Lightweight composite gangway

for the offshore access market

AMPELMANN

E-LASS event Bremen
30 January 2020

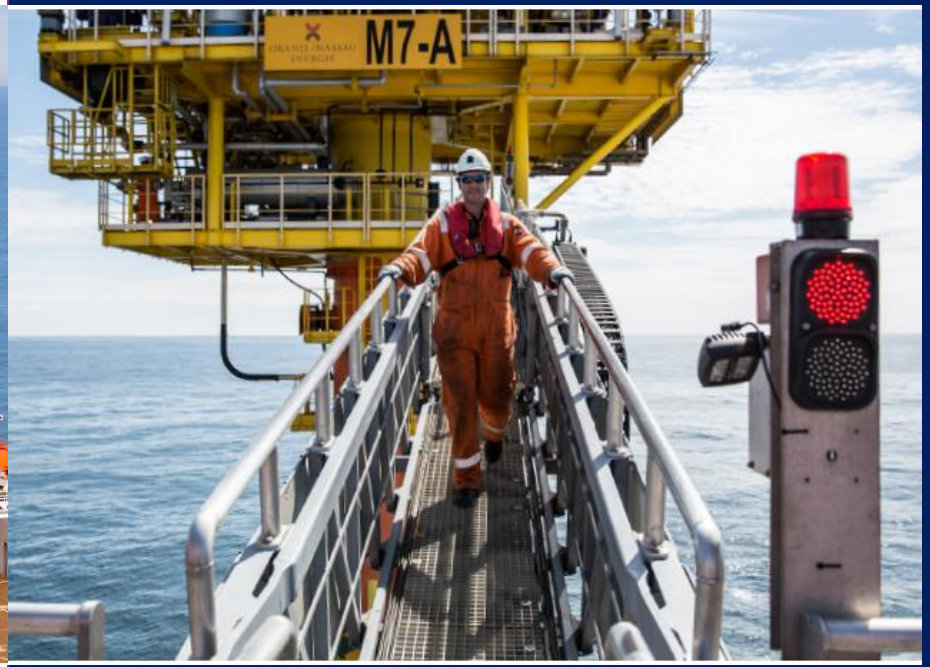
Who are we?

