ONS 2016 Archives and history

The remaking of Norwegian concrete technology for the offshore business

Jan Moksnes,

former CEO of Norwegian Contractors

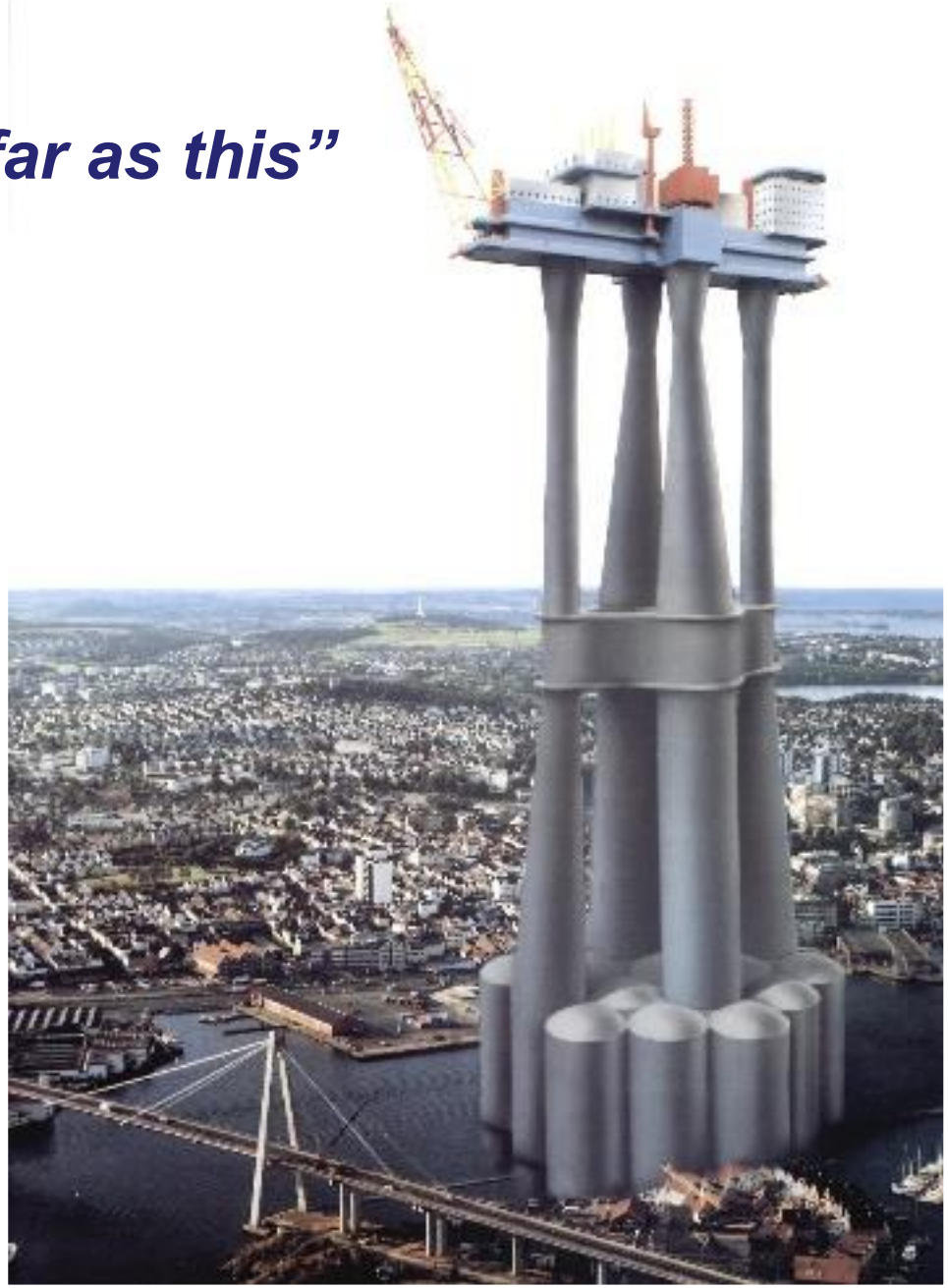
"It started with a market opportunity, a good concept and determined people…

