

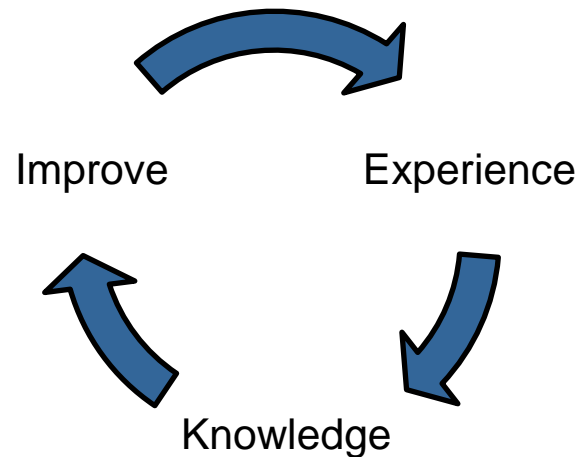
ExproBase

Presented by

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What is ExproBase

ExproBase is a collection of practical knowledge independent of company affiliation and product type for improved safety and reliability of well and subsea technology



Why reliability is important

■ Safety

- Most well and subsea technology components are barrier elements and must also be reliable to maintain safety and integrity

■ Environment

- Most well and subsea technology components are barrier elements and must also be reliable to protect the environment

