

# La plataforma de la Fragata F-110



CF José M<sup>a</sup> Riola  
Doctor Ingeniero Naval

26 de mayo de 2017  
Santander - SODERCAN

# CONDICIONANTES HACIA EL 2030



# POLÍTICA INDUSTRIAL DEL PAÍS

Creación de una Base Industrial y Tecnológica Nacional

Participación industrial en proyectos internacionales

Obtención de capacidades de diseño e ingeniería

Aumento de la competitividad internacional

Acceso a mercados de explotación

Mejora en la formación y conocimientos técnicos del personal

Mejora en la gestión empresarial



## PROGRAMAS ERAGATAS

- España: 5 x F-100
- Noruega: 5 x F-310
- Australia: 3 x AWD



# TENDENCIAS NAVALES

Formas no convencionales de casco

Modularidad y Escalabilidad

Invisibilidad y supervivencia

Dotaciones reducidas

Propulsión híbrida

Robótica y digitalización

Mástil/superestructura Integrada

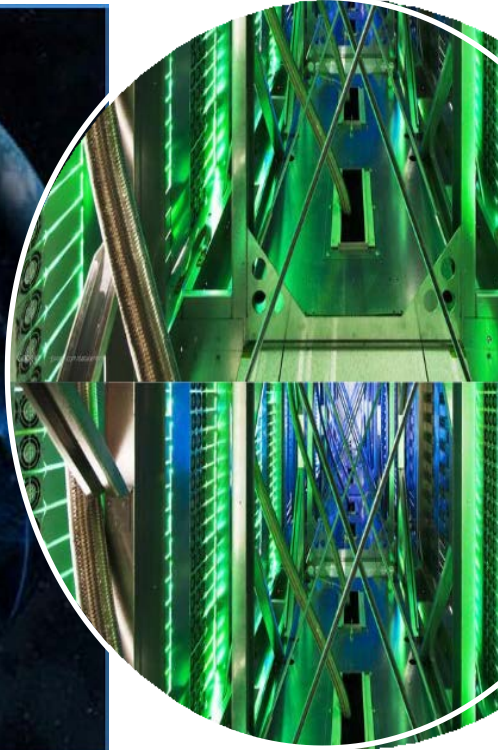
Empleo combinado de UXV y tripulados

Mayor capacidad de combate

Bajo Consumo y Ecológicos



FUTURO

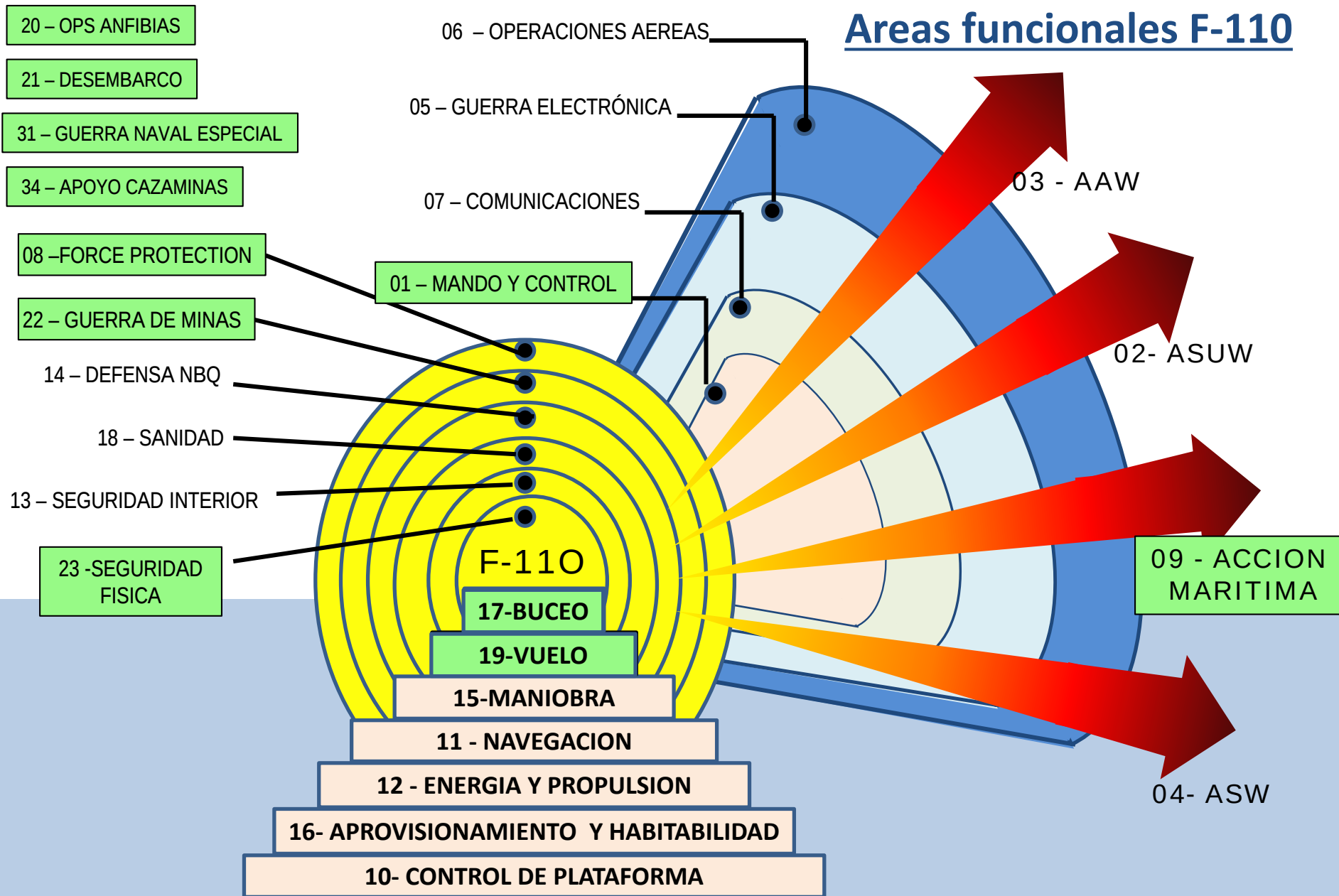


CONECTADO

DIGITAL

AUTONOMO

# Áreas funcionales F-110

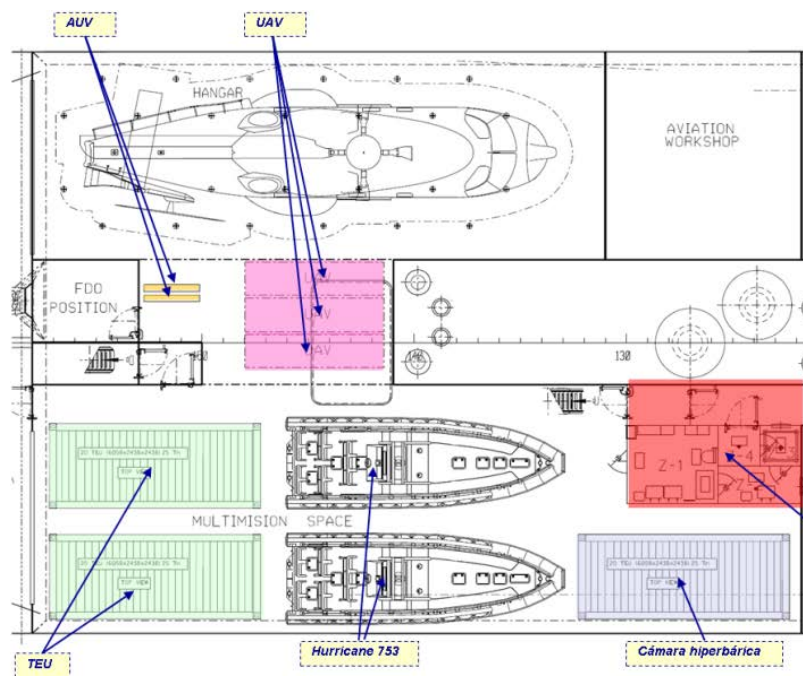
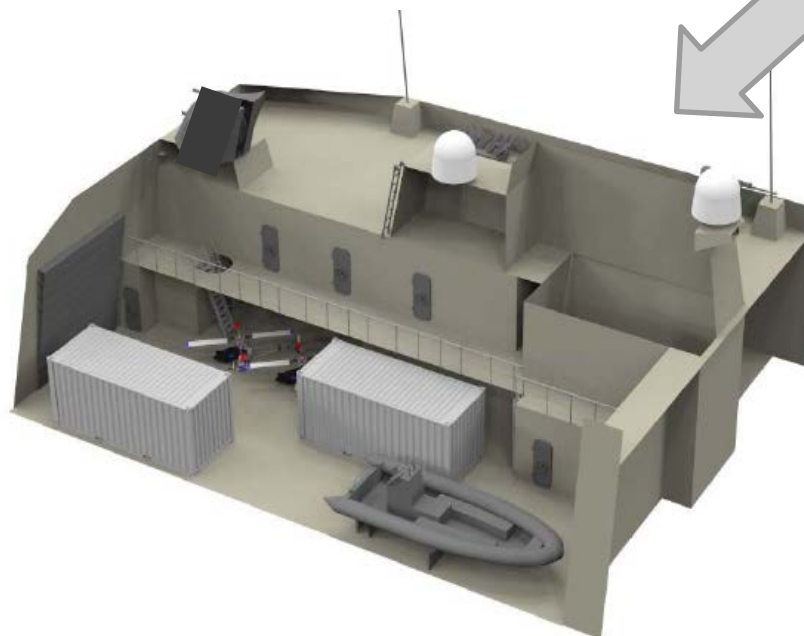
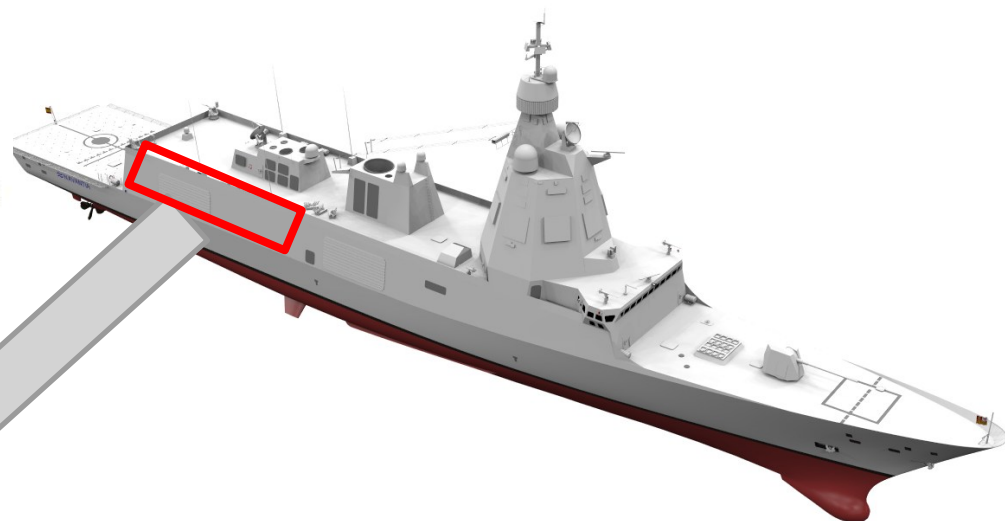


Complementada o proporcionada a través de las capacidades modulares

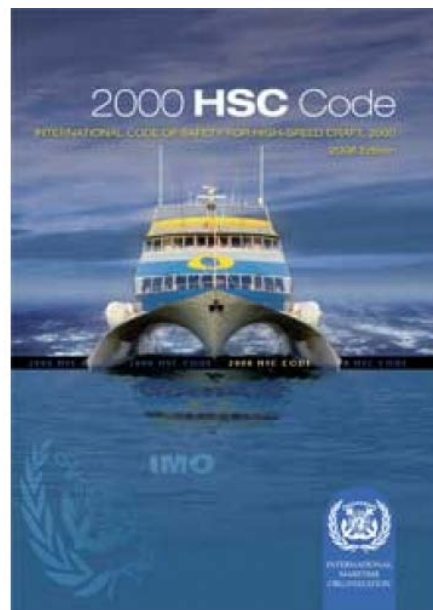
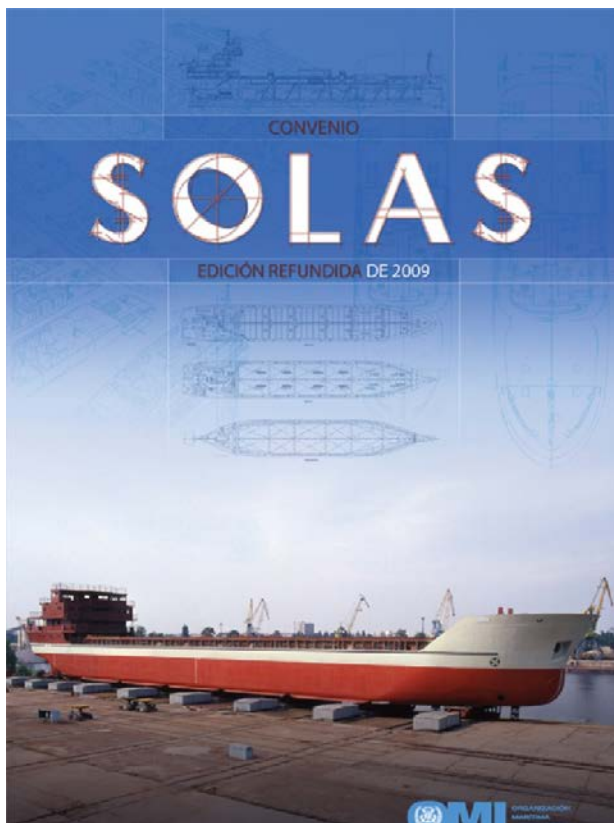
# Espacio Multimisión