..and got as far as this”

Troll A

Client: Norske Shell

- Delivered 1995
- Height 369 / 472 m
- 245 000 m3 concrete
- 106 000 tons steel
- 227 m towing draft
- 40 m skirt piles

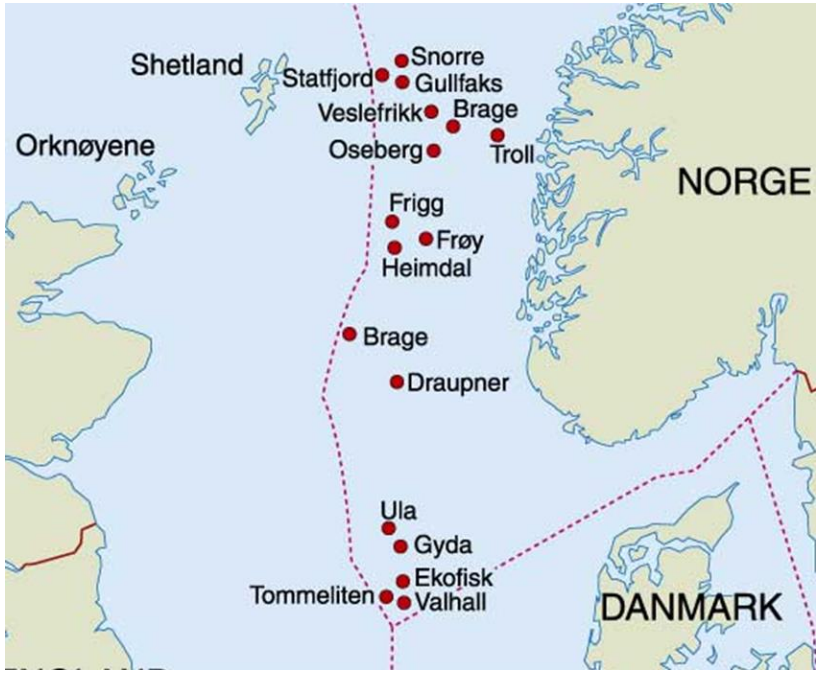


North Sea 1971 – construction opportunities arising in a hostile marine environment

The oil and gas industry needing **production facilities** capable of dealing with

- Water depths up to 300 m
- Wave heights 30 m
- Up to 200 km from shore
- Storage capacity 2 mill bbl.
- Top side up to 50 000 tons
- Soft soils up to 40 m deep

Is this a realistic opportunity for concrete in a steel minded industry?



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1971 – 1995 a golden era for offshore concrete platforms

In this period 15 large concrete offshore structures were built in Stavanger by Norwegian Contractors, now Kvaerner.

The concrete pioneer was Ekofisk. A large storage tank developed and designed in France and built in Stavanger, taking advantage of a deep fjord and a readily available construction site. Ekofisk was installed in 1973 and paved the way for new ideas and new concepts for production facilities in other North Sea oil and gas fields.

One such concept was **Condeep,** developed by Norwegian Contractors, built at Hinna and supported by a network of consultants and suppliers.

Condeep. How did it happen? Not entirely by chance

In 1971 the construction industry was familiar with demanding land based projects: large dams, processing plants, bridges, harbours, urban developments

Offshore was something else - different clients, environment, rules, risks. Some bold contractors accepted the challenge…

Experienced contractors and skilled designers developed the *Condeep concept*

The main elements:

- Storage capacity
- Slim shafts supporting a heavy production facility and protecting the risers
- Large heavy base for stability and floating
- Inshore completion
- Instant installation
- Reinforced concrete – strong and durable
- High local content

Construction in a dry dock and floating in a deep fjord, deck mating and tow to field

Hinna Dry Dock 1986.
GFC 42 m tall in a 14 m deep dock.
Float-out on giant air cushion

Deck mating by float over – not for the faint hearted.
Draugen 1993. 279 m below water, 6 m above! Top side float-over.
Sleipner A cracked and sank during trial submergence in 1991

The concrete GBS era – what made it happen?

