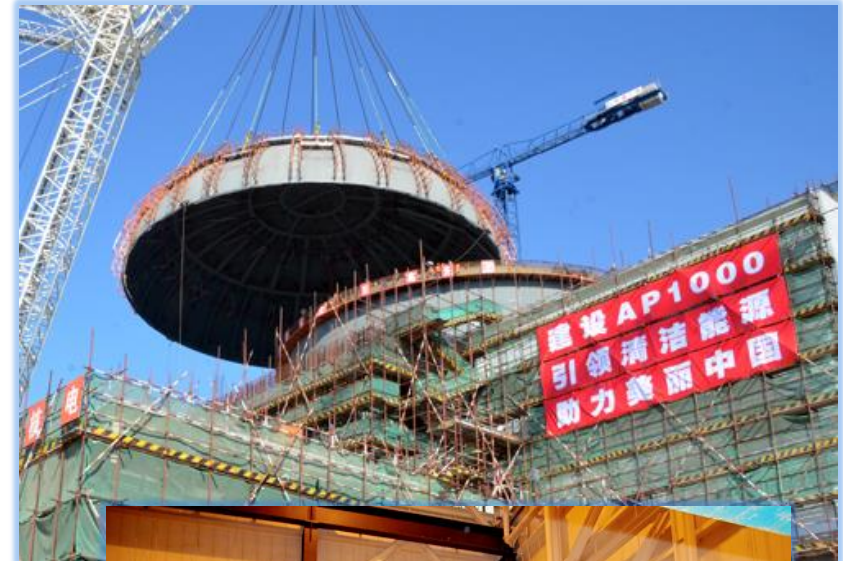


Supply chain management: International cooperation

WNU Short Course
Brazil
17 November 2020



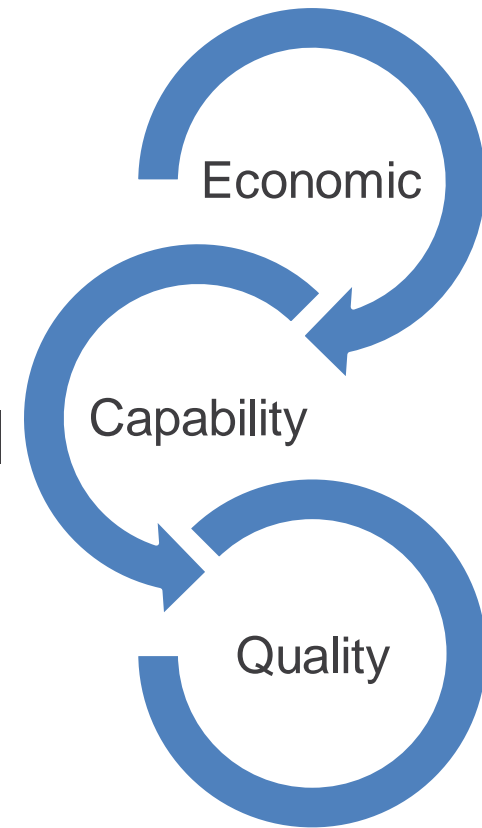
1. Supply chain challenges
 - Market
 - Quality
 - CFSIs
2. Quality Management
3. Achieving excellence
4. Take-aways



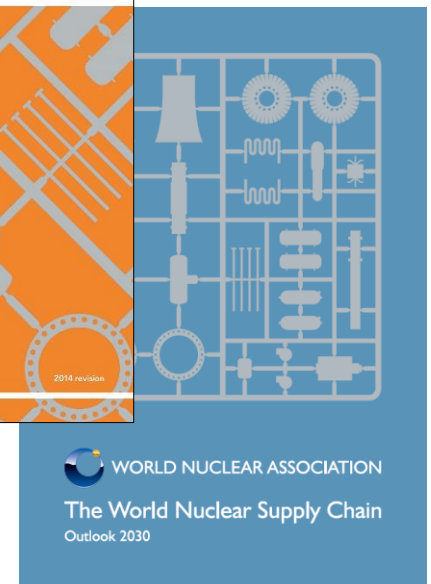
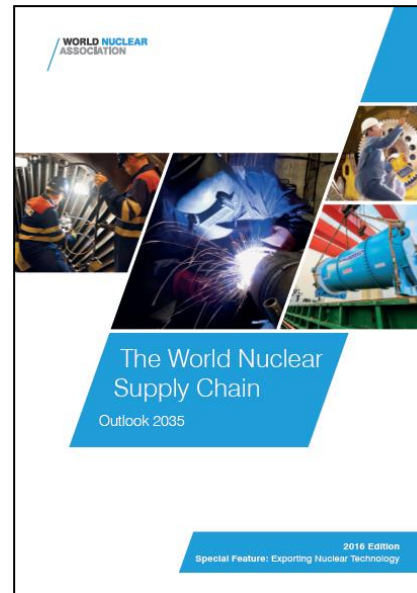
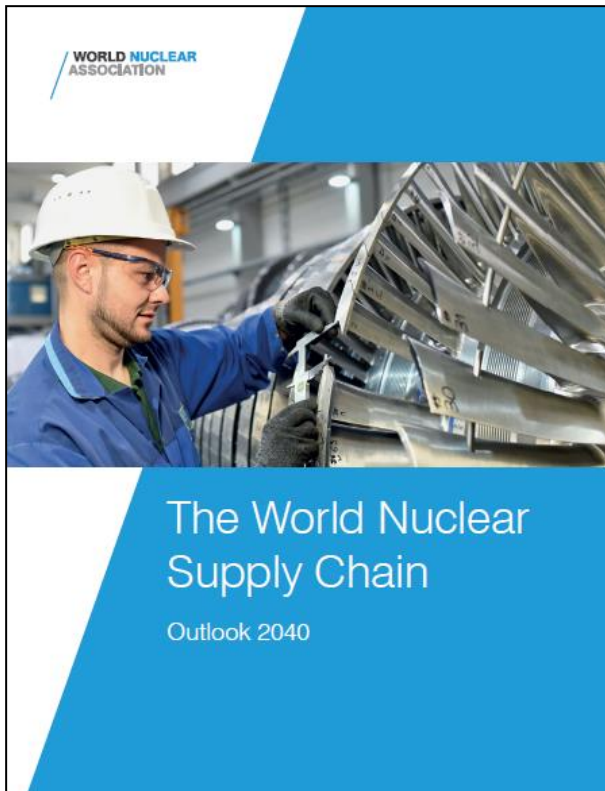
1. Inter-related challenges

How can nuclear power stay competitive?

- Ensuring that the economics of nuclear power are competitive with other generating sources:
 - Economic challenges
- Developing reliable international supply chains:
 - Capability challenges
 - Quality challenges
- Challenges are inter-related.