Koen van Valkenhoef
Structural Engineer

Siebert Frieling
Lead Engineer

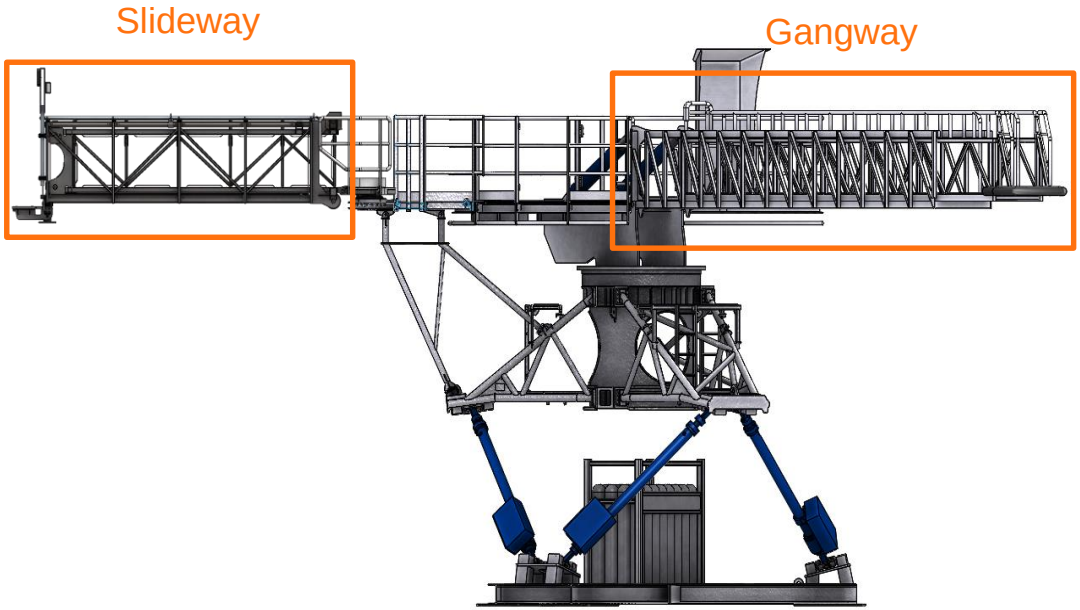
What does Ampelmann Operations provide

Safe and efficient offshore access



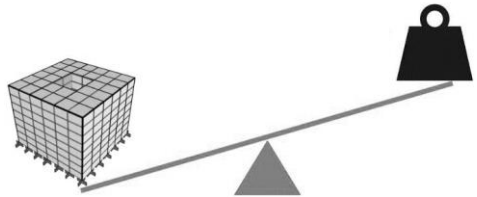
What does Ampelmann Operations provide

Ampelmann offshore access system



Opportunities and risks of composites

Low maintenance, lower OPEX