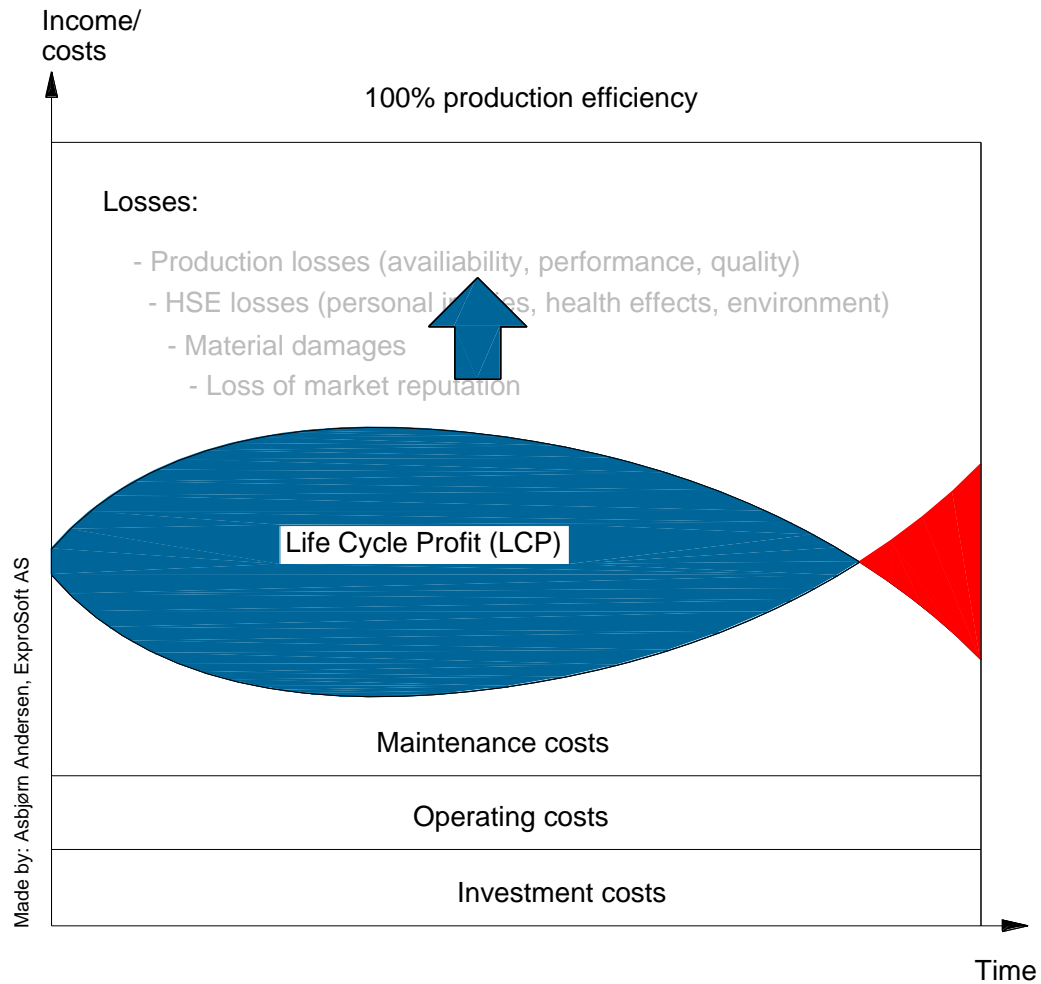
■ Efficiency

- Reliability is an absolute requirement for operational efficiency

■ Profit

- Reliability is probably the most important attribute for well and subsea technology from a life cycle profit point of view

Profit influencing factors



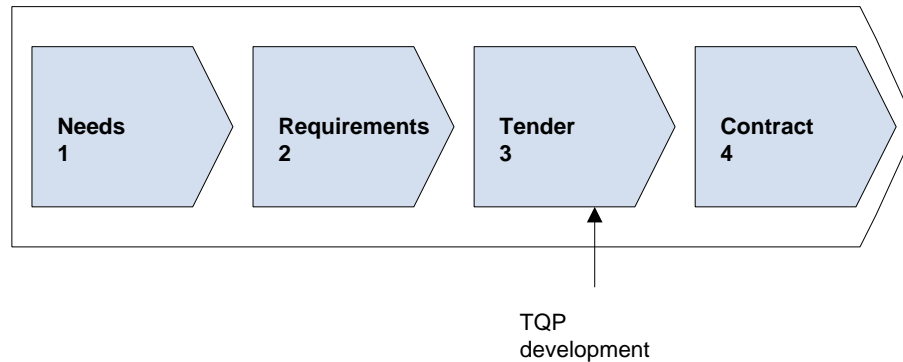
Guidelines

- **The following guidelines are currently included**
 - Guideline for project planning
 - Guidelines for project execution
 - Guidelines for risk analyses

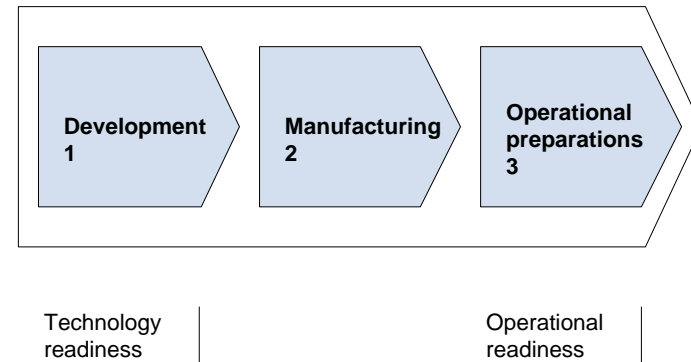
The guidelines describes how to work and are supported by supporting tools like databases, textbooks and templates

Guidelines for project planning/execution

1. Project planning



2. Project execution



- **Guideline for project planning has focus on requirement and tender**
- **Guideline for project execution has focus on technology qualification**

New and modified products must be ready from a technological and operational point of view before installation and operational use.

