Bringing energy and the environment into harmony.®





Complex Power Systems for offshore oil & gas topside installations

Odd Guldsten
VP & General Manager
Dresser-Rand AS

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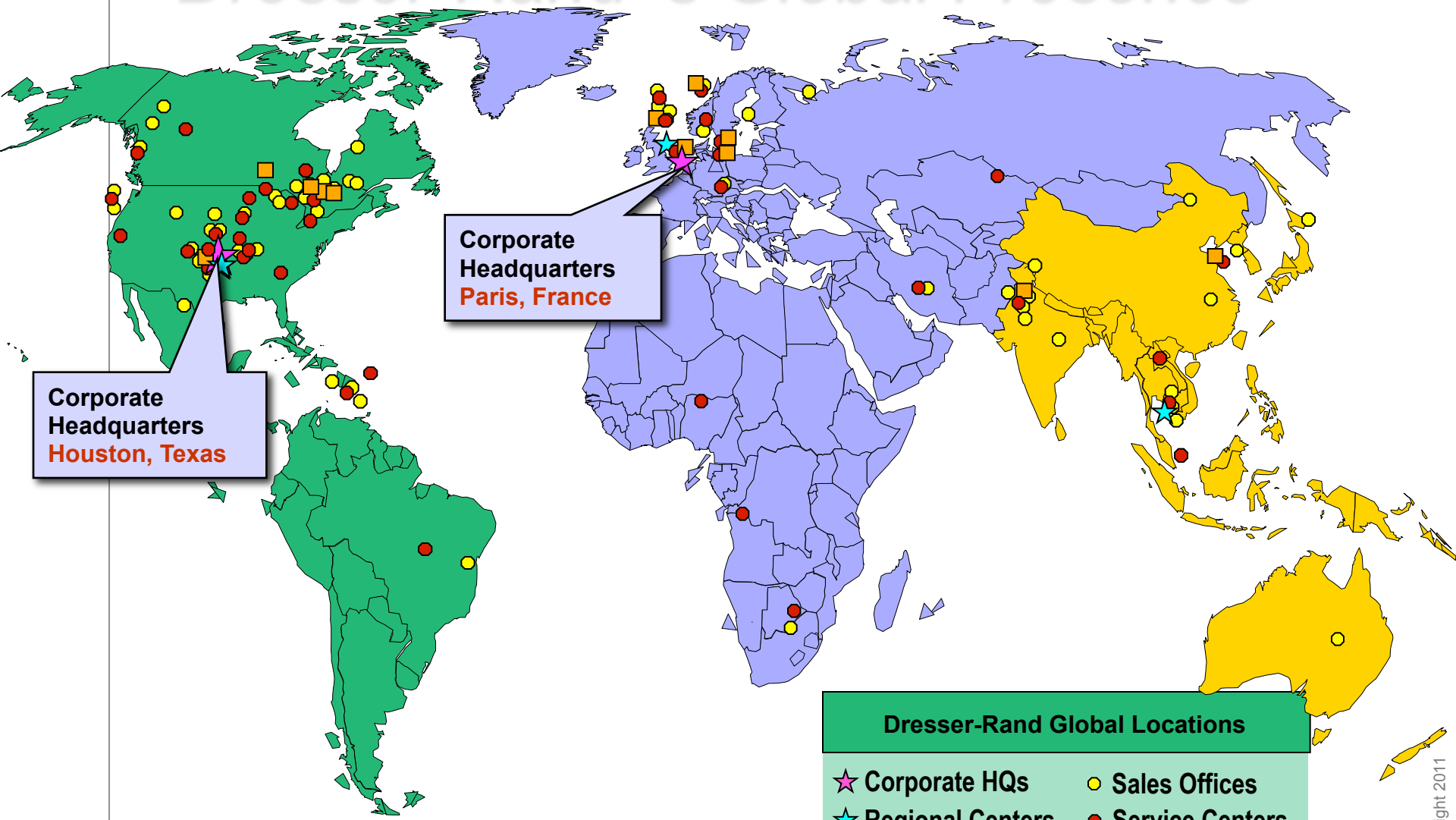
Dresser-Rand's Global Presence



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Dresser-Rand AS

- Former Gas Turbine Division of state owned Kongsberg Våpenfabrikk
- D-R established in Norway since 1985, part of D-R inc(NYSE)
- Sales approx 1,500-1,750 mill NOK pr year with approx 200 employees
- Norway is D-R's sole packager of Gas turbines incl GE's Aero derivate Industrial turbines (15-55 MW)
- Has delivered or in backlog more than 5000 MW of gas fired (gas turbines) power from the Norwegian Operation
- Approx 70% of Norwegian natural gas export is going through D-R centrifugal compressors
- Has approx. 600 MW (22 units) of gas turbine packages in backlog
- Has developed a 3rd generation KG2 gas turbine (2 MW) named K2-3G (2008-11) which now is going through the initial testing