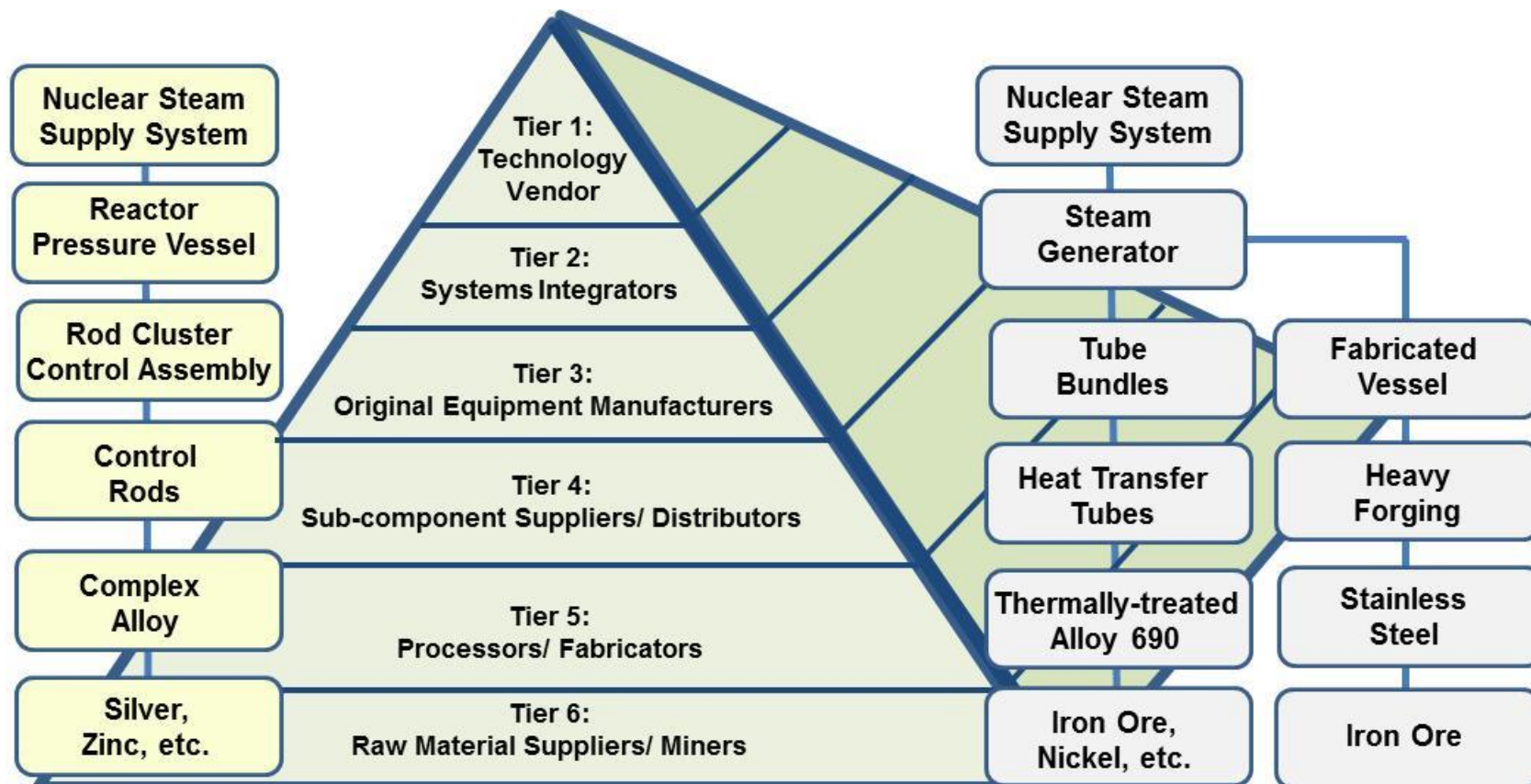


World Nuclear Supply Chain Reports 2012-2020



The nuclear supply chain

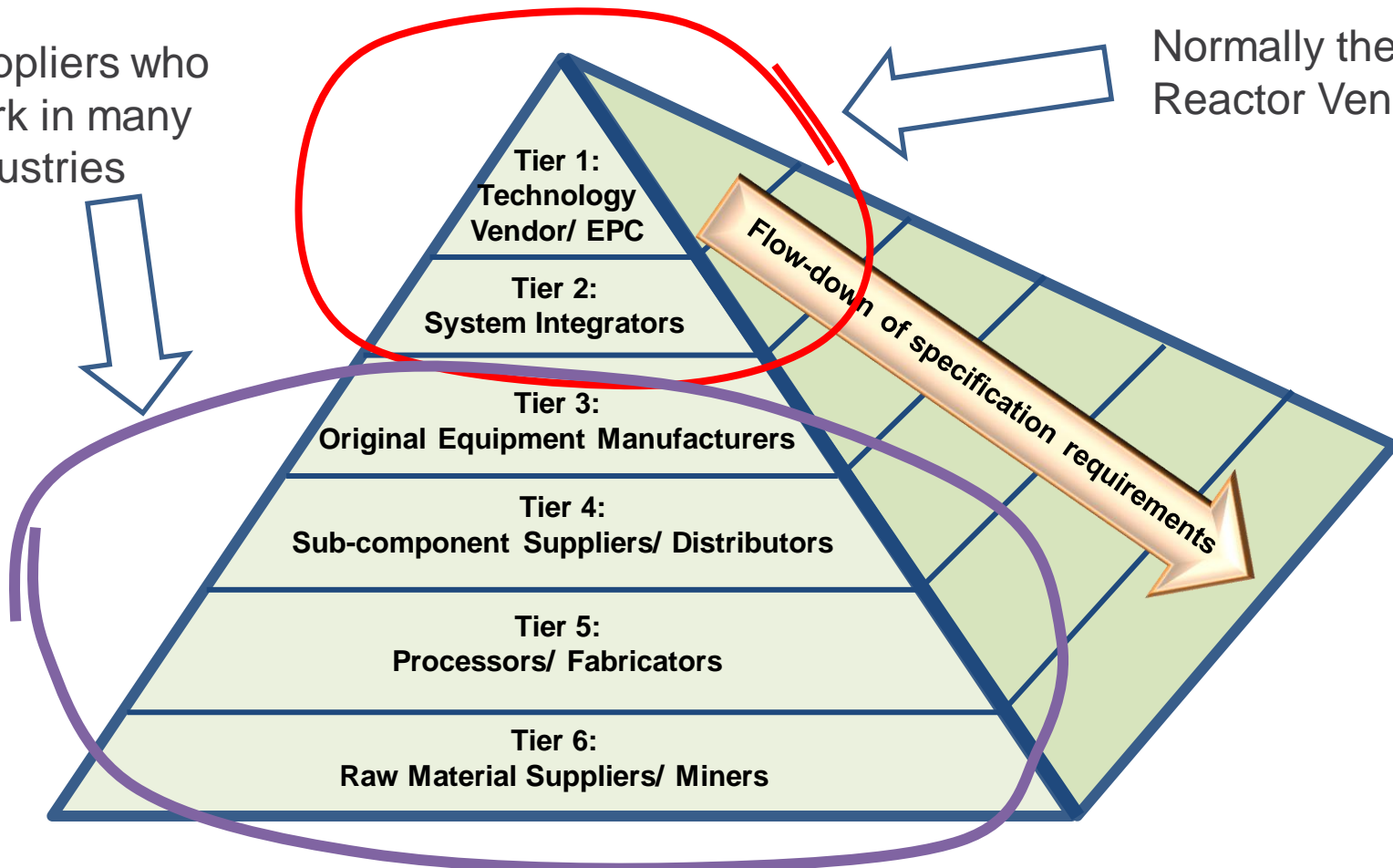
All tiers need to be qualified to high standards