TQP = Technology qualification program

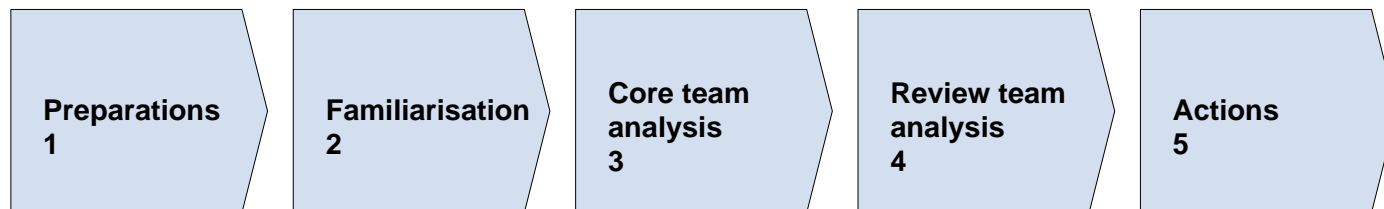
QT = Qualification testing

FAT = Factory acceptance testing

Guidelines for risk analyses

■ Type and when to be used

- OPERA (operational problem analysis) - *during concept design*
- FMECA (failure mode effect and criticality analysis) - *during detail design*
- AEA (action error analysis) - *during detail design*
- SORA (specific operational risk analysis) - *during operational preparations*

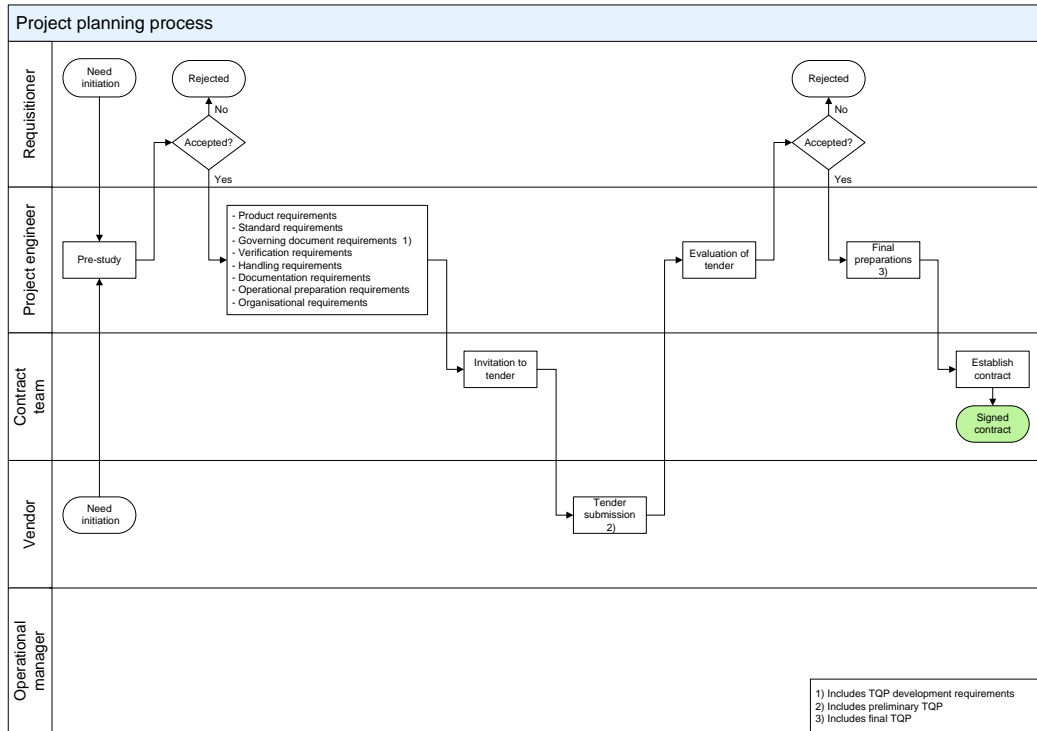


	The core team becomes familiar with the documentation		The analysis is reviewed and corrected by a multi-discipline review team	
Agree on what to do, appoint participants and provide documentation		The core team is filling out the risk analysis worksheet		Actions are evaluated and implemented