= CAPACIDAD MODULAR



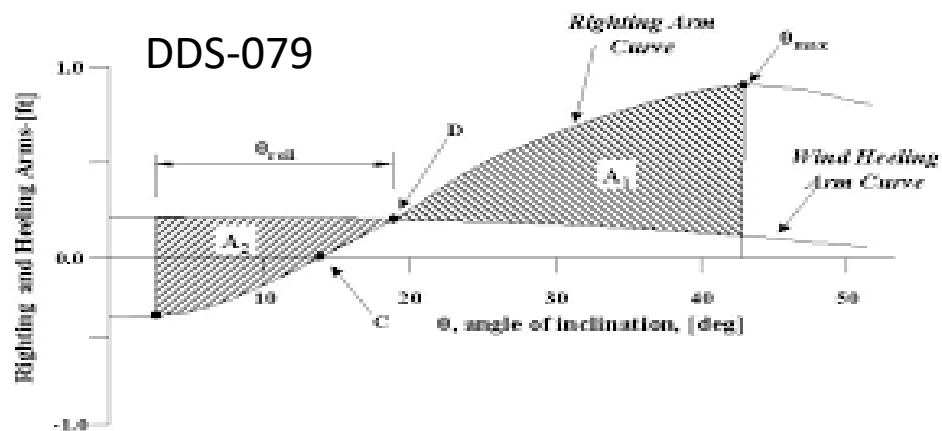




MARINE BUSINESS REVIEW  
2011-2012



## General Specifications for Ship

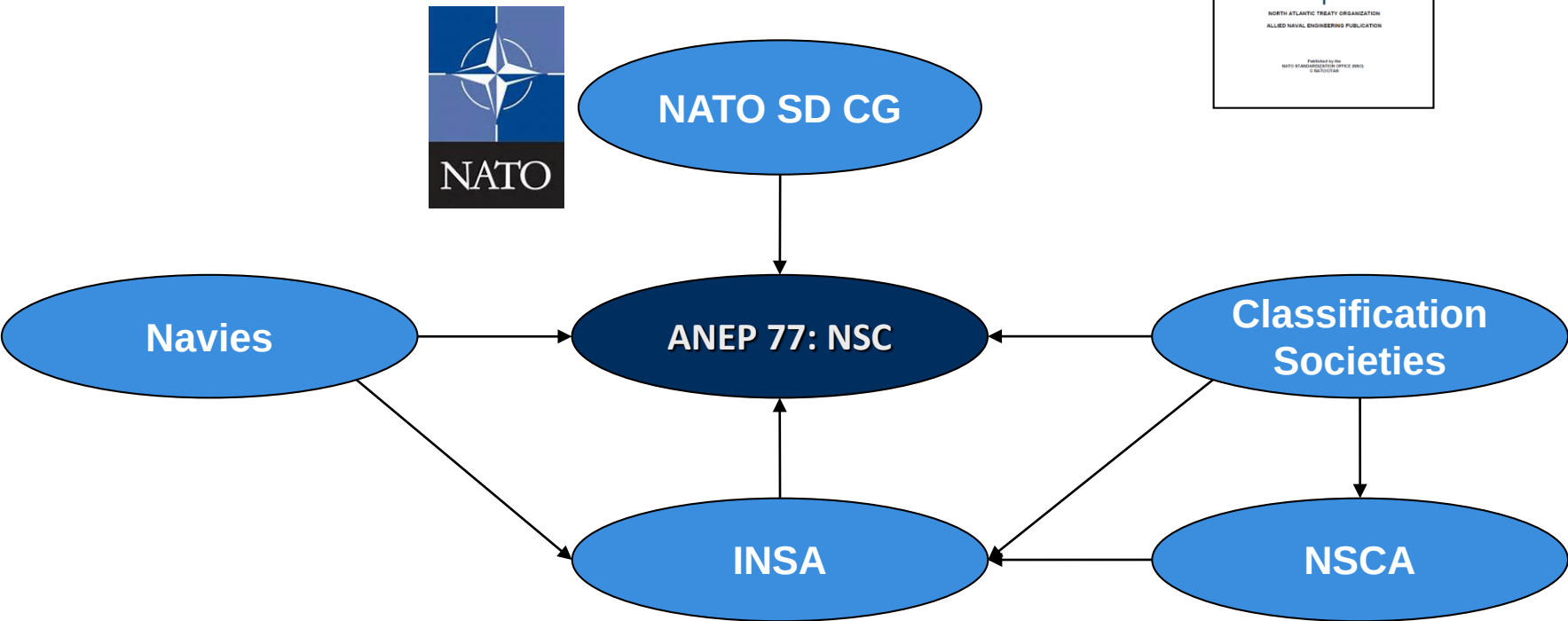


## Rules for the Classification of Naval Ships

NR 483

### AMENDMENTS

July 2014





Chapters I, II, III, IV, VI & VII applied.



Adopted for all future naval ship acquisition projects



Aim to have all vessels certified against the NSC by 2018



Applying Chapters VI & VII to a new build project



Incorporated into law as regulations for naval ships



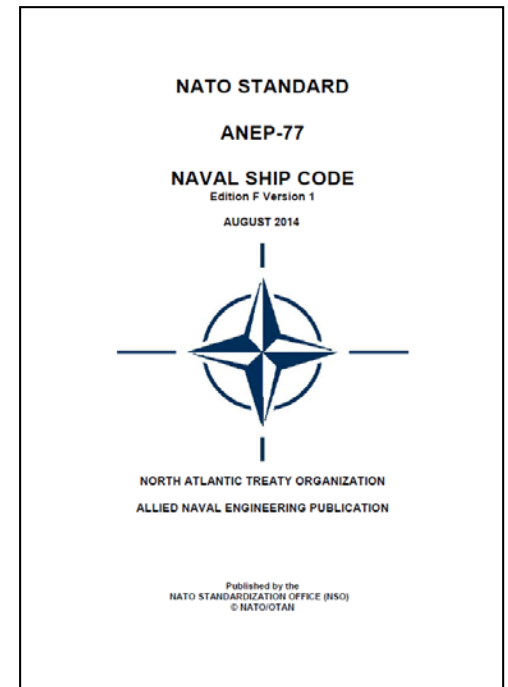
Striving to adopt the NSC, currently setting up Naval Authority