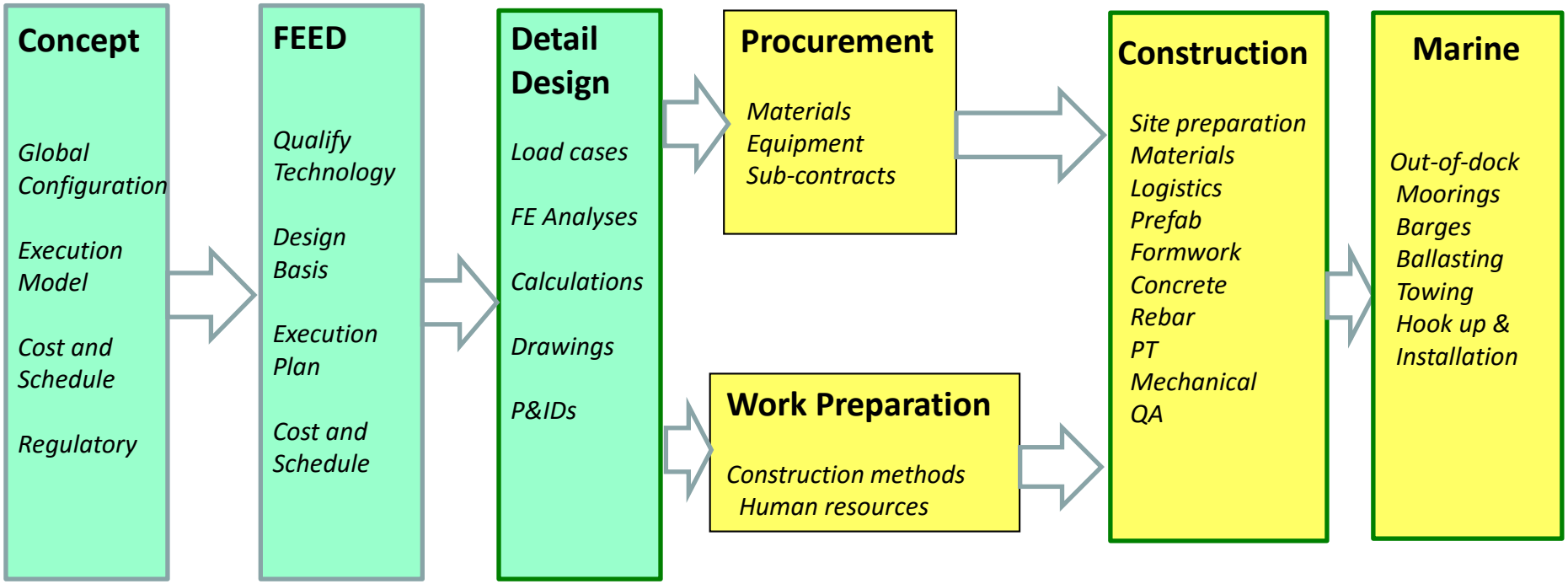
- ✓ A demand for new products in a new setting
- ✓ Competent clients with open minds
- ✓ Contractors with experience and courage
- ✓ Designers with flair and front end competence
- ✓ A JV attitude and a cooperative national network
- ✓ Marine traditions
- ✓ Resolute politicians
- ✓ A productive and loyal work force