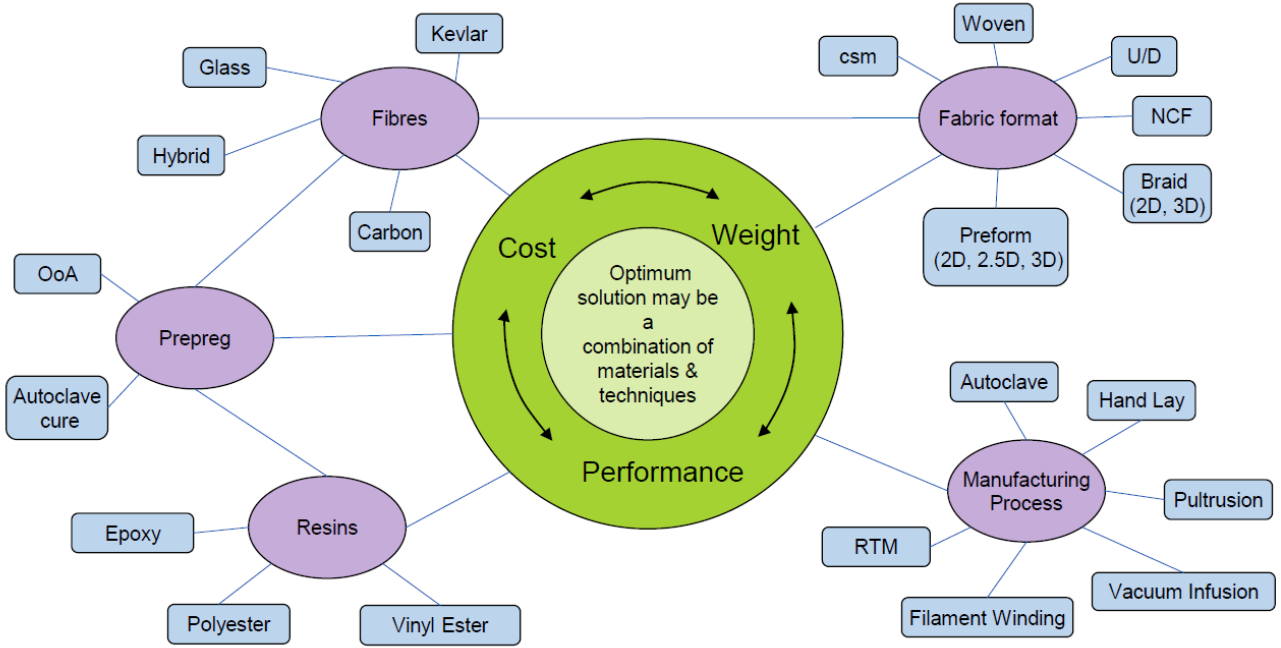
Weight optimization

Possible future product portfolio expansion

Failure mechanisms

RELIABILITY

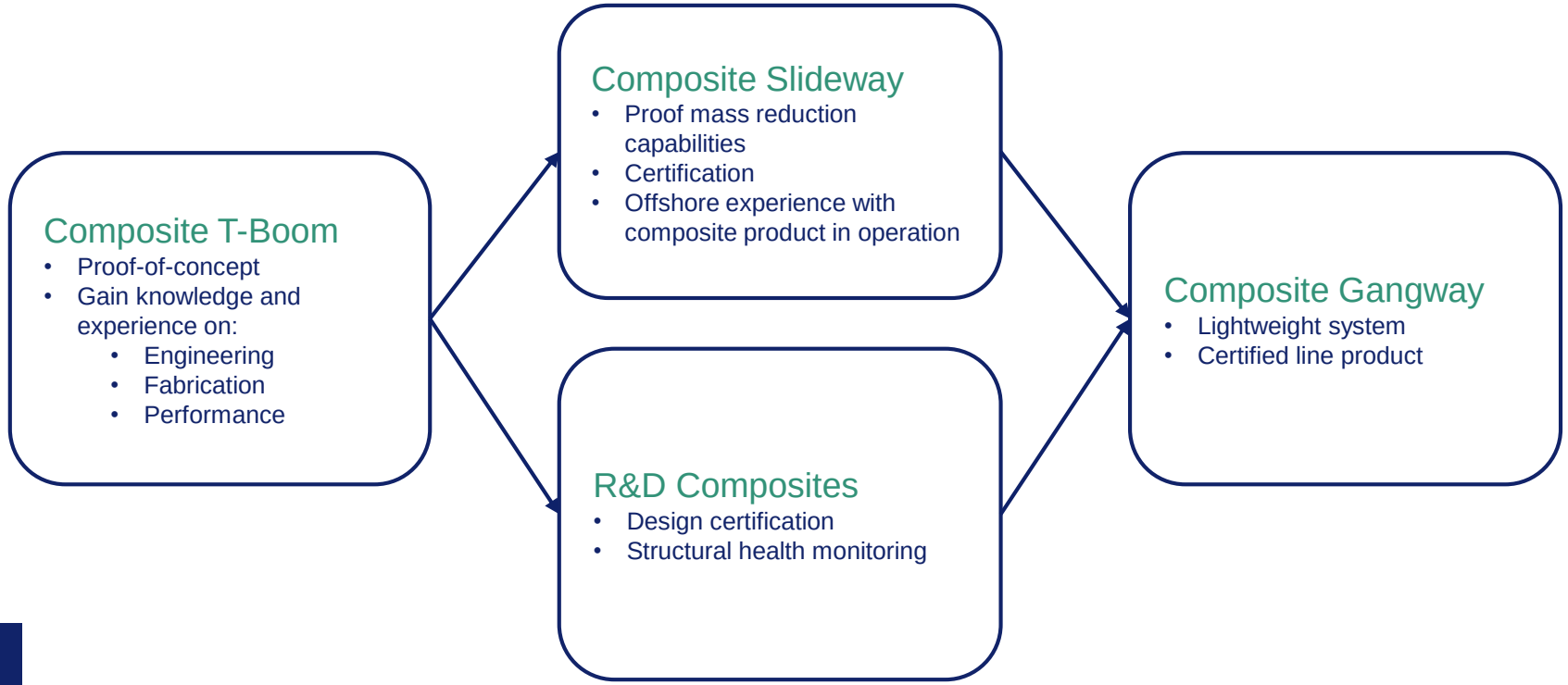
Challenges of working with composites



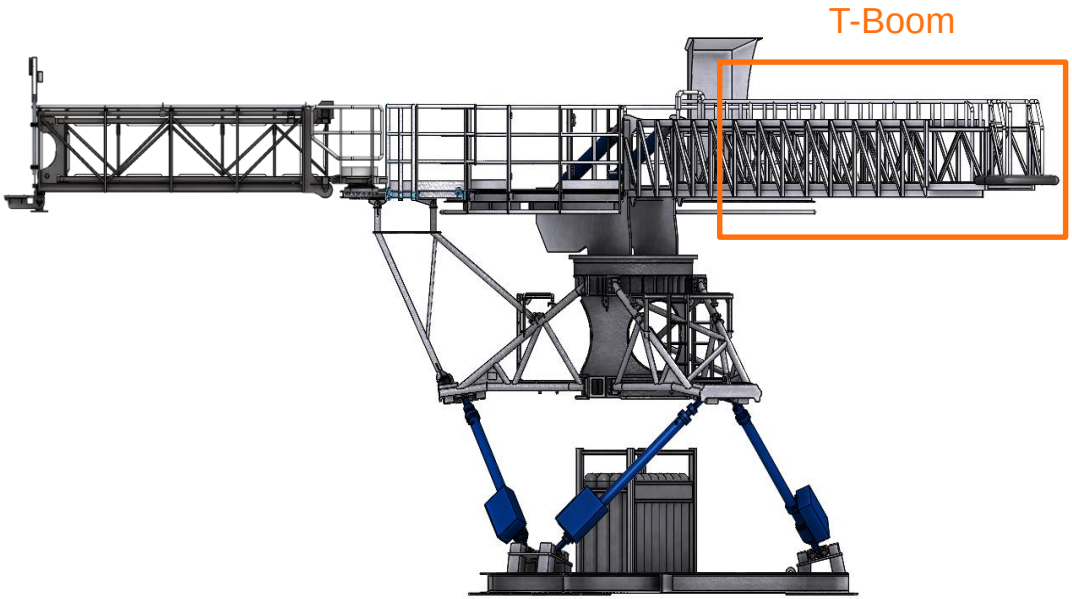
So many choices…

Reference: Maximising the Advantage of Composites in Lifting Appliances, Dr. Linda Starink (Lloyd's Register)

