



Unión Europea

Fondo Europeo
de Desarrollo Regional
"Una manera de hacer Europa"



XUNTA DE GALICIA
CONSELLERÍA DE ECONOMÍA,
EMPREGO E INDUSTRIA

SUBVENCIONADO POR:



NAUTILUS

Nuevos materiales y sistemas automatizados para
fabricación avanzada con aplicación en buques militares

Nautilus, a joint research project

June, 11th, 2019

- 1. **Navantia.** A short brief on the Company
- 2. **Nautilus Project.** Drivers and goals.
- 3. **Nautilus research lines**
- 4. **Nautilus and composite materials technology**



NAUTILUS

Nuevos materiales y sistemas automatizados para
fabricación avanzada con aplicación en buques militares

Who are we?



Navantia

Approx. **5500 persons** (20% nav. archs. and engineers)

3 shipyards in strategic locations

Headquarters at Madrid (General management and Conceptual Engineering)



Unión Europea
Fondo Europeo
de Desarrollo Regional
"Una manera de hacer Europa"



XUNTA DE GALICIA
CONSELLERÍA DE ECONOMÍA,
EMPREGO E INDUSTRIA

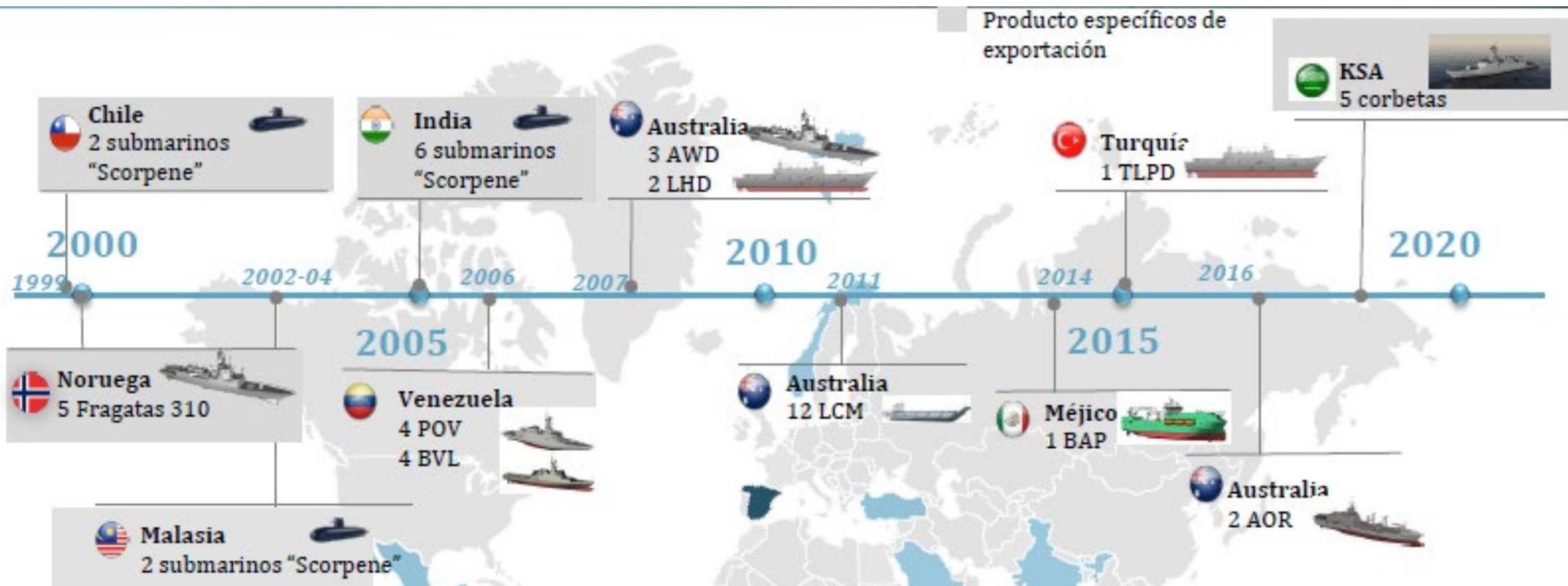
SUBVENCIONADO POR:
gain

Our main customer



The Spanish Navy has trusted Navantia through the years to **design, build** and **sustain** the fleet (frigates, auxiliary oilers, LHDs, LPDs, aircraft carriers, minehunters, submarines)





Exports up to **10.000 M€**
(50 % of turnover per year since
2005)

Navantia in a nut shell ...



