Supply Chain
Localization in FOAK reactors and supplier challenges

November 2021

IDOM

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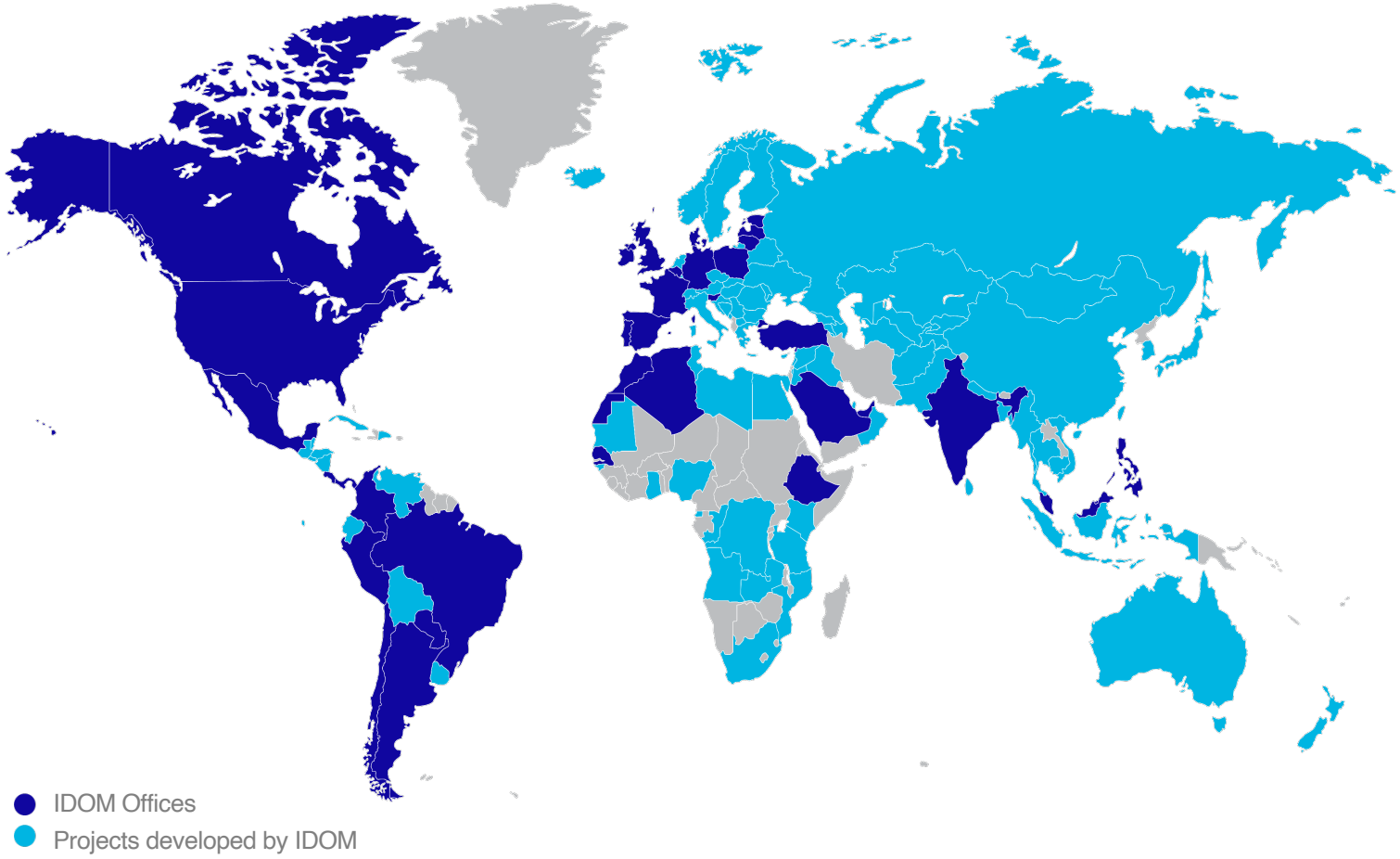
IDOM in the world



Delivering independent professional services since

1957

International presence at

125

Countries

45 Offices

IDOM is an employee-owned company

3,800 People

893 Partners

EXCELLENCE
INNOVATION
COMMITMENT

IDOM

Main business areas

Main Services

+36,000 M€
managed in national and international projects in the last 3 years

140MW Cogen CC Power Plant (Middle East)

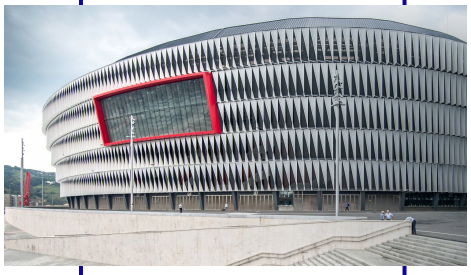
EPC

The refinery of Talara (Peru)

PMC

The Riyadh metro (Arabia Saudi)

