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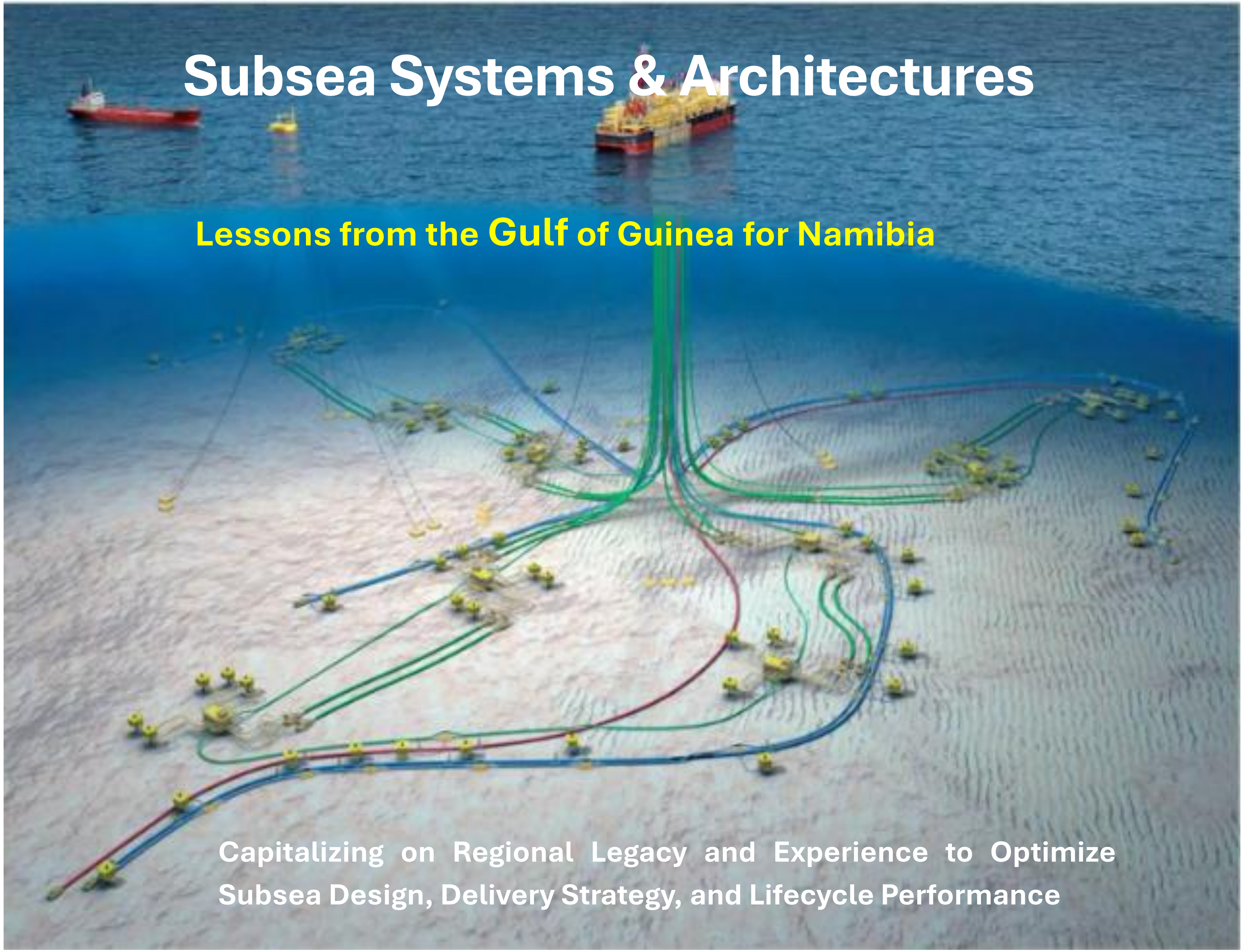
Subsea Systems & Architectures