Kongsberg Teknologipark

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Drammen
Assembly - Testing

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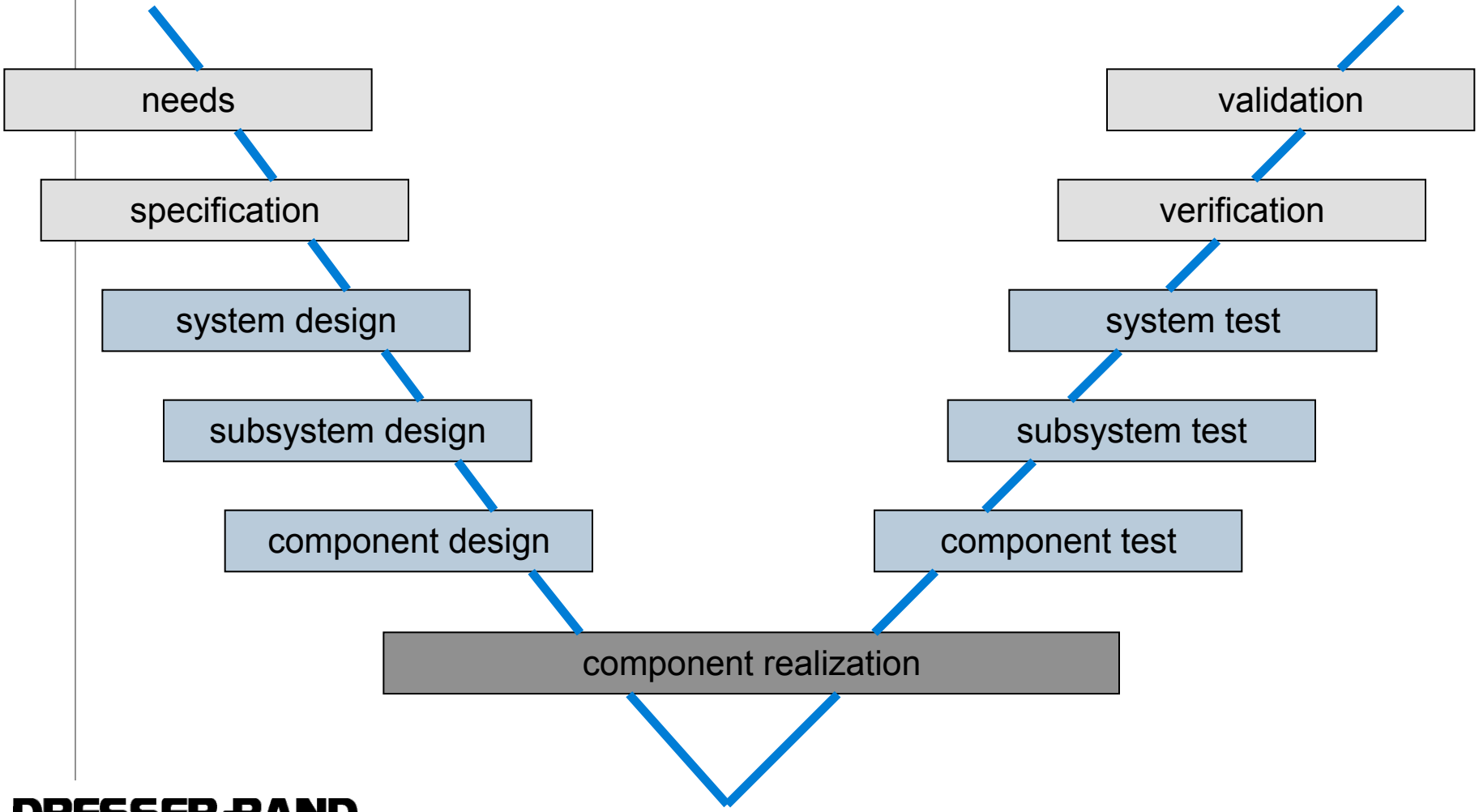
V-Model for Systems Engineering



