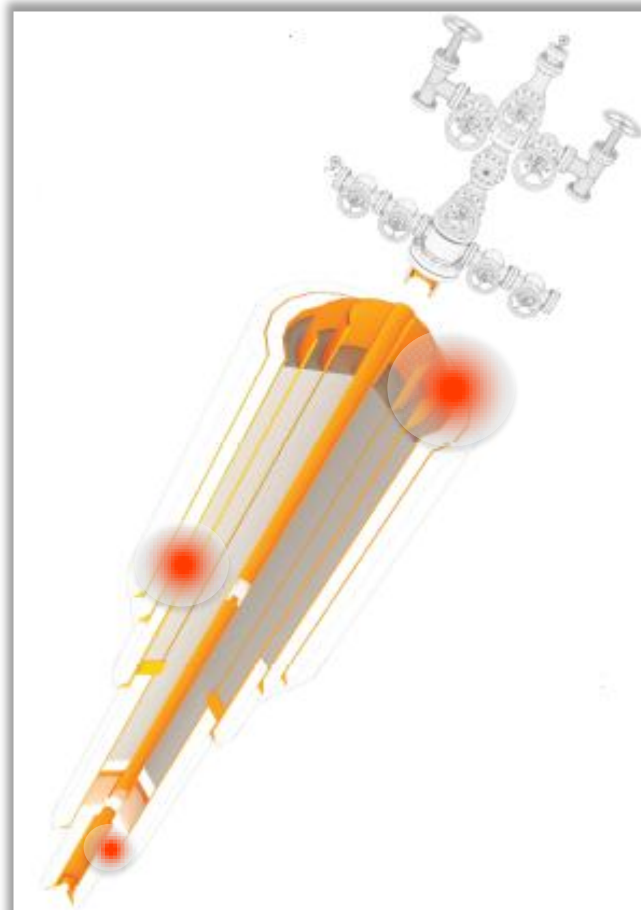
Lessons learnt from past well failures

Link operational data with systemic risk based approaches to reinforce both curative and preventive decision-making

Increase industry partnerships and collaboration to share knowledge and experience on well-related risks

Develop risk management culture, tools and processes devoted to wells

Manage knowledge and effectively transfer experience from experts to young engineers

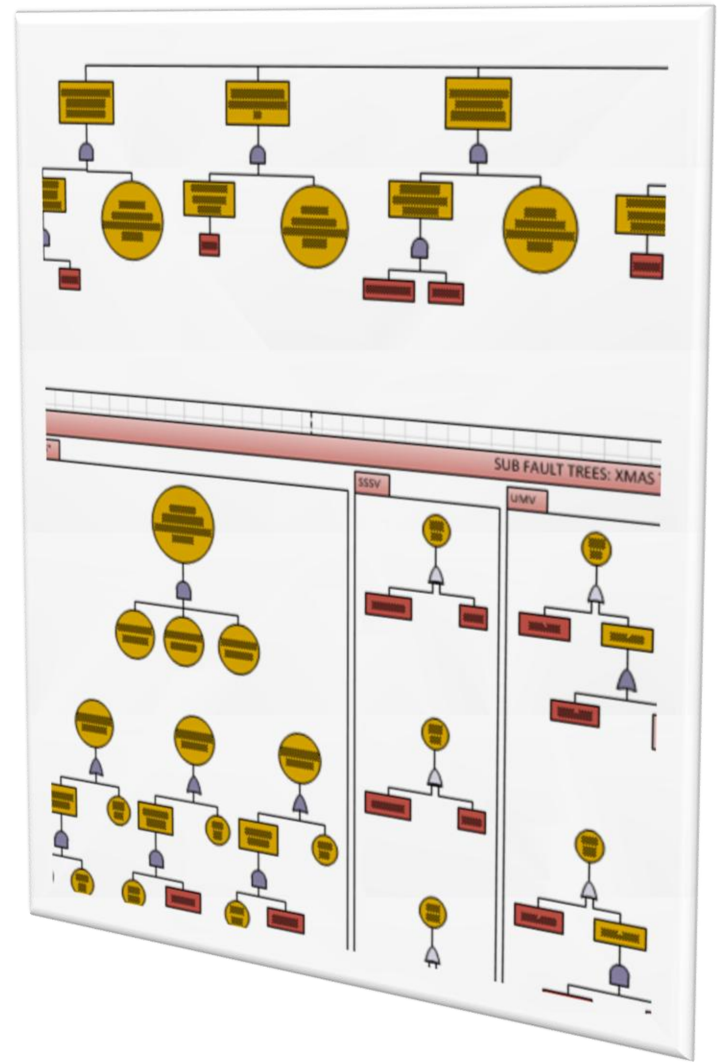


Fault Trees

- ➜ The main purpose of fault trees is to identify the sequences of events which could lead to a “major” or “system” failure (such as “release to atmosphere”)

- ➜ Fault trees also enable the estimation of the likelihood of the sequences of events identified using either qualitative or quantitative methods

- ➜ Fault trees also support the assessment of the “criticality” of individual components by quantifying their importance to the functioning of the whole system