Lessons from the Gulf of Guinea for Namibia



Capitalizing on Regional Legacy and Experience to Optimize Subsea Design, Delivery Strategy, and Lifecycle Performance

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Agenda

From subsea fundamentals to a fit-for-purpose Namibia delivery model

01	**SUBSEA FUNDAMENTALS**	Systems, architecture, production and control paths
02	**ARCHITECTURE OPTIMIZATION**	Reservoir, host, flow assurance, installation and lifecycle decisions
03	**GULF OF GUINEA LEGACY**	Regional experience, weak links and transferable lessons
04	**DELIVERY & COMMERCIAL STRATEGY**	SPS/SURF contracting, standardization and life-of-field support
05	**NAMIBIA FIT-FOR-PURPOSE MODEL**	Local capability, regional ecosystem and recommended roadmap

The core idea

System is the equipment. Architecture is how it is configured.

SUBSEA SYSTEM

The integrated equipment used to produce, control, monitor and transport fluids from subsea wells.

Examples: trees, manifolds, jumpers, flowlines, risers, umbilicals and controls.

SUBSEA ARCHITECTURE

The arrangement and connection philosophy linking the reservoir, seabed equipment and host facility.

It defines the field layout, production routes, controls, redundancy and expansion strategy.

What drives the architecture decision?

Architecture is a system-level optimization, not an equipment-by-equipment choice.

Reservoir & wells	Size, distribution, pressure and production profile
Host & distance	FPSO, platform or shore; new-build or existing infrastructure
Fluids & flow assurance	Temperature, pressure, hydrates, wax, scale and slugging
Installation & intervention	Vessel capability, seabed access, inspection and repair philosophy
Economics & lifecycle	CAPEX, OPEX, availability, flexibility and future expansion

Architecture optimization decisions

Optimize installed and lifecycle value, not individual equipment cost.

Well grouping

Satellite, cluster, daisy-chain or manifolded layout according to spacing and phasing.

Production routing

Loop configuration, commingling, pigging, depressurization and chemical strategy.

Host interfaces

Riser count, hang-off, umbilical distribution, topside capacity and controls integration.

Expandability

Future wells, tiebacks, boosting, debottlenecking and brownfield access.

Reliability

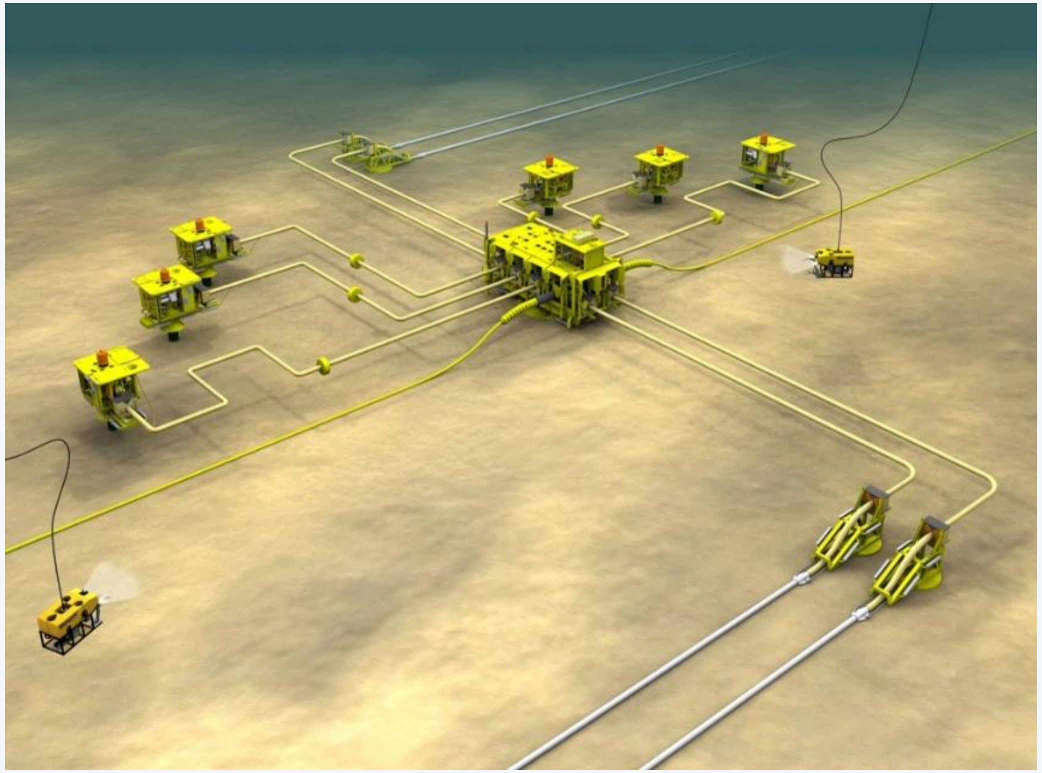
Redundancy, isolation, failure containment, recoverability and critical spares.

