EXTREME BRIDGES IN MARINE ENVIRONMENT: CONCRETE & STEEL FLOATERS

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Agenda

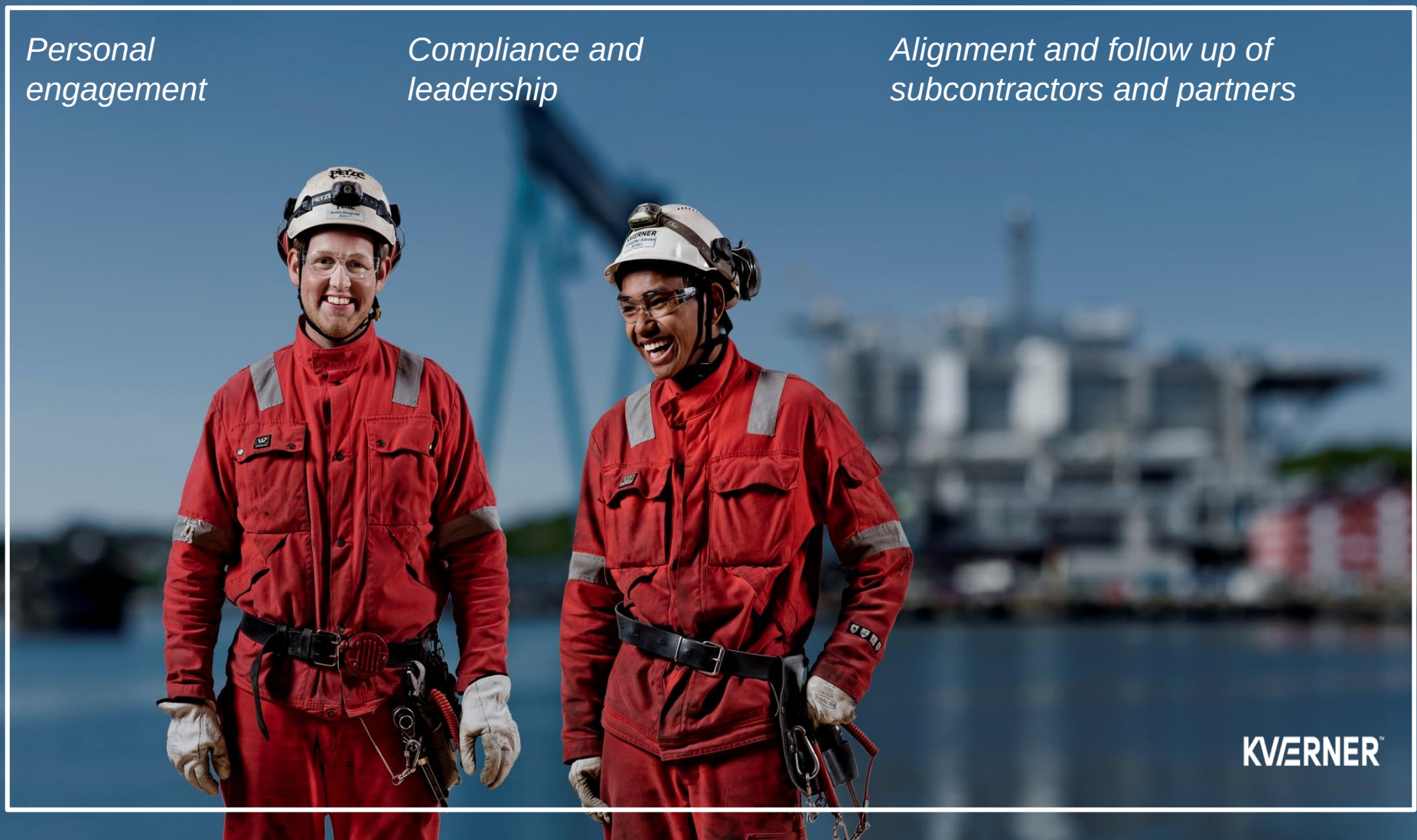
1. Background
2. Technical challenges and how we resolved them
3. «New» technology
4. International cooperation and regulations
5. Lessons learned from international projects / fabrication
6. Our Norwegian partners abroad
7. Utilization of our competency into other product segments
8. E39 projects relevance for an offshore contractor