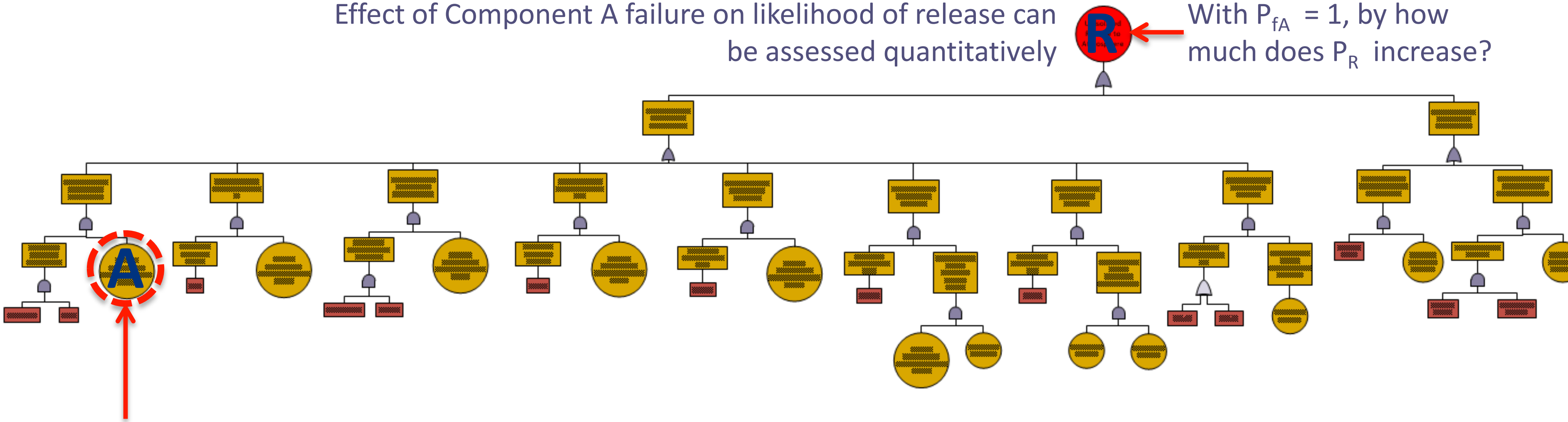


Assessing component "importance"

- ➜ **Fault trees support the assessment of the "criticality" of individual components by quantifying their importance to the functioning of the whole system**
- ➜ **If we know that component A *(circled)* has failed, set $P_{fA} = 1$, and calculate the effect on the probability of overall system failure (e.g.: release, P_R)**
  - By comparing the relative increases in probabilities of system failure due to individual component failure we can arrive at a ranking of component criticality

Effect of Component A failure on likelihood of release can be assessed quantitatively

With $P_{fA} = 1$, by how much does P_R increase?

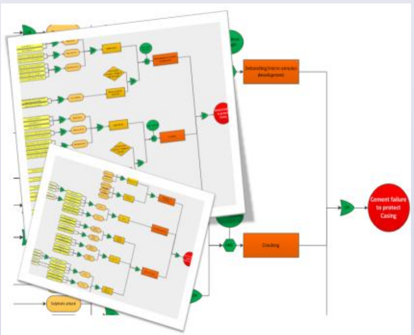


Component A failed, set $P_{fA} = 1$

General Overview of Methodology

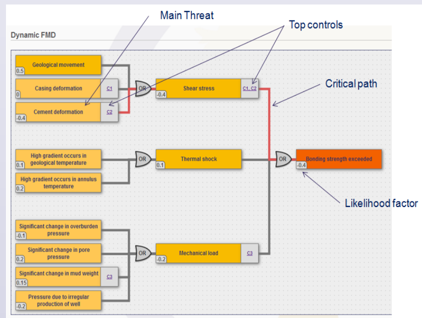
ANALYSIS METHODS

What can go wrong?



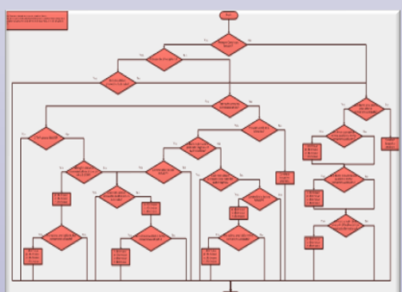
Library of failure scenarios

How likely and/or serious are these failures?



Fault Tree analysis

What is the potential impact?



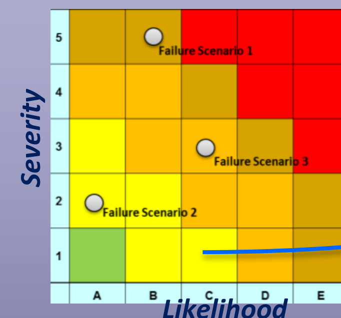
Severity potential assessment

How could things escalate?

Event tree analysis

DECISION-SUPPORT METHODS

What is the risk picture?



Risk Assessment of the failure scenario

How should we manage the risks?

Well Failure Criticality

		Platform Wells			Subsea Wells		
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	Subsurface Failure 2	5	5	5	5	4	4
	Subsurface Failure 3	4	4	5	4	3	3

Criticality	Required Action
1	Address issue in the long term
2	Address issue in the medium term
3	Address issue in the short term
4	Risk Assess issue
5	Make well safe immediately

