RINA MARITIME INNOVATION COMMITTEE

Theme: Materials and Coatings

Version: 2

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Materials and Coatings

This theme includes the materials from which marine vehicles and offshore structures may be constructed, and coatings that may be applied to protect materials from damage / corrosion.

Objectives

- The key objectives for technology and innovation of materials and coatings within the marine industry include:
  - Improve strength and / or lighter weight materials to improve asset performance.
  - Materials that can adapt to changing conditions for improved performance.
  - Improve efficiency of marine asset construction and repair.
  - Reduce maintenance requirements.

Technology Priorities

Technologies that we believe will have the most significant impact on the marine industry

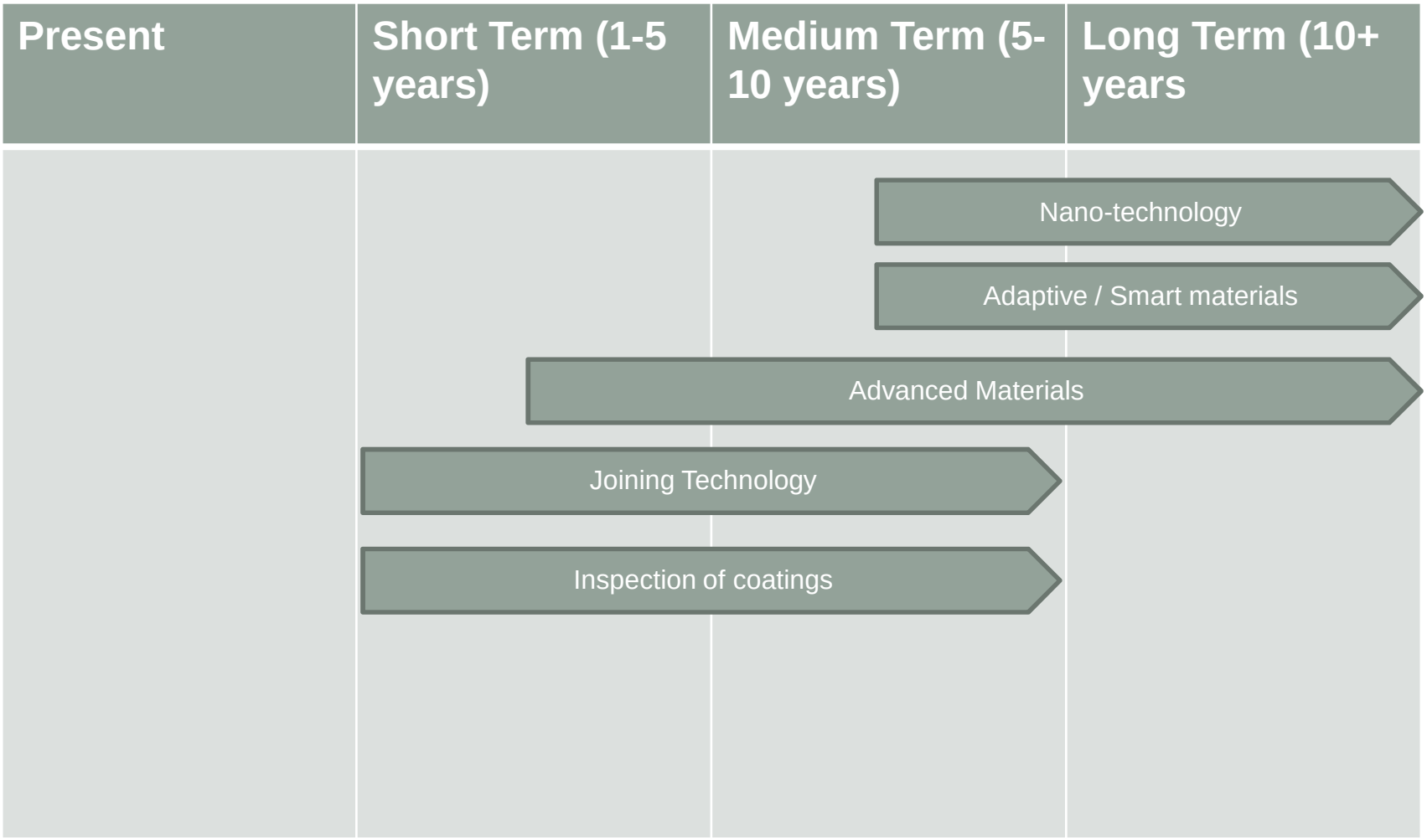
Technology	Technology Description
Nanotechnology	Nanotechnology is an emerging discipline with potential for producing new materials (stronger, lighter) /coatings, improving energy efficiency, and creating new diagnostic tools. Examples include ductile structural composites, low maintenance coatings, reducing the thermal transfer rate materials, nanosensors, smart materials, intelligent structure technology. Properties include self-sensing, self-rehabilitation, self-cleaning, vibration damping, self-structural health monitoring and self-healing.
Adaptive/Smart materials technology – self healing systems etc. (subset of Nano-technology)	Smart materials too can be structural or functional. In a structural context, either the material itself could be smart, e.g. shape memory alloys or magnetorheological elastomers or, when meshed into a structure could provide smart capabilities, e.g. specially tuned composite laminates. These are used for vibration damping or changing hull shapes for better flow characteristics. Functional materials typically offer adaptive reflection properties for an adjustment of heat take up (high heat take up in cold regions and vice versa) or they are phase-changing materials (preferably applied in coatings or panels) for storage of thermal energy or they could even be fire retardant materials. Self healing coatings technology is available for thin films and concepts have been developed by the large paint companies but not yet practical.