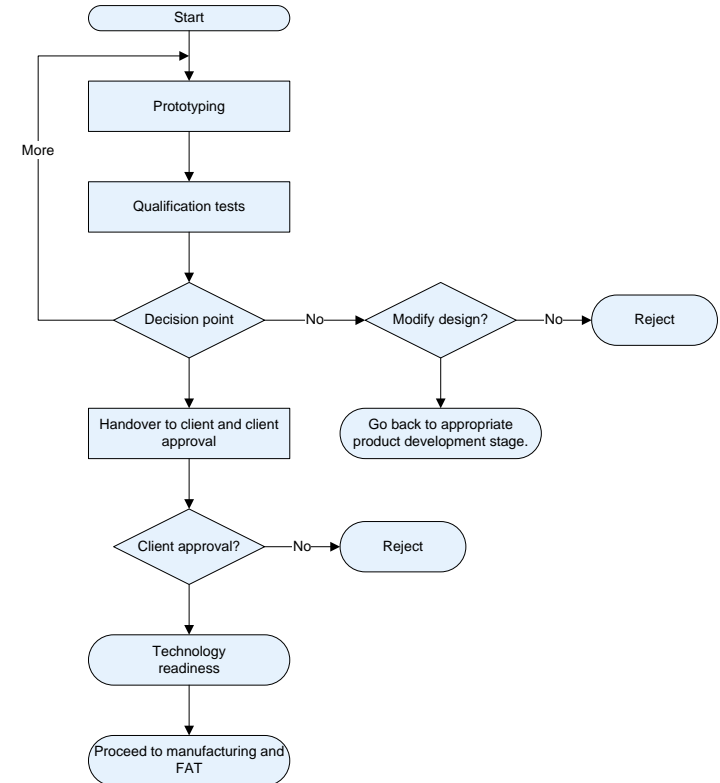
Guideline structure

- **The guidelines are made as a work processes with phases**
- **Each phase consists of activities and decision gates**
- **Each activity describes**
 - What
 - Why
 - Deliverables
 - General recommendations (general 'how' recommendations)
 - Specific recommendations (specific 'how' recommendations related to deliverables)
 - Responsibilities

Guidelines flow charts



Example 1: Flow charts with responsibilities



Example 2: Flow chart without responsibilities

Supporting tools

■ Databases (collections of datasheets)

- Failure mechanism
- Human errors
- Materials
- Operational conditions
- Performance influencing factors
- Surface treatments
- Well operations
- Well equipment
- Well scenarios

■ Textbooks (basic introductions)

- Barriers
- Design
- Failure cause categories
- Functional failures
- Life cycle profit
- Maintenance
- Profit influencing factors
- Reliability
- Torque controlled preloading
- Tubing stress analysis

■ Templates (pre-made documents)

- Requirement specifications, evaluations, TQP, worksheets, etc.

Supporting tools

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- Human errors
- Material
- Operational
- Performance influencing factors
- Surface treatments

Emphasis on basic descriptions and relations

■ Textbooks

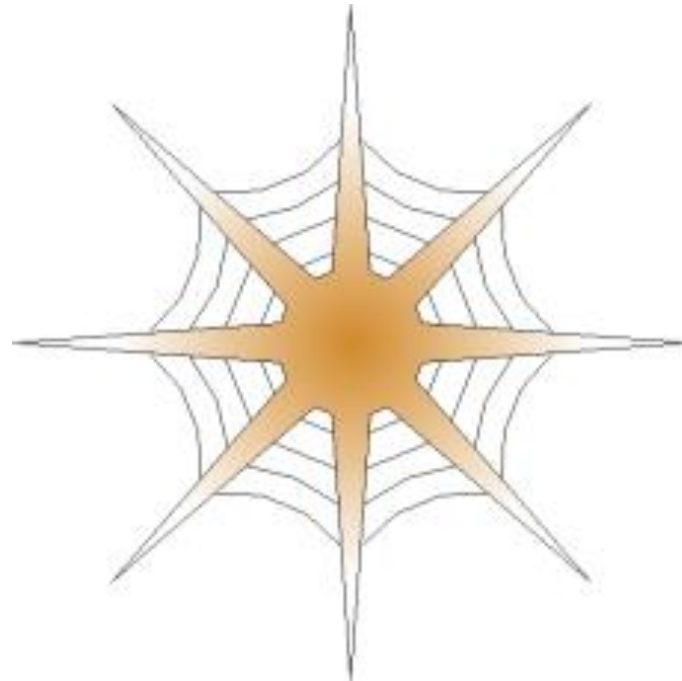
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Supporting tools

Relations between knowledge are as important as the knowledge itself...