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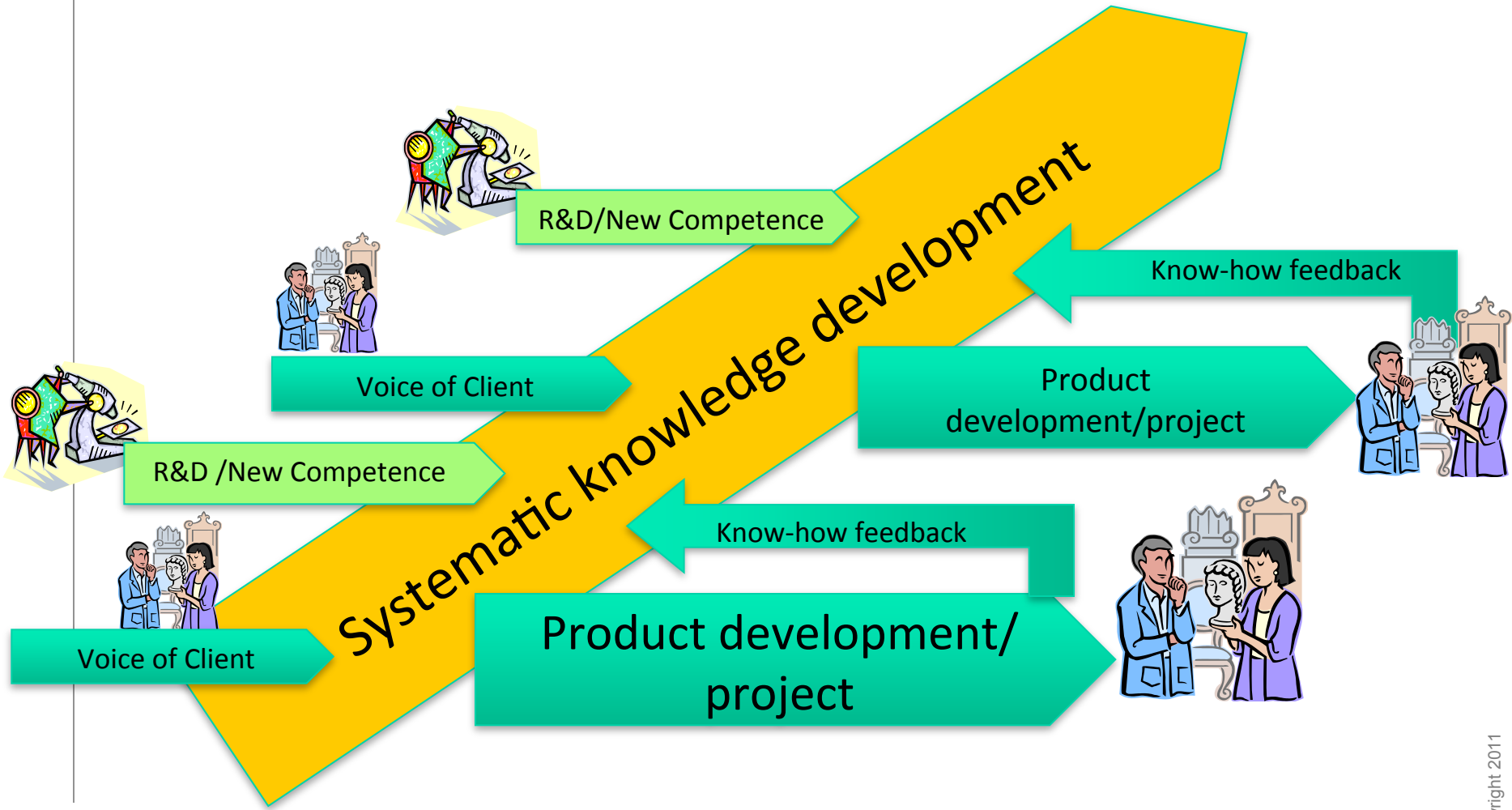
Knowledge Based Development