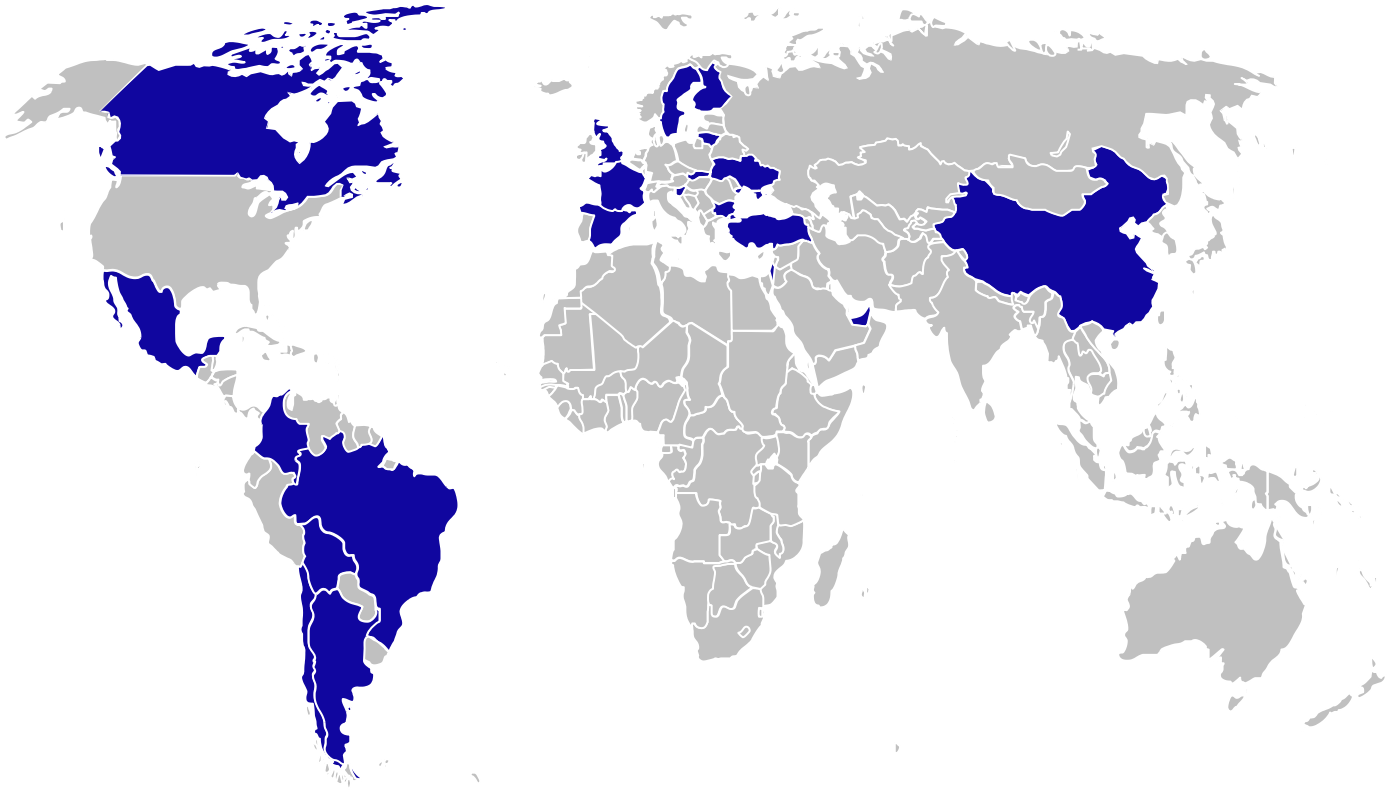
E



San Mamés Football Stadium (Spain)

EPCM

IDOM Nuclear Services in the world



MORE THAN:

400
people having participated in nuclear projects

350
projects

40
years

23
countries

#8
in international nuclear engineering design ranking
**ENR Global Sourcebook 2020*

Spain, UK, Slovenia, Slovakia, Bulgaria, Ukraine, Lithuania, Finland, China, Mexico, Bolivia, Brazil, Argentina, Chile, Colombia, Belgium, Netherlands, Israel, Sweden, Emirates, Canada, France, Turkey

IDOM has worked together with the main players in the international nuclear ecosystem

Governments, Public Organizations & Agencies

Nuclear Owners, Operators & WMOs

Nuclear Supply Chain

IDOM

Value Proposition

Independent multinational company, providing services worldwide 24/7, from local offices and site support.

Assembling and deploying a multidisciplinary tailor made SQEP team for the specific project requirements.

Strong support from international nuclear actors and technologist, due to our extensive partnership.

Comprehensive consulting advisory services at any stage of the nuclear power programmes.

Compliance and responsive services focus on client.

Promoting and developing a prominent level of nuclear safety awareness among stakeholders based in an strong safety culture.

Demonstrable excellence in EPC projects and major design modification of Nuclear Power Plants fully based in Cost effective & efficient design process.

A global reach into specialized and nuclear supply chain.

In-house International Expert Advisory Board & extensive Home Office network.

Nuclear Quality Assurance board.

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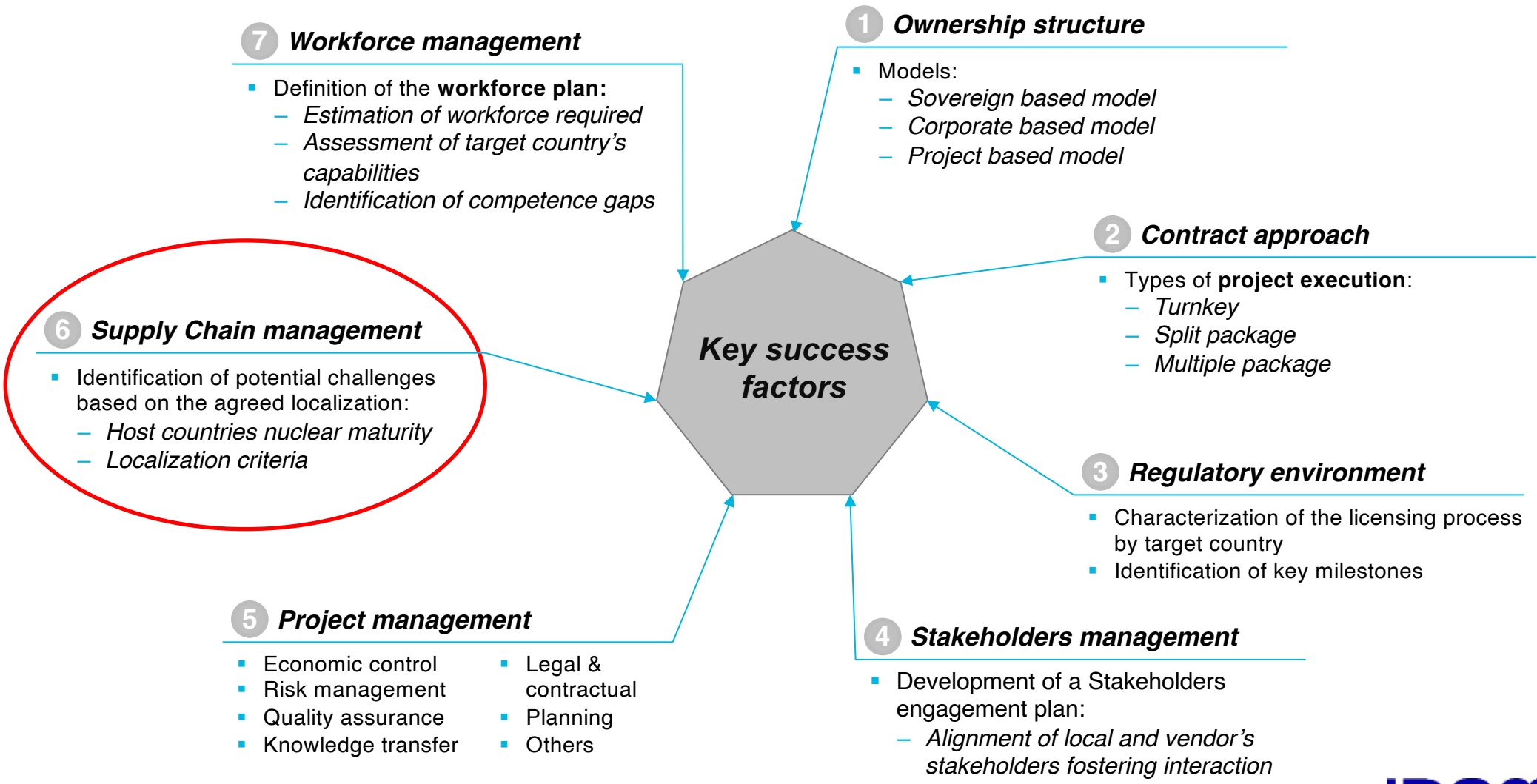
IDOM has identified 7 key success factors required for successfully developing NNB projects