Well failure criticality matrix

A failure scenario = a specific failure* on a specific well

** or combination of failures*

Integrity Threat Mapping

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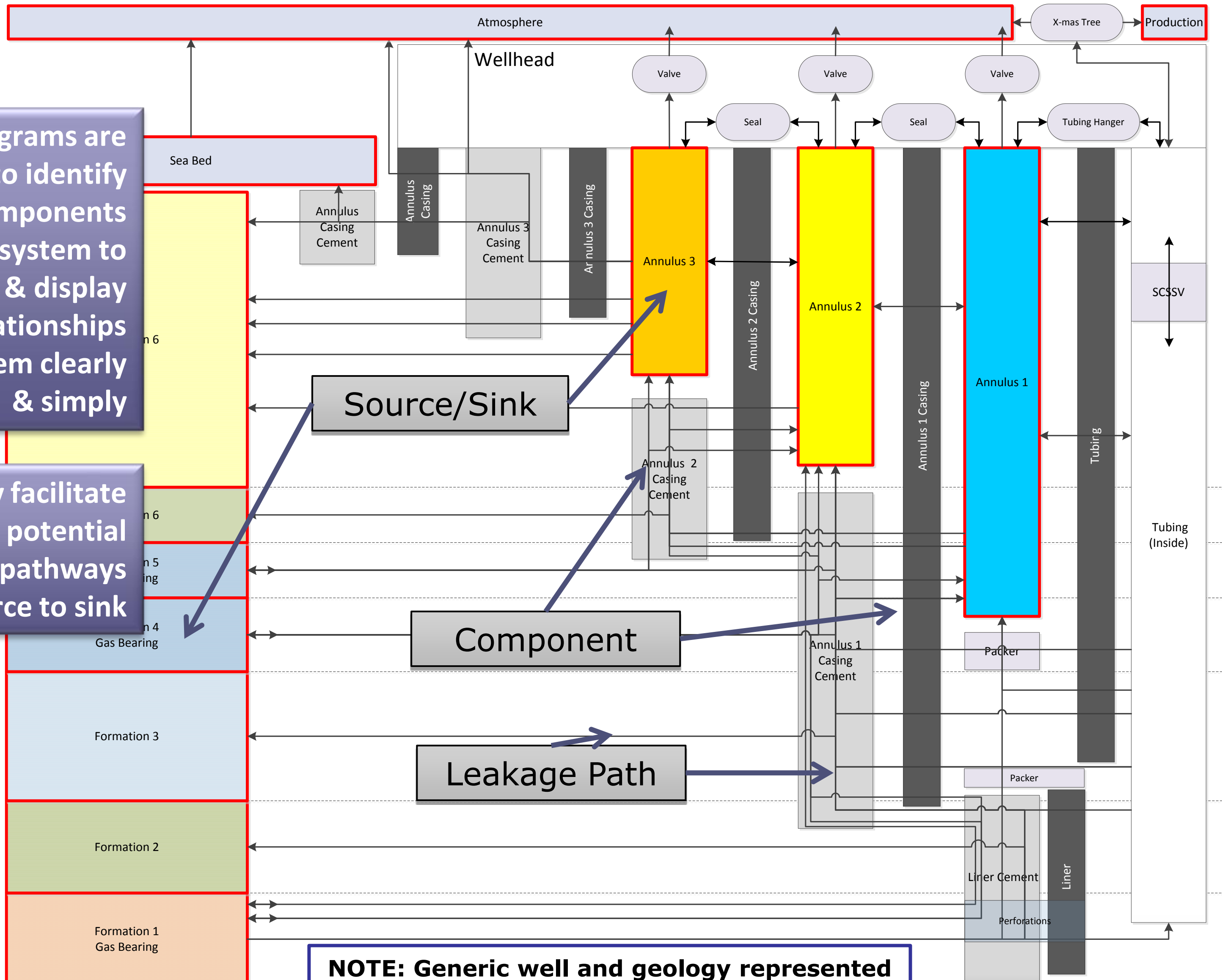
Block diagrams are used to identify relevant components in the well system to be studied & display the relationships between them clearly & simply

They facilitate mapping of potential leakage pathways from source to sink



NOTE: Generic well and geology represented

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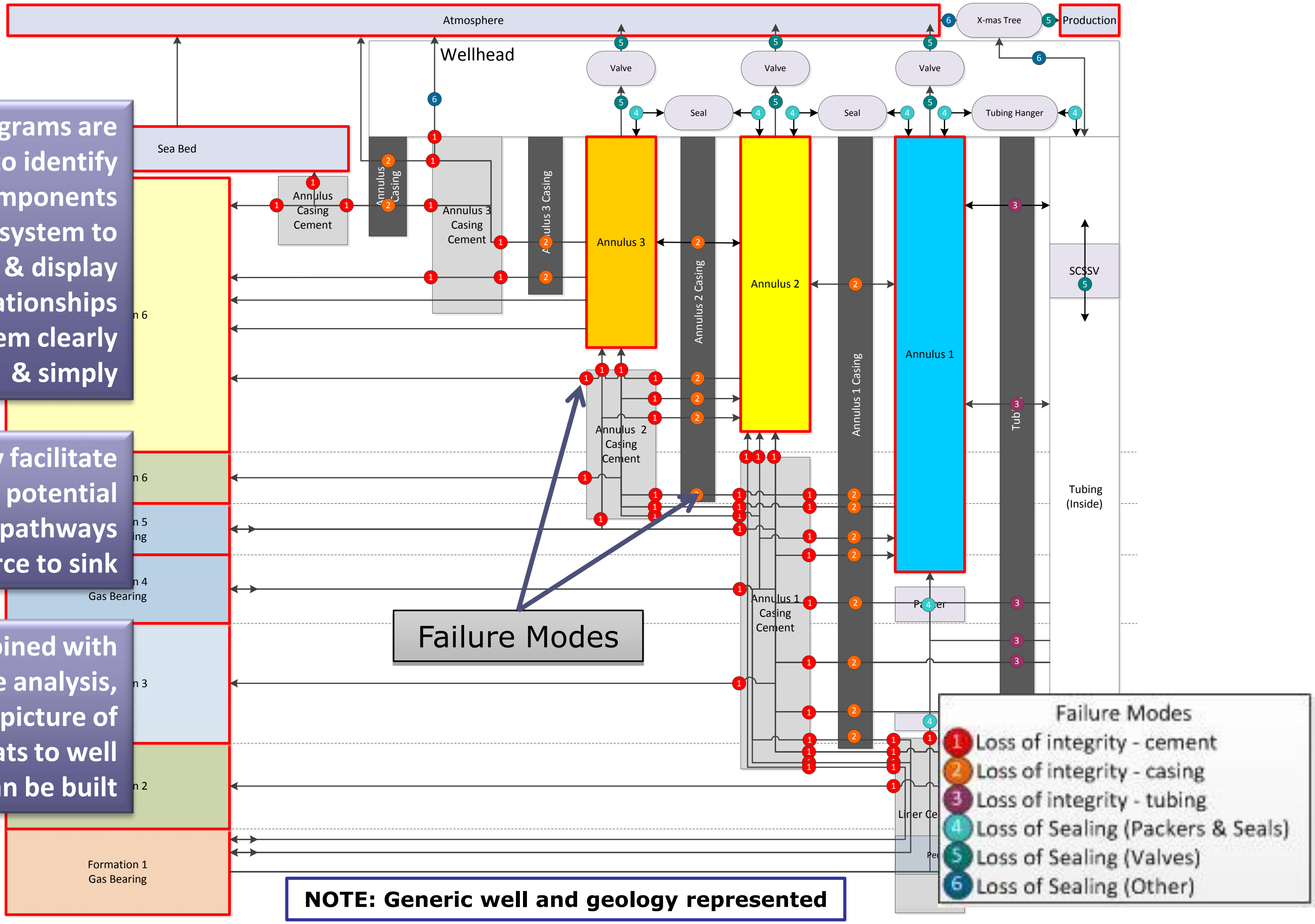
Integrity Threat Mapping

Block diagrams are used to identify relevant components in the well system to be studied & display the relationships between them clearly & simply

They facilitate mapping of potential leakage pathways from source to sink

Combined with failure mode analysis, an overall picture of threats to well integrity can be built