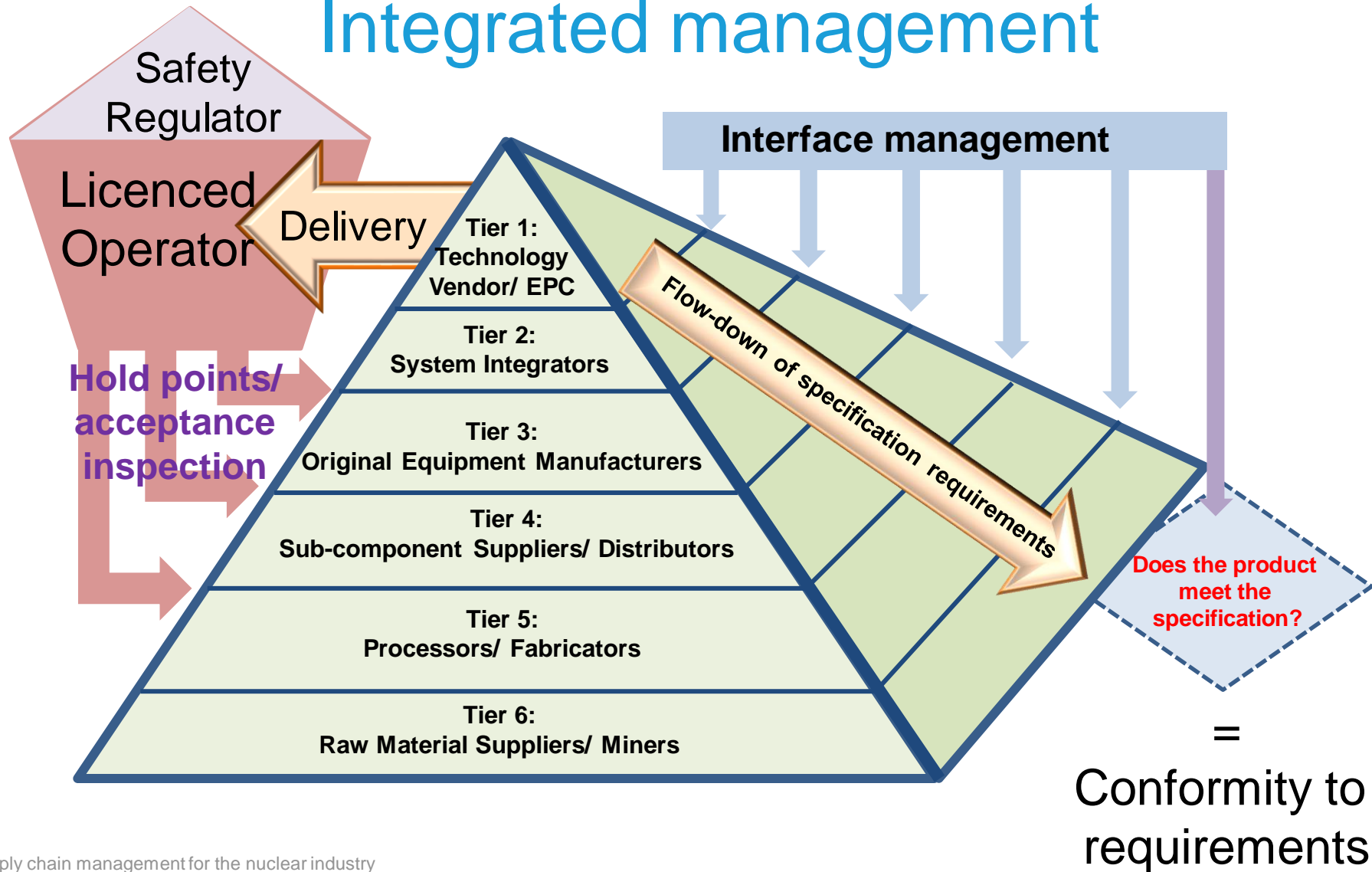
Cascading requirements along the supply chain