Installation

Structure weights, vessel availability, campaign logic and weather exposure.

How production moves through the system

The production path and the control path operate together.



1 Reservoir / well → 2 Subsea tree → 3 Jumper → 4 Manifold → 5 Flowline → 6 Riser → 7 Host facility

Control path: topside control system → umbilical → subsea control modules → valves and sensors

Four decades of architecture evolution

The region progressed from pioneering standalone FPSOs to modular hubs and infrastructure-led tiebacks.

1990s–early 2000s	2000s–early 2010s	2010s	2020s onward
Pioneer systems	**Scale-up**	**Complexity & processing**	**Reuse & standardization**
Kuito • Zafiro • Ceiba • Girassol	**Bonga • Kizomba • Dalia • Agbami • Jubilee**	**Pazflor • CLOV • TEN • Moho Nord • Kaombo • Egina**	**Bonga North • Baleine • Sangomar • Agogo • Kaminho**
Standalone FPSO + dedicated SURF& SPS	Clustered wells, manifolds and larger FPSOs	Flow assurance, subsea processing and mega-EPCI	Brownfield tiebacks, phased hubs and lifecycle value

Strategic shift **Dedicated megaprojects → scalable hubs → tiebacks and infrastructure reuse**

What the Gulf of Guinea offers

Decades of deepwater development provide a rich reference base across architecture, delivery and operations.

Architecture

FPSO-hosted developments, manifolded wells, riser systems, umbilicals and phased tiebacks.

Execution

Integrated engineering, long-lead management, offshore campaigns and interface governance.

Reliability

Lessons from flow assurance, materials, subsea controls, inspection and intervention.

Industrial capability

Regional fabrication, logistics, offshore services, supplier development and technical training.

Commercial models

Package EPCI, integrated EPCI, alliances, framework agreements and lifecycle services.

Lifecycle learning

Spares, obsolescence, IMR, intervention tooling, upgrades and late-life optimization.

Regional Legacy

Namibia should use Gulf of Guinea legacy as a reference envelope, then adapt it to frontier constraints and lifecycle objectives.

TRANSFER

Deepwater architecture, FPSO integration, qualified equipment, execution methods and operating lessons.

REVALIDATE

Reservoir, fluids, metocean, geotechnics, host response, logistics and regulation.

REDESIGN

Modularity, standard interfaces, control reliability, intervention access and future expansion.

OUTCOME

A fit-for-purpose Namibia subsea model, not a copy of legacy solutions.

SPS and SURF EPCI contracting strategies

Contracting should follow architecture maturity, interface complexity, market capacity and risk ownership.

SEPARATE SPS / SURF

Operator retains integration and can compete packages independently.

INTEGRATED EPCI

Integrated SPS/SURF engineering and delivery reduce contractual interfaces.

ALLIANCE / EARLY ENGAGEMENT

Joint optimization, aligned incentives and transparent governance.

HYBRID

Integrate critical boundaries while preserving selected competition and local scopes.