NOTE: Generic well and geology represented

Scenario modelling: Release points

➜ **The point of release of a potential leak scenario can provide a factor to qualitatively classify the severity of impact of that scenario**

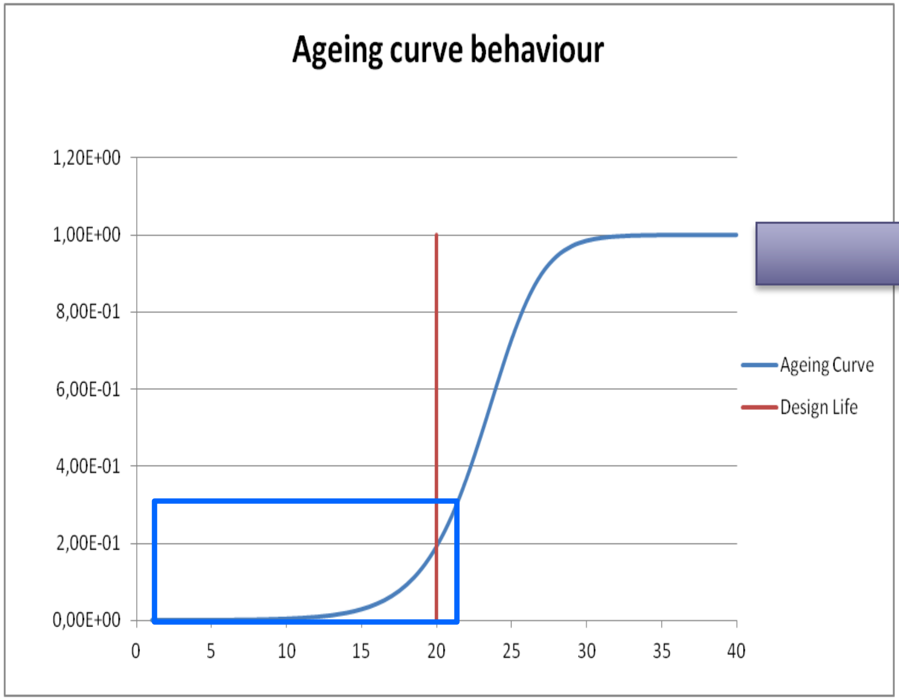
➜ **Points of release differ according to well architecture/design:**

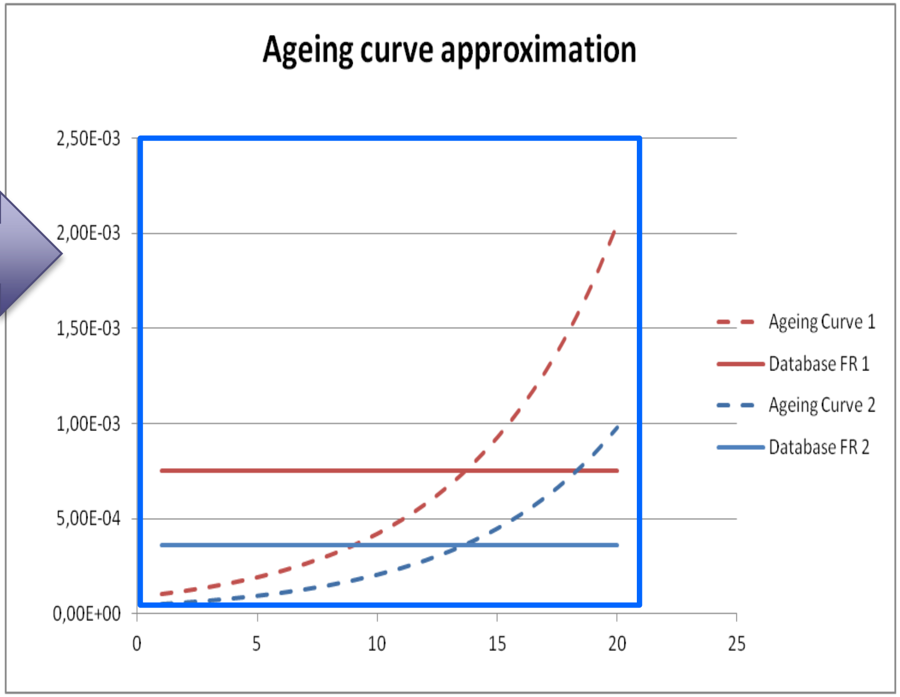
	Platform	**Subsea tieback**	**Subsea**
Platform	Platform wellhead seals Xmas tree valves/seals	Platform wellhead seals Xmas tree valves/seals	N/A
Above sea level	Conductor (above SL)	Riser (above SL)	Riser (above SL)
Below sea level	Conductor (below SL)	Riser (below SL) Mudline suspension seals	Riser (below SL) Subsea wellhead seals
Subsurface	Casings Cement sheaths	Casings Cement sheaths	Casings Cement sheaths
To production*	*Via PWV at platform level*	*Through subsea PWV into flowline*	*Through subsea PWV into flowline*

* *Refers to scenarios in which isolation is not available upstream of PWV (i.e.: failure of SSSV and/or UMV and/or LMV)*