And from nature: Deep fjords

Buoyancy

Chain of activities in a concrete GBS project

From concept to delivery – technology, management, execution



More than concrete and steel

EPCI = 1 contract / 1 contractor. Constructability focus

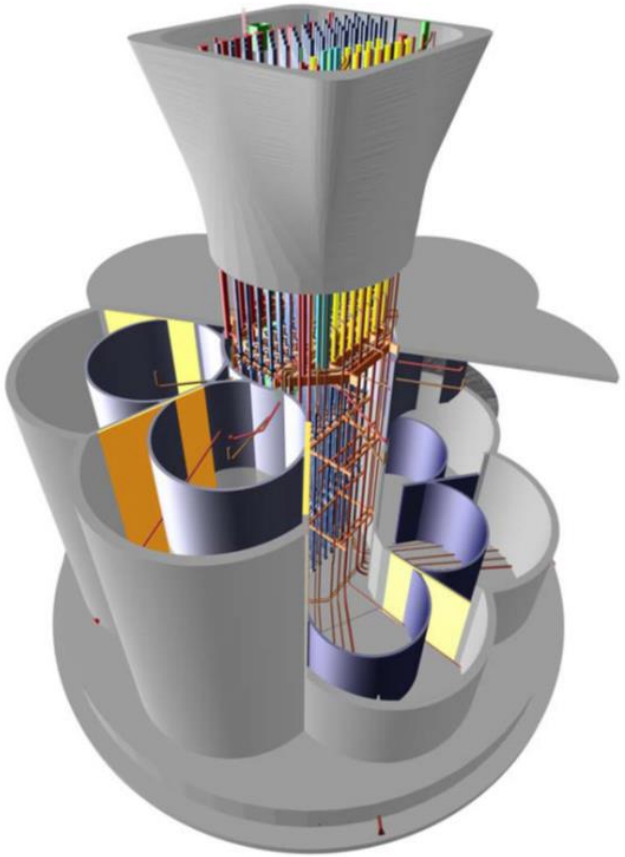
Some Condeep era toolbox hand overs

- **Developments in structural analysis and design.** FE analysis of numerous load cases defining stresses and strains
- **Much improved concrete strength and workability.** Slimmer walls and slabs, lighter structures
- **Slipform developments** for demanding geometries
- **Skirt piling** Instant installation and stable foundation in soft soils
- **Planning and monitoring systems** for multidiscipline activities
- **Updated Codes and Standards** incorporating decades of R&D and front end technology

Remaking of the Condeep experience in Australia, Newfoundland, Spain, Russia …

Dry dock near Vladivostok in Russia. Sakhalin 1 in 2011. Water depth 33 m, concrete volume 52 000 m^3.

Hebron GBS in Newfoundland 2016 Single shaft, 7 storage cells, cylindrical ice wall. Concrete volume 135 000 m^3. Water depth 93 m