Suppliers who work in many industries

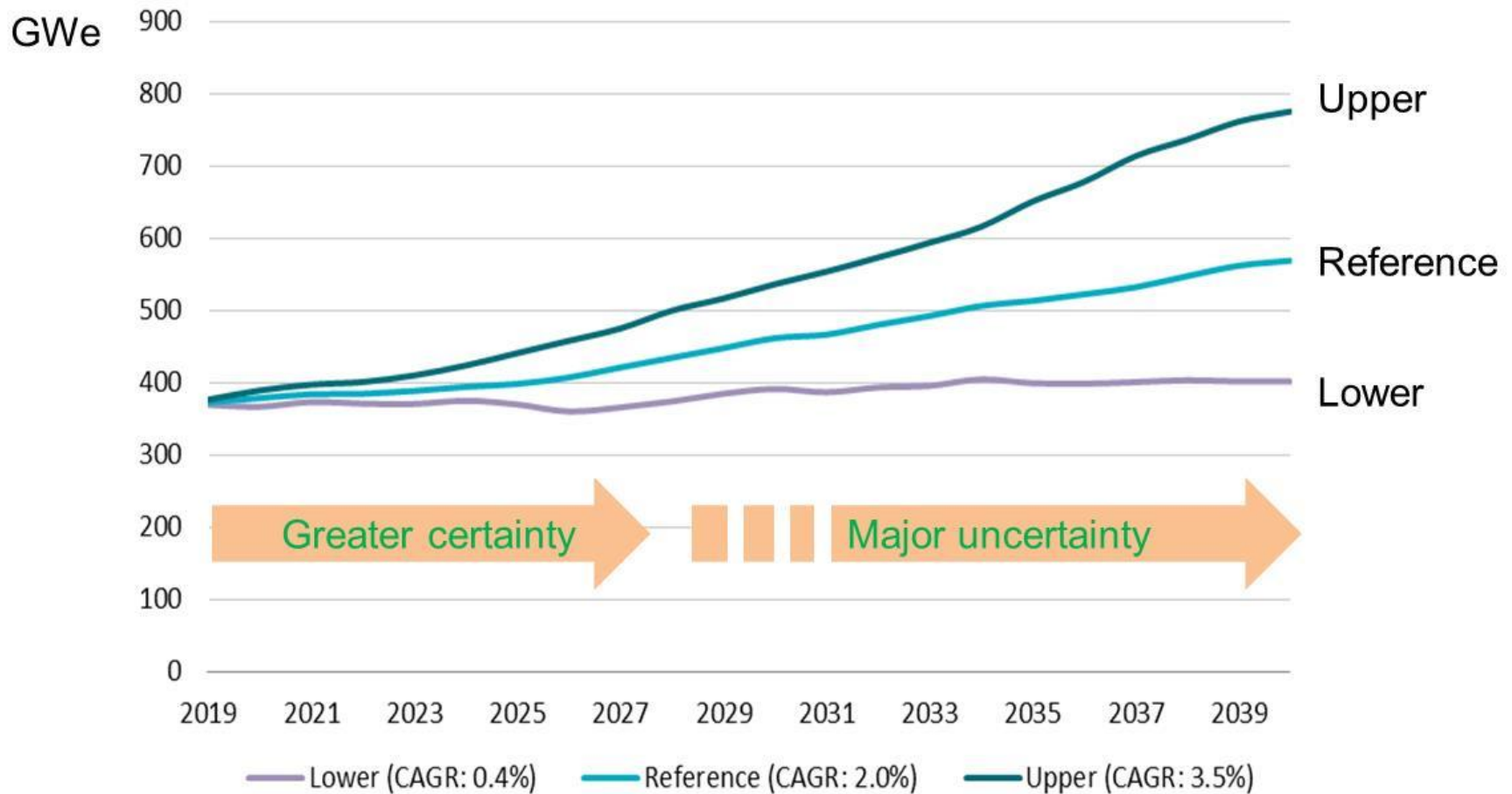
Normally the Reactor Vendor



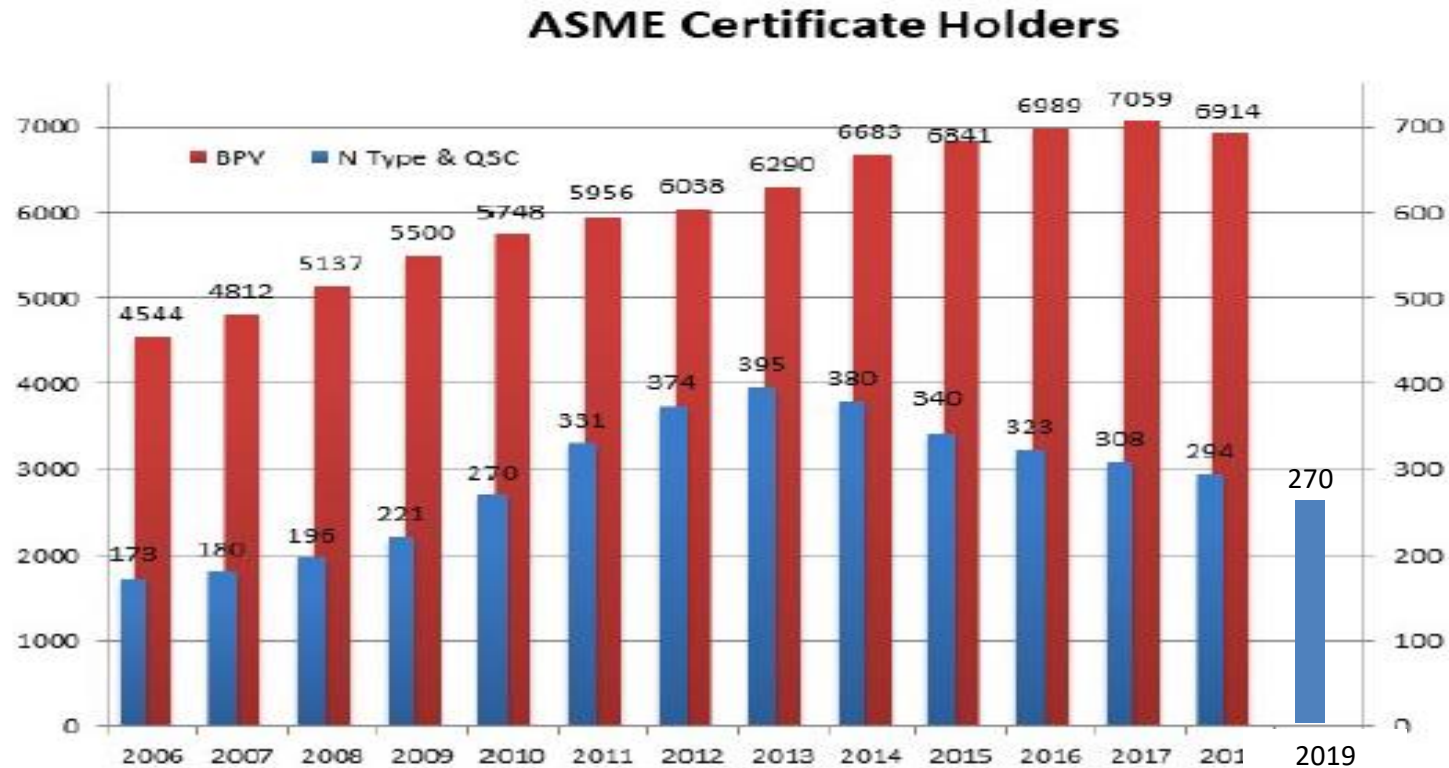
Safety = Quality = Integrated management