Modelling component ageing

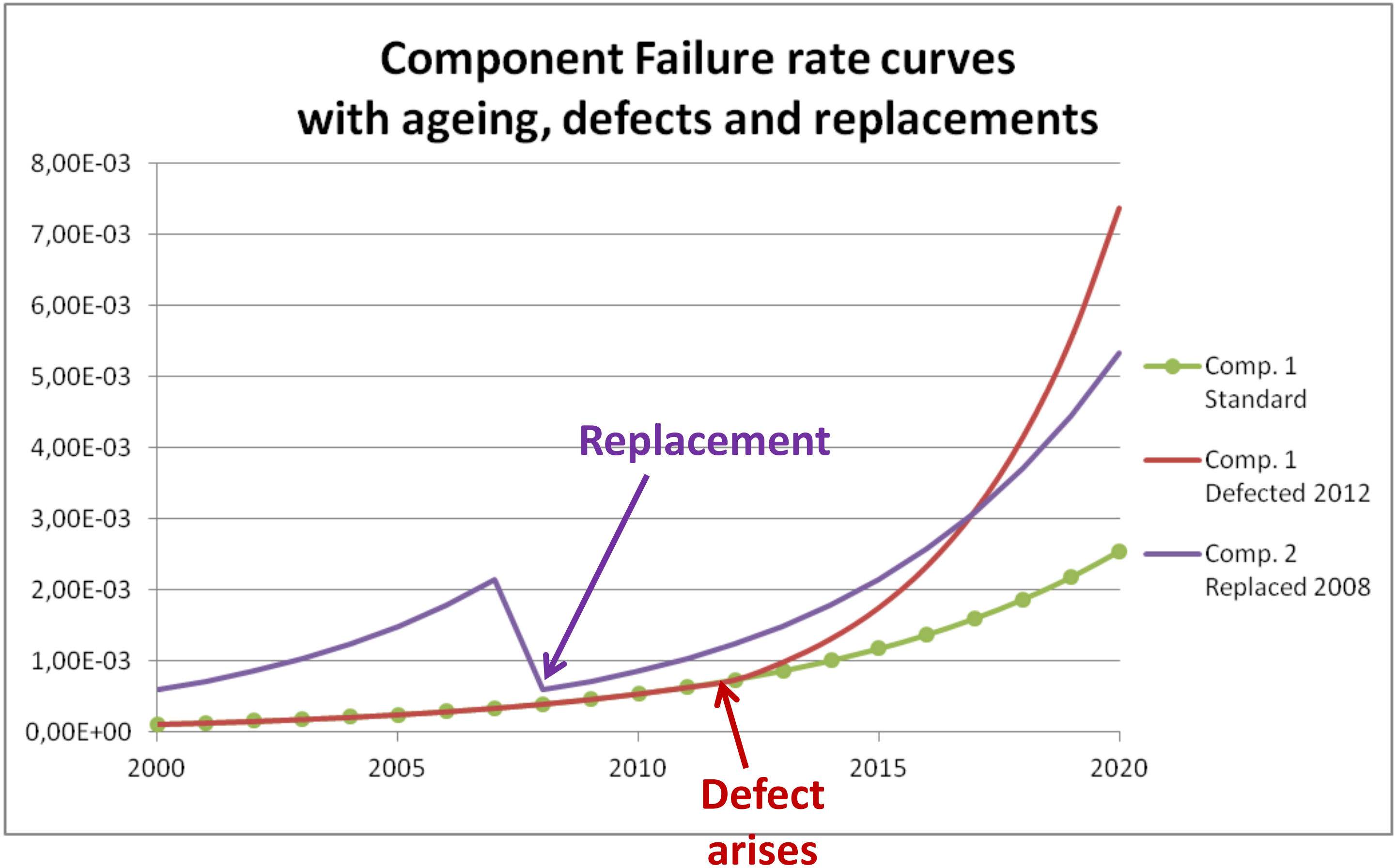
- **Assumed "bathtub" curve function for failure rate over component lifetime as per standard reliability engineering practice, e.g.: OREDA**
  - Early life failures not considered as per e.g. OREDA
- **Translate function to estimate impact of ageing on failure rate within Design Life, using industry data as a benchmark**

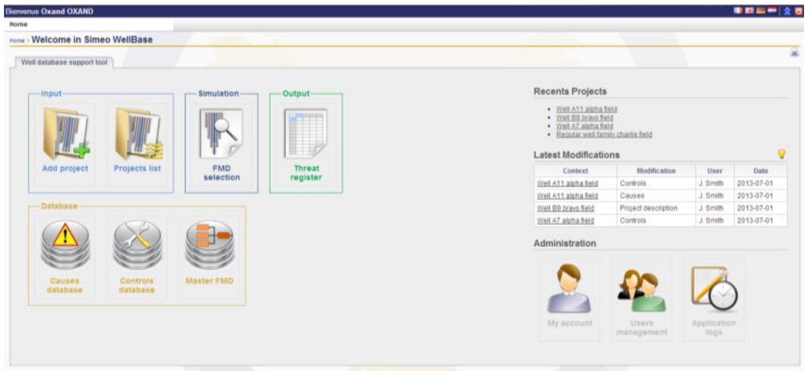




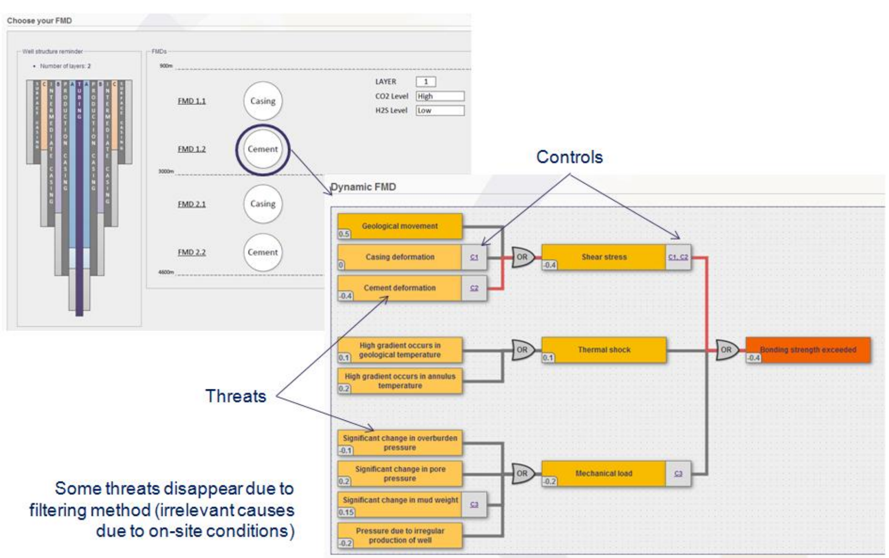
Modelling component ageing

➜ **Apply component-specific ageing curve, defects and replacements to estimate failure rate over well-life**