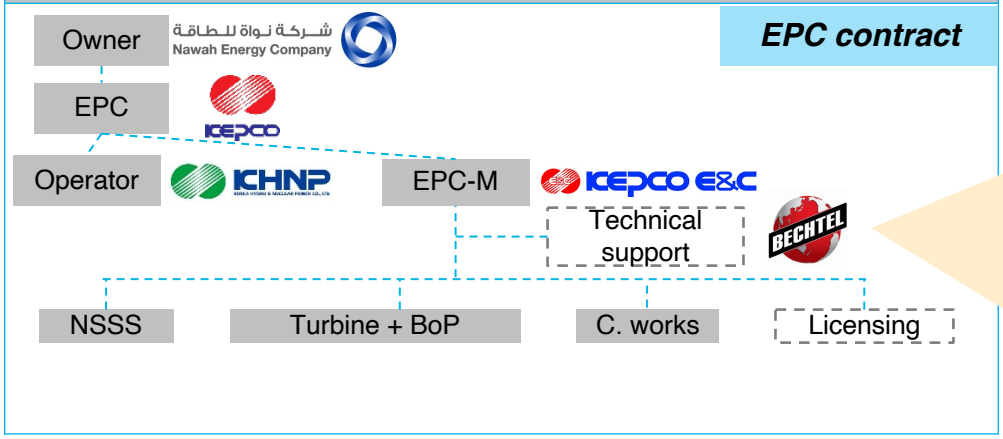
Key success factors in the development of NNB projects



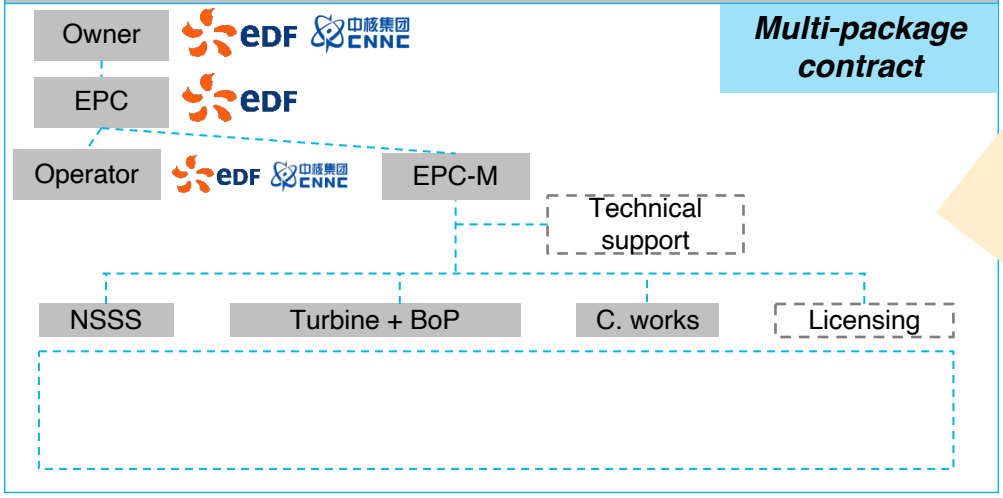
Regardless of the contract approach, successful NPP projects rely on independent international engineering companies

Reference case studies

UAE- Barakah NPP (4 reactors)



UK - Hinkley Point C



Source: IDOM analysis

Observations

Key tasks carried out by international engineering companies:

- Acting as an interlocutor between the vendor and the host country's engineering and construction companies; (i) reviewing, (ii) adapting and (iii) ensuring that the project is correctly carried out
- Ensure that the documents sent by the vendor comply with the standards and requirements set by the Nuclear Regulatory Authority
- Equipment qualification services in several key areas
- End-to-end procurement management: (i) Definition of word packages; (ii) RFP preparation; (iii) Bids review; (iv) Contract award
- Construction design management, responsible for implementing construction regulations and managing design risks

Based on their nuclear maturity, some of the host countries will find it challenging to cope with the agreed localization

The ambition of Newcomers for high localization approaches might turn into a source of delays and cost overruns

Localization approach

Deep localization

- Uranium mining, enrichment and fuel manufacture
- Heavy reactor components (NSSS)