Adopted for new build project in 2014/2015 - joined INSA in 2016



Last constructions from 2010

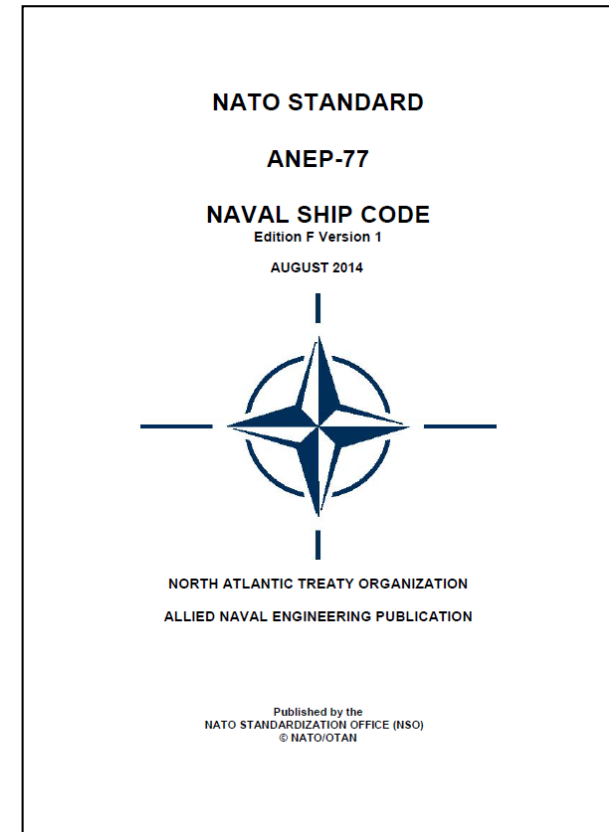


# Part 1 - Naval Ship Code Overview

## Aim

1 The overall aim of the Naval Ship Code is to provide an internationally accepted standard for naval surface ship safety based on and benchmarked against IMO conventions and resolutions that embraces the majority of ships operated by Navies.

- Goal based standard
- 3 Parts each with 10 Chapters
  - Part 1: Regulations
  - Part 2: Solutions
  - Part 3: Justification and Guidance
- Freely available from NATO library (STANAG section)
- Link from [www.navalshipcode.org](http://www.navalshipcode.org)
- Latest Version: Ed. G, Ver.1
- (F-110): Ed. F, Ver.1



## **NAVAL SHIP CODE**

\*Chapter 0 – Using the Naval Ship Code

Chapter I - General Provisions

Chapter II - Structure

Chapter III - Buoyancy, Stability and Controllability

Chapter IV - Engineering Systems

\*Chapter V - Seamanship Systems

Chapter VI - Fire Safety

Chapter VII - Escape, Evacuation and Rescue

Chapter VIII - Communications

Chapter IX - Navigation

Chapter X - Dangerous Goods

\* New in Edition G, Version 1



# Naval Ship Code Structure

NATO STANDARD

ANEP-77

NAVAL SHIP CODE

Edition F Version 1

AUGUST 2014



NORTH ATLANTIC TREATY ORGANIZATION  
ALLIED NAVAL ENGINEERING PUBLICATION

Published by the  
NATO STANDARDIZATION OFFICE (NSO)  
© NATO/OTAN

## Part 1

**0 Aim**

*Overall objective of the Naval Ship Code*

**1 Goal**

*Goal for each Chapter*

**2 Functional Objectives**

*Functional Objectives  
defined to create  
the Regulatory structure*

**3 Performance Requirements**

*The requirements for each  
Functional Objective*

## Part 2

**4 Solutions**

*Detailed Rules and  
methods for verifying  
Compliance*

Verification

## Part 3

**5 Justification and Guidance**

*Statements to  
justify text*

Guidance

*Explanatory  
Information*

# Selecting Solutions

ANEP 77

PART 1 CHAPTER I ANNEX A: CONCEPT OF OPERATIONS STATEMENT

|                                             |                                 |                                                                |
|---------------------------------------------|---------------------------------|----------------------------------------------------------------|
| <Official seal of the Naval Administration> | CONCEPT OF OPERATIONS STATEMENT | <If appropriate, official seal of the Recognised Organisation> |
|---------------------------------------------|---------------------------------|----------------------------------------------------------------|

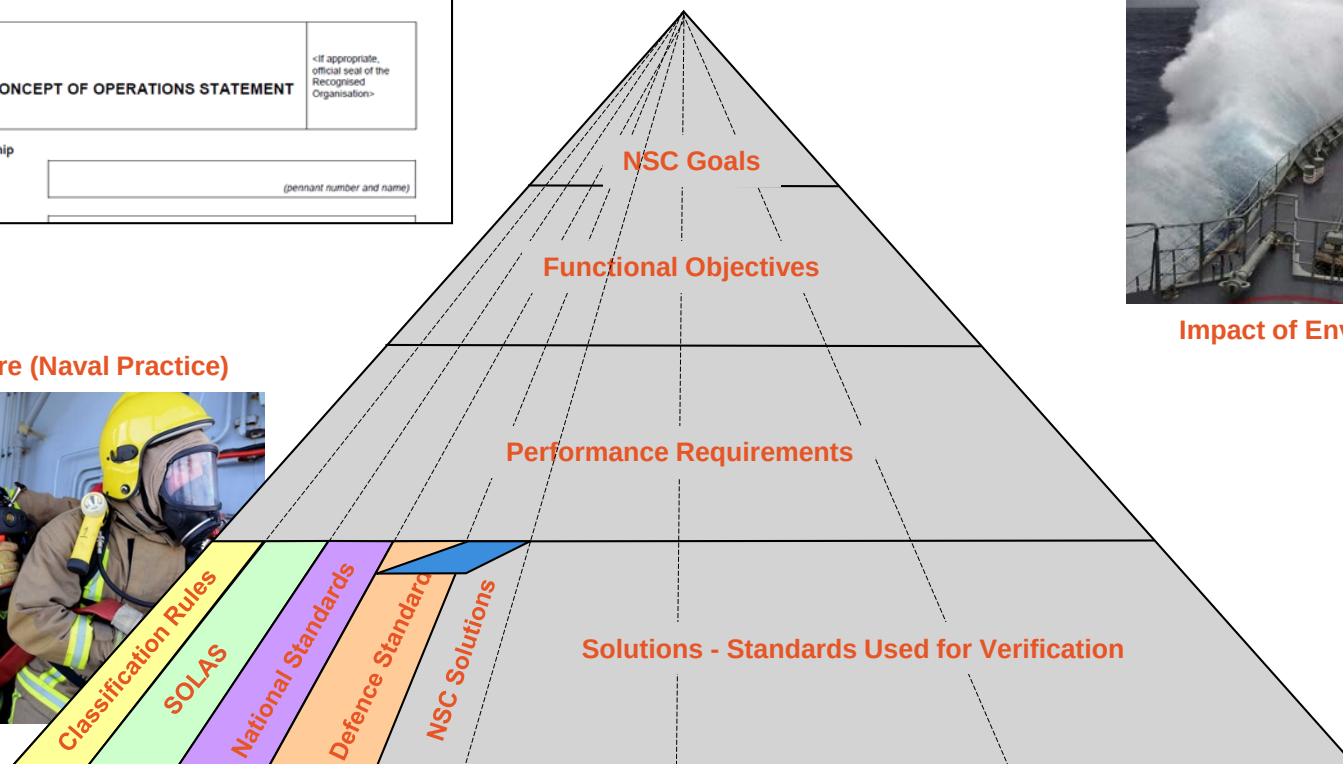
Particulars Of The Ship

Ship Name  (pennant number and name)