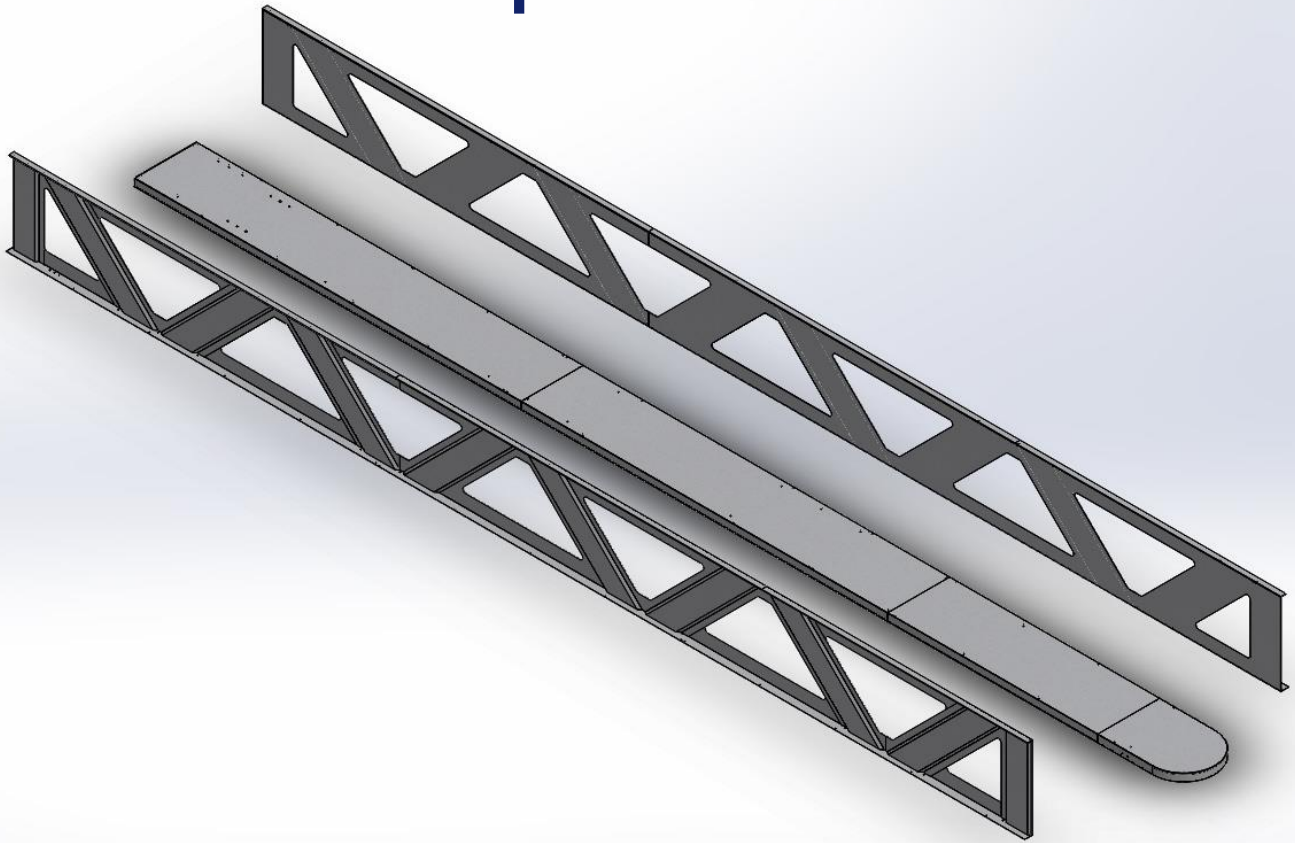
Composite development roadmap



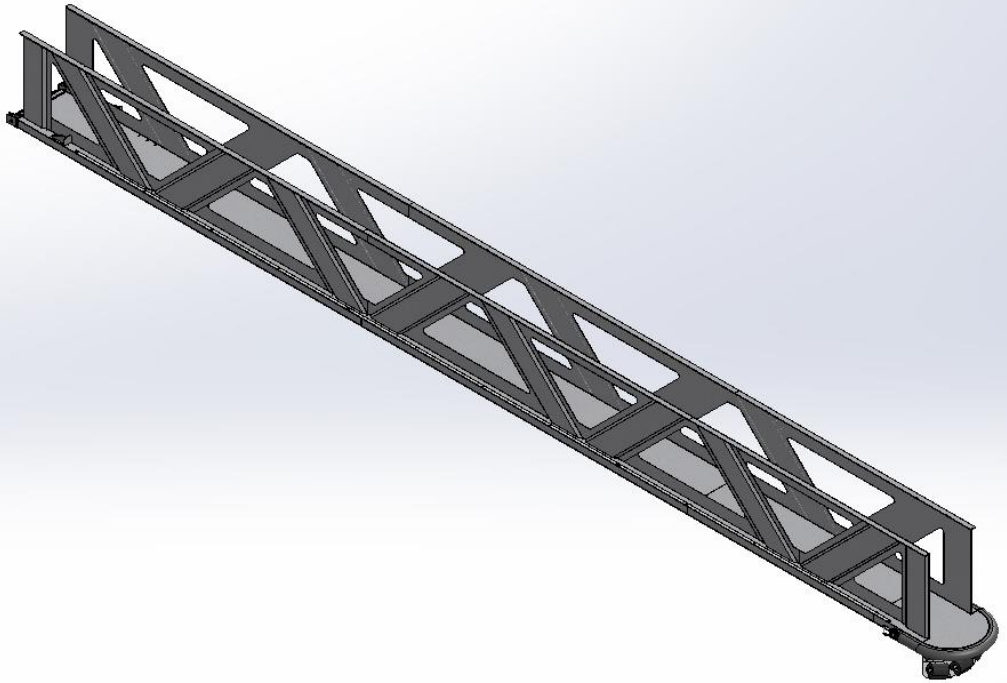
Ampelmann offshore access system



Three main components built in the same mold



Side panels and deck adhesively bonded



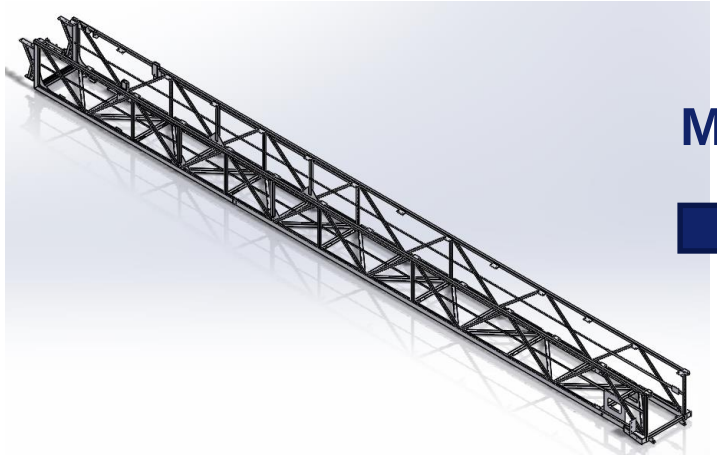
Composite T-Boom in reality

Assembly

Testing

Comparable to steel but lighter

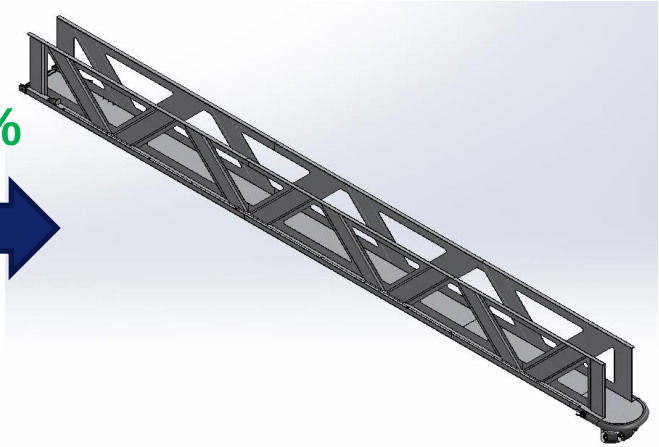
Steel T-Boom



Mass -33%

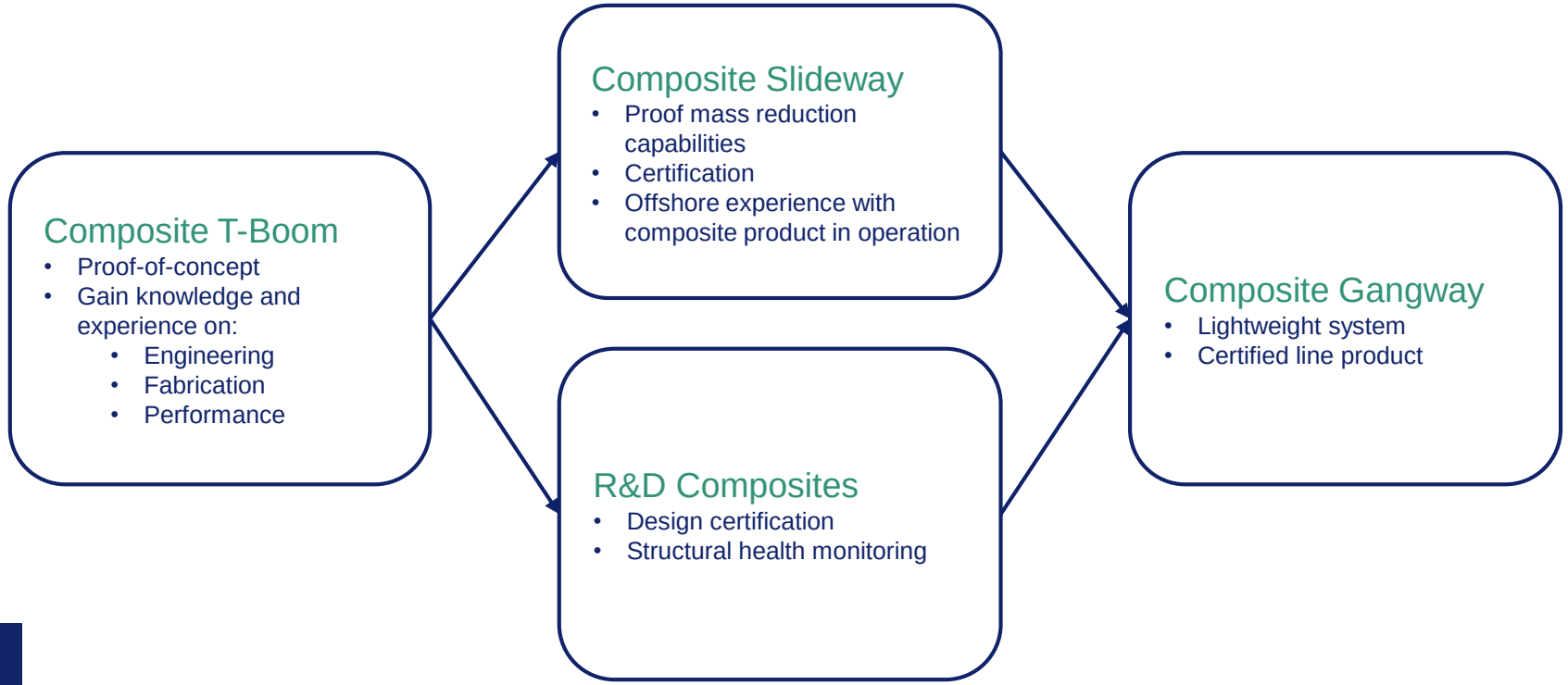
€ +14%

Composite T-Boom