Medium localization

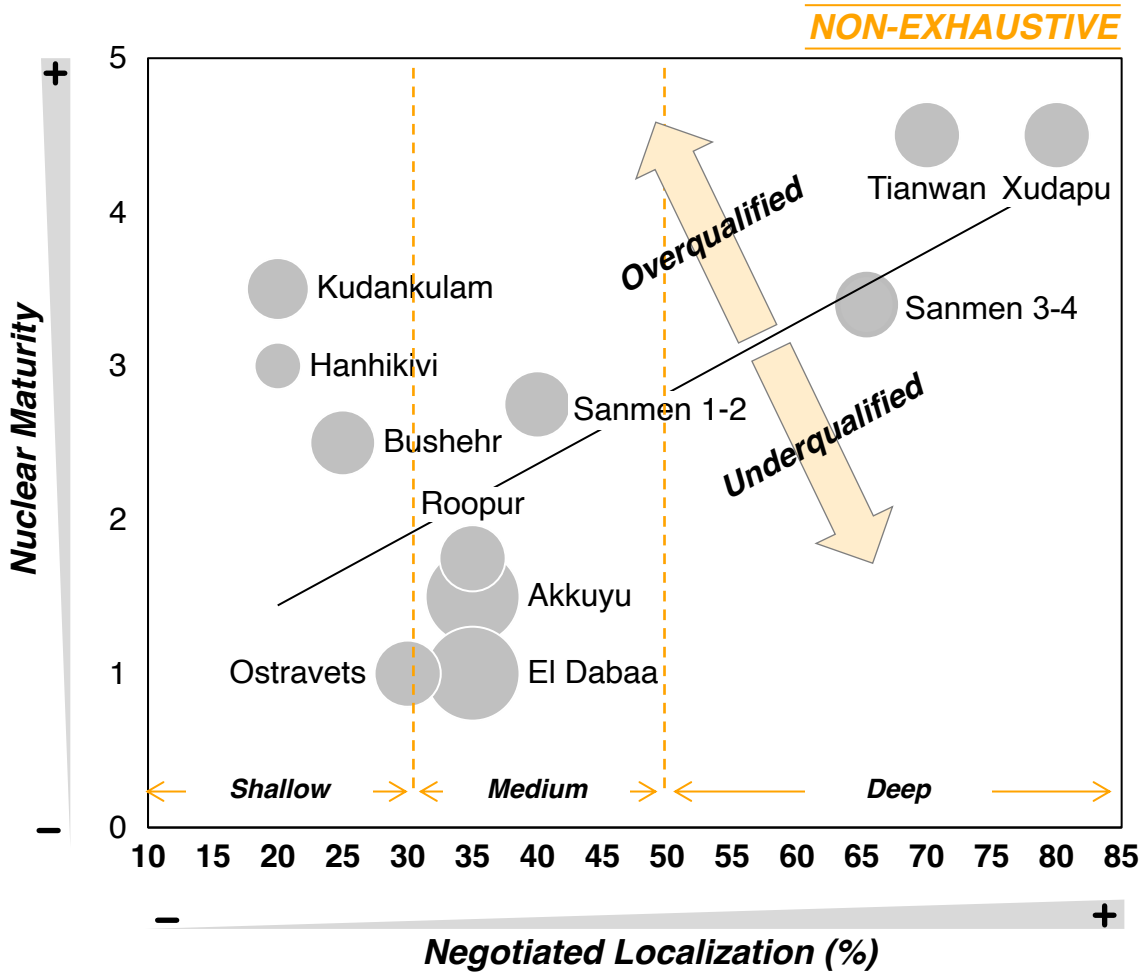
- Civil works
- Manufacture of non-nuclear components:
  - *Pumps, valves, feedwater heaters, reheaters, cooling systems, other.*

Shallow localization

- Civil works

Correlation Nuclear maturity – Localization

(%)



Source: IDOM analysis, WNA

IDOM's scope of work

Thus, supporting local entities with the arising challenges is key to ensure time and cost management

Host country's assessment

- *Industrial capabilities*
- *Nuclear know-how*
- *Public acceptance of nuclear power*
- …

	Requirements of the host country	***Supply chain management challenges***
Deep localization	▪ Previous experience in the construction and operation of NPPs ▪ Heavy forging capabilities ▪ Nuclear industry know-how	▪ Support in the transfer of knowledge process ▪ Supplier (i) qualification, (ii) monitoring and (iii) quality assurance
Medium localization	▪ Previous experience providing electrical and mechanical equipment for energy generation plants: - *Conventional plants* - *Combined cycle plants* - *Cogeneration plants*	▪ Local suppliers' identification and capabilities auditing ▪ Suppliers' lack of awareness on nuclear codes and standards
Shallow localization	▪ Construction companies with previous experience in large infrastructures	▪ Higher standards required in: - *Welding* - *Concrete mixing and pouring* - *Non-destructive examination* - *Quality hold-points*

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To ensure safety, the industry has created **strict standards** for the design, engineering and construction of nuclear facilities, as well as **strict quality** regimes for all structures, systems and components.

In addition, it is crucial for potential suppliers to have a positive nuclear **safety culture,** developed and demonstrated by all organizations and individuals involved in the manufacturing & construction process (and in all stages).

It is important for companies to understand the key differences working in nuclear compared to industrial/conventional activities during the commercial actions, bidding process, and project delivery stages.

- A **quality assurance programme** designed and implemented by trained personnel shall be in place in each supply chain organization in order to correctly develop all their processes.

- All managers and personnel in supply chain companies shall understand how their work contributes to the **effective and safe delivery** of new nuclear power plants.

- All parties to the supply chain shall fully understand and implement agreed **processes for Inspections, Tests, Analysis and Acceptance Criteria**.

- All work shall be developed by **SQEP.**

IDOM

NUCLEAR REQUIREMENTS

CONVENTIONAL

NUCLEAR

COST

TIME

RISKS

Quality and safety culture are paramount in nuclear…

Management Systems

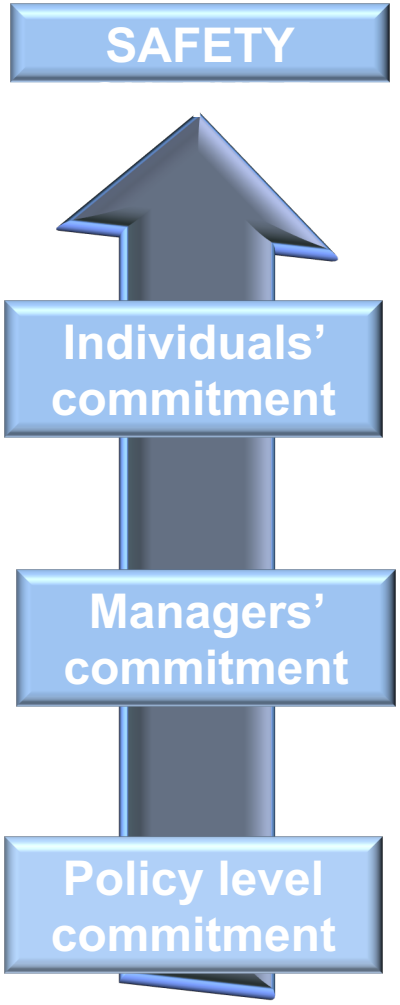
- Continuous Learning
- Problem Identifications and Resolution
- Environment for Raising Concerns
- Work Processes