The NC / Kvaerner track record consists of 18 + 8 projects world wide

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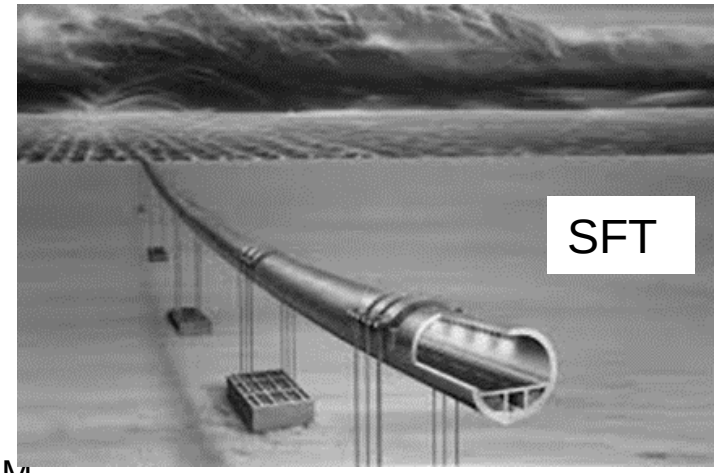
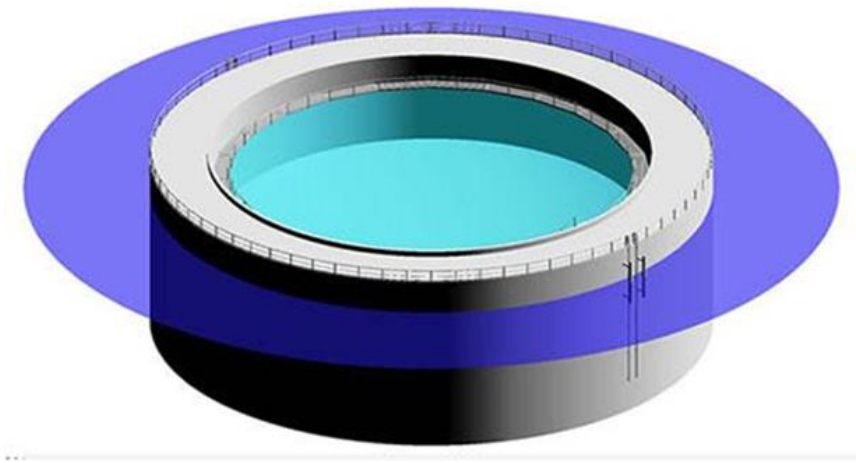
Remaking of offshore concrete technology in new solutions for strait crossings