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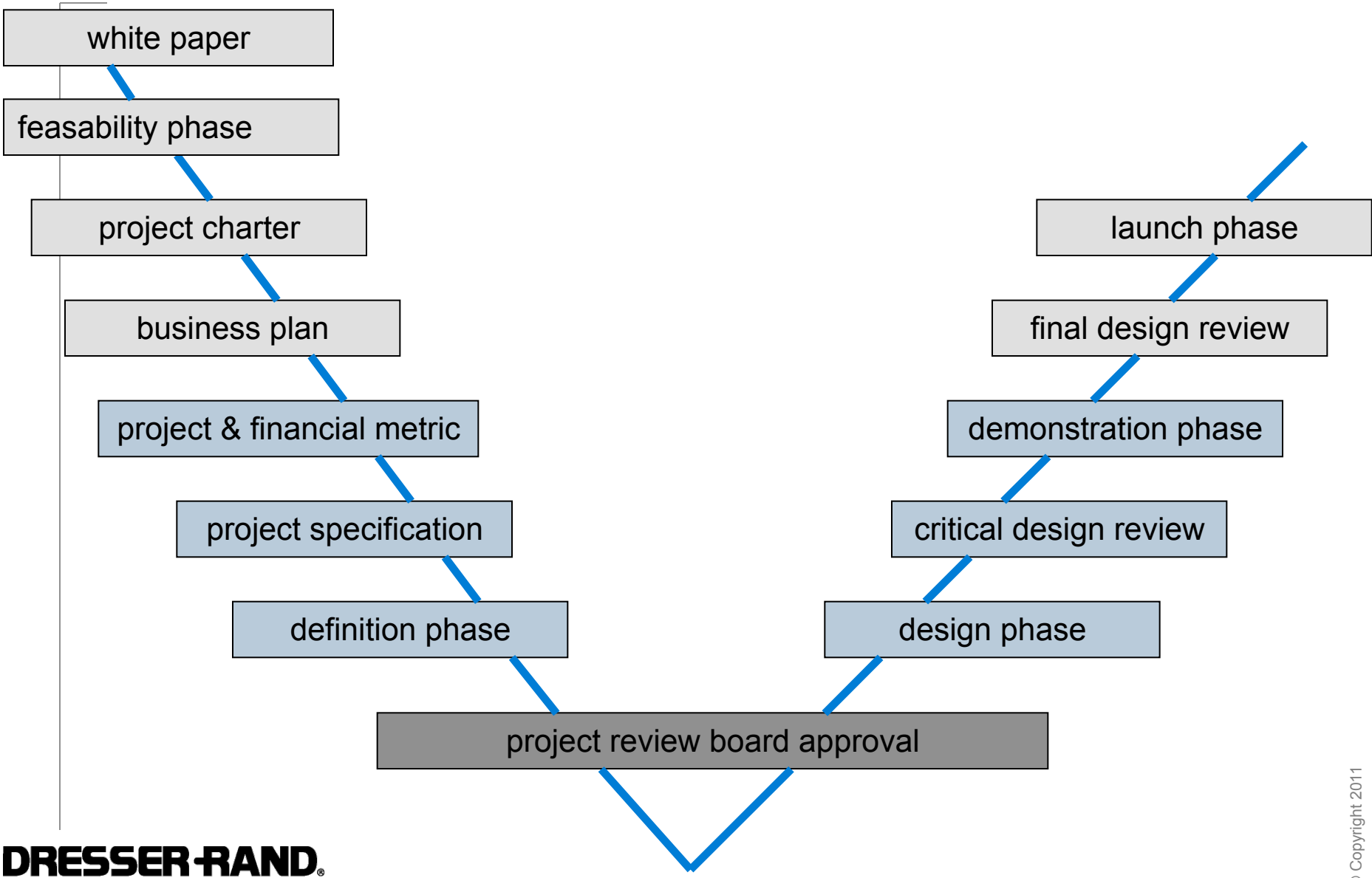
D-R's "V-Model" for R & D



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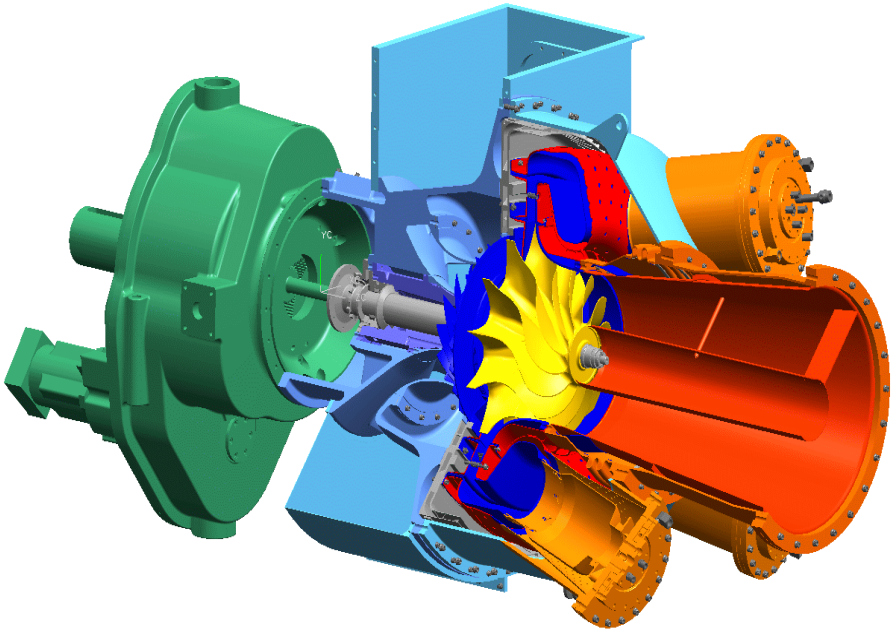
Solution Creation