Impact of Culture (Naval Practice)

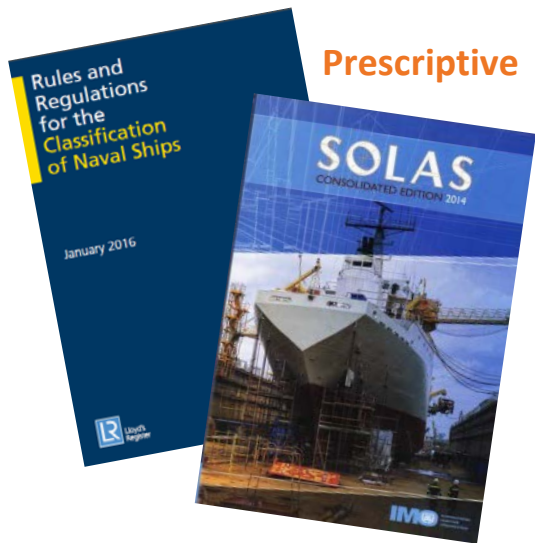


Impact of Environment (Location)



*“ Goal-based regulation does not specify the means of achieving compliance but sets goals that allow alternative ways of achieving compliance ”*

(H Hoppe, IMO)



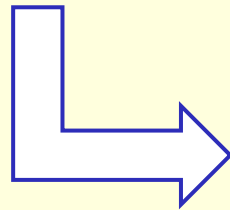
- Based on historical experience
- Easy to contract against



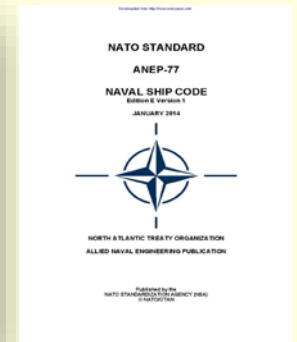
- Supports new technologies & innovation
- Existing standards can be demonstrated to meet the goals

# Cumplimiento de Requisitos

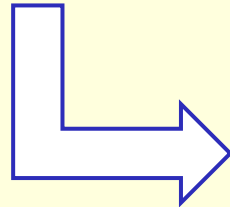
## REQUISITOS DE LA SOCIEDAD DE CLASIFICACIÓN



**Cotas de Clase**



## REQUISITOS DEL ESTADO MAYOR



**Normativa Asociada**



# Cotas de Clase

Las Fragatas F-110 alcanzará las siguientes cotas:

- **NC ✕HULL ✕MACH**
- **FRIGATE**
- **UNRESTRICTED SERVICE/NAVIGATION**
- **AVM-APM**
- **AUT-PORT/IAS**
- **COMF-NOISE/VIB**
- **CLEANSHIP**

Además se toman como referencia para el proyecto las siguientes notas adicionales de clase:

- **SEA KEEP FLY/RAS**
- **SYS-NEQ**
- **INWATERSURVEY**
- **MANOUVR-MIL**



**BUREAU  
VERITAS**

## Rules for the Classification of Naval Ships

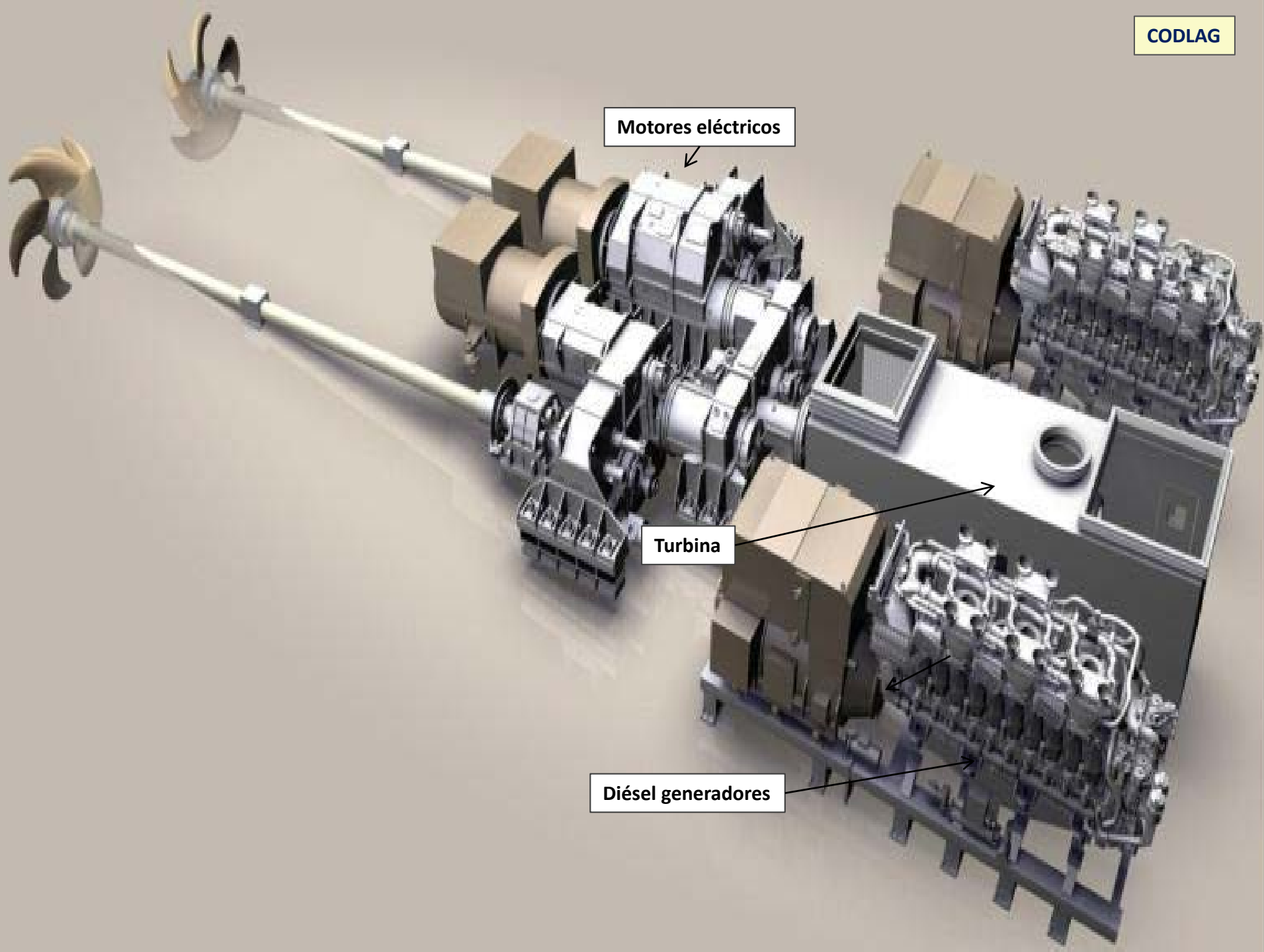
### PART A - Classification and Surveys

Chapters 1 – 2 – 3 – 4 – 5

NR 483.A1 DT R01 E

November 2011

Marine Division  
92571 Neuilly sur Seine Cedex – France  
Tel: + 33 (0)1 55 24 70 00 – Fax: + 33 (0)1 55 24 70 25  
Marine website: <http://www.veristar.com>  
Email: [veristarinfo@bureauveritas.com](mailto:veristarinfo@bureauveritas.com)  
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- PINTURAS ANTIFOULING