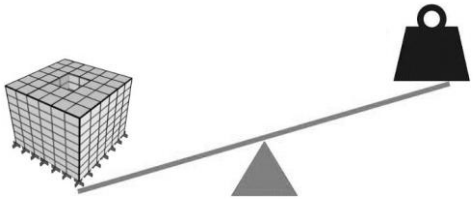
☑ Structural performance
☑ Functional requirements

Composite development roadmap

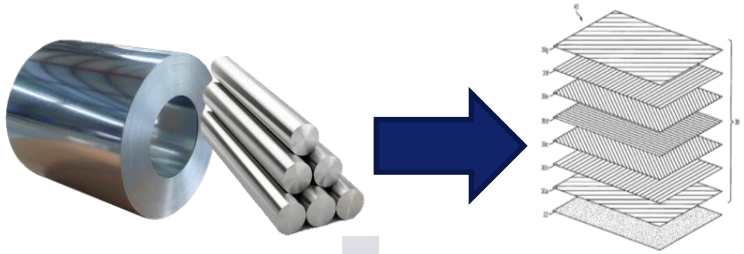


Innovation required in order to

Reduce OPEX



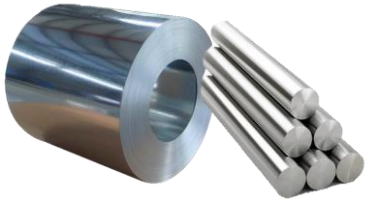
Weight reduction

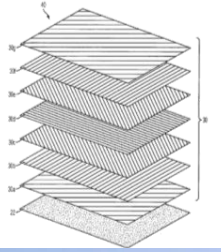


Design Certification

Failure mechanisms

Certification



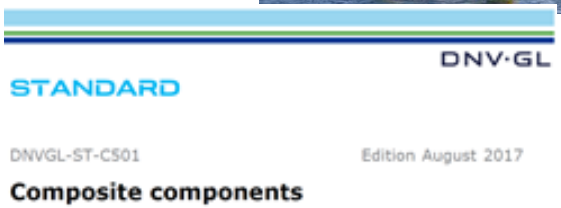


Offshore cranes
CLAME

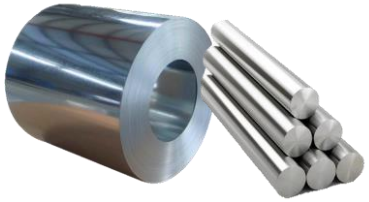
Offshore access systems
???