Safety – Our licence to operate

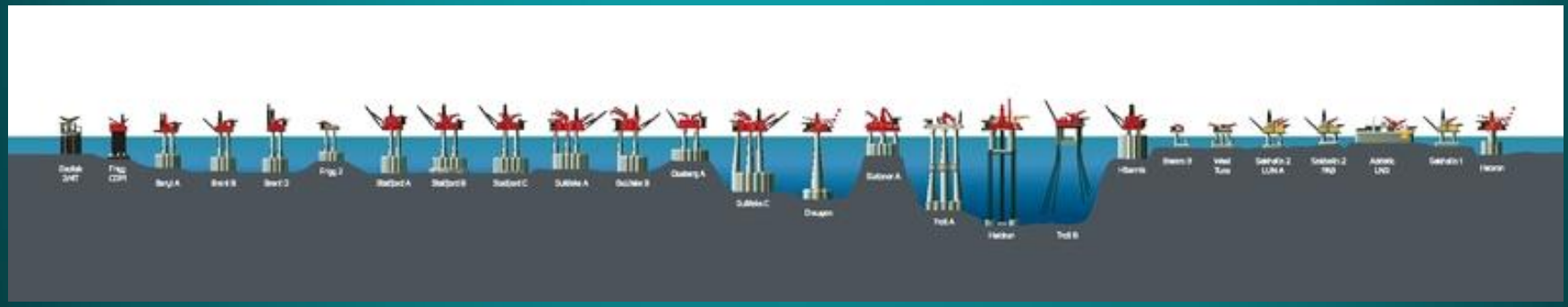
Personal engagement

Compliance and leadership

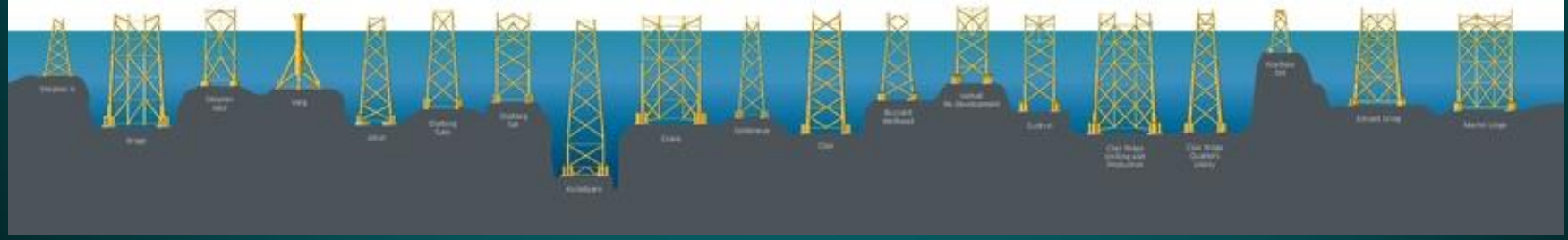
Alignment and follow up of subcontractors and partners