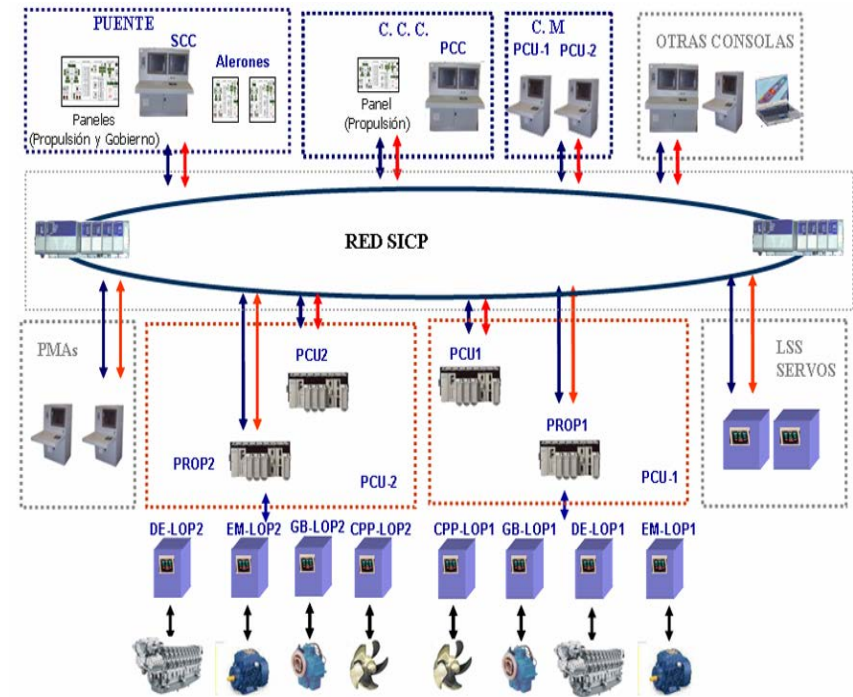
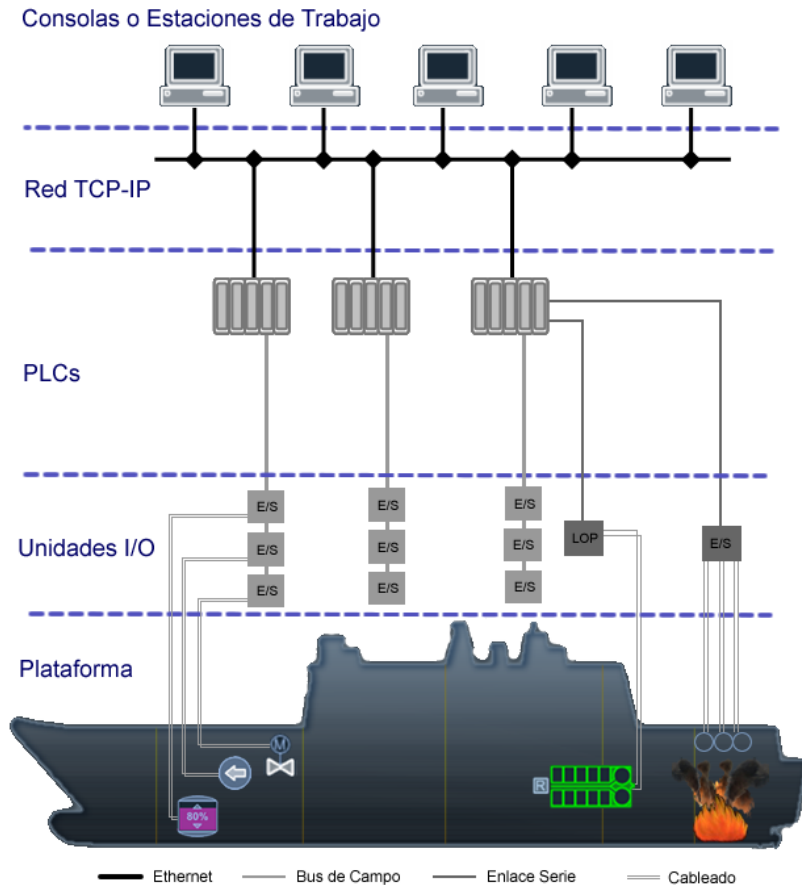
| Patente        | Título                                                                                                                                                                                      | Solicitante            |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 94810A         | UNDERWATER ANTIFOULING PAINT COMPOSITION                                                                                                                                                    | SHINETSU CHEMICAL CO   |
| 88398A         | ANTIFOULING COATING COMPOSITION, ANTIFOULING COATING FILM, SHIP OR UNDERWATER STRUCTURE COATED WITH THE SAME COATING FILM, AND METHOD FOR ANTIFOULING OF SHIP SHELL OR UNDERWATER STRUCTURE | CHUGOKU MARINE PAINTS  |
| 20524A         | UNDERWATER COATING COMPOSITION, METHOD FOR FORMING UNDERWATER COATING FILM, AND UNDERWATER COATING MEMBER                                                                                   | MIZUSAWA KIKAI SHOJI K |
| US2002022044   | Non-toxic coating composition, methods of use thereof and articles protected from attachment of biofouling organisms                                                                        | MATIAS JONATHAN R      |
| EP1138725A1    | Antifouling coating                                                                                                                                                                         | NIPPON PAINT CO LTD    |
| WO2001079359A2 | Guanidinium and Isothiourenium compounds and methods for their use                                                                                                                          | UNIV VICTORIA INNOVAT  |
| JP2001348532A  | ANTIFOULING COATING                                                                                                                                                                         | NIPPON PAINT MARINE KK |
| WO2001094479A1 | SELF-POLISHING MARINE ANTIFOULING PAINT COMPOSITION COMPRISING SILICON-CONTAINING CO-POLYMERS AND FIBRES                                                                                    | HEMPEL AS              |