Selection criteria

• Concept maturity • Interface ownership • Schedule • Contractor capability & Standardization • Vessel access •Commercial risk • Local-content obligations • Lifecycle accountability

Weak links in traditional subsea systems

The objective is not to reject legacy technology, but to identify where lifecycle exposure becomes unacceptable.

Carbon-steel flowlines

Internal corrosion, external corrosion, fatigue, free spans, buckle management and difficult repair.

Subsea control systems

Power, communications, hydraulic distribution, electronic modules, software and obsolescence.

Welds & connectors

Fabrication quality, fatigue hot spots, sealing interfaces and inspection limitations.

Umbilicals & flying leads

Damage, insulation degradation, connector faults and limited replacement access.

Bespoke interfaces

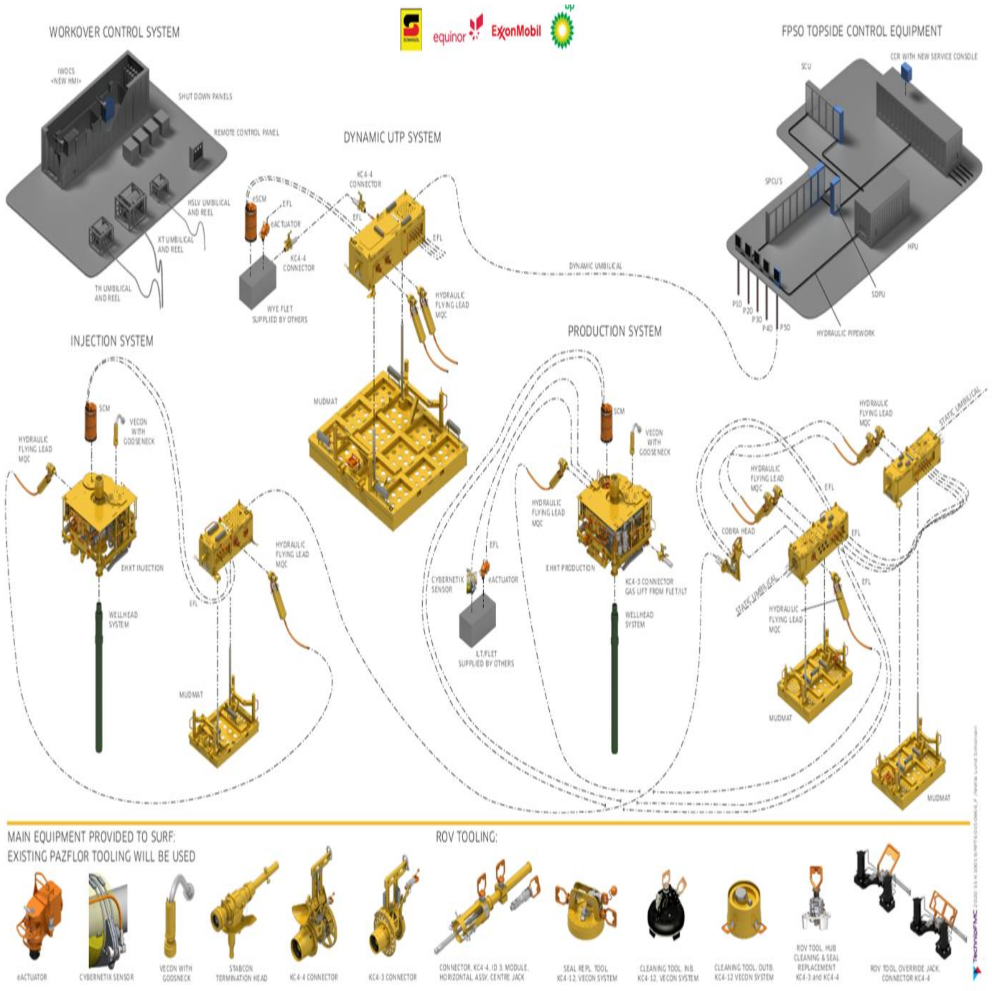
Vendor lock-in, unique tooling, spares fragmentation and restricted competition.