Management Commitment to Safety

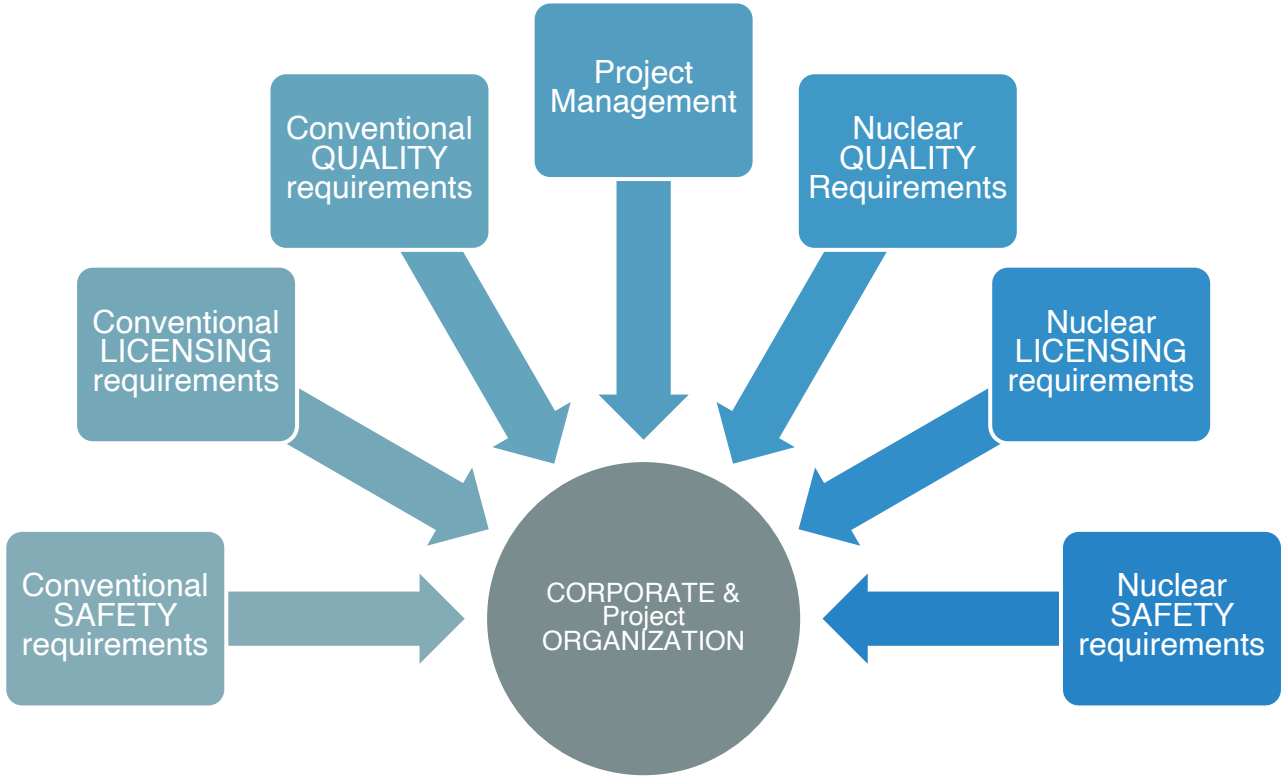
- Leadership Safety Values and Actions
- Decision-Making
- Respectful Work Environment

Individual Commitment to Safety

- Personal Accountability
- Questioning Attitude
- Effective Safety Communication



Nuclear quality versus conventional



The main requirements concerning **CONVENTIONAL** and **NUCLER PROJECTS** deal with Licensing, Safety and Quality matters in addition to Project Management.

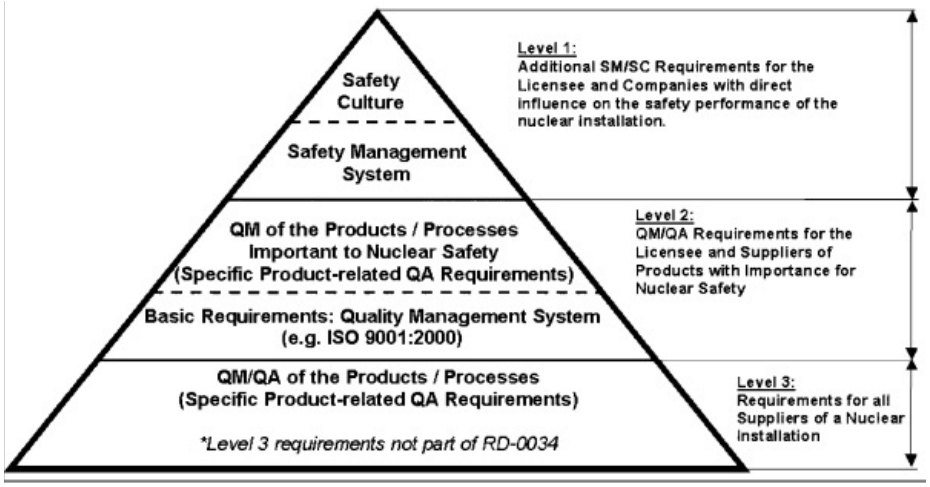
Structure of a Nuclear Integrated Management System (NIMS)

How to implement a NIMS within an organisation:

- Apply **Requirements**
- Delimit the NIMS **scope** (**Graded Approach**)
- Deploy **Appropriate resources**

Aspects to be considered:

- The **safety importance** and **complexity** of the services/products:
- **Hazards** and potential impact on nuclear and radiation safety
- **Consequences** for the fundamental safety functions if any SSCs **fails**.