- TECNOLOGÍAS PARA EL TRATAMIENTO DE LAS AGUAS DE LASTRE DE LOS BUQUES

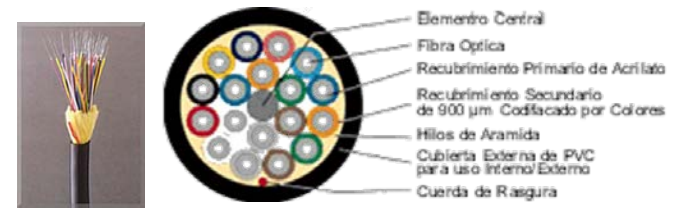


| Nº Patente      | Título                                                                                   | Solicitante              |
|-----------------|------------------------------------------------------------------------------------------|--------------------------|
| US6361695B1     | Shipboard wastewater treatment system                                                    | ZENON ENVIRONMENTAL INC  |
| US20030015481A1 | METHOD AND APPARATUS FOR TREATING/DISINFECTING BALLAST WATER IN SHIPS                    | EIDEM OLA MAGNE          |
| US6402965B1     | Ship ballast water ultrasonic treatment                                                  | OCEANIT LAB INC          |
| US6516738B2     | Method and apparatus for delivering ozone to ballast tanks                               | NUTECH 03 INC            |
| US6500345B2     | Apparatus and method for treating water                                                  | MARITIME SOLUTIONS INC   |
| JP2001000974A   | TREATMENT OF BALLAST WATER AND SHIP                                                      | KONISHIROKU PHOTO IND    |
| US6616833B2     | Ship-board system for decontaminating wastewater contaminated by firefighting operations | LYNCH GERARD             |
| WO2001036339A1  | PROCESS AND APPARATUS FOR THE CONTROL OF UNDESIRABLE ORGANISMS IN A WATER SYSTEM         | FORINNOVA AS             |
| JP2002192161A   | TREATING METHOD FOR SHIP BALLAST WATER AND ITS TREATING APPARATUS                        | MITSUBISHI HEAVY IND LTD |
| US6626122B2     | Deactivatable biocides in ballast water                                                  | O'REILLY KIRK T          |

# Estructura del SICP



# Arquitectura



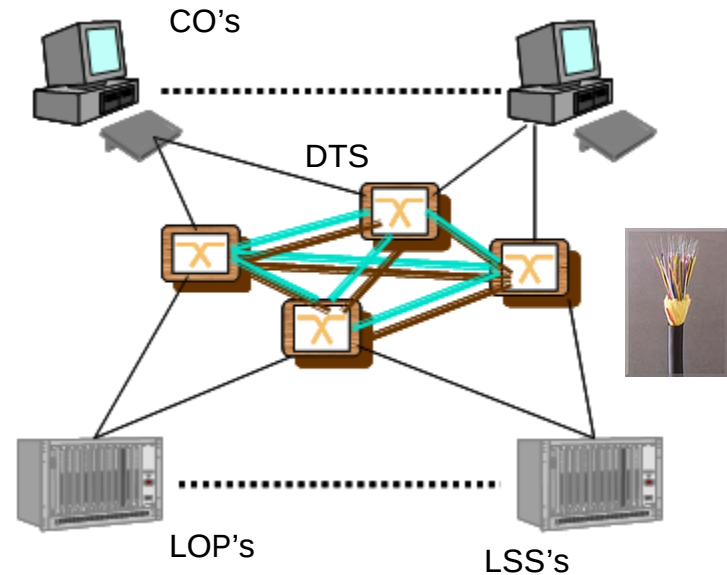
Consola de Operador

40

DTS: Data Transmission System.  
Sistema de Transmisión de Datos

LOP Panel de Operación Local (Local  
Operation Panel)

(+400 PLC's)

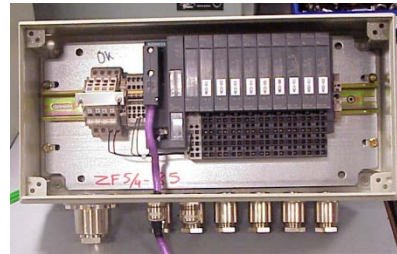


Subestaciones Locales  
(LSS, Local Sub-Station)

Unidades de Terminal Remoto  
(RTU, Remote Terminal Units)



100

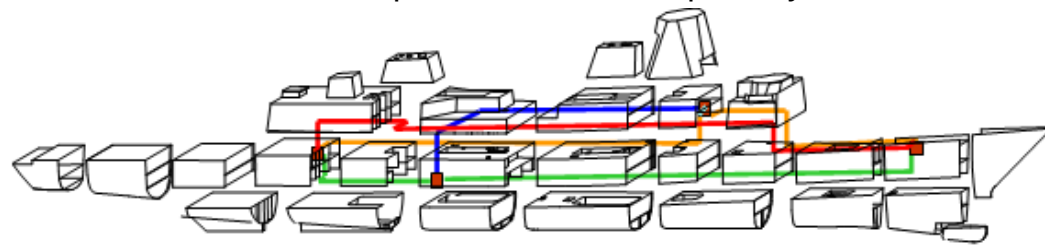
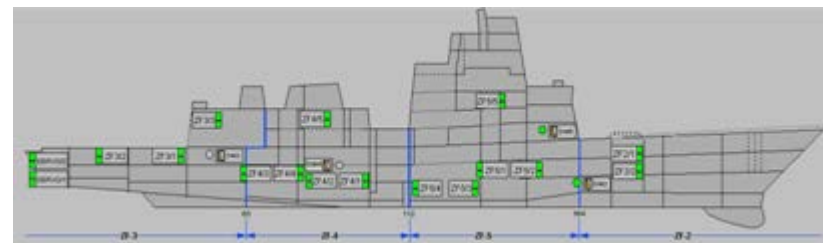