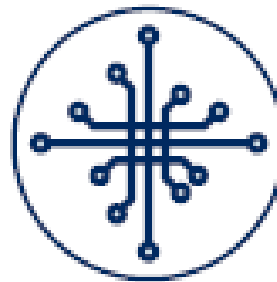
**Strategic
Company**

Homeland security
National defence interests
Independent capability



**Employment
generator**

+700 M€ (direct)
to National GDP
+12K Jobs (direct/subctr)



**Technological
Company**

+12% turnover to R&D
(Top 10 Spain)



**International
Company**

+50% turnover
from exports

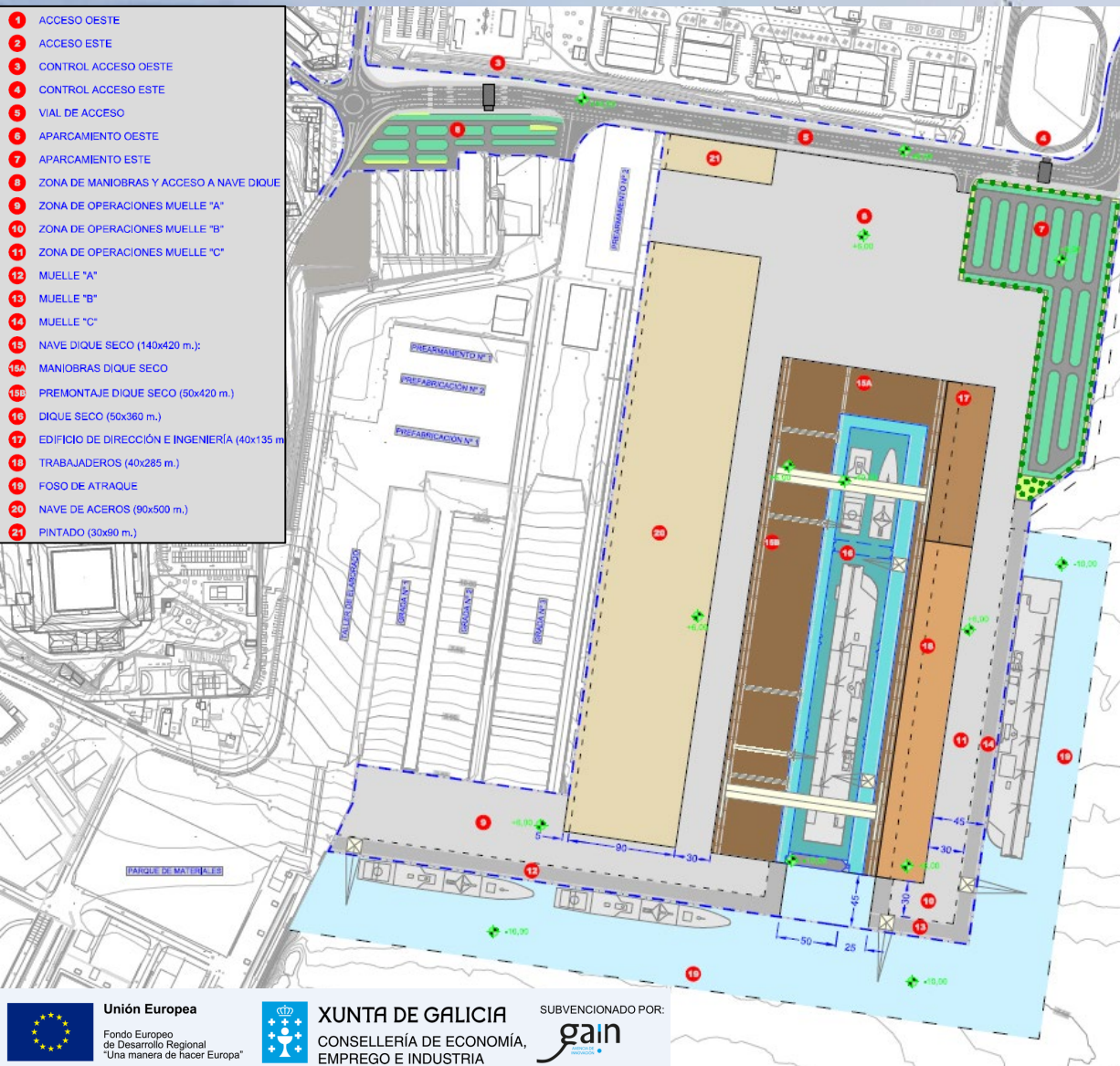
Why Nautilus?