The spider's approach of stopping the flies from getting through the web

Material database

Metals

- Low alloy steels
- Stainless steels
- Copper alloys
- Nickel alloys
- Cobalt alloys
- Titanium and titanium alloys

Polymers

- Elastomers
- Thermoplastics

The list on the left shows material categories only. Within each category there are several alloys. For each metal alloy there are datasheets with:

- Summary
- Heat treatments
- Applications
- Chemical composition
- Mechanical and physical properties
- Machining and welding properties
- Failure mechanism resistance
- Surface treatments
- Processing problems
- Costs
- Design codes
- Sources

There are 'applications' for e.g. comparing two materials

Failure mechanism database

Abrasive wear	Ductile to brittle transition	Intimate contact	Solid metal induced embrittlement
Adhesive wear	Elastic deformation	Liquid metal embrittlement (LME)	Stress corrosion cracking (SCC)
Ageing	Electromigration	Nibbing	Sulphide stress cracking (SSC)
Bacterial corrosion	Erosion	Oxidation	Swelling
Brittle fracture	Explosion decompression	Particle wedging	Thermal expansion
Buckling	Extrusion	Pitting corrosion	Thermal fatigue
Cavitation	Fatigue	Plastic deformation	Voltage drop
CO2 corrosion	Flashing	Pressure drop	
Compression set	Fretting	Relaxion	
Contact fatigue	Friction variations	Resonance	
Corrosion fatigue	Galling	Scuffing	
Creep	Galvanic corrosion	Seizure	
Crevice corrosion	General corrosion	Setting	
Deposit corrosion	H2S corrosion	Shrinking	
Dielectric breakdown	Hydrogen embrittlement cracking		
Ductile fracture	Hydrogen induced cracking (HIC)		
	Induced current		
	Intergranular corrosion		
	Intermetallic compound embrittlement		

Datasheets:

- Description
- Influencing factors
- Typical components
- Preventing actions

Surface treatment database

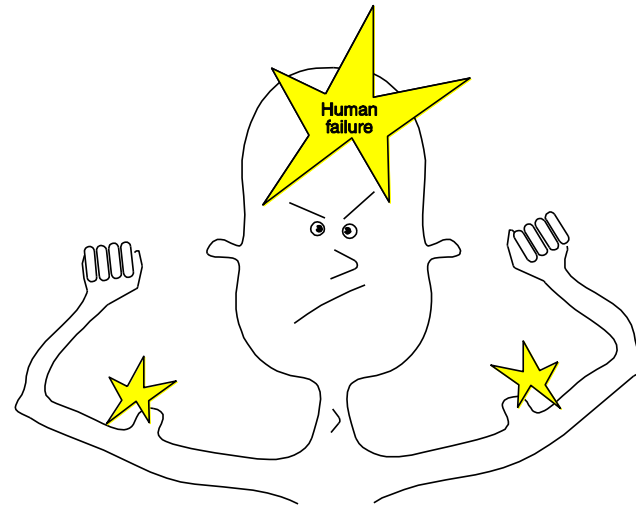
■ Datasheets for basic methods

- Anodising
- Antifriction coating
- Browning
- Case hardening
- Chemical vapour deposition (CVD)
- Chromadizing
- Chromating
- Cladding
- Electroplating (galvanising)
- Electropolishing
- Flame hardening
- Gas nitriding
- Hot dip galvanising
- Induction hardening
- Nitriding
- Nitrocarburising
- Phosphating
- Physical vapour deposition (PVD)
- Plasma nitriding
- Polymer film
- Shot peening
- Thermal spraying

Performance influencing factors database

Workplace factor categories

- Workplace economy
- Workplace equipment
- Workplace environment
- Workplace interaction
- Workplace layout
- Workplace personnel policy
- Workplace routines