Intervention constraints

Extreme depth increases vessel, tooling, weather and recovery complexity.

Equipment standardization and configure-to-order delivery

Standardize the platform and interfaces while retaining controlled options for field-specific duty.



Product families

Preferred trees, manifolds, controls, connectors, tooling and documentation.

Interface control

Mechanical, hydraulic, electrical, communication, software and data boundaries.

Qualification reuse

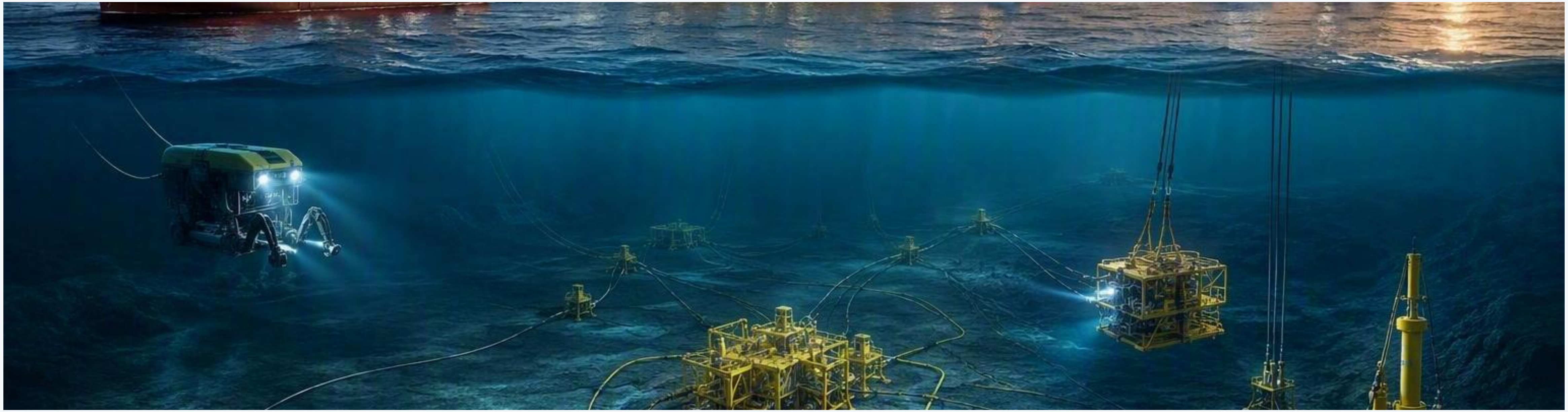
Reuse proven designs and manage deviations through formal product governance.

Supply-chain readiness

Long-lead strategies, common spares, repeatable fabrication and regional support.

Life-of-field contract strategy

Make operability, integrity, data, spares and intervention readiness part of the project contract architecture.



START-UP

Data handover, training, tools, procedures, initial spares and readiness assurance.

OPERATIONS

Technical support, condition monitoring, production optimization and obsolescence.

IMR & INTERVENTION

Inspection, maintenance, repair, workover, vessel access, production enhancement and emergency response.

LATE LIFE

Upgrades, tiebacks, life extension, integrity reassessment and decommissioning readiness.

Local content: capability before percentage

Sustainable participation is phased, data-driven and linked to repeatable demand.

Map

Baseline suppliers, facilities, workforce, certification and infrastructure.

Segment

Match scopes to maturity, safety criticality, technology ownership and investment lead time.