Fuel Report scenarios to 2040

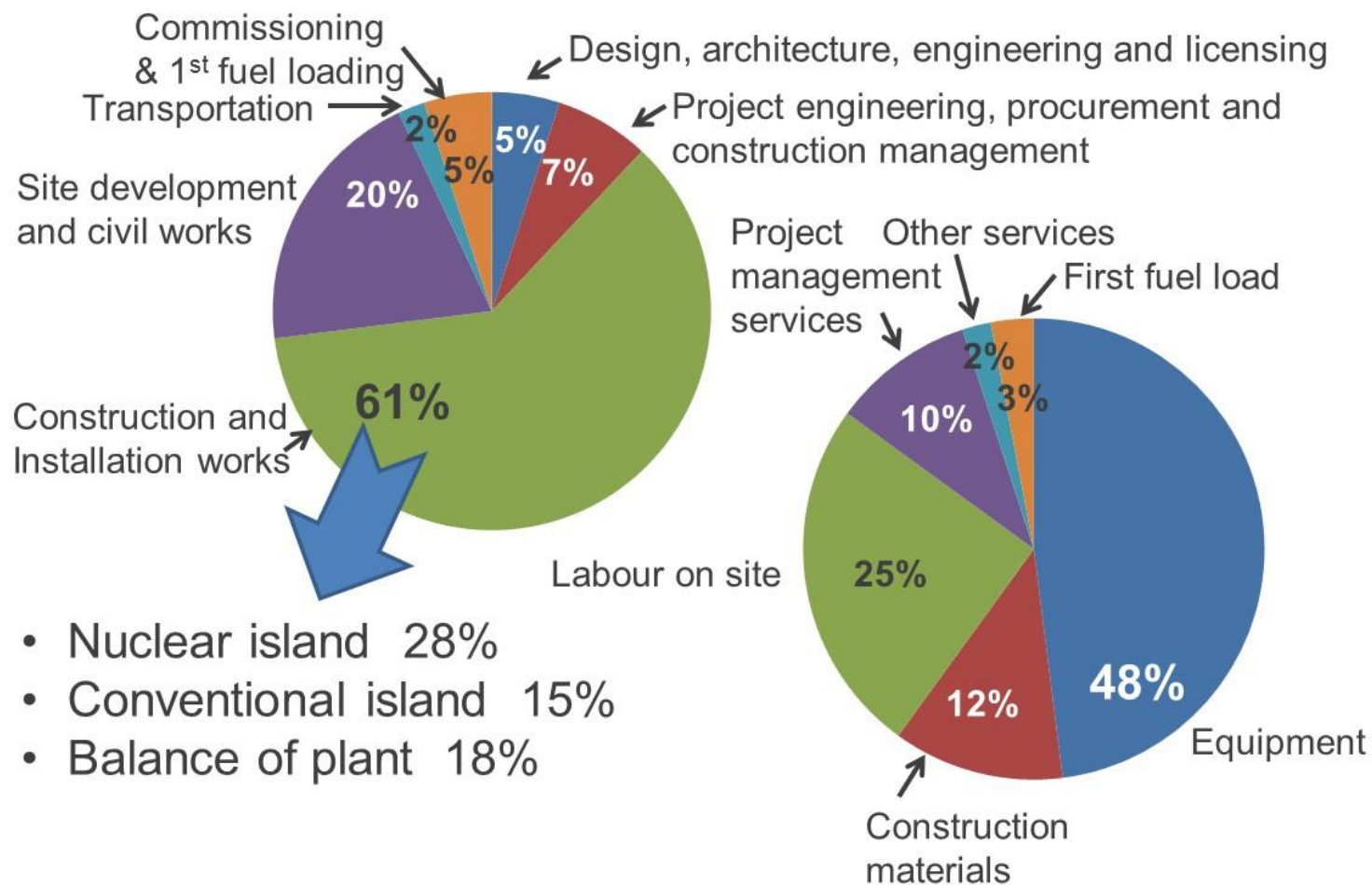


Falling number of ASME Certificate holders

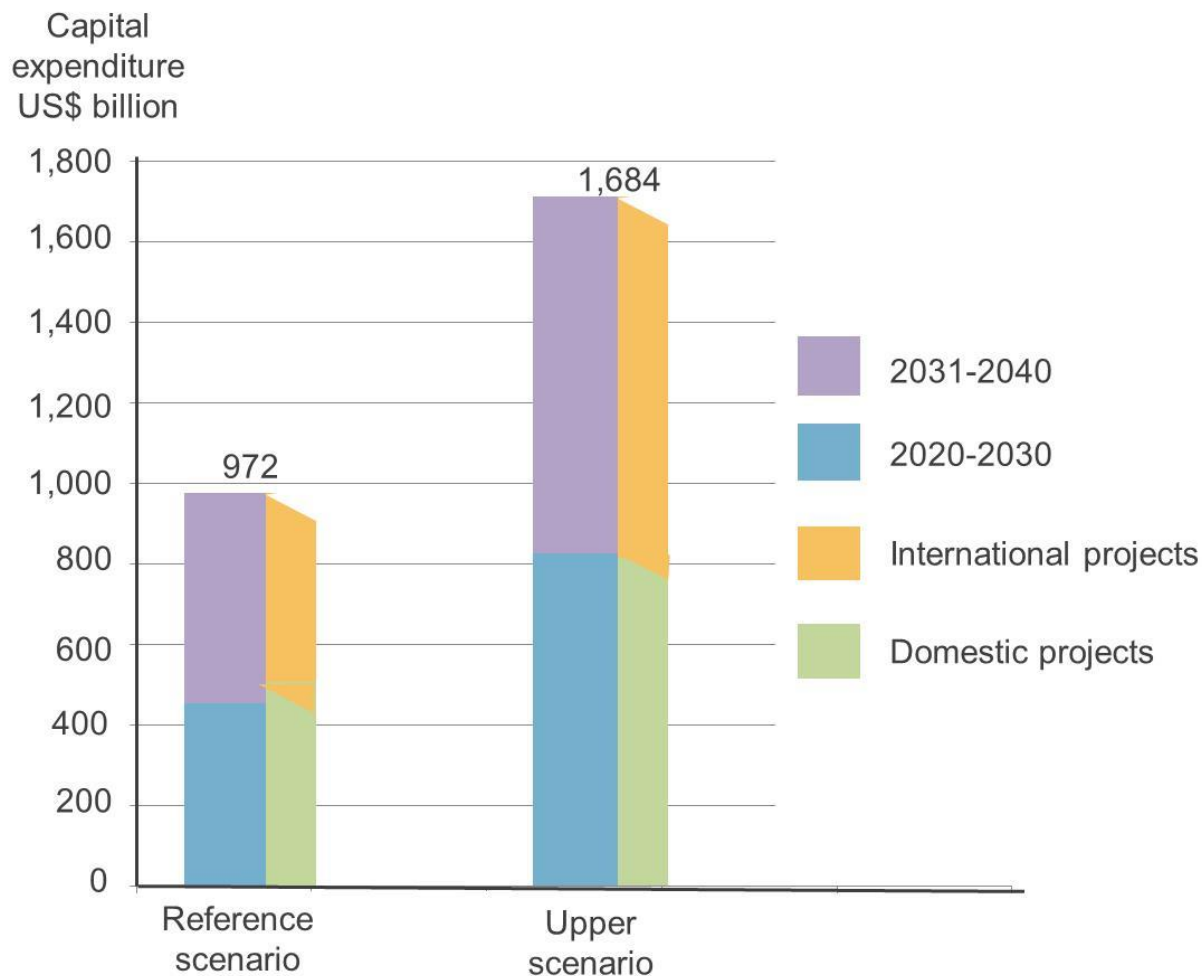


Source: Dirk Kölbl, CIS GmbH Consulting Inspection Services and World Nuclear Association update for 2019

Cost breakdown for a GW size nuclear reactor



Capital expenditure to 2040



International procurement for equipment could total \$288 billion by 2040

Lower scenario:

- Reactors: 3 by 2030; 2 by 2035; 2 by 2040

Reference scenario:

- Reactors: 3 by 2030; 4 by 2035; 5 by 2040
- Angra 3 completed by 2026
- Angra 4 completed by 2035
- Nordeste 1 completed by 2037

Upper scenario:

- Reactors: 3 by 2030; 5 by 2035; 7 by 2040

- Erosion of capability that existed in the past in Europe and North America. Companies have lost staff to retirement or redundancy.
- Companies had too few nuclear-related orders to have made it worthwhile to invest in upgrading their civil nuclear capability.
- Suppliers are not at the same level: some new entrants (e.g. Chinese companies) are still learning - even some qualified suppliers are not delivering fully.
- Different total quality management systems have been adopted.
- High cost of enhanced quality control is a deterrent to companies entering the market.

“When analyzing the past performance of nuclear projects and nuclear incidents, most of them can be traced back to managerial mistakes, not to technical ones”

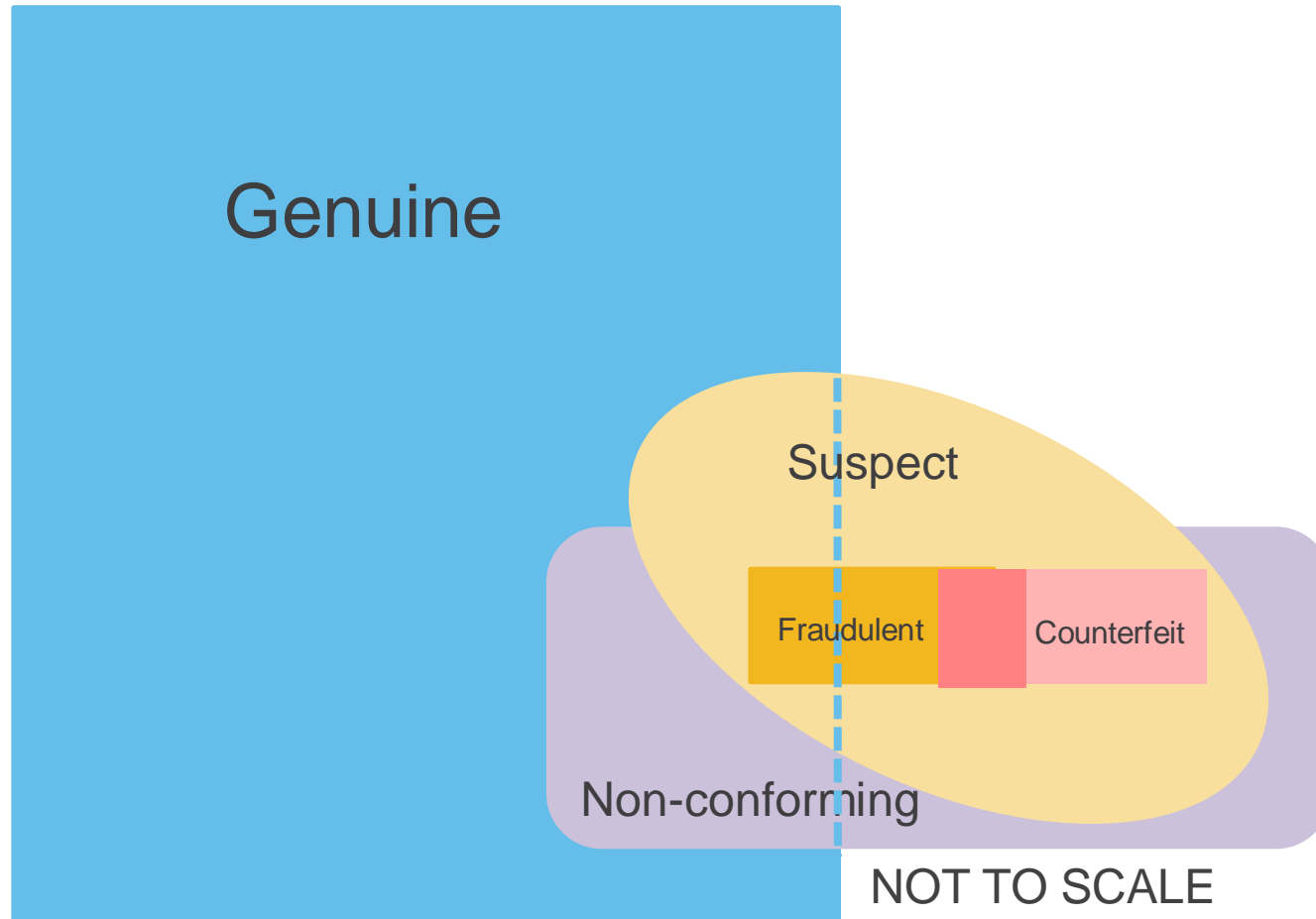
“The managerial evolution of the military and aerospace supply chain can be considered as a benchmark, since they are from an organizational point of view comparable to the nuclear industry.”