Individual factor categories

- Personal factors
- Psychological factors
- Physiological factors

Human performance can be drastically improved by controlling these factors

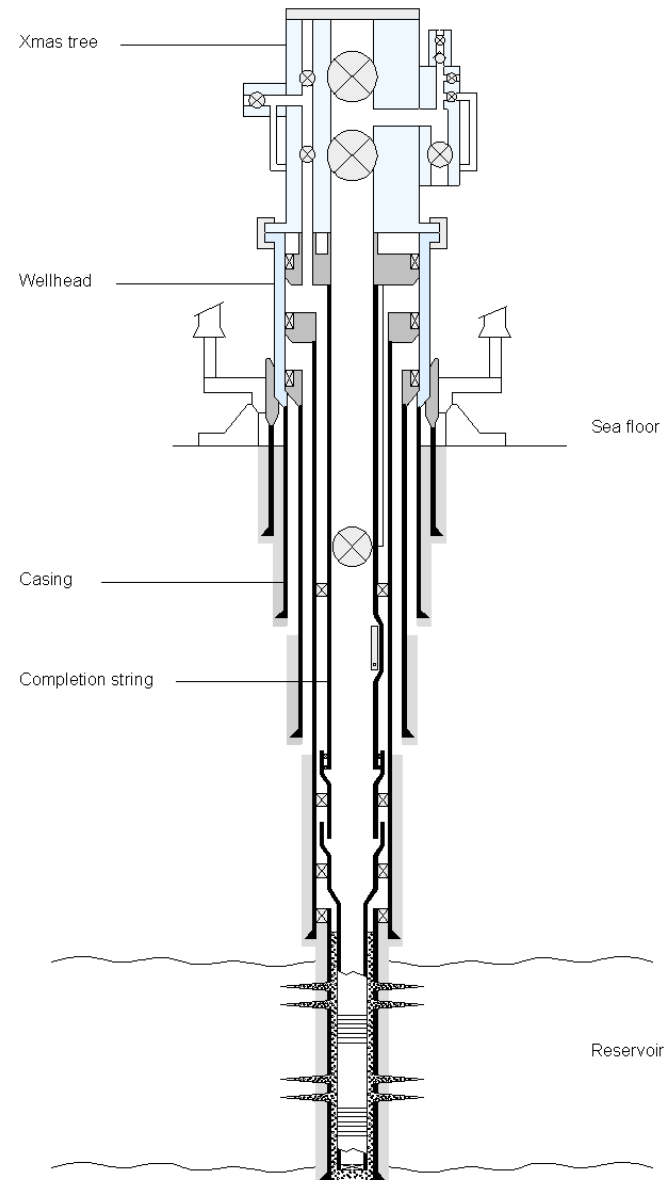
Equipment database

■ Equipment categories

- Xmas tree
- Wellhead
- Casing
- Completion string

■ Datasheets content

- What is a ...
- Equipment description
- System description
- Failure modes and causes
- Worst case scenarios
- Accessories
- Requirement specification
- Equipment standards
- Abbreviations



Operational condition database

■ Environmental condition categories

- Temperature
- Pressure
- Medium
- Contamination
- Deposits
- Radiation

■ Physical loads

- Introduction tensile forces, compression, bending, torsion, etc.

User group

- **ExproBase is made for practical safety and reliability engineers**

- **ExproBase is not made for**
 - Material experts
 - Reliability theory experts
 - Psychologist
 - Etc.

But could of course also be used as a timely reminder for the experts...

Safety and reliability engineer challenges

Technology qualification program (TQP)...

Stress corrosion cracking (SCC)...

Perfluoroelastomers (FFKM)...

Human performance factors...

ISO, API...



Alloy 718...

CO2 corrosion...

Nitriding...

FMECA...

Scale...

When to use

■ Tasks

- Technology procurement
- Technology qualification
- Maintenance
- Well integrity monitoring
- Organisation development
- Reliability data analysis
- Failure investigation

■ Reference for everyday use

- Dictionary
- Synonym- and abbreviation lists
- Standard overviews
- 'What is' and 'How it works' descriptions

How to use

■ Navigate in structure

- Hierarchic structure for learning at different levels

■ Search function

- Search the entire structure
- Search from your location in the structure and below
- Search result presented as matches in 'header' and 'text'

How to benefit from ExproBase

■ Individual

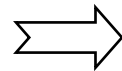
- Improved learning and motivation
- Improved problem solving abilities and efficiency
- Improved communication with experts
- Improved experience transfer to new employees
- Easy access to basic knowledge



■ Which is a condition for....