White Paper (idea)

Operational

- Specification
- Business plan/budget
- Schedule

Design & Demonstration

- Technical
- Engineering
- Product Costing
- Detail Design
- Verification

Marketing

- Voice of the client
- Commercial
- Support
- Introduction
- Full & Unconditional release

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SE-KBD is much more than a tool for technicians:

Comprehensive approach to solving complex challenges:

- **Essential for market success**
  - **Meet or exceed client expectation**
  - **Focus on execution of correct tasks in expected time frame**
- **Essential for profit**
  - Effective execution process
  - Minimize rework
  - Life cycle evaluation at design stage
- **Essential for enhancing clients efficiency and competition**
  - **Create client loyalty**

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Small, but complex topside services

- Limited space
- Need stable power and process heat
- Large consumers w/step-loads
- Limited gas supply, but want to use what is available
- Unmanned
- Remote

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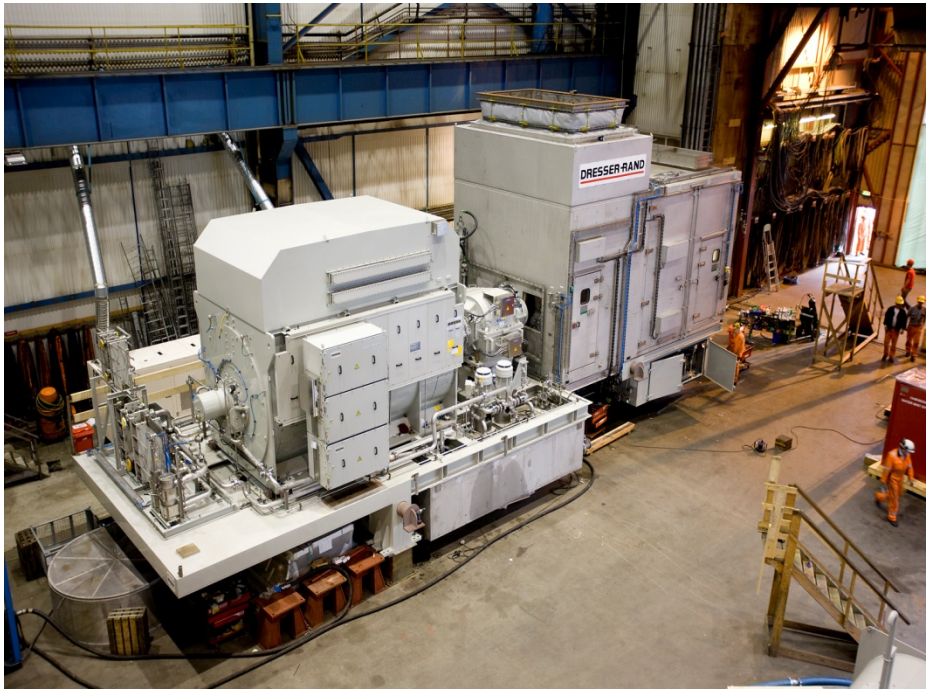
Project Metrics for Large (>75 MW) Power Systems



- Meet Specifications (Quality)
- On Time Delivery
- Documentation flow on time
- Not exceeding weight (penalty)
- Frequency and Voltage stability
- Material to meet life>25 years
- High efficiency
- Provide enough process heat for the platform in all operation cases
- No or limited number of punch items at time of delivery
- Neutral cash low by meeting payment milestone conditions
- Meet cost target