Develop

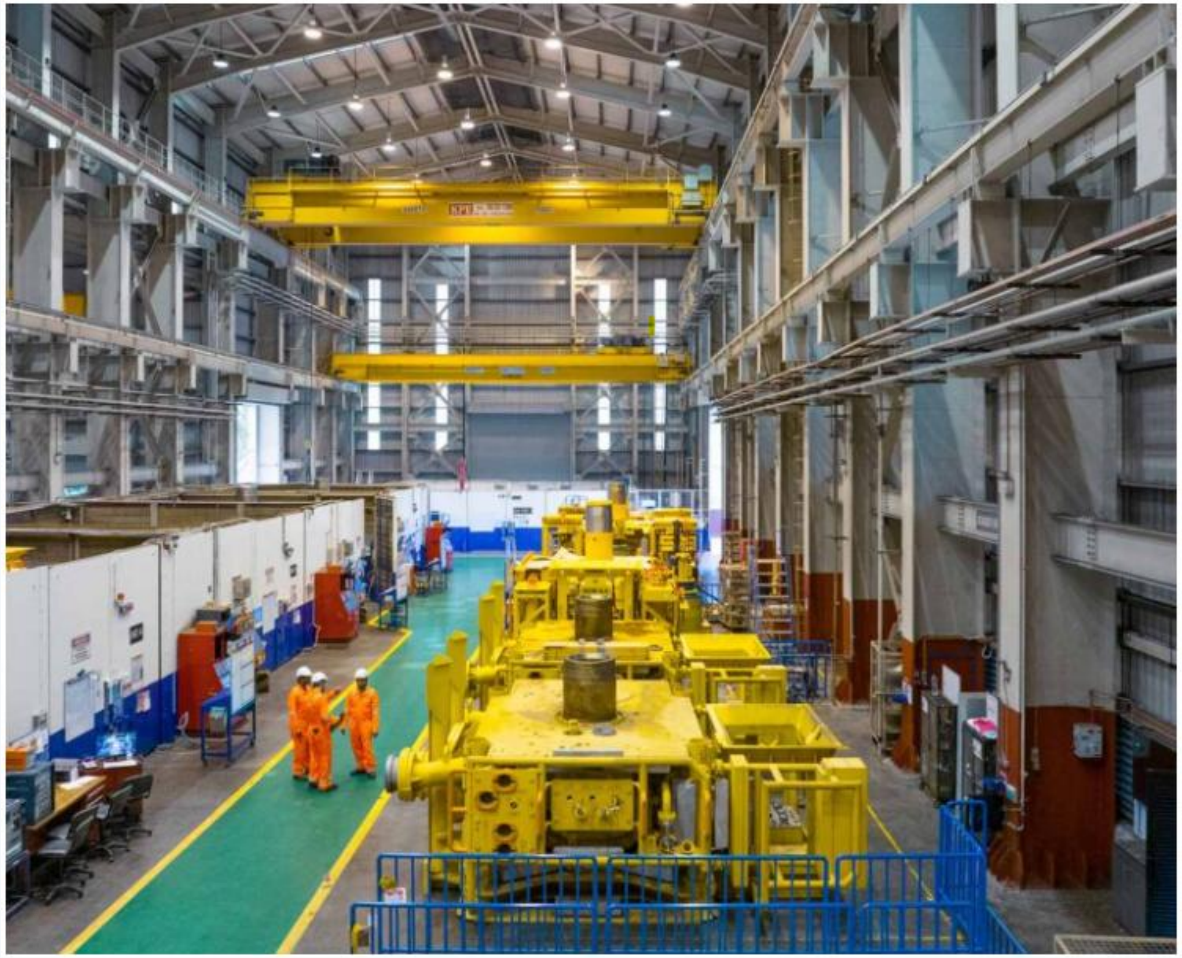
Training, mentoring, joint ventures, qualification plans and technology transfer.

Sustain

Operations, IMR, logistics, data, repair and recurring supply scopes.

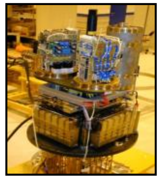
Measure

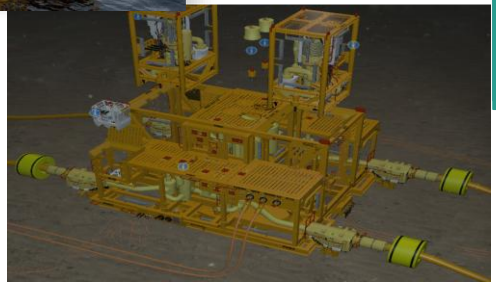
Competent roles, quality, delivery performance, local procurement and retained capability.