Where do we come from

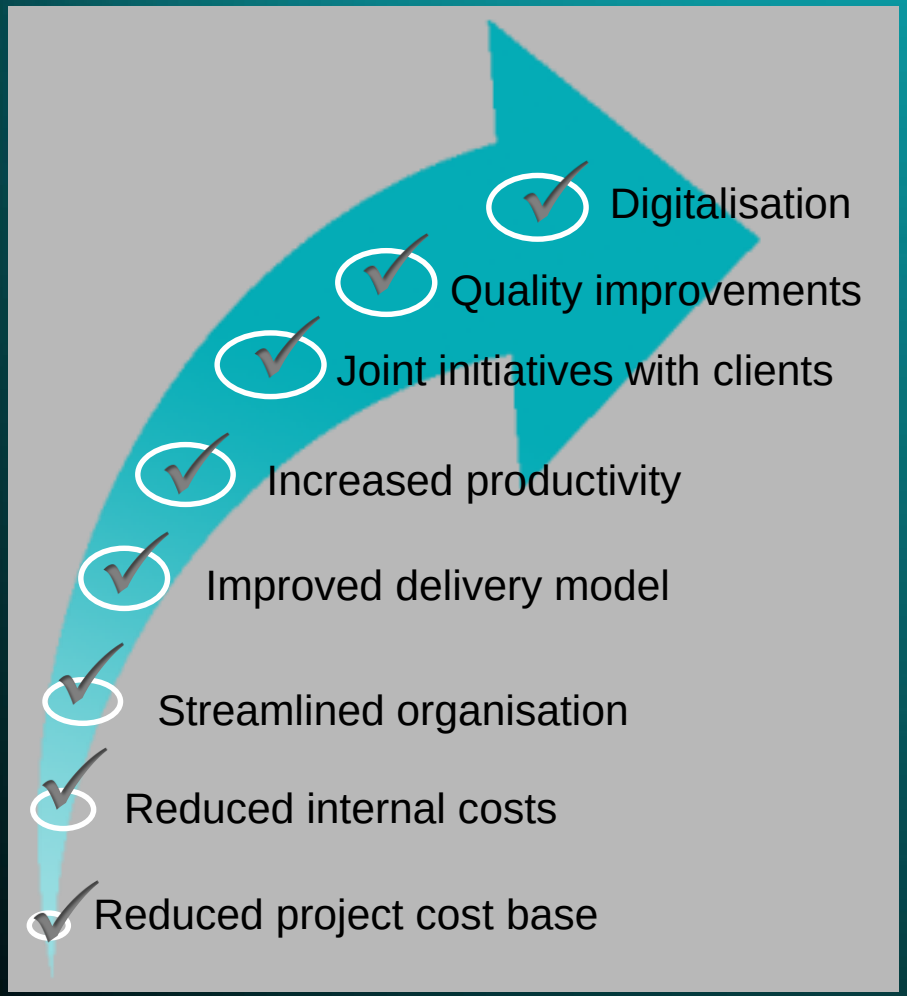


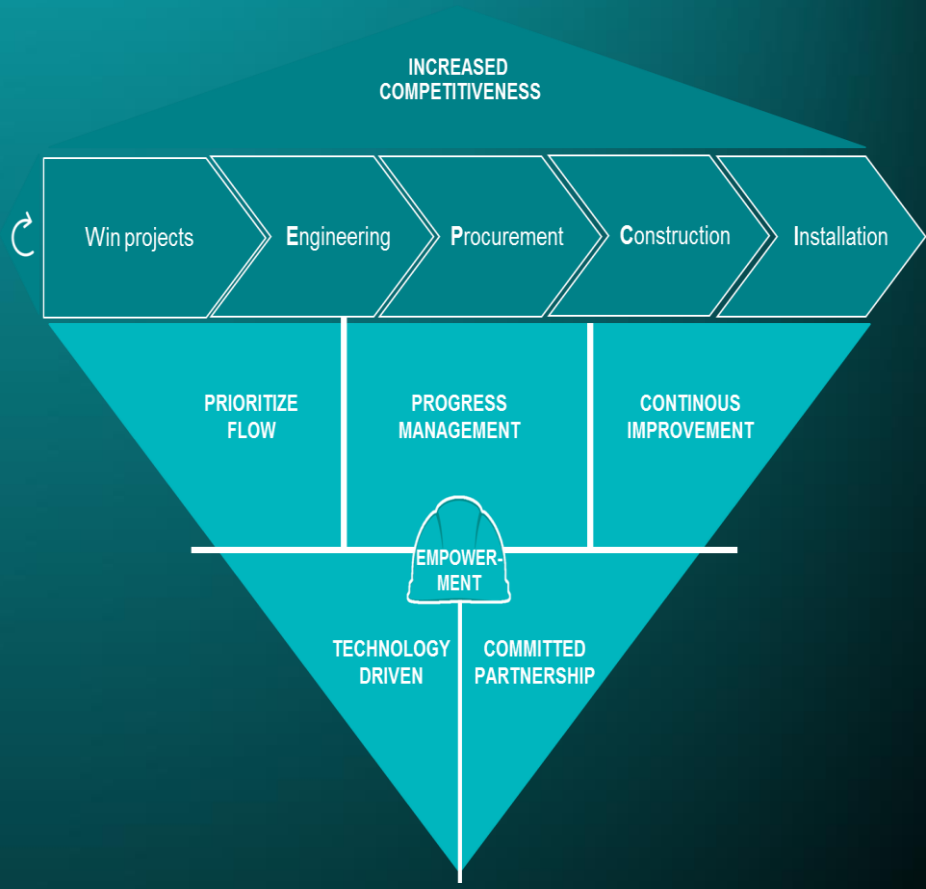
Steel Jackets: EPCI deliveries



Process structures: EPCI and PC deliveries

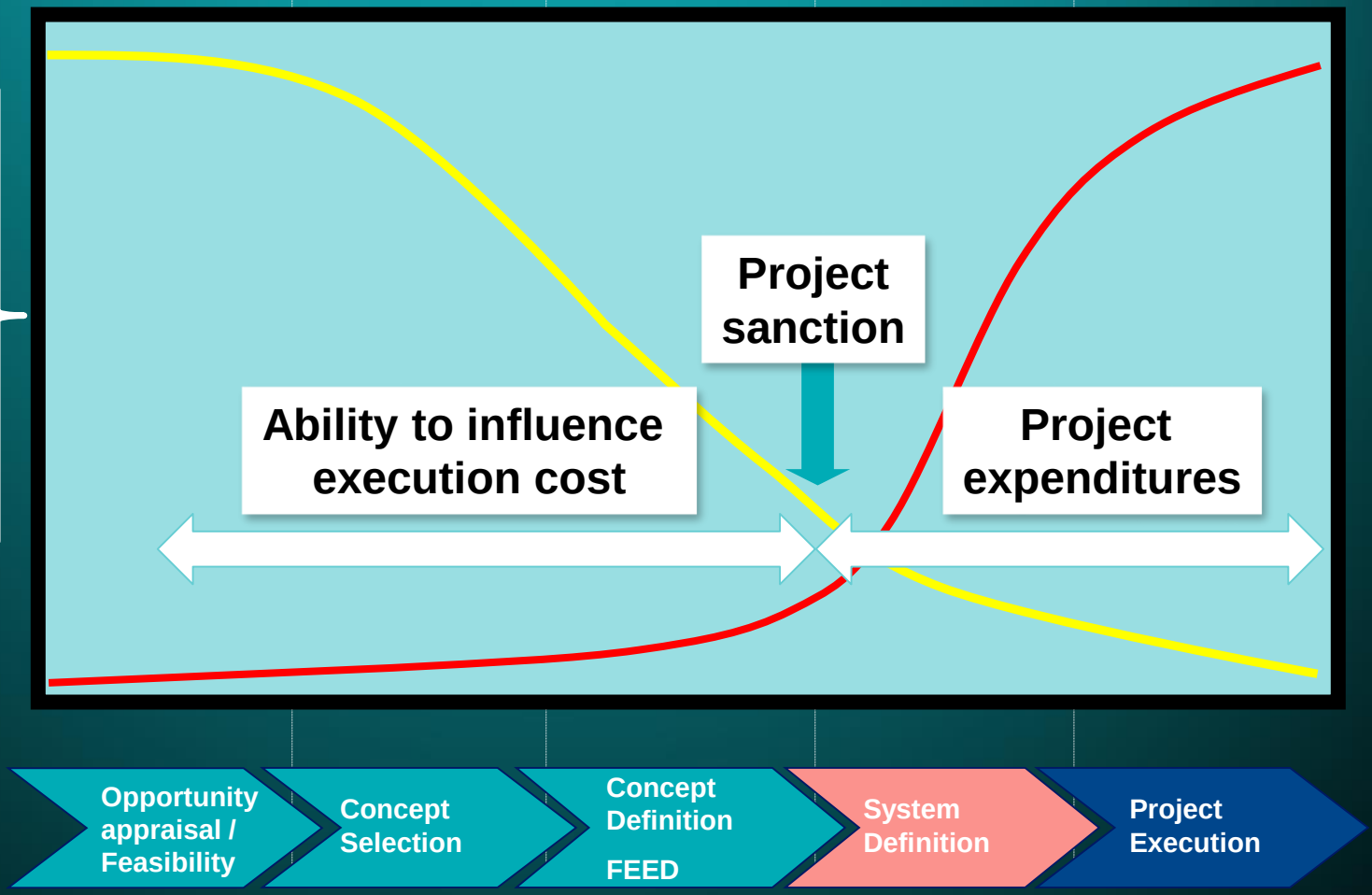
Continuous Improvement – Kværner beyond





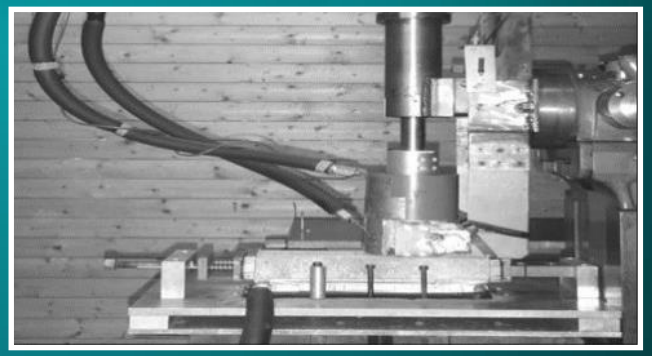
Technical challenges and solutions

- Design
- Prefab Yards
- Construction Yards
- Construction methods