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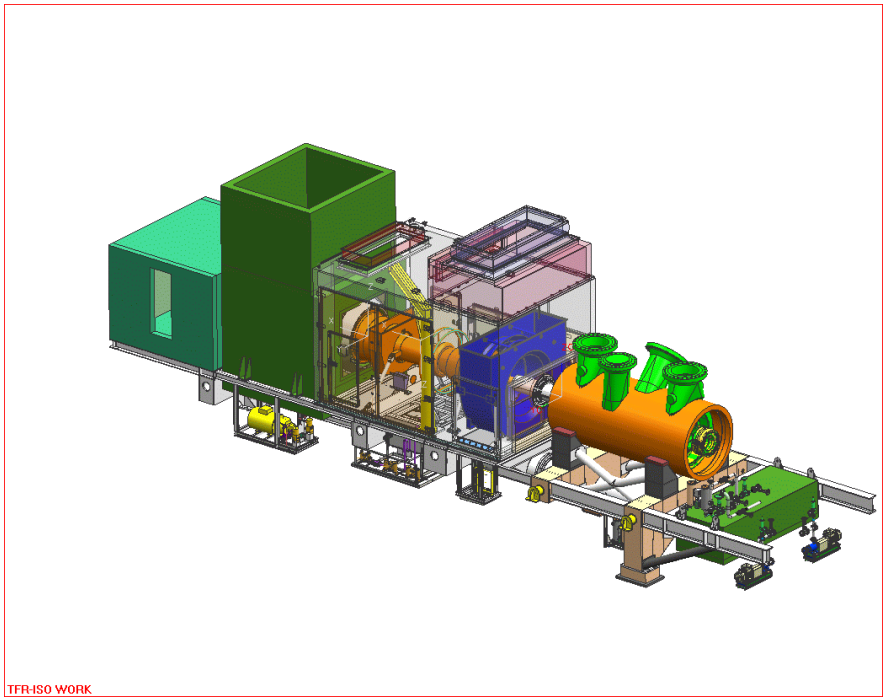
Planning & Resource Management (PRM)



- Energy market can be characterized as cyclic for capacity and competences
- Conflicts between projects
- Critical chain vs cost to secure good flow
- Progress and cost earned vs cost spent

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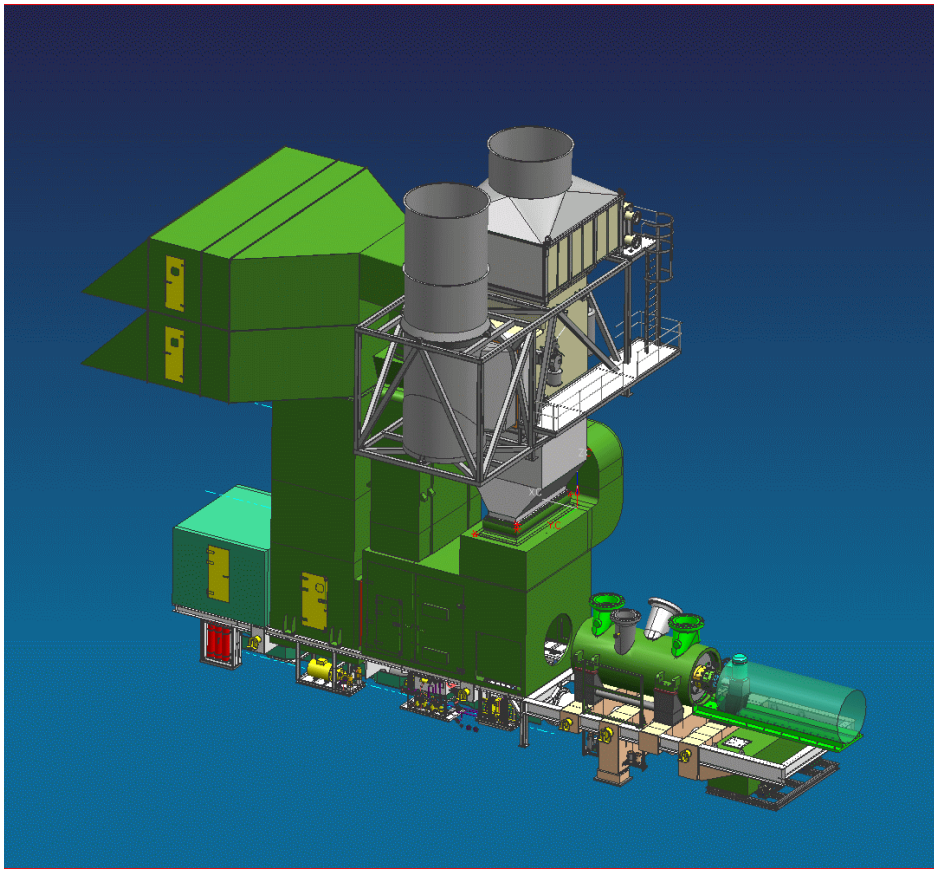
System Architecture



Initial Considerations:

- Schedule and milestones
- Size
- Weight
- Interfaces
- Working environment & serviceability
- Fabrication
- Transportation
- Sub assemblies
- Packaging
- Lifting
- Testing
- Commissioning & start-up