A coordinated regional subsea ecosystem

Namibia can combine frontier-project demand with Gulf of Guinea experience to create sustainable regional capability.





Operators & authorities

Align standards, qualification expectations, policy objectives and visible project pipelines.

Vendors & contractors

Develop regional product support, repair, testing, spares and lifecycle services.

Local suppliers

Progress from logistics into qualified technical and manufacturing scopes.

Universities & training bodies

Build curricula, laboratories, apprenticeships and research partnerships.

Regional collaboration

Share learning, aggregate demand and avoid unsustainable duplication.

Namibia fit-for-purpose subsea model

The recommended model integrates technical design, execution strategy, industrial development and lifecycle performance.

REFERENCE

Use Gulf of Guinea evidence, qualified products and operating lessons.

VALIDATE

Close Namibia-specific reservoir, environment, host and infrastructure gaps.

MODULARIZE

Standard product platforms, controlled interfaces and expandable layouts.

INTEGRATE

Align SPS/SURF engineering, commercial risks and execution incentives.

LOCALIZE

Develop realistic, repeatable and measurable in-country capability.

LIFECYCLE

Design controls, integrity, data, spares and intervention from day one.

Fit-for-purpose means selective adaptation, not wholesale replication.

RECOMMENDED DELIVERY ROADMAP

Turn regional experience into repeatable lifecycle value

1	**Define the reference case**	Capture reservoir, water-depth, host and operational design envelopes.
2	**Freeze modular principles**	Set architecture rules, identify the weak links, product families and controlled interfaces.
3	**Select the delivery model**	Align SPS/SURF packaging with interface and risk strategy.
4	**Embed local capability**	Place development commitments into executable scopes and KPIs.
5	**Contract for lifecycle outcomes**	Plan spares, data, services, intervention and performance support from day one.

Standardize what is repeatable, integrate what is interdependent, and localize what can be sustained

Back UP

Representative deepwater subsea portfolio

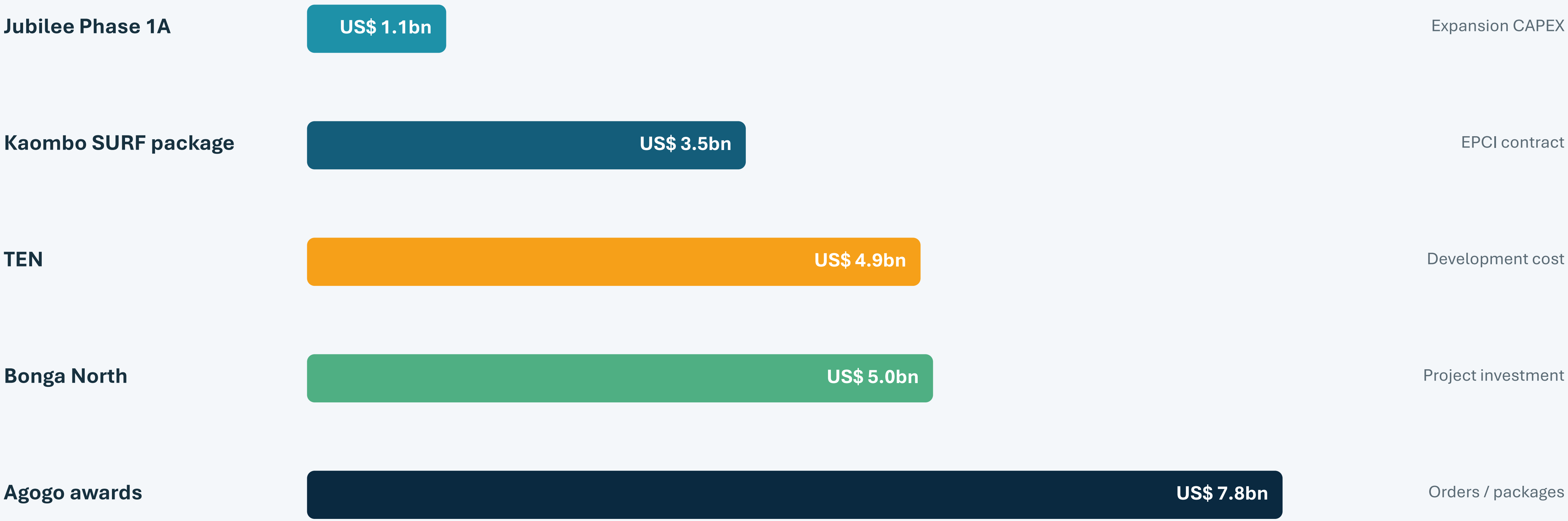
Selected projects illustrate how Angola and Nigeria built the core installed base, followed by new producing provinces.