(OECD-NEA, 2015, *Nuclear New Build: Insights into Financing and Project Management*: pp. 186-187)

Counterfeit, Fraudulent and Suspect Items (CFSIs)

- Counterfeit
 - Items that are imitations of a legitimate product
- Fraudulent
 - Items that are misrepresented with an intention to deceive
- Suspect
 - Items that are suspected of being counterfeits or fraudulent

Classification of CFSIs



Evidence of CFS items in the nuclear supply chain

- A small increase in confirmed cases of CFS items in the commercial nuclear power industry
- An indication of an increase in the incidence of CFS items in the construction industry more generally.
- Detected CFS items in nuclear applications included:
 - Structural (plates, forgings, struts);
 - Mechanical (pipes, fasteners, filters, gaskets, seals, valves, rotating equipment);
 - Electrical (cables, circuit breakers, fuses, resistors, transformers);
 - Electronic (80-90% of counterfeit electronic items have been recycled from legitimate products).
 - Materials (concrete, cement, gravel, sand);
 - Inspection, testing and certification services.

Potential solutions

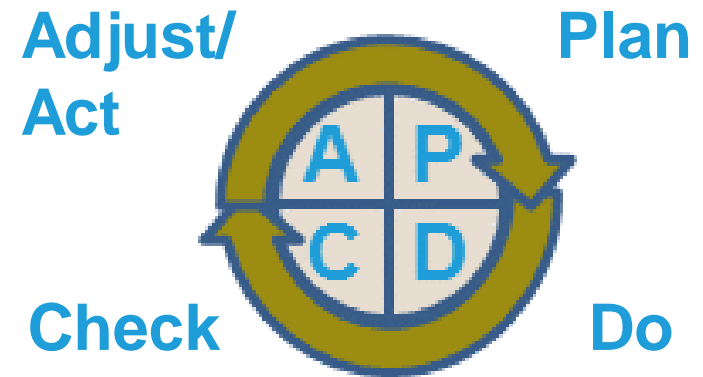
Safety regulators are looking for an integrated management system that delivers **exceptional performance**:

- **Quality management system**: a set of business processes focused on meeting customer requirements and applicable legal and regulatory requirements AND result in enhanced customer satisfaction.
- **Human performance**: aim to reduce human error – focus on strengthening defences against the consequences of mistakes.
- **Safety culture**: fostering a positive learning culture and a corporate atmosphere where safety is understood to be and accepted as the number one priority.
- **Business excellence model**: integrate processes to avoid conflicting objectives.

2. Quality Management

- **Quality management system** (QMS): a set of business processes focused on meeting customer requirements and applicable legal and regulatory requirements AND result in enhanced customer satisfaction.
- **Quality assurance** (QA): procedural activities put in place to ensure that the product is fit for purpose and no mistakes are made during production (right first time).
- **Quality control** (QC): activities that review the product or process of production.

PDCA Cycle



Plan: Establish objectives, identify and address risks and opportunities, provide resources, and plan product realization

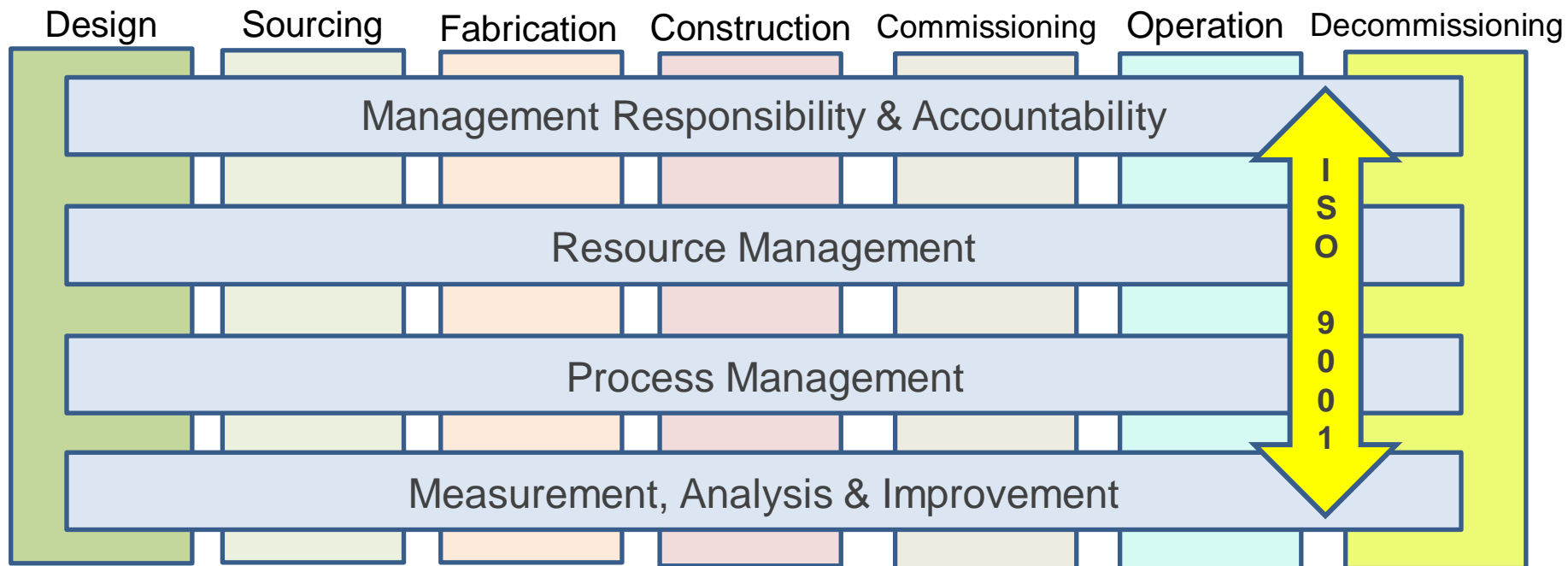
Do: Implement what was planned

Check: Monitor, measure and report the results and performance

Adjust/Act: Take actions to improve performance

Quality Management System is more rigorous in nuclear

Most companies base their Quality Management System (QMS) on the ISO Standard 9001 – but this is not sufficient for the nuclear industry.



Addressing the quality management challenge

The nuclear safety and quality management system specifies requirements, standards and guidance on activities or processes. The system is evolving as a result of IAEA, ISO and ASME reviews.



Vendor quality and oversight in Aerospace

- Enhanced oversight of suppliers is expensive
- The aerospace industry is an example of how companies in the supply chain can work together:

The logo for SAE International, with "SAE" in bold black and "International" in blue script.

Aerospace Quality Management Standard
AS/EN 9100 complimenting ISO 9001 with extra requirements

The logo for the International Aerospace Quality Group (IAQG), featuring the letters "iaqg" in blue with a globe icon integrated into the "a".

Provides guidelines and best practice

The logo for the Performance Review Institute (PRI), featuring a red globe icon to the left of the text "PRI" in red and "PERFORMANCE Review Institute" in black.

Industry-managed quality control program and performance metrics to drive up product quality and reliability

The logo for Nadcap, featuring a stylized globe icon to the left of the word "Nadcap" in blue script.