- Transport
- Installation



Technical Challenges and solutions

- Sakhalin 1, Far East Russia: Ice-abrasion concrete mix and method developed (method patented)
- Hebron Topside mating – weight of 65.000 tonnes
- UHPC (Ultra High Performance Concrete)



«New» technology – Automated welding & NDE

- Time savings: 38% compared with manual welding
- Improved HSSE and sickness absence
- Optimal robot operation replaces 5 to 8 persons
- Improvement productivity of 50-80 %
- Today up to 50% of welds are automated
- Identify more SOW transferred to robots
- Digitalized NDT methods Phased Array Ultrasonic Testing (PAUT)
- Note: Material selection – low carbon content, CEV, primer etc.

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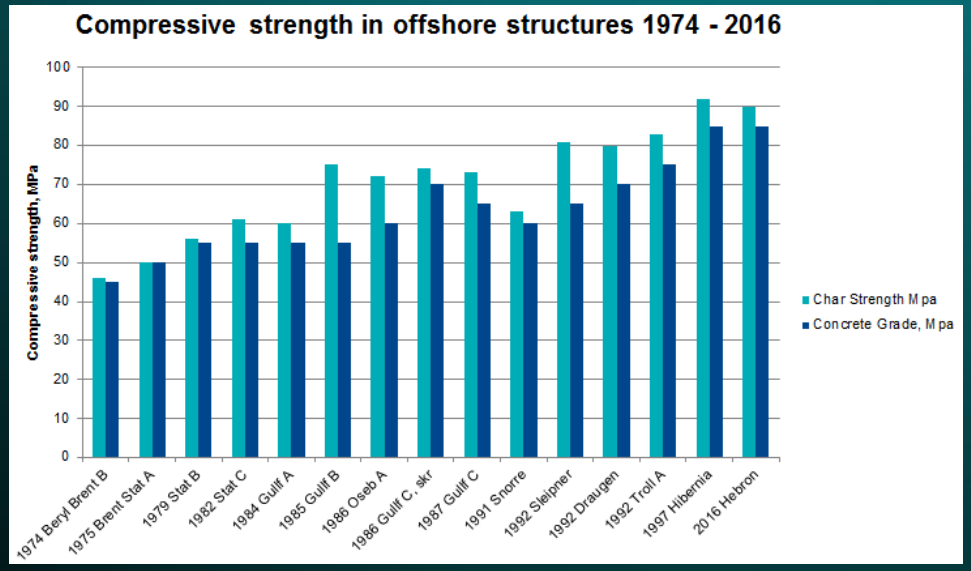
«New» technology - Concrete