Navantia is working towards the concept of **Shipyard 4.0**

A new production layout is to be configured where the following **technologies** shall be emphasized,

- IoT
- M&S
- Augmented reality
- Smart products
- UAVs
- Cybersecurity

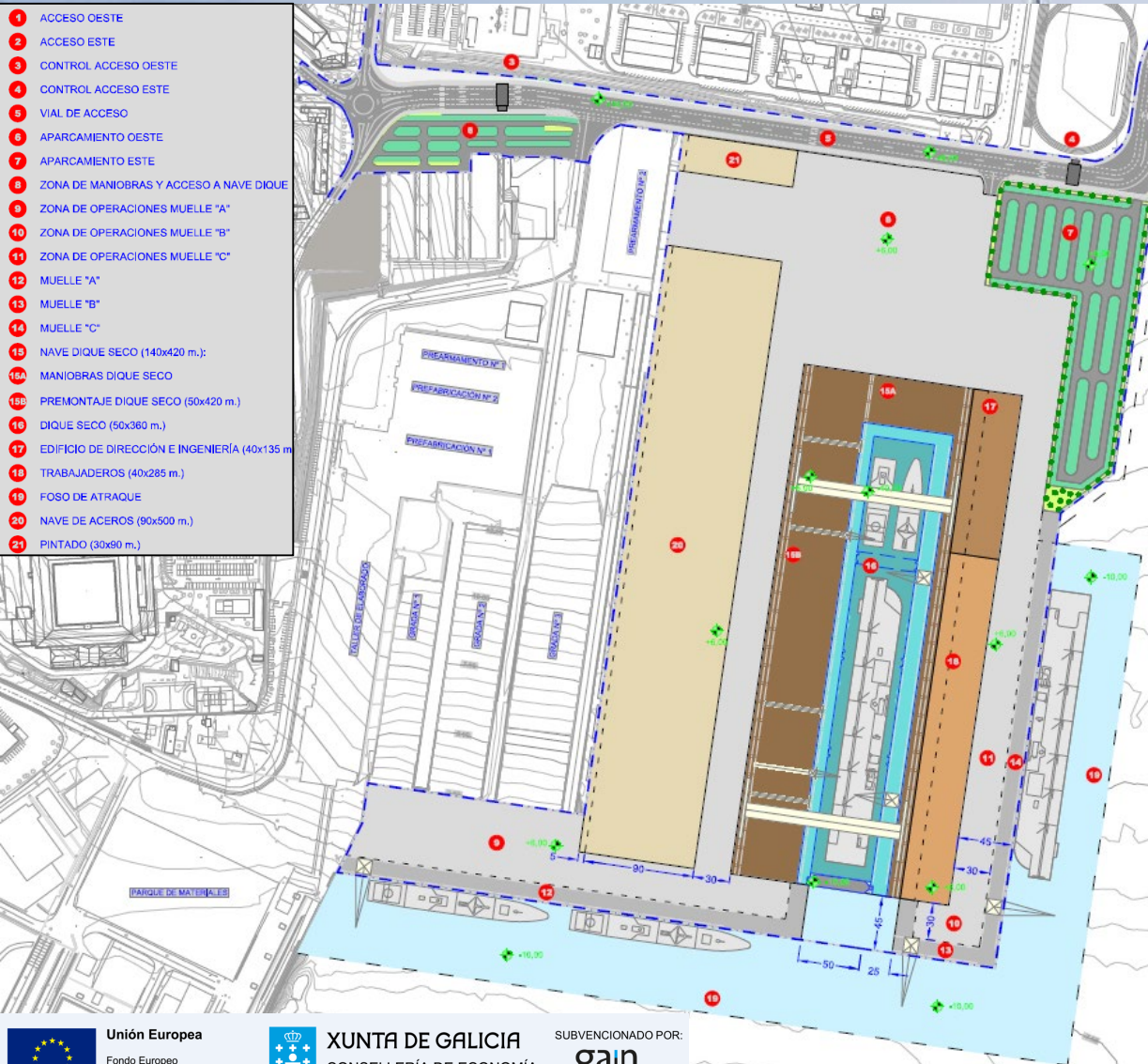
**DIGITAL
BACKBONE**



Why Nautilus?