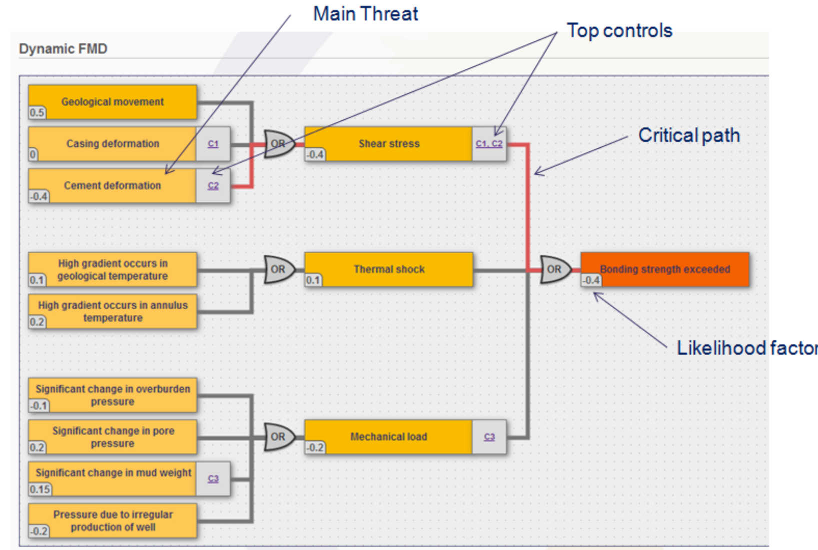




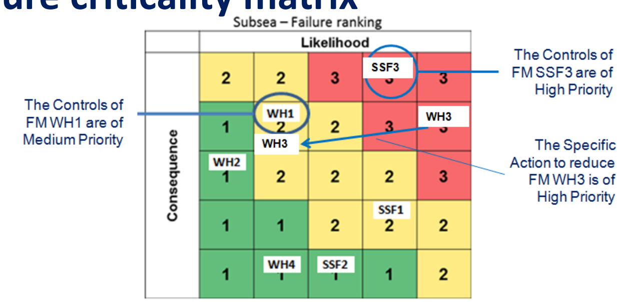
Risk Identification Generic Fault Trees
Filtering method



Risk Assessment / FT Assessment



Intervention Planning
Well Failure criticality matrix



Risk Level	Priority level for intervention
1	Low priority for intervention : frequency **X years**
2	Medium priority for intervention: frequency **Y years**
3	High priority for intervention: **Z months**

WellBase: A Fault Tree Knowledge Base

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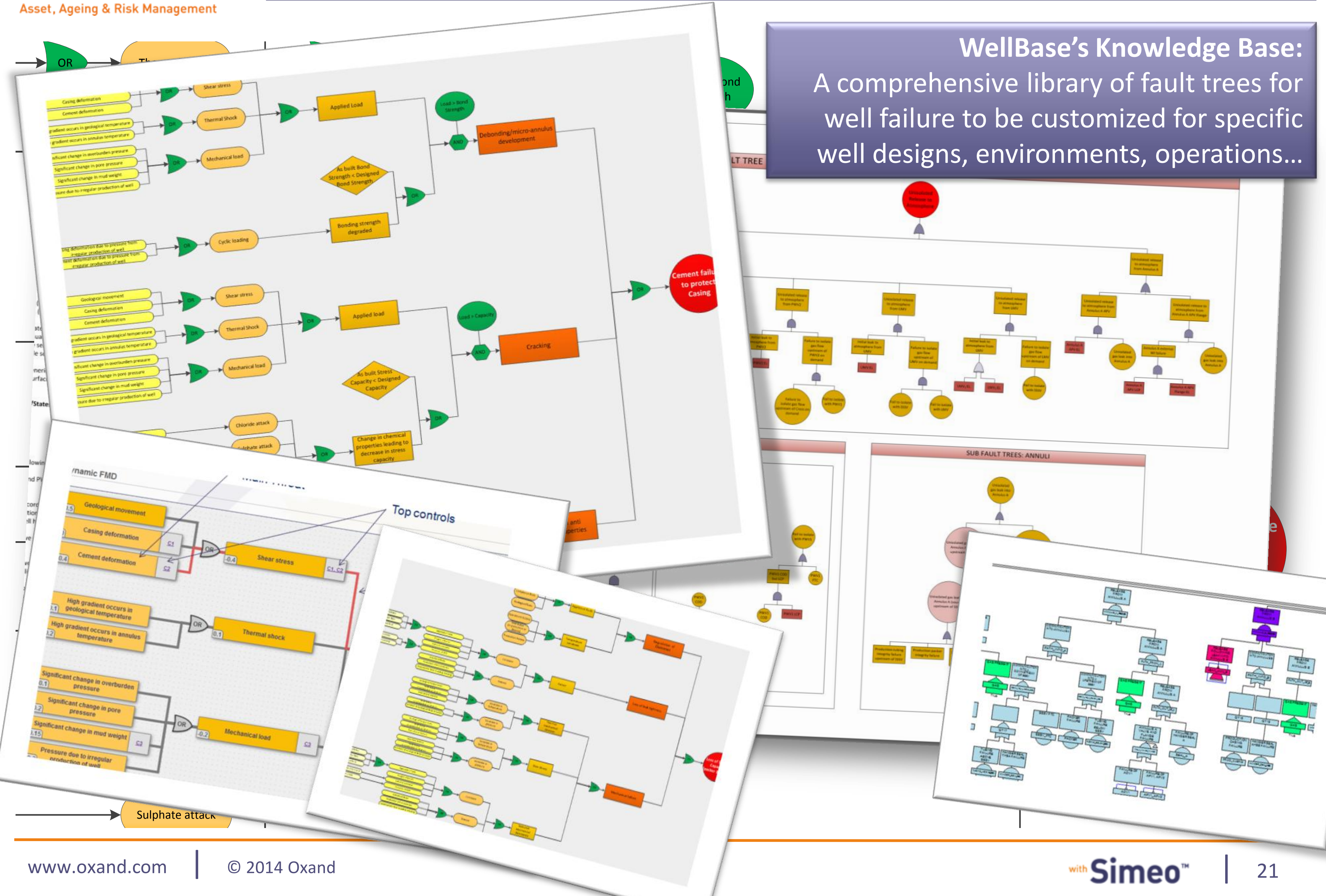
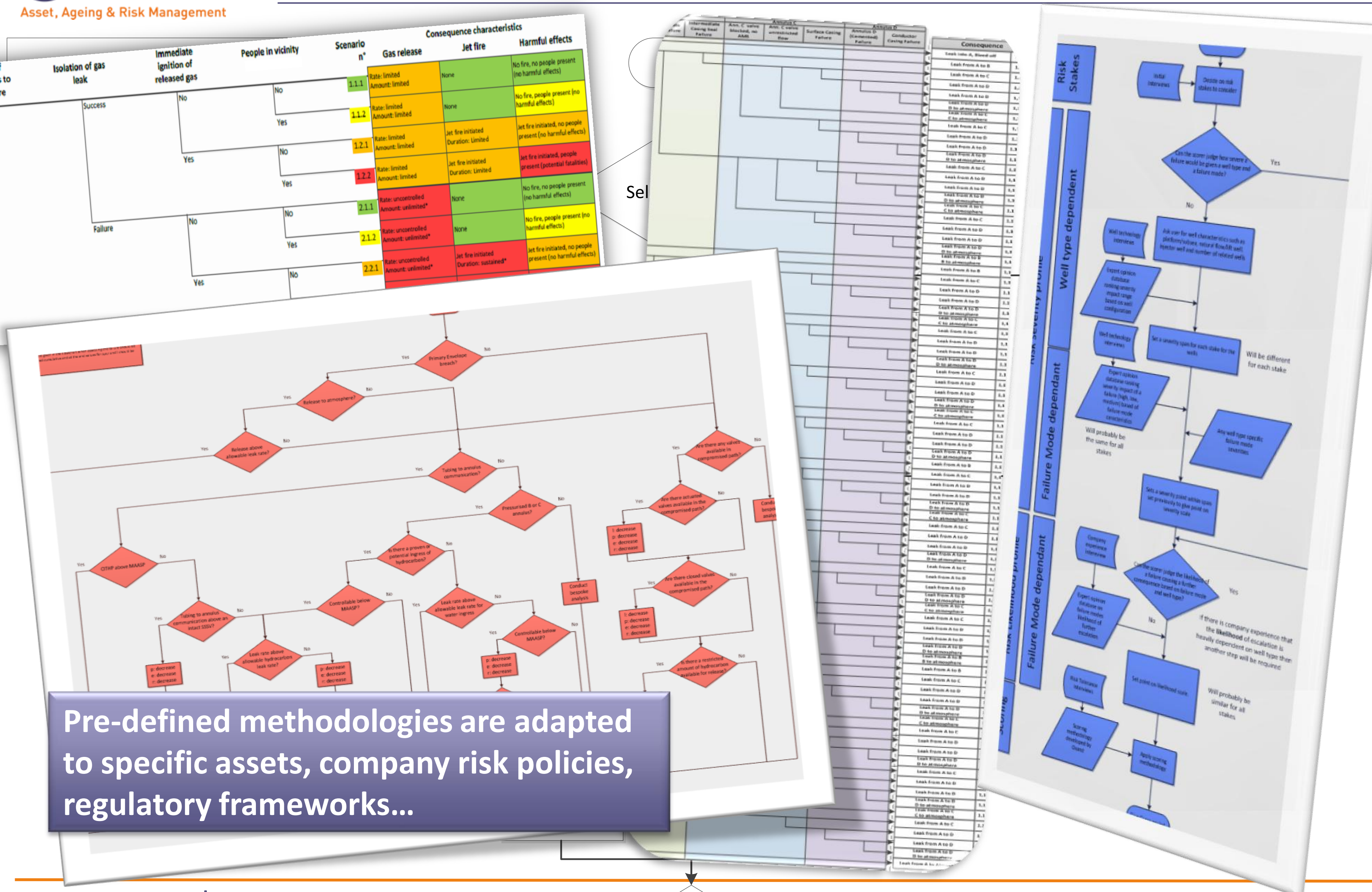