Typical structure of a Nuclear Integrated Management System

Quite often RD requires a safety and quality classification system of the SSCs (under the holder of a Nuclear installation license responsibility)

Some typical issues and lessons learned from NNB projects

Findings

- Escalation and increased requirements by Safety Authorities and Utilities. Especially Post-Fukushima in 2011.
- Most Suppliers to date have experienced quality issues in early production and fabrication. Loss of nuclear know-how.
- Traditional QA Audits & Surveillances failed to uncover many significant issues.
- Licensee has had to take much more intrusive role in Supplier Oversight.
- Gaps Exist in License-Design-Fabrication translation.

Lessons Learned

- Vendors must have a strong nuclear safety culture that starts at the top
- Licensees must ensure standards and expectations are understood starting with vendor executives
- Vendors' QA/QC organizations must have nuclear expertise
- Must be accurate flow down of design & licensing basis requirements as it relates to their work including subcontractor supply chain
- Change Management processes need to be verified to ensure continued compliance

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A typical process of developing the nuclear value chain in a FOAK project

01

Quantify demand

Establish for a construction of a NPP, which will be the main packages, quantities or requirements.

- Products, goods and services for the construction and operation
- Localization strategy of CUSTOMER into the list of working packages
- Methodologies for calculating localization ratio

02

Evaluate the offer

Assess the current situation of the supply chain and which companies are the ones that can cope with the construction and operation of the NPP

- A data set of companies and products, goods & services for NPPs
- Develop business plans
- Develop a marketing plan to atract investors

03

Create the responsible organization

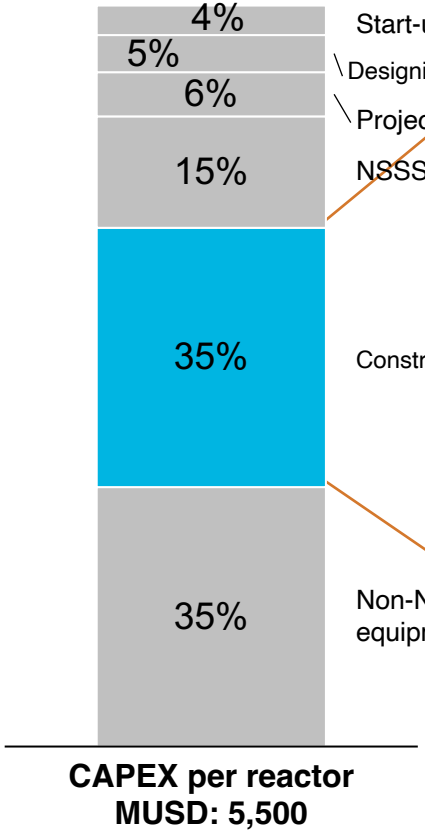
Create an organization that is responsible for attracting investors and localizing the nuclear value chain

- Organizational plan and tasks to be developed
- Model of relationship with CUSTOMER and other key stakeholders
- A benchmark analysis of the best practices which have successfully orchestrated localization activities

Through the development of these objectives, a FOAK project will have the necessary means to start developing the new nuclear landscape in the country

In order to assess the expected demand IDOM will breakdown the expected CAPEX of a NNB into relevant WP

Breakdown of NNB Capex
(%; MUSD)



Example of Work packages in NNB project: Civil Works

1 Contract categories

- A Associated Developments
- B Balance of Plant
- **C Civil Works**
- D Conventional Island
- E Electrical and I&C
- F Enabling Works
- G Handling & Ventilation
- H Mechanical Equipment
- I Nuclear Island
- J Site Operation Services
- K Valves
- L Other

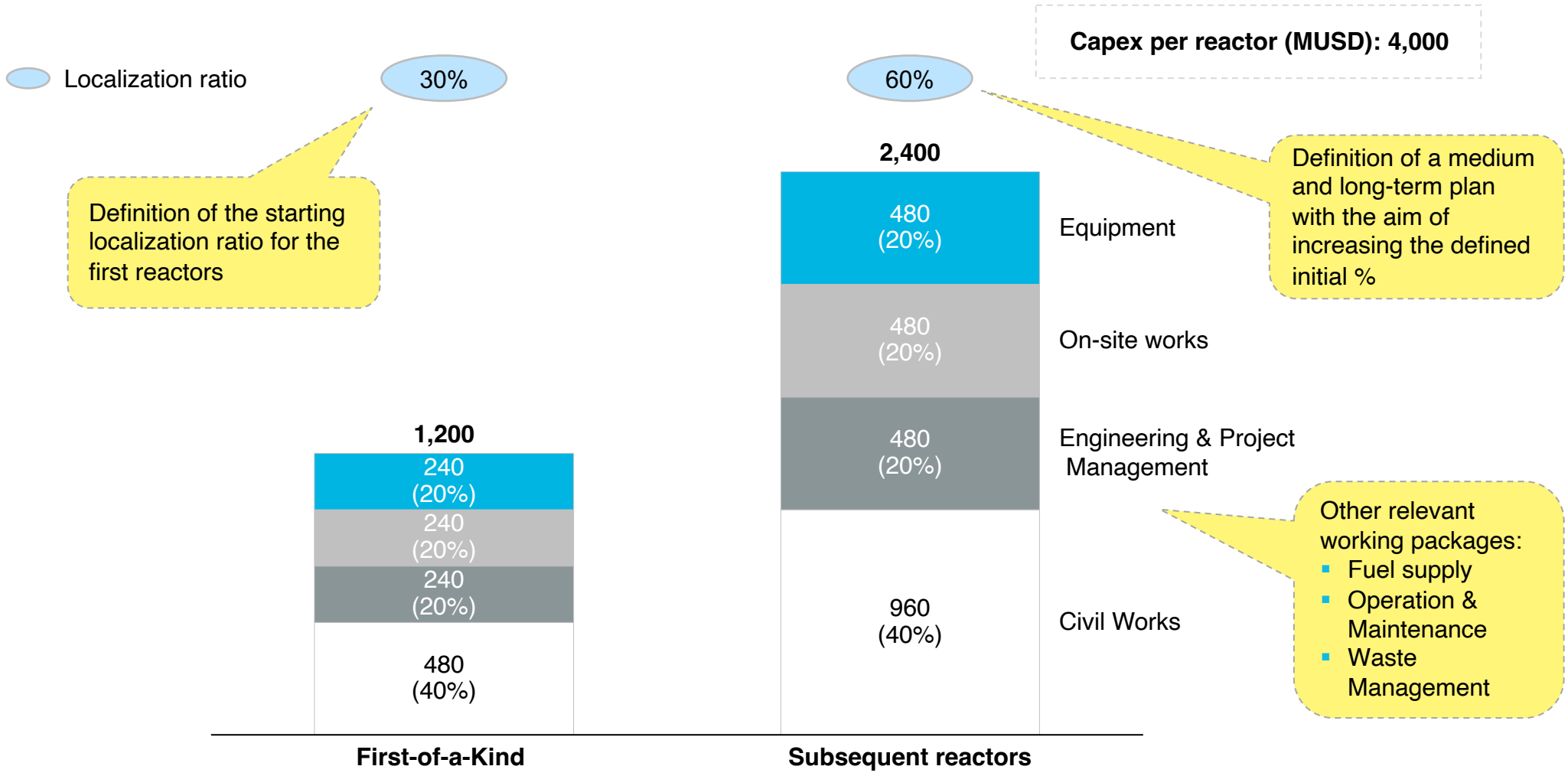
2 Work packages for each contract category