To aid on this upgrade, several R&D projects and research teams have been created

Nautilus Project (Joint Research Team) has been created with the help of *Xunta de Galicia*, through the *Axencia Galega de Innovación (GAIN)* with the aim to support on some of the goals identified within the 4.0 initiative





Nautilus main goals,

To investigate on new materials and feasible applications in the mid/long term

To investigate on new automated systems to provide advanced fabrication techniques in the mid term



Navantia

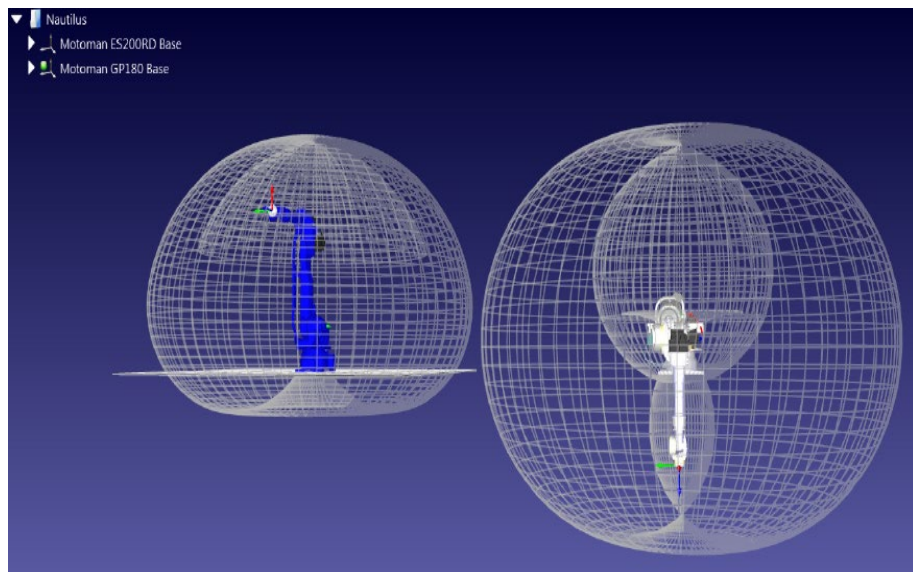




1. **Structure** interim products **automatization**
2. **Hybrid LASER** welding techniques
3. **Automated** steel plates **conforming**
4. **Cathodic protection** simulation
5. **Ballistic** protection materials
6. **Composite** materials solutions

Goal : *To provide **automated fabrication system** to build up different steel interim products according to the building strategy*

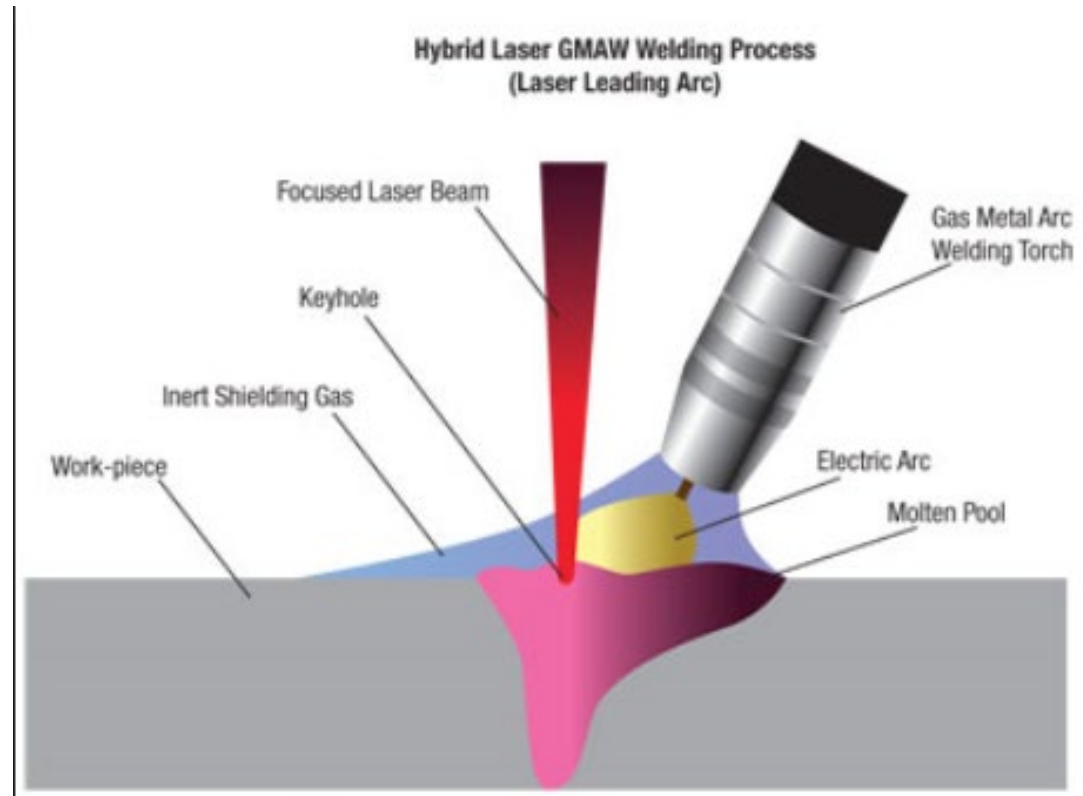
Development of an articulated arm with artificial vision to aid on the automated fabrication