WellBase's Knowledge Base:
A comprehensive library of fault trees for well failure to be customized for specific well designs, environments, operations…

WellBase: Assessing Potential Severity

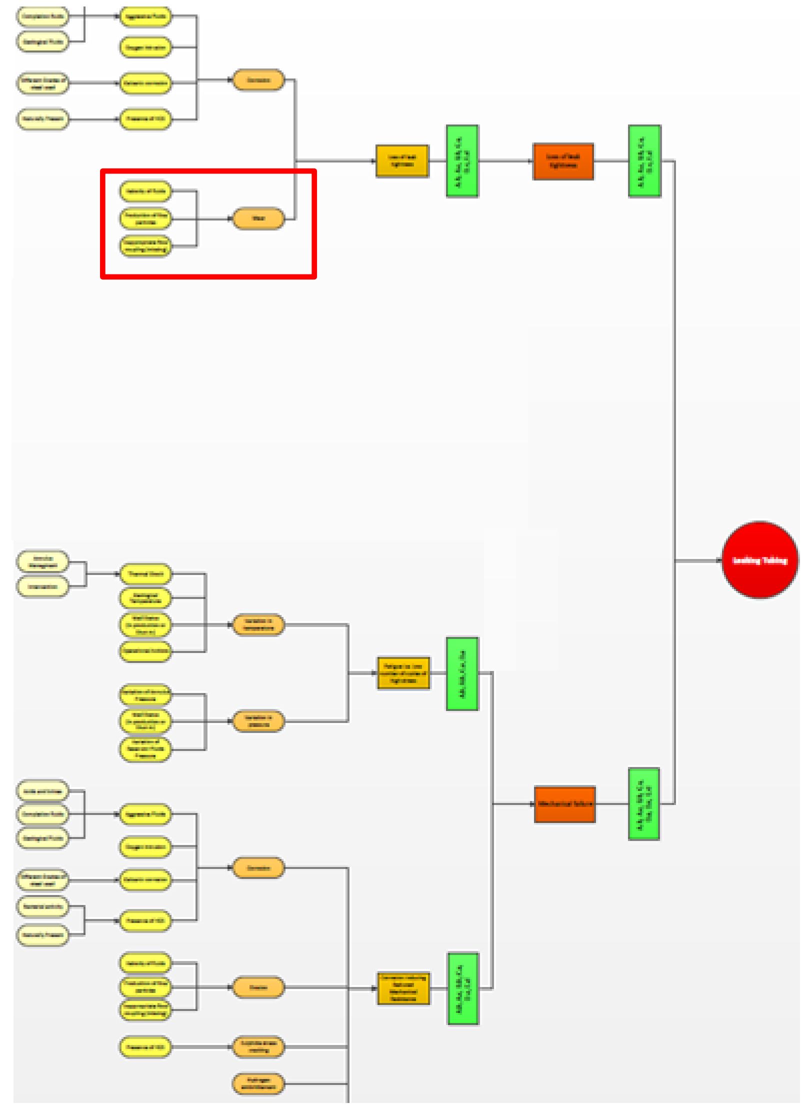


Pre-defined methodologies are adapted to specific assets, company risk policies, regulatory frameworks…