Work package	Cost example (MUSD)	Year example	Activities
HR Air Lock	19	2015 Q2	Design, manufacture, transportation, installation and commissioning of 4 airlock assemblies
Equipment Hatch	19	2015 Q2	Design, manufacture, transportation, installation and commissioning of 2 equipment hatch assemblies
Main Civils	1,290	2016 Q3	Common base slab, aircraft protection, reactor buildings, fuel buildings, etc.
CRF Pipes	19	2017 Q1	Design, manufacture, transportation, installation and commissioning of sea water intake and water discharge pipes
Neutron & Gamma Shielding Doors Lot B	19	2017 Q2	Design, qualification, manufacture, transport to site, assembly and installation of special doors
Marine Works	483	2017 Q4	Construction of structures used to bring cooling water into the power station
Ancillary Buildings	48	2018 Q2	Development of Simulator Training Centre and Framatome Warehouse
Special Doors, Duct Hatches and Articulated Hatches	48	2018 Q3	Design, qualification, manufacture, transport to site, assembly and installation of special doors, duct hatches and articulated hatches
HPC Civils Framework	48	2019 Q1	Internal site roads and networks, construction of electrical network civils works, remediation, etc.
HPC Seismic Instrumentation	4	2019 Q1	Design, qualification, manufacturing, delivery, supervision of erection and commissioning on site of the Seismic Instrumentation
Ancillary Buildings	97	2019 Q2	Common base slab, aircraft protection cover, reactor buildings, fuel buildings, electrical and mechanical safeguards divisions, etc.
Permanent Roads & Networks	97	2020 Q1	Permanent roads & networks in the phase 3 and 4 areas and the permanent security fence
Interim Dry Store	97	TBD	Design, construction and commissioning support of the interim spent fuel store building

Localization strategy of is mapped into the list of working packages

Example of localization strategy per working package (6 units x 1650MW)

JAITAPUR CASE



Source: EDF

A data set of companies and products, goods & services for NPPs is be prepared

Workstreams to be developed — NON-EXHAUSTIVE

1 Sources to identify suppliers

- A Consultant's expertise
- B Main Oil & Gas Suppliers
- C CUSTOMER
- D Ministry of Investment
- E Others (NIDLP, IC, PIF, SIDF…)

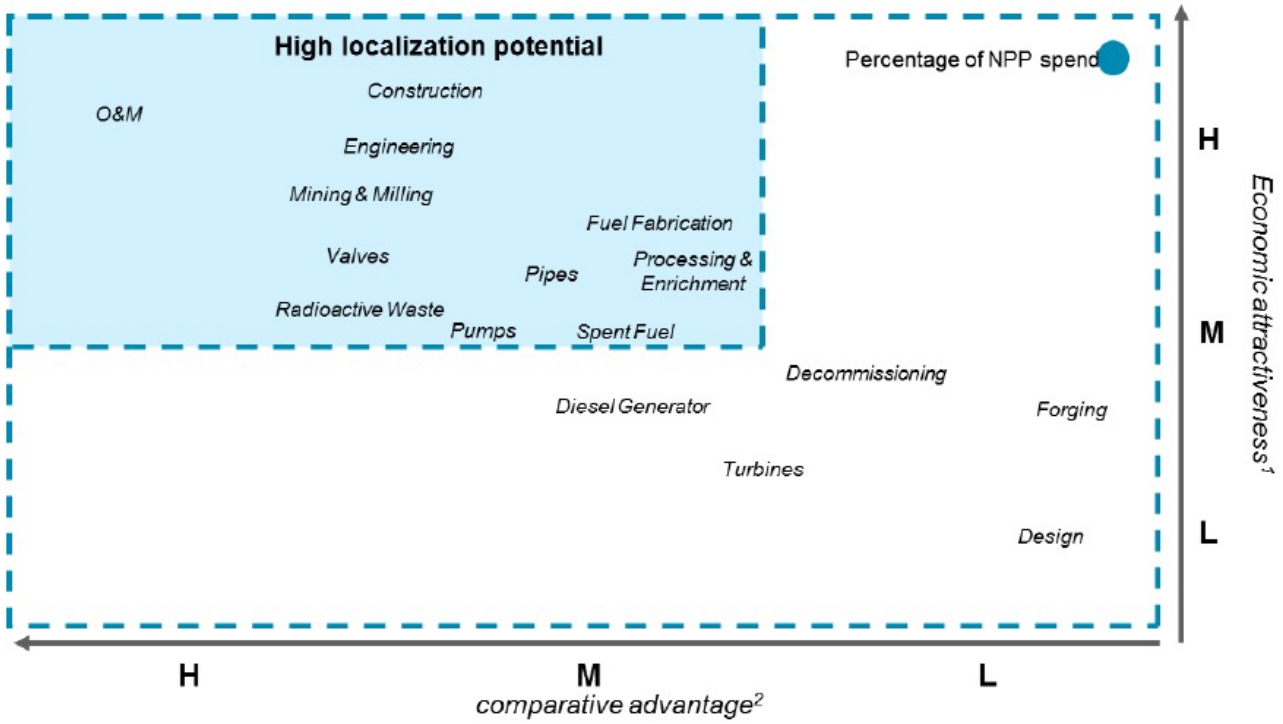
2 Definition of products, goods and services