Goal : *To provide a **welding procedure** capable **to reduce** as much as possible post **welding deformations** within plate thicknesses common in a light/medium combatant ship*

Several testing coupons to be welded as per this technique, covering different structural details commonly used

Class Society engagement to make **approved WPS** with this welding procedure



Goal : *To investigate on the **technical basis of automated steel conforming machines***

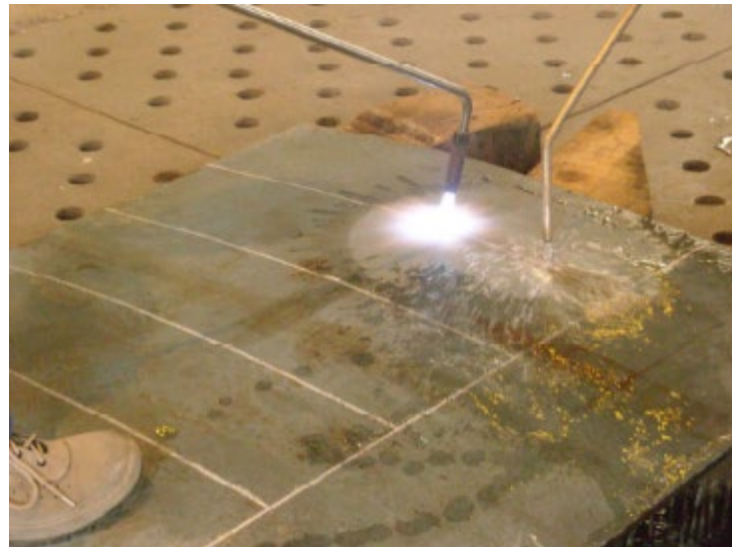
Steel conforming considered as one of the most **craft-required tasks** within the shipyard, taking decades to master appropriately, with **no continuity** between workers generations

An important percentage of steel of a light to medium combatant requires conforming

Reference shipyards in the world are known to use automated techniques with **increasing levels of productivity**

Research lines – Automated steel conforming

Currently undertaken by pressing cylinders together with checking templates, as well as with heat lines/triangles





NAUTILUS

Nuevos materiales y sistemas automatizados para
fabricación avanzada con aplicación en buques militares