Suspension bridge on floating pontoons

Floating cable stay bridge

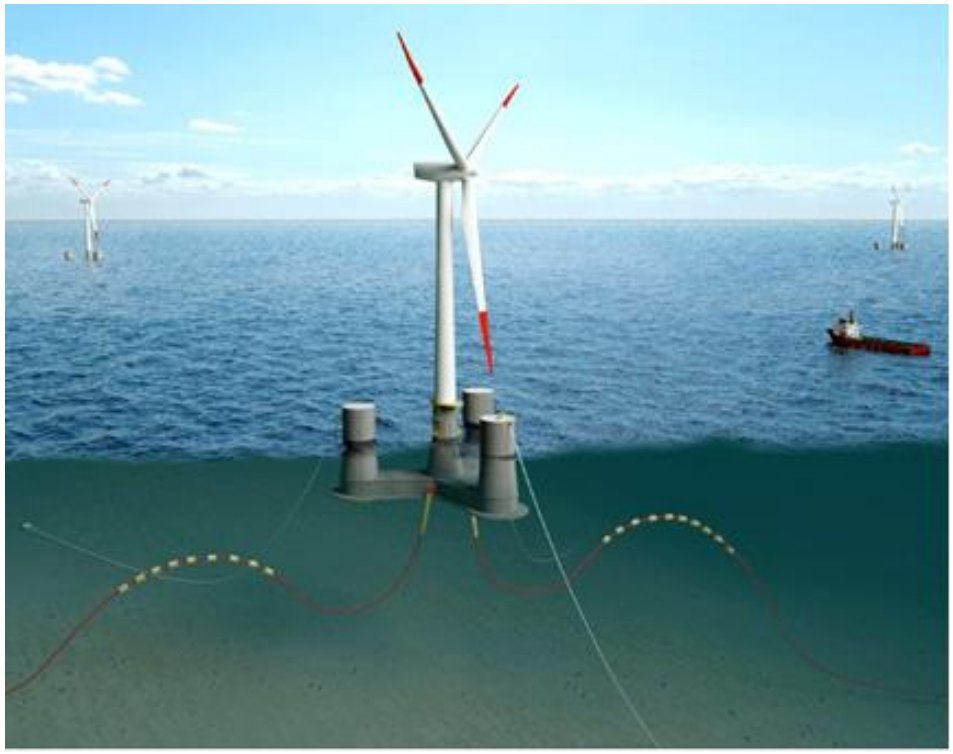


Remaking of offshore concrete technology in fish farms and offshore wind mills



.Concrete fish farm

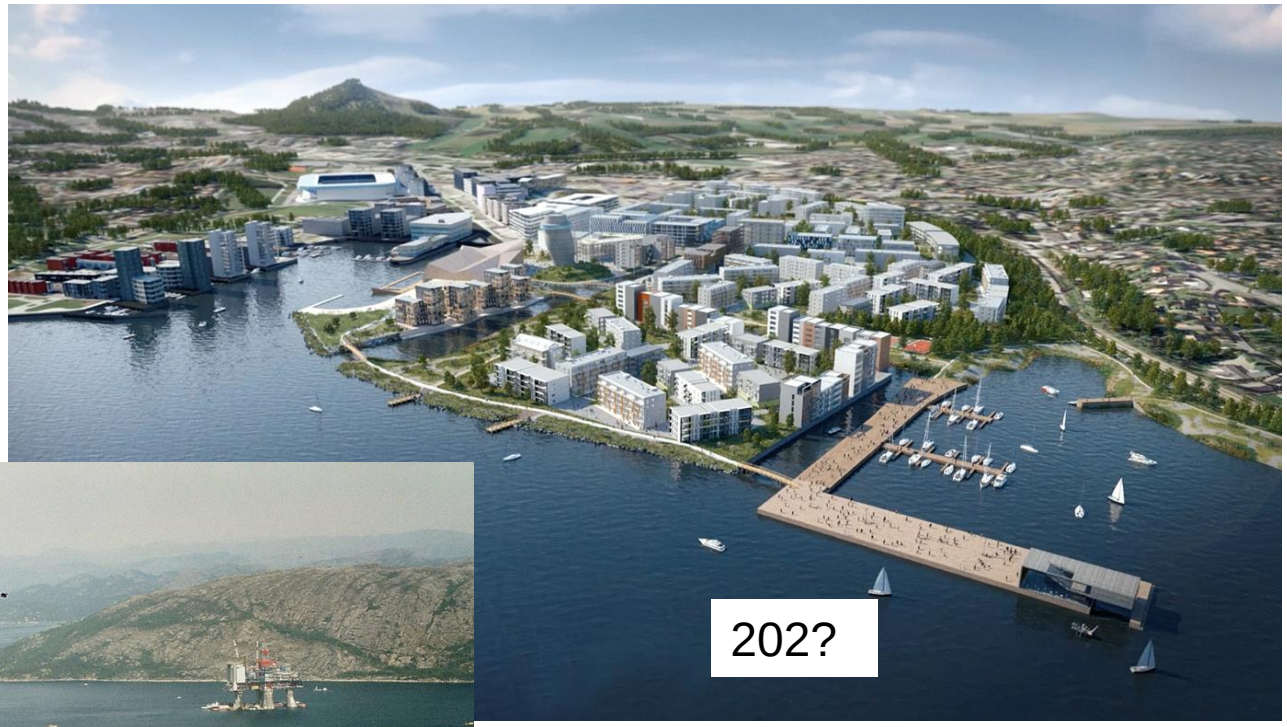
- Strong
- Durable
- Slim walls
- Escape proof



Semisubmersible offshore wind floater

- Inshore completion
- Robust wrt turbine size
- Good motion characteristics

Remaking of the Hinna yard…from an efficient dry dock facility to a modern Hinna Park



The legacy of the Condeep era

- Demonstrated how catching windows of opportunity can lead to major developments in technology and in business.
- Demonstrated how EPCI contracts work well for demanding projects. One contract / one contractor / multidiscipline coordination focus
- Demonstrated that maintenance free service life performance can be achieved for concrete structures in hostile environments
- Created significant progress and knowledge in concrete technology, construction methods, project execution and quality assurance
- Contributed to updates on Codes and Standards fostering progress in design and construction for new projects
- For the archives: making records from the Condeep era available to *Norsk Olje- og Gassarkiv (NOGA)* and *Norsk Oljemuseum*