- Effective design
- Higher compressive strength
- Robust execution
- Frost resistance
- Greater security for long lifetime - improved durability
- Weight control and –methods
- Participation in several Norwegian and international R&D projects



International cooperation and regulations

Prefabrication internationally for Norwegian market

Execution internationally for international markets

Common challenges:

- Our design is normally according to NS/EN standards
- Our project requirements are often more stringent than regulations
- Local material standards – different tolerances compared with NS/EN standards
- Culture differences
- Familiarize with facilities to determine methods – may impact design

International cooperation and regulations

Prefabrication internationally for Norwegian market

- Self-perform, prefab externally in Norway or prefab internationally?
  - Analysis of: complexity, competence, on critical path, cost etc.
- Requires a multi-discipline & hands-on site team from Kværner
- Transport costs
- All regulations not well known:
  - Training and project certification
- Limit carry-over work – close monitoring
- Develop long term partners

Lessons learned from international fabrication

Johan Sverdrup subcontracts at DryDocks World Dubai (DDWD):

- High capacity – 13.000 workers
- Low level of mechanisation (old equipment & manual work)
- Training of NDE inspectors
- NDE results achieved: good excepts UT
- Dimensional control – high focus (several NCRs)
- Weekly quality walks

International cooperation and regulations

Execution internationally for international markets

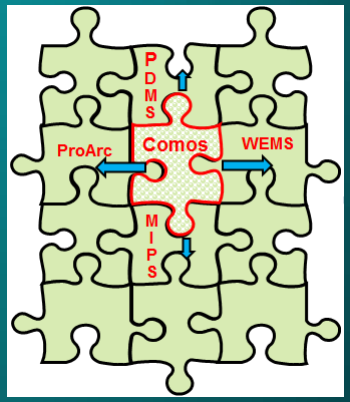
- GAP-analysis of standards and regulations
- Local design partner for identification and for closure of GAPs
- Perform testing and validation in accordance with both NS/EN and local standards
- Training of local engineers and workers
- Develop long term suppliers and partners

Partners

- Both local and Norwegian partners have been required on our projects
- Local content
- Local knowledge about e.g. suppliers, subcontractors, HSSE requirements, equipment
- Norwegian partners involved in our projects abroad – e.g.:
  - Sintef
  - IKM
  - Vitec
  - Concrete Structures (50% Kværner)
  - Engineering partners supporting with personnel on Hebron (Aas Jakobsen, Sweco, Multiconsult, Norconsult, Olav Olsen)

Utilization of our competency

- EPCI experience – understanding the cost drivers
- Constructability – influence on design
- Project management – large, complex projects
- Interface management and system
- HSSE & Q management system
- Multidiscipline Engineering and Construction skills
- Capacity
- International experience
- Systems



Applications are linked together by means of data transfers, interface rules and customized consistency checks between the applications.

Øymerd fish farms

Wind foundations

Extreme fjord crossings

E39 projects of interest?

- We use of effort where we can **add value** to the concepts and projects positively for the Clients
- Early involvement and impact on concept and design for reducing CAPEX and OPEX:

  - Secure execution of the project
  - Contract strategy and international experience
  - Impact cost drivers
  - Consider fabrication and installation facilities for optimizing the methods and concept
  - Material selection
  - Advise on modifications to Clients' specifications
  - Early alignment with Client on best practice
  - Utilize long experience with concept developments transferred to FEED and EPCI
  - Multidiscipline interface handling (internally and externally)
  - Utilize experience with handling uncertainties throughout design phases and establish robust solutions that can handle changes in design input