Technology Priorities

Technologies that we believe will have the most significant impact on the marine industry

Technology	Technology Description
Advanced Materials – High Strength, Fire Resistant, Thermal Insulation, Low Weight	These can be classified under two broad headings, namely structural and functional. Structural materials can be metallic, such as high strength steels, aluminium and titanium or polymeric which covers fibre reinforced plastics. Functional materials are those that offer either thermal insulation or fire protection features.
Joining Technology (e.g. Glue)	Adhesives have been used in the marine industry for structural purposes in specialist composite boat and ship construction for some time now. They offer wider use in metallic structures as well.
Inspection	The inspection of surface preparation and quality both at new building and through life is restricted by access and is dangerous. Data collection and subsequent retrieval is poor and technologies exist to improve the way this is carried out.

Exploitation Timescales



Challenges & Risks

- Rate of change of technology is a challenge, designers must keep abreast of these developments.
- CAPEX vs OPEX is a key consideration when selecting materials, which may make it difficult to select more advanced materials if financial models do not change.

Examples

- Smart Materials https://ec.europa.eu/programmes/horizon2020/en/news/how-smart-materials-could-transform-shipping-eu
- Advanced materials http://www.npl.co.uk/advanced-materials
- Nano-technology https://www.nano.gov/you/nanotechnology-benefits
- Joining Technology https://www.twi-global.com/capabilities/joining-technologies/
- Inspection Robots https://www.rina.org.uk/Magnetic_hull_inspection_robot.html

Conclusions – Materials and Coatings

- Adoption of materials technology into marine construction may be seen as evolutionary rather than revolutionary.
- Advances in materials technology will continue to have an impact on the design and construction of marine vehicles and offshore structures. High strength, low weight materials and those with protective capabilities (fire, acoustic etc) will continue to be of interest.
- Perhaps the most potential comes from Nanotechnology allowing the development of ‘smart materials’ that can be optimised for their application to improve performance or modify their characteristics with changing conditions. Shape adaptation to improve hydrodynamics is one possibility.
- Self healing materials can offer operational benefits and may be essential to support long endurance autonomy.

Conclusions – Materials and Coatings

- New joining technologies including adhesives will improve the efficiency of marine vehicle construction.
- Inspection of large or autonomous structures, including coatings, to ascertain material state is likely to become more automated in the future.