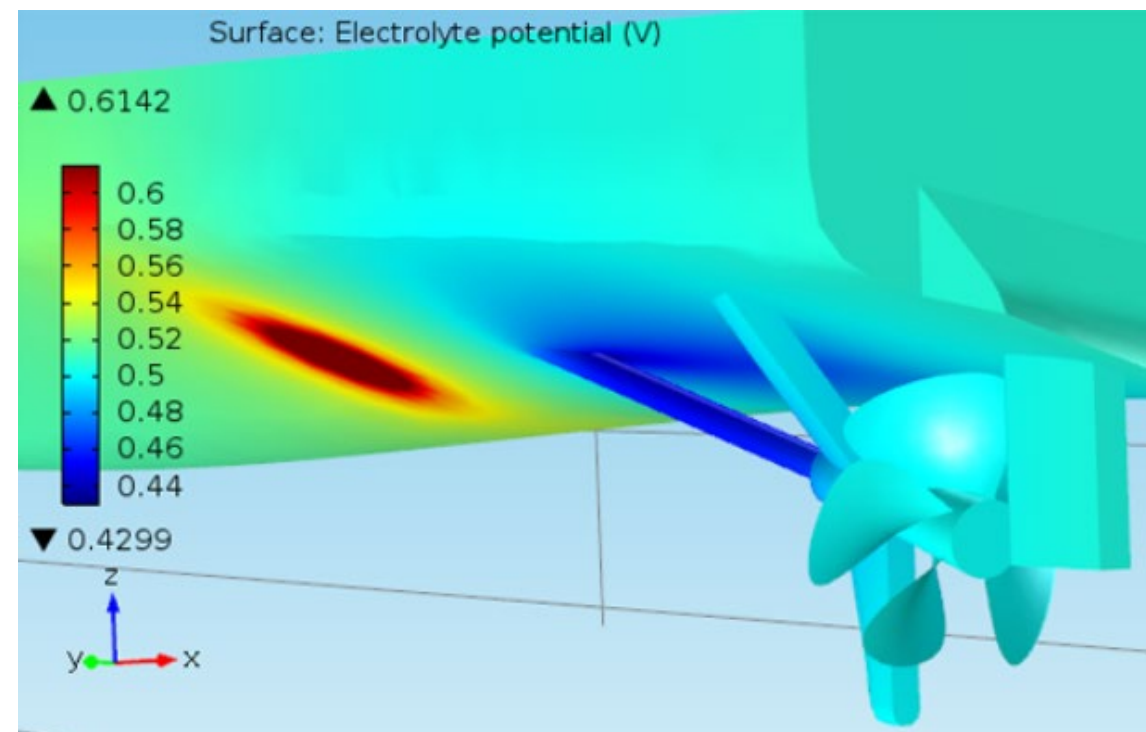
Research lines – Cathodic protection simulation

Goal : *To optimize the **design of the cathodic protection system** of a light to medium combatant and offshore wind related projects*

Several functioning issues have been recorded on different Programs, during and after construction

Simulations are to be developed accounting for different factors affecting the functioning.

Several tests shall follow.



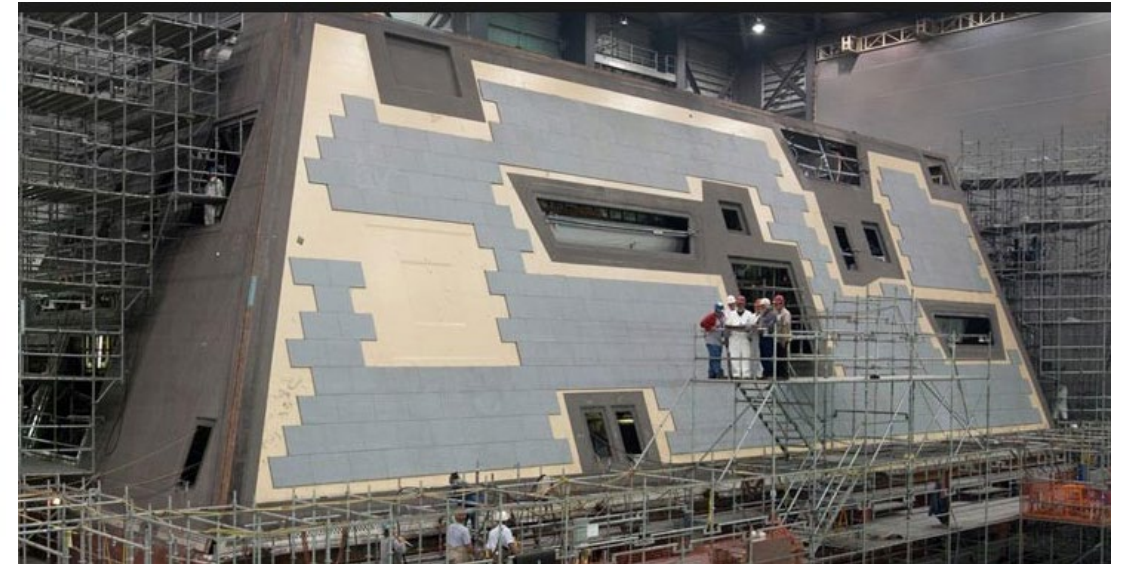
Goal : *To explore the **feasibility to use composite materials** on different areas of the naval ship design*