ANGOLA	Girassol • Kizomba A/B • Dalia • Greater Plutonio • Pazflor • CLOV • Kaombo • Agogo • Kaminho
NIGERIA	Bonga • Erha • Agbami • Akpo • Usan • Egina • Bonga North
GHANA	Jubilee • TEN • Sankofa-Gye Nyame
OTHER WEST AFRICA	Zafiro & Ceiba (Equatorial Guinea) • Moho Nord (Congo) • Sangomar (Senegal) • Baleine (Côte d’Ivoire)

Note: this is a representative timeline, not an exhaustive project database.

Selected publicly disclosed cost benchmarks

Values use different boundaries and should not be compared as equivalent total project CAPEX.



Use for order-of-magnitude context only: project CAPEX, expansion CAPEX, package awards and operating disclosures have different scopes, dates and commercial bases.

What drives cost, and what the history teaches

Architecture and lifecycle strategy matter more than water depth alone.

01 Architecture

Standalone FPSO vs tieback; infrastructure reuse is the strongest CAPEX lever.

02 Wells & SPS

Well count, trees, manifolds, controls and injection scope.

03 SURF

Lengths, risers, materials, seabed, installation spread and interfaces.

04 Flow assurance

Hydrates, wax, corrosion, insulation, chemicals and intervention philosophy.

05 Host & contracting

FPSO capacity, brownfield modifications, EPCI risk allocation and vessel market.

06 Lifecycle

Local capability, spares, IMR, obsolescence, integrity and production availability.

Executive takeaway: standardize the repeatable, preserve expansion capacity, and optimize total installed and lifecycle cost rather than the lowest package price.

CAPEX AND OPEX COMPARISON | GULF OF GUINEA SUBSEA PROJECTS

Public values have different cost boundaries. Project-development CAPEX, package awards and operating costs should not be treated as directly equivalent.

CAPEX / CONTRACT BENCHMARKS

LIkEMBE | ANGOLA	Tieback EPCI | USD 150–300M | Subsea contract category
BONGA NORTH | NIGERIA	Tieback | ~USD 5.0B total estimate | SURF award ~USD 1.0B
TEN | GHANA	Standalone FPSO + subsea | USD 4.9B | FPSO lease excluded
AGOGO WEST HUB | ANGOLA	Integrated hub | USD 7.8B main contracts | Includes FPSO, SPS, SURF and services

OPEX / OPERATING-COST DISCLOSURES

JUBILEE | GHANA	H1 2024 production cost | USD 92.13M
TEN | GHANA	H1 2024 production cost | USD 58.48M
SANKOFA-GYE NYAME | GHANA	H1 2024 production cost | USD 95.09M
AGOGO FPSO | ANGOLA	15-year FPSO lease + O&M | >USD 5.0B total contract value

KEY INTERPRETATION | Tiebacks reduce host CAPEX but can retain substantial wells, subsea and brownfield-modification costs. Greenfield hubs carry the highest CAPEX. Public OPEX normally covers total field production costs, not SPS/SURF alone.

M = million | B = billion | Values are nominal public disclosures and are not normalized for year, scope, inflation or production.