Nadcap was formerly called the National Aerospace & Defence Contractors Accreditation Program

ISO 19443: 2018 for the nuclear supply chain

Specific requirements for the application of ISO 9001:2015 for quality management by organizations in the supply chain of the nuclear energy sector supplying products and services Important To Nuclear Safety (ITNS)

ISO 9001

- Process approach
- Risk management
- Plan-Do-Check-Adjust

ISO 19443

- Quality management
- Documentation
- Planning
- Responsibility
- Resource management
- Procurement
- Product realization
- Measurement, analysis and improvement
- Control of non-conformances

Improve understanding of quality requirements by the suppliers

Helps increase safety culture

Translates very general requirements and providing guidance for implementation

Standardize the requirements

Capitalizes on industrial practices already well understood and applied in other industries while strengthening the integration of the nuclear requirements

Promote all major nuclear industry players to work in the same direction with their suppliers

Helps suppliers through an unique and shared quality platform

Represents a greater attractiveness for suppliers as an international and recognized standard, trans project and over time

➡ **cost reduction, quality enhancement**

Creates a capitalization of know-how and competence of supply chain

➡ **creates a high quality platform of nuclear suppliers**

Memorandum of Understanding on a Roadmap for Certification to ISO 19443

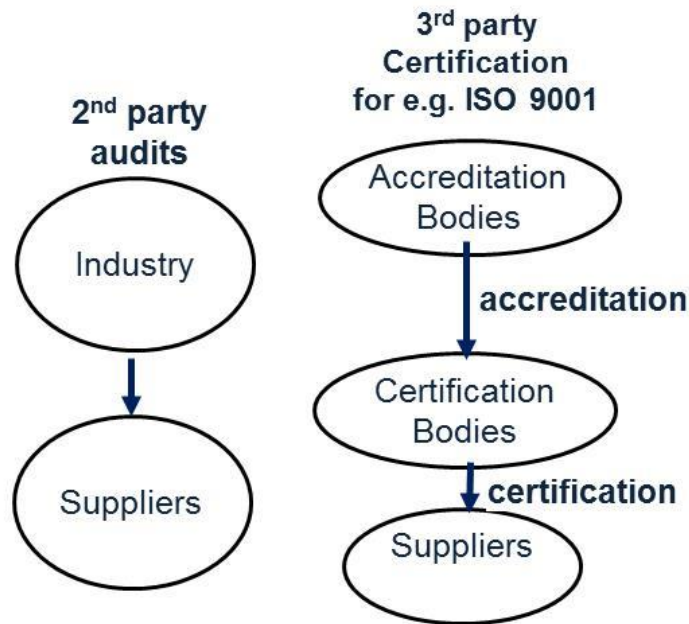
A memorandum of understanding to explore a roadmap for an industry-controlled certification scheme was signed on 6 November 2018 in Paris. In addition, an ISO working group is preparing guidance material to support the implementation of the standard (ISO TS 23406).



'Industry Controlled Other Party' accreditation and certification to ISO 19443 (17021-NUC)

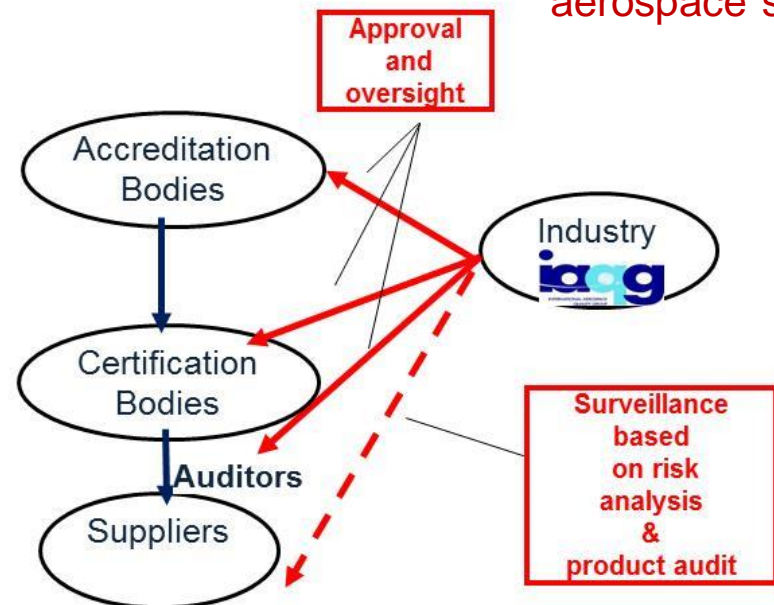
Discussions are on-going on the introduction of a possible structure that might be similar to that used in the aerospace sector.

The 'traditional' schemes



The 'ICOP' scheme for EN9100

aerospace standard



Cooperation Roadmap for a Nuclear Industry-Controlled Certification Scheme

1. To cooperate on defining **the most adequate scheme**: scope, participants, rules, governance, functioning, and interface with other organisations (such as regulators or accreditation bodies) or nuclear industry associations (for example, reactor owners' group, WANO, NUPIC, CANPAC).
2. To cooperate on a **scheme to strengthen the competence of the ISO 19443 auditors**
3. To cooperate on **information exchanges and mutual recognition** of national certification.

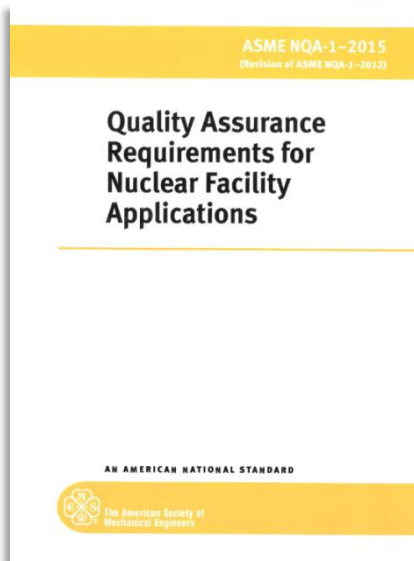
Existing exchange platforms that exist in the aeronautics, automotive and the railway industries can be used as input data. Consideration will be given to topics such as: shared data base, what information can be shared and with whom.

Strengthening oversight of the nuclear international production system



19443: Requirements for quality management systems in the supply chain of the nuclear sector supplying products and services important for nuclear safety
17021: Requirements for certification bodies
TS 23406: Guidance material