200

**+10.000 señales**

Disposición de nodos y LSS

Disposición de fibra óptica y nodos ATM



# Elementos Típicos HW de un SICP



**Consolas de Operador o Estaciones de Trabajo**



**Paneles de Operación Remota**



**Unidades de almacenamiento (DSU, 'Data Storage Unit'):**

**Módulo impresoras**



**Cuadros de control local (LOP, Local Operating Panel)**



**Subestaciones locales (LSS, Local SubStation)**



**Unidades E/S Remota (RTU)**



**Conmutadores de Red GB (Gigabit)**



**4ª revolución industrial**

**Industria 4.0**

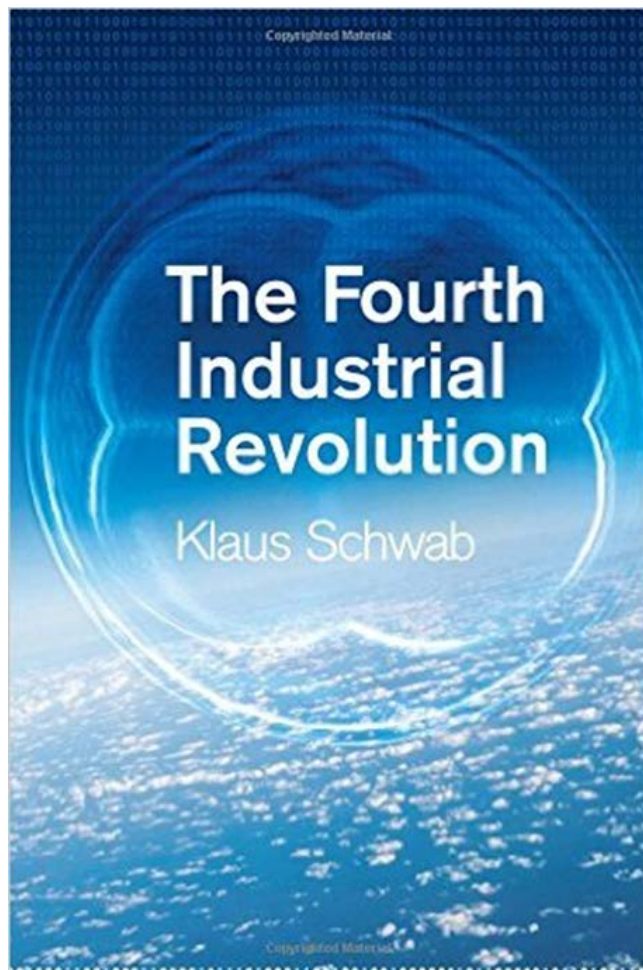
**Astillero 4.0**

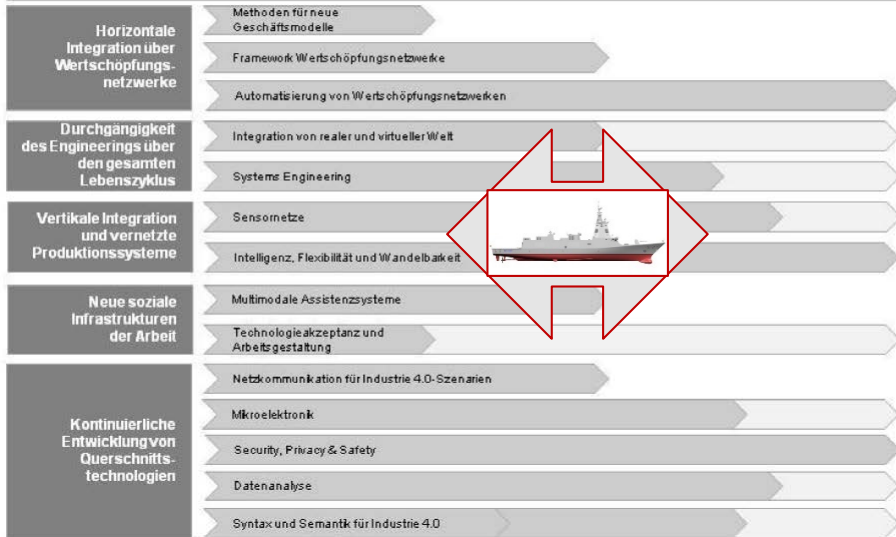
**Tecnologías digitales  
a gran escala**

4ª revolución industrial

Industria 4.0

Astillero 4.0



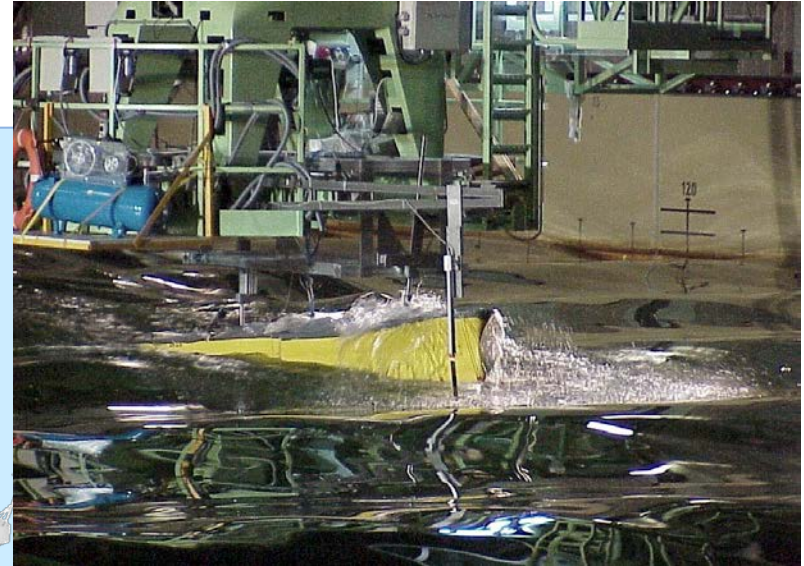


El diseño y construcción de las Fragatas F110 se desarrollan en pleno lanzamiento de la INDUSTRIA 4.0.



# Competencias digitales





**Maqueta digital,  
modelo físico y  
buque real**



# El Astillero 4.0 es un sistema ciberfísico

## Dominio virtual o ciber



**Maqueta digital**



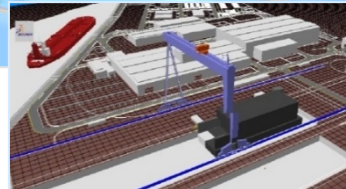
**Personas**



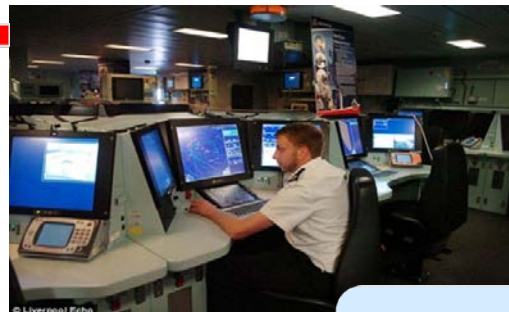
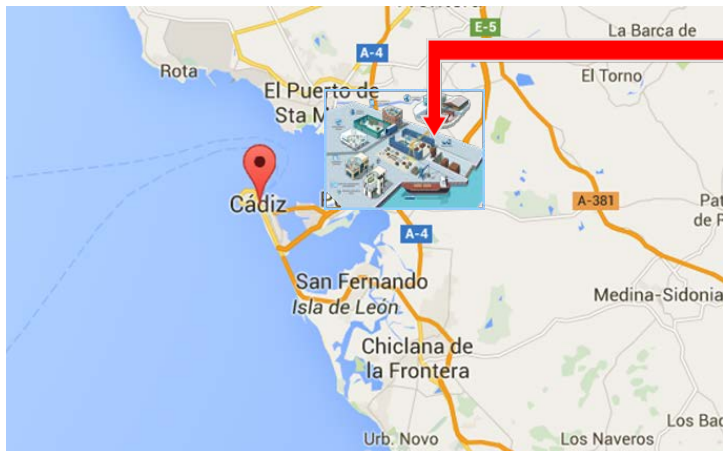
## Dominio físico o material



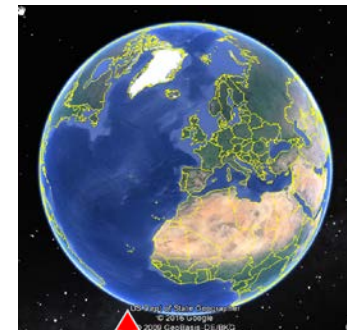
**Infraestructura inteligente**