Offshore wind turbines
DNVGL-ST-0376

Vessels
Class



From steel to composite design validation



No. of independent engineering constants
2

$$\sigma_a = F\sigma \qquad \sigma_e = \sqrt{\sigma_{xx}^2 + \sigma_{yy}^2 - \sigma_{xx}\sigma_{yy} + 3\tau_o^2} \le 1{,}1\sigma_a$$

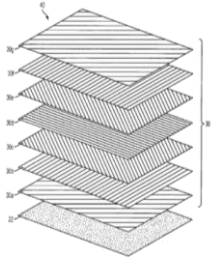
Allowable stress design

σ_a = allowable stress
F = stress factor
σ = failure stress.
σ_e = von Mises equivalent stress

Table 4.2.6 Stress factor, F

Load case	Stress factor, F
1	0,67
2	0,75
3 and 4	0,85

Failure mechanism	Steel
	Yielding
	Buckling
	Deflection



No. of independent engineering constants
21

$$\gamma_F \cdot \gamma_{Sd} \cdot S_k \le \frac{R_k}{\gamma_M \cdot \gamma_{Rd}} \qquad S_d = \gamma_{Sd} \cdot \max_{j=1}^{N} \left[\gamma_F^j S_k^j + \sum_{i \neq j} \gamma_F^i S_k^i \Psi^i \right]$$

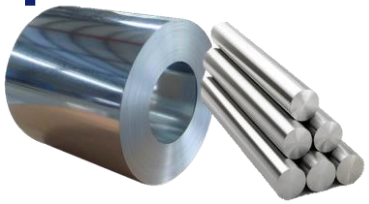
Load and Resistance Factor design

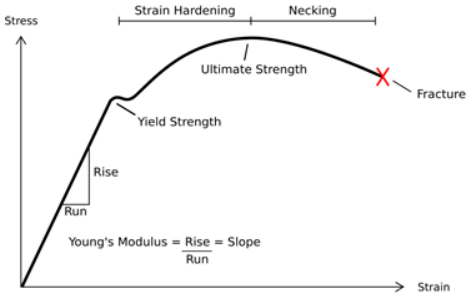
γ_F partial load effect factor
γ_{Sd} load model factor
S_k characteristic load effect
R_k characteristic resistance
γ_M partial resistance factor
γ_{Rd} resistance model factor.

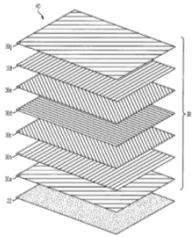
γ_{Sd} Load effect model factor
S^j_k Characteristic value of load effect i
γ^j_F Partial load effect factor for load effect i
Ψ^i Combination factor for load effect i.

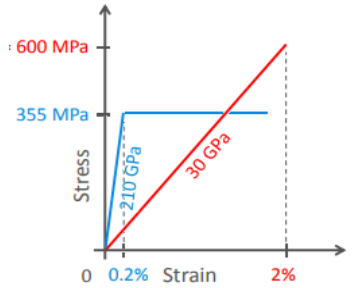
Failure mechanism	Composite	
	Buckling	Deflection
	Fibre failure	Interfiber failure
	Resin failure	Facesheet tearing
	Core failure	Fatigue
	Stress rupture	Creep
	Matrix cracking	Impact

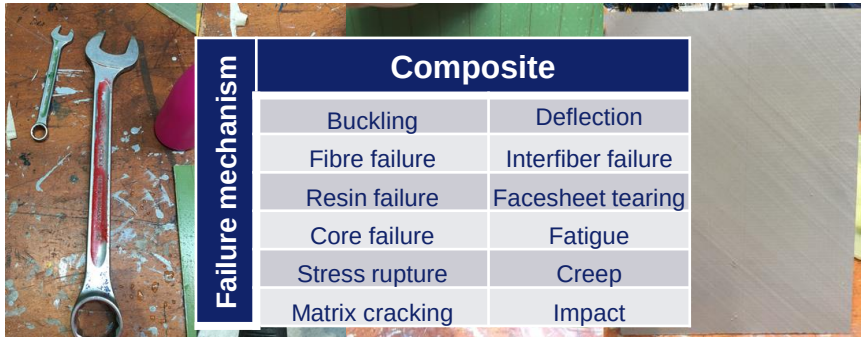
Unpredictable failures





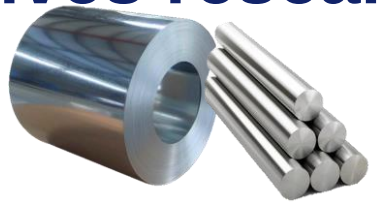


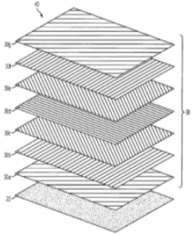




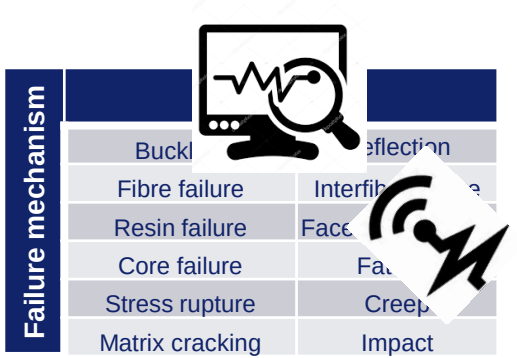
Failure mechanism	Composite	
	Buckling	Deflection
	Fibre failure	Interfiber failure
	Resin failure	Facesheet tearing
	Core failure	Fatigue
	Stress rupture	Creep
	Matrix cracking	Impact