ASME
NQA-1



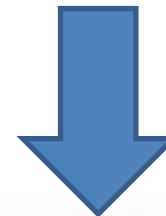
Special
processes



Prerequisites



Common
QMS



Guidance
Audits
Checklists

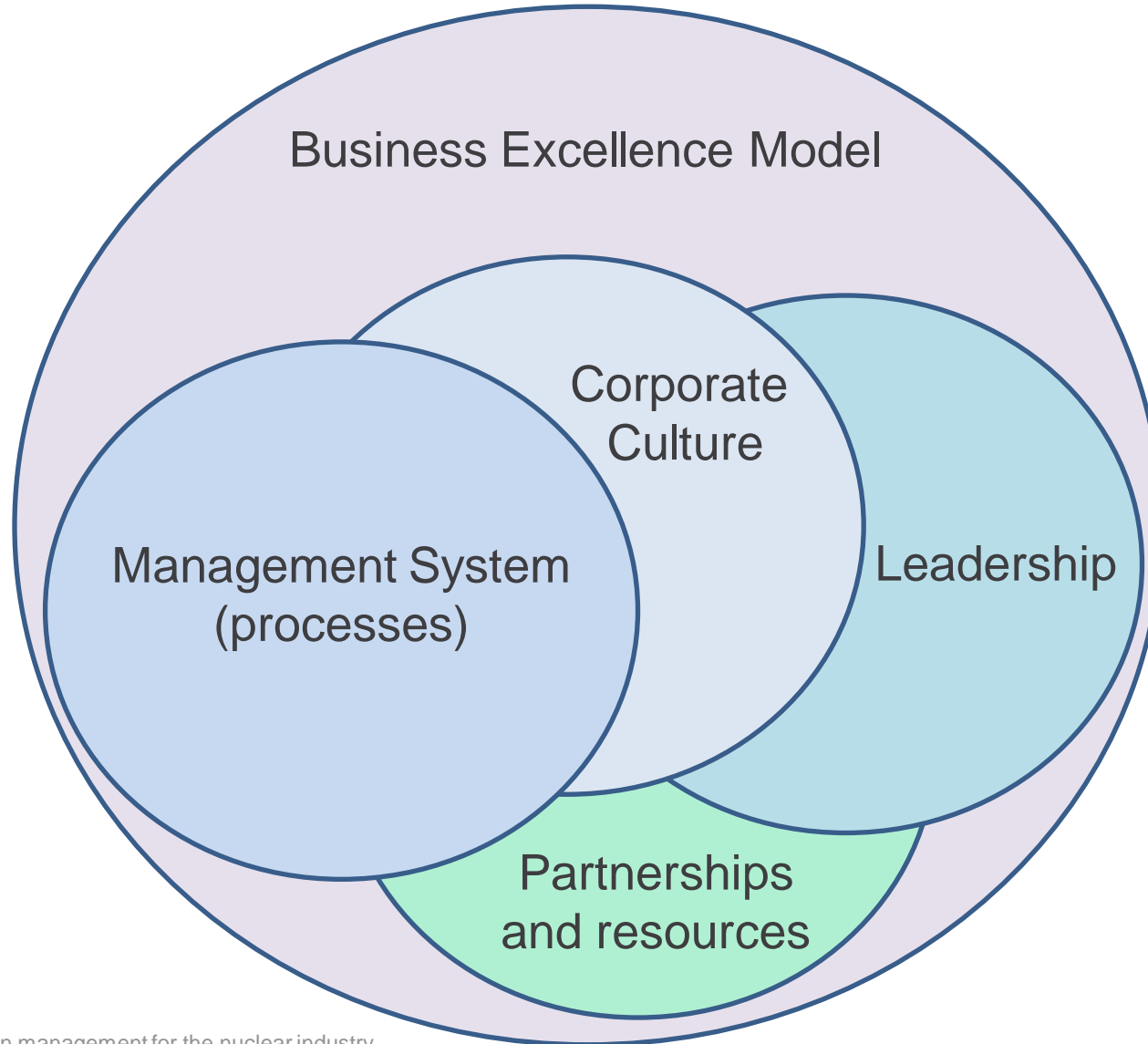
3. Achieving Excellence

- Business excellence models aim is to integrate business processes to:
 - Avoid **conflicting objectives**;
 - Encourage **continual improvement**.
- Performance excellence refers to an **integrated approach** to organizational performance management that **results** in:
 - Delivery of ever-improving value to customers and stakeholders, contributing to organizational sustainability;
 - Improvement of overall organizational effectiveness and capabilities;
 - Organizational and personal learning.
- The principles are similar to those espoused in ISO 9004 and by the Institute of Nuclear Power Operations (INPO).

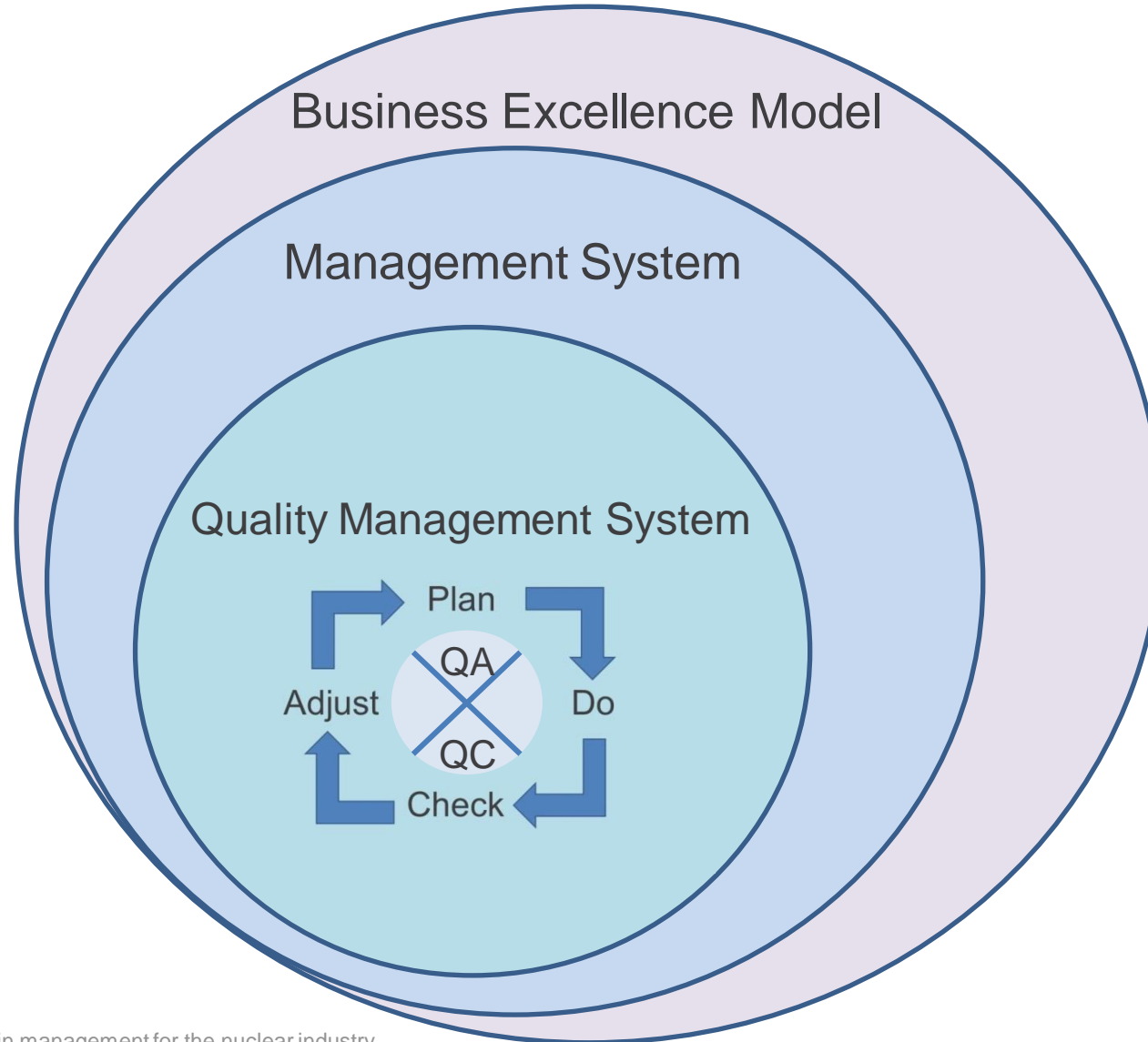
Institute of Nuclear Power Operations (INPO) model

- INPO 09-011 Traits of Organizational Excellence:
 - The picture [vision] of excellence is well known;
 - Problems are prevented and mistakes avoided;
 - Performance gaps are analyzed thoroughly and solved efficiently; and,
 - Performance improvement is ingrained as a core business practice.

Business excellence



4. Take-aways



- Quality management system = PROCEDURES
- Human performance = CAPABILITY
- Safety culture = MINDSET
- Business excellence model = FOCUS

Thank you:
Greg KASER
WNA London

greg.kaser@world-nuclear.org
www.world-nuclear.org

www.world-nuclear.org