- *General design items traditionally made in metallic materials*
- *Ballistic protection*

Light to medium combatants are **weight sensitive**, requiring weight optimization to meet operational/regulatory needs

Composite materials provide not only lightweight solutions but also additional properties (fatigue and corrosion improvement)

Technology currently in use (samples: Visby Class / DDG1000 superstructure)



Research lines – Composite materials solutions

Ballistic protection

Navantia experience in composites materials – excluding minehunters – is not extensive.

- Submarine Programs → **Sail and superstructure** (sandwich and monolithic material)
- Frigates → **Bulwarks** and antennas **supports** (mast)

Navantia aims to redefine several design items such as,

- Masts (enclosed type)
- Internal compartmentation (non *load bearing*)
- Structural/Non structural closures (doors, hatches ...)
- Ballistic protection tiles

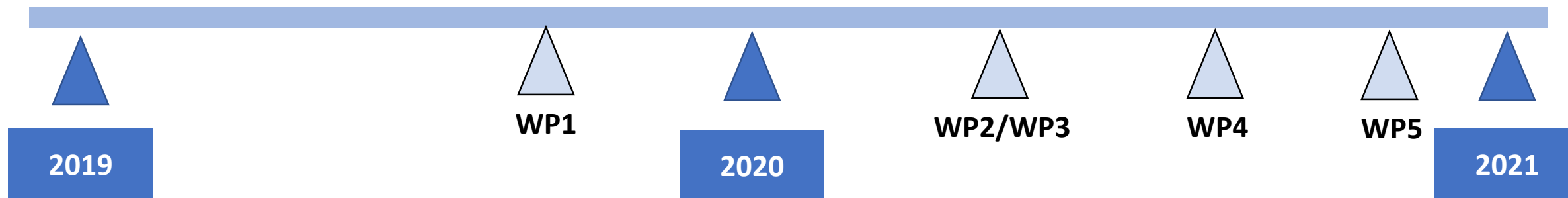
Approx. 100 T
(potential reduction)



NAUTILUS

Nuevos materiales y sistemas automatizados para
fabricación avanzada con aplicación en buques militares

Research lines – Composite materials solutions Ballistic protection



WP1_State of the art (Composite materials in ships/Joining comp.-steel technologies)

WP2_Regulatory framework & technical specs.

WP3_Select composite material and manufacturing process/parameters

WP4_Testing program (fire and mechanical properties)

WP5_Cost assessment

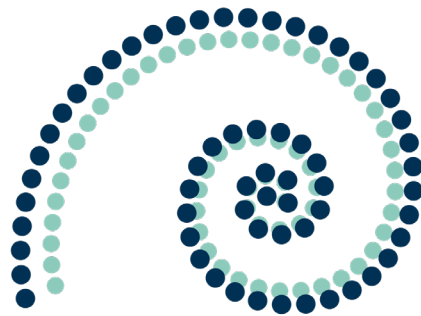
Research lines – Composite materials solutions

Ballistic protection

- Composite materials selection/caracterization shall be based on,
 - Screening of the candidate composite → **Mechanical characterization**
 - Polyester, vinylester or epoxy based composites shall be explored.
 - Glass (fiber) most probable candidate to keep the cost low.
- Woven type/resin system, availability and cost among criteria for selecting the composite materials to be explored.
- Material concept (single skin or sandwich) and manufacturing method (i.e. vacuum infusion, RTM...) being additional parameters.

Thank you!

Saúl Balsa Barros
General Design & Naval Architecture Manager
sbalsa@navantia.es



NAUTILUS

Nuevos materiales y sistemas automatizados para
fabricación avanzada con aplicación en buques militares



Unión Europea
Fondo Europeo
de Desarrollo Regional
"Una manera de hacer Europa"



XUNTA DE GALICIA
CONSELLERÍA DE ECONOMÍA,
EMPREGO E INDUSTRIA

SUBVENCIONADO POR:
gain