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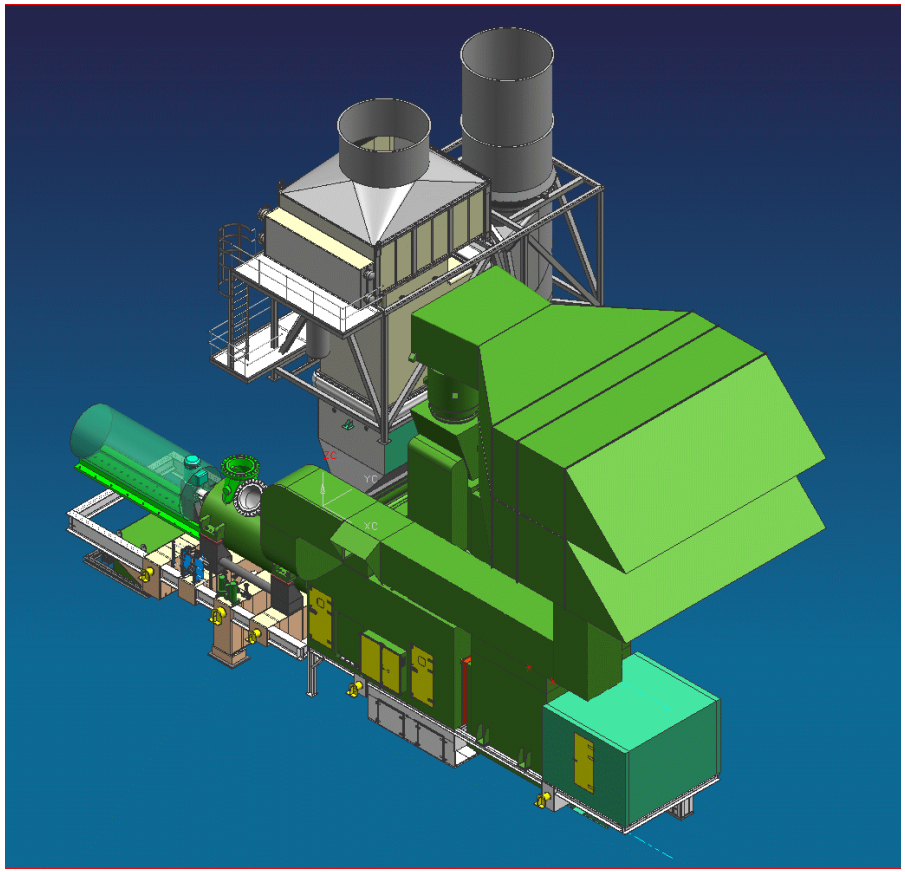
Systems Integration



AUX systems

- Start
- GT Lube oil
- Driven Eq Lube oil
- Liquid Fuel
- Gas Fuel
- Fire Detection
- Fire Extinguishing
- Ventilation
- Combustion Air
- Exhaust
- Waste Heat Recovery
- Fuel and Speed Control
- Sequencing

(cont.)

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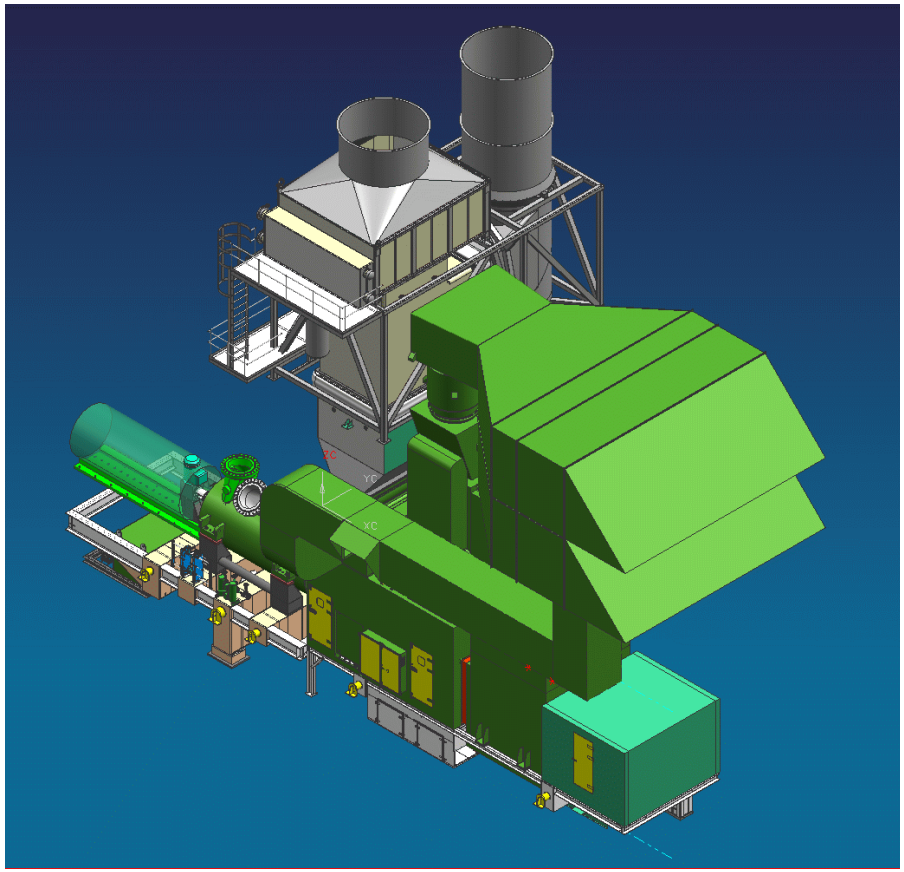
Systems Integration