Using well data & knowledge: risk identification

➜ **Well data & knowledge enables an extensive register of well failures and risks to be "filtered" to identify relevant risks**

Input data (examples)
Well type/function
Well design/architecture
Well age/history
Geological conditions
Environmental conditions

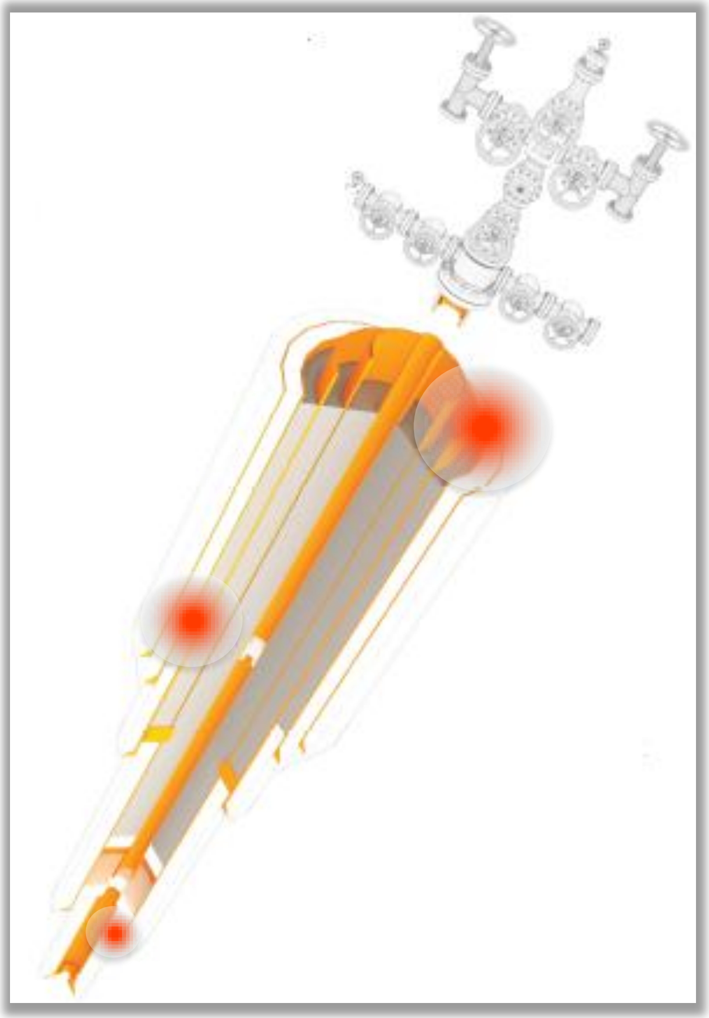


➜ **A "risk picture" can thus be built up for more specific cases, such as fields or individual wells**

Knowledge Management

➜ **Collaborative Fault and event trees data bases are cost-effective to :**

- ➜ Create robust bridges between data and decisions
- ➜ Train younger generations
- ➜ Support operation integrity and risk workshops
- ➜ Make objective well risk assessments increasing exhaustivity of analysis



Simeo™ WellBase

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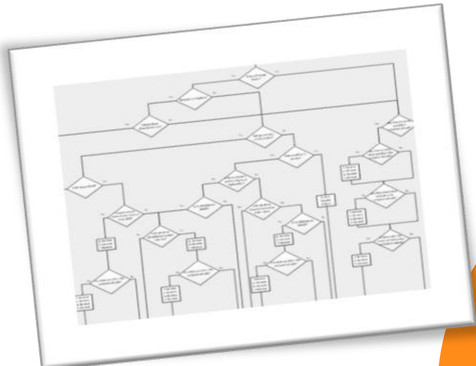
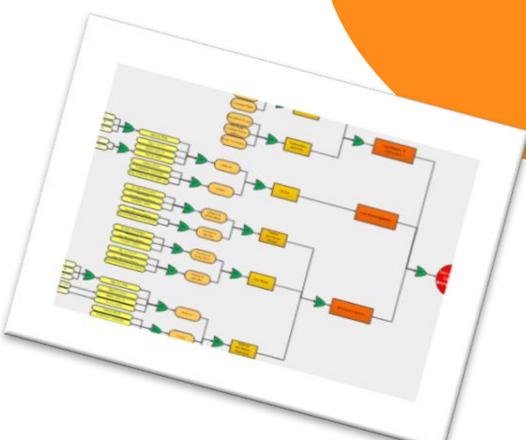
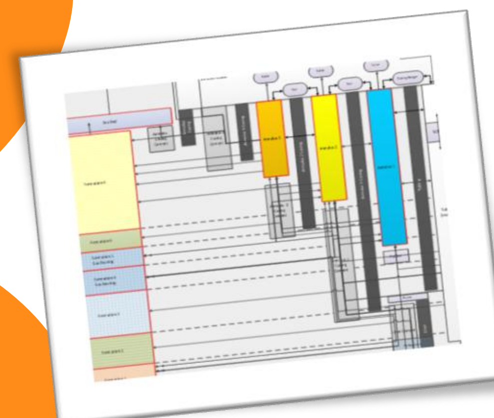
WellBase



Knowledge &
Data Base



Value-Creating
Decision Support



Performance &
Reporting

More skills ⇨ More opportunities ⇨ More value

Conclusion

A risk-informed approach provides benefits for decision-making at all stages of the well lifecycle…

DESIGN

Determining optimum well design, component specs…

OPERATIONS

Asset management to create value from wells, optimising maintenance strategies…

ABANDONMENT

Planning P&A to ensure safety, minimise disruption to production…

… when deployed as part of a successful overall asset management process

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Thank you.

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