Desired equivalent safety & reliability level drives research on SHM area

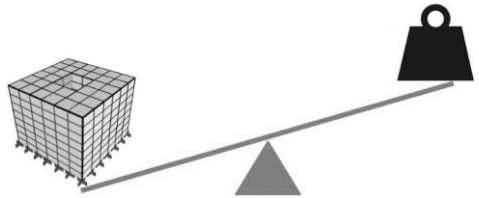




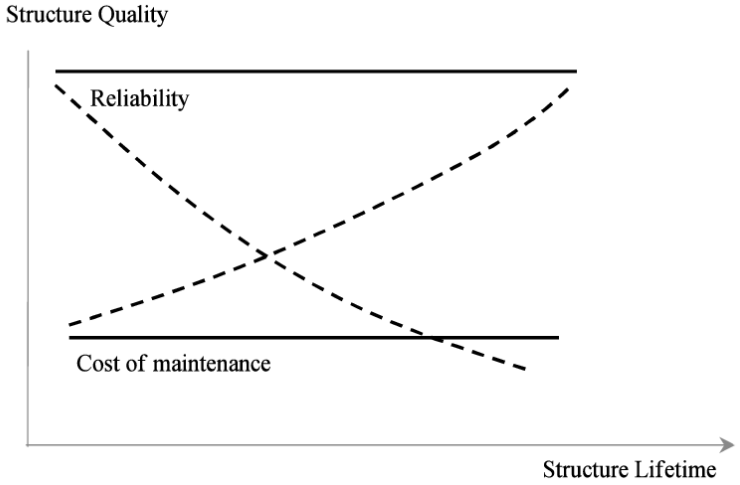
Failure mechanisms



Aimed goal of Structural Health Monitoring

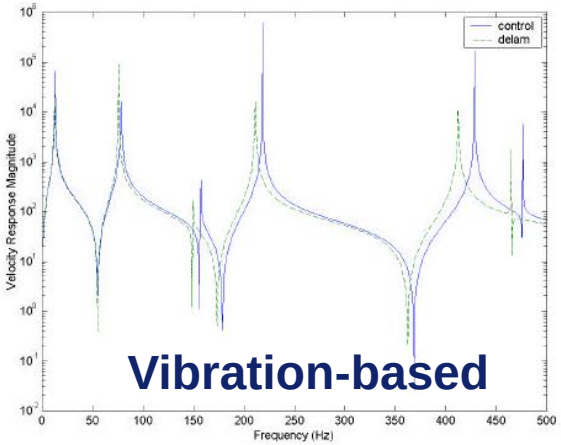


Weight optimization

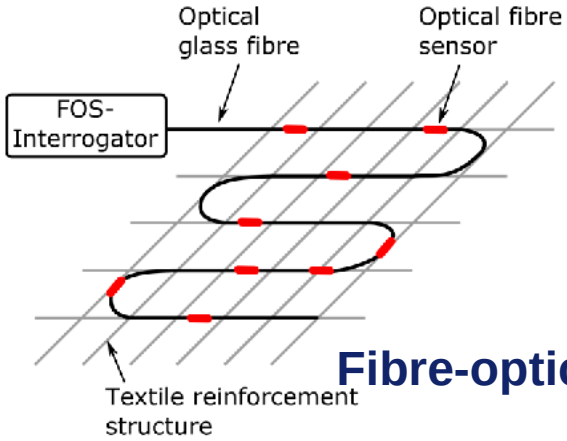


RELIABILITY

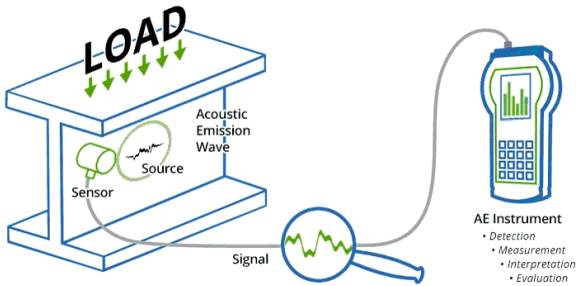
What would an appropriate SHM technology be for offshore access applications?