- Civil Works (Cement, aggregate, concrete, formwork, reinforcement, embedded parts, high tension steel, decontamination paint)
- Mechanical equipment (Supports, pipes & fittings, welds, pumps, vessels/tanks, heat exchangers, valves…)
- Electrical equipment
- Instrumentation & Control
- Engineering & Project Management
- Quality assurance & Quality Control
- Operation & Maintenance services

Expected outcome — ILLUSTRATIVE

Company name	Source of identification			Products & Services
	IDOM	NUKSAK	Other	
Supplier 1	X			Waste treatment
Supplier 2		X		Valves
Supplier 3		X		Vacuum components, custom products
Supplier 4		X		Quality steel products
Supplier 5	X			Process Treatment
Supplier 6		X		Radioactive sources
Supplier 7		X		Industrial pipes, Iron solutions
Supplier 8	X			Valves
Supplier 9		X		Cables and Electrical eq.
Supplier 10		X		Wind towers platforms, steel construction workds, pipe bridges
Supplier 11	X			Bolts, Studs, Nuts
Supplier 12	X			Storage Tanks and Vessels , Mechanical Eq
Supplier 13		X		Steel structures
Supplier 14	X			Storage Tanks and Vessels , Mechanical Eq
Supplier 15	X			Pipes & Fittings
Supplier 16		X		Hot rolled steels, structural steels
Supplier 17		X		Roof panels
Supplier 18			X	Steelstructure
Supplier 19			X	Cables and Elect Eq.
Supplier 20	X			Pipes and Fittings
Supplier 21	X			Containers used for general purposes during construction works
Supplier 22	X			Crane Transportation
Supplier 23	X			Compensator
Supplier 24			X	Steelstructure
Supplier 25	X			Sea Water Artesian Pumps
Supplier 26	X			Pipes and Fittings
Supplier 27			X	Cables and Electrical eq.
Supplier 28				
Supplier 29				
Supplier 30				
Supplier 31				
Supplier 32				
Supplier 33				
Supplier 34				

Considering all the previous studies carried out for the localization strategy



Source: Oliver Wyman analysis

The main traceable disciplines have already been broadly established, and how ready COUNTRY's conventional supply chain may be for a nuclearization process

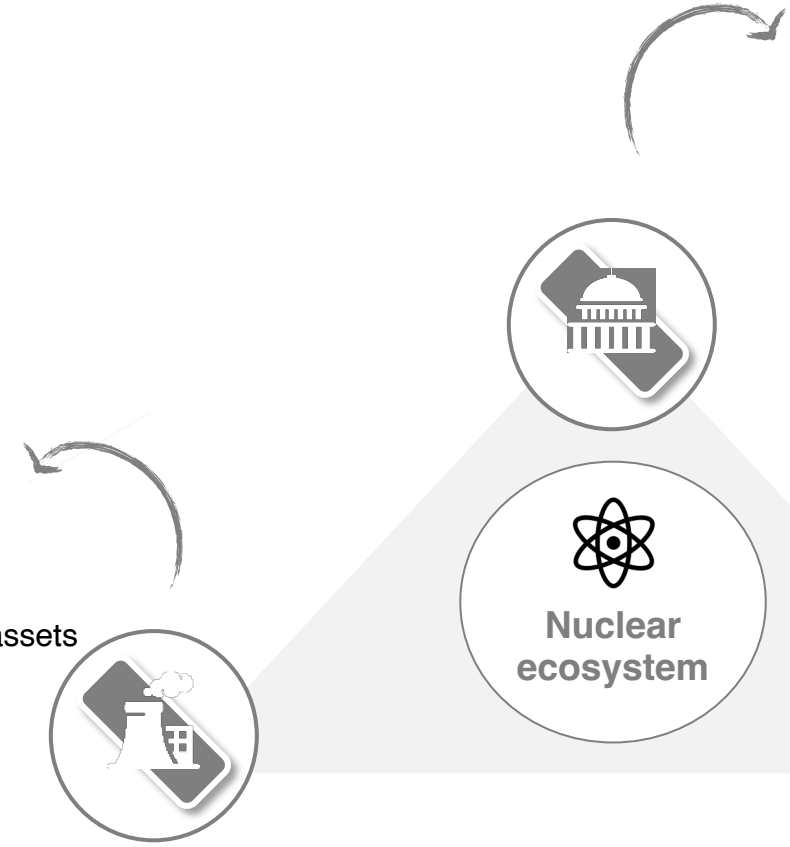
IDOM

Most promising localization opportunities will be prioritized based on the following criteria

Weight %	Prioritization criteria and description		Variables	
40%	Attractiveness	• Sizing of the total market space available and its growth	50%	• Imports substitution
			20%	• Potential product offtake
			20%	• Imports in GCC (potential COUNTRY exports)
			10%	• Sector CAGR
40%	Ease of implementation	• Identification of the main restrictions that can even conditionate or to eliminate the possibility for an investment • Time for implementation can be delayed as long as the restriction is resolved	30%	• Competition with key stakeholders in COUNTRY
			30%	• Raw material availability
			20%	• Saudi investor requirement
			20%	• Need of incentives
20%	Fit	• Alignment to the vision and objectives defined by COUNTRY • Expected impact for the opportunities in order to identify those with the most “added value”	50%	• GDP
			20%	• Unique utility / infrastructure
			15%	• Land demand
			15%	• Jobs created

First, the positioning within the nuclear ecosystem will be identified

Three major groups of Stakeholders neeed to be analyzed to identify the positioning in the nuclear ecosystem



National governments and agencies

- Existing policies
- Planned strategy
- Demand requirements
- Required infrastructure
- Communication networks and costs
- Planned developments
- Localization strategies
- Education and training plans
- Public-private partnerships

Owners and operators

- Major players
- Planned strategies
- Existing market
- Investment plans
- Resources and available assets
- Government models

Local supply chain

- Existing Markets
- Main players by supply
- Localization degree
- Business models
- Potential costs
- Existing technologies
- Existing processes
- Potential partners

To carry out the analysis of these Stakeholders, IDOM can use its knowledge and contact with large entities in the nuclear sector based on previous projects and existing collaborations