AUX systems (continued)

- Communication
- MCC + EI
- Anti Surge
- Seal Gas
- N2 Purge
- Rundown
- Depressurization
- Hot Bypass

Note: Approx 300 I/O signals, scanning time down to 5ms

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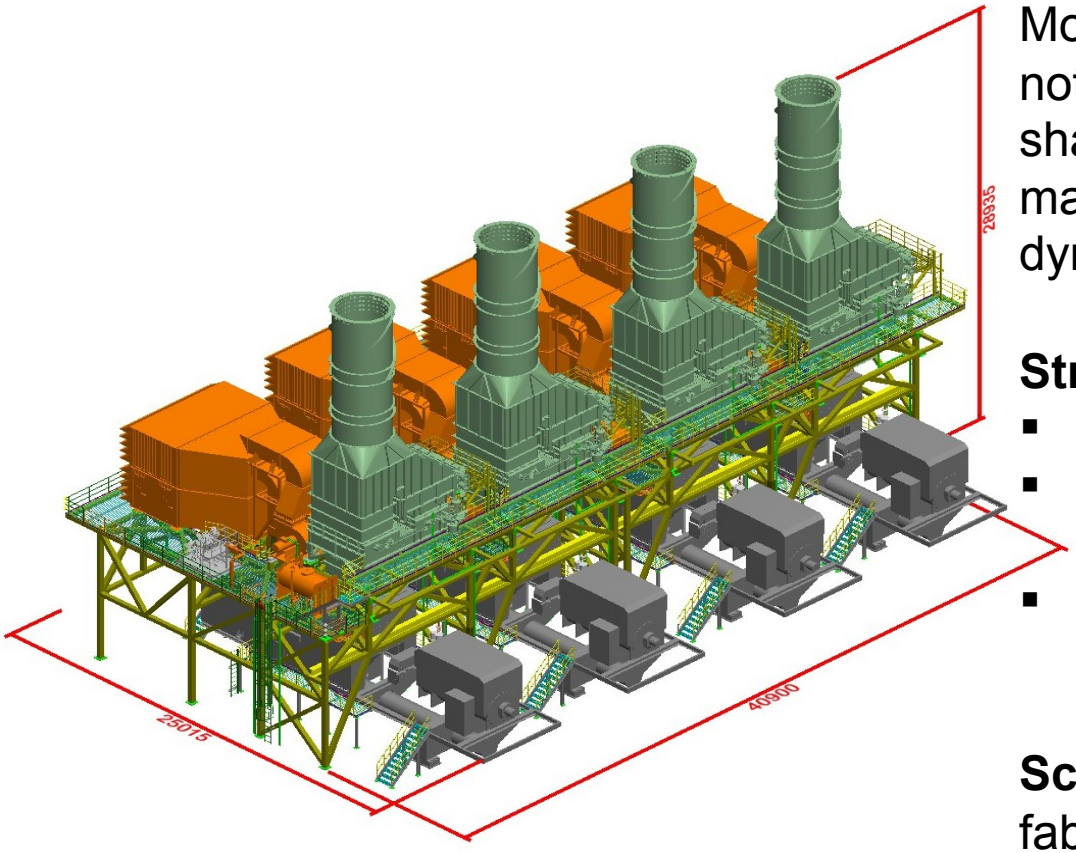
Mechanical Integration



Design to forces:
Most offshore installations are not built close to where they shall operate and are subject to many types of static and dynamic forces

Structural analyses

- Static
- Dynamic incl lateral and torsional for rotors
- Support stiffness's incl "spring and dampers"

Schedule conflicts with fabrication which need to start prior to completion of finalization of analyzes.

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Conclusion

To optimize and manage projects for large power and compression plants for offshore topsides, SE,Lean and KBD are all relevant and essential knowledge required to be successful

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