Vibration-based

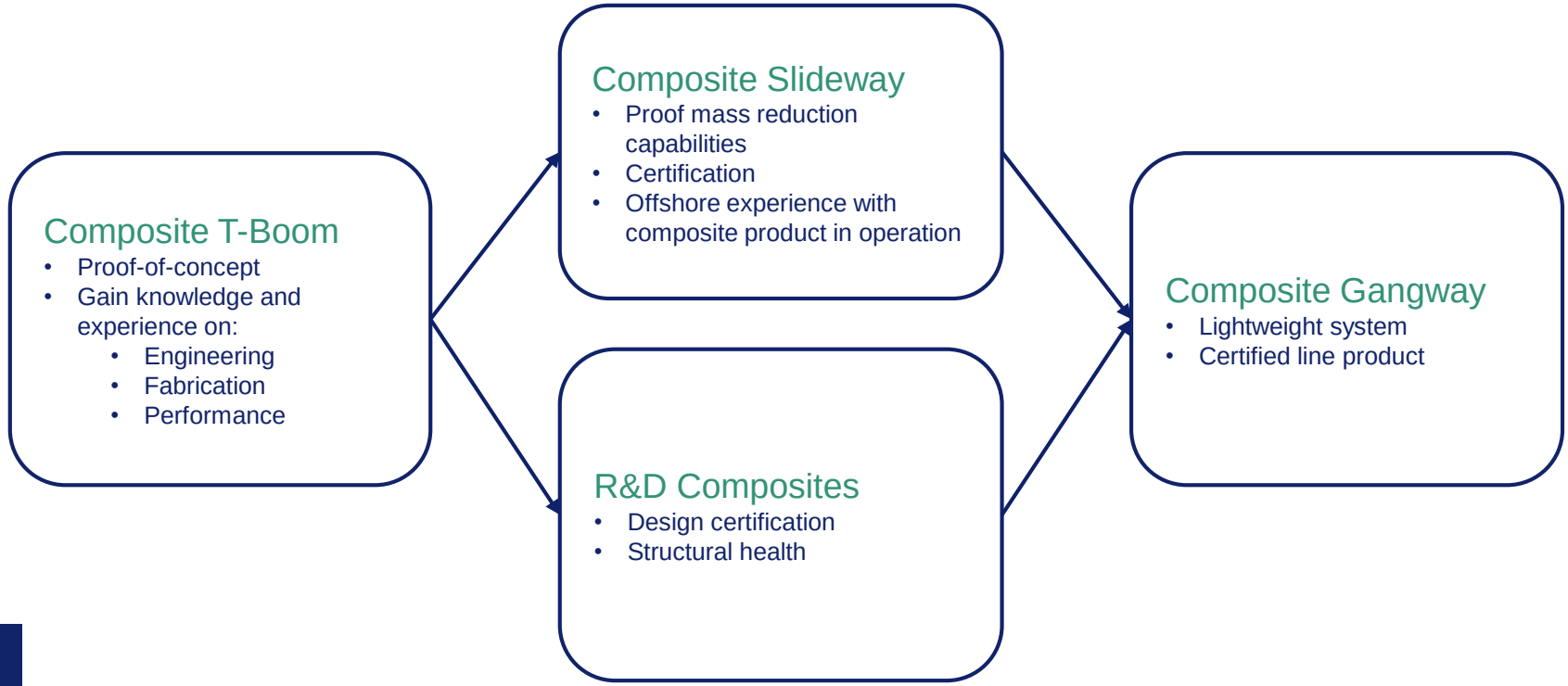


Fibre-optics

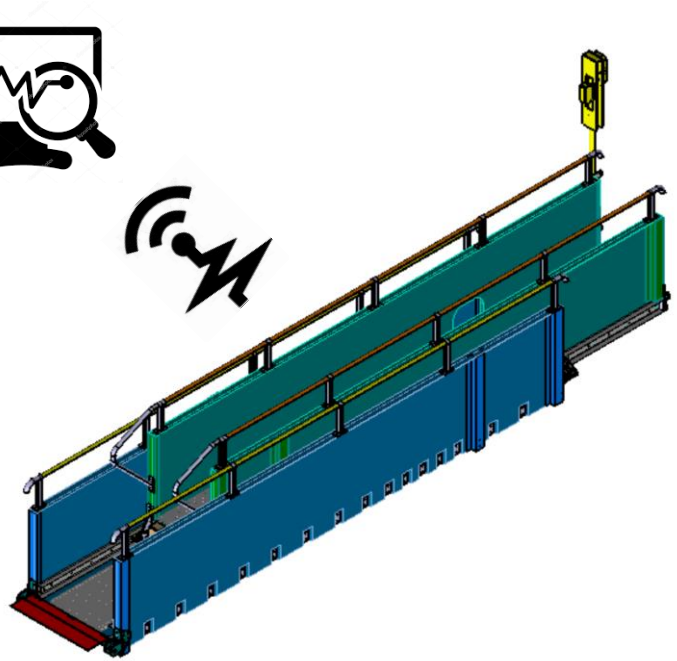


Acoustic Emission

Composite development roadmap

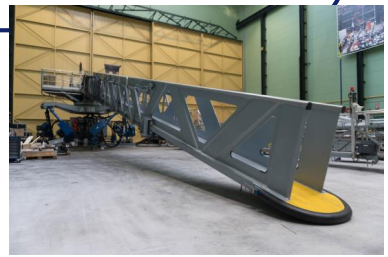


Offshore experience with Slideway

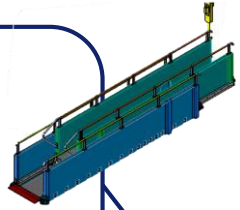


Composite development roadmap

Composite T-Boom
- Proof-of-concept
- Gain knowledge and experience on:
  - Engineering
  - Fabrication
  - Performance



Composite Slideway
- Proof mass reduction capabilities
- Certified demonstator
- Offshore experience with composite product in operation



R&D Composites
- Design certification
- Structural health monitoring

Composite Gangway
- Lightweight system
- Certified line product

2019 | 2020 | 2021

Share experience for a composite future in the maritime and offshore industry

Product development	Composite design	Structural health monitoring
Siebert Frieling	**Koen van Valkenhoef**	**Dimitrios Bekas**
Lead Engineer	Structural Engineer	R&D Composite Engineer
siebert.frieling@ampelmann.nl	koen.vanvalkenhoef@ampelmann.nl	dimitrios.bekas@ampelmann.nl
+31 (0)6 21597182	+31 (0)6 16965268	+31 (0)6 89921530

Ampelmann Operations B.V.
Oostsingel 209, 2612 HL Delft, The Netherlands
+31 (0)20 2400 121
www.ampelmann.nl