From

- What
- Information (monolog)
- Involvement (passive)
- Parallel work
- Individual (lone wolf)



To

- What, why, how, who, what if
- Communication (dialog)
- Participation (active)
- Interaction
- Team



Sources

■ Practical experiences

- ExproSoft experiences
- User experiences

■ Open sources

- Short extracts (fair use) from the web, industry standards, research reports, text books, guidelines, papers etc

Every document in ExproBase is made from scratch

ExproSoft services

■ Project definition

- Concept evaluation (FieldSim)

■ Project planning

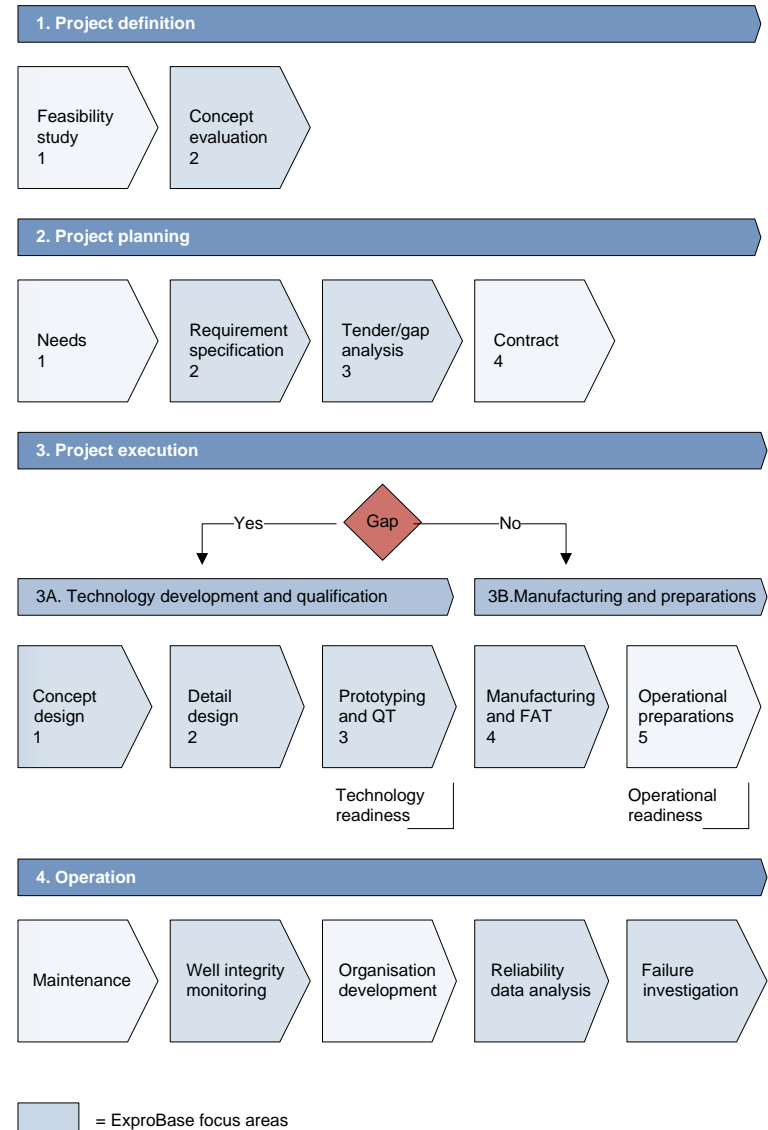
- Requirement specification (ExproBase)
- Tender development (ExproBase)

■ Project execution

- Technology qualification (ExproBase)

■ Operation

- Well integrity monitoring (WIMS)
- Reliability data analysis (RMS/ WellMaster)
- Failure investigation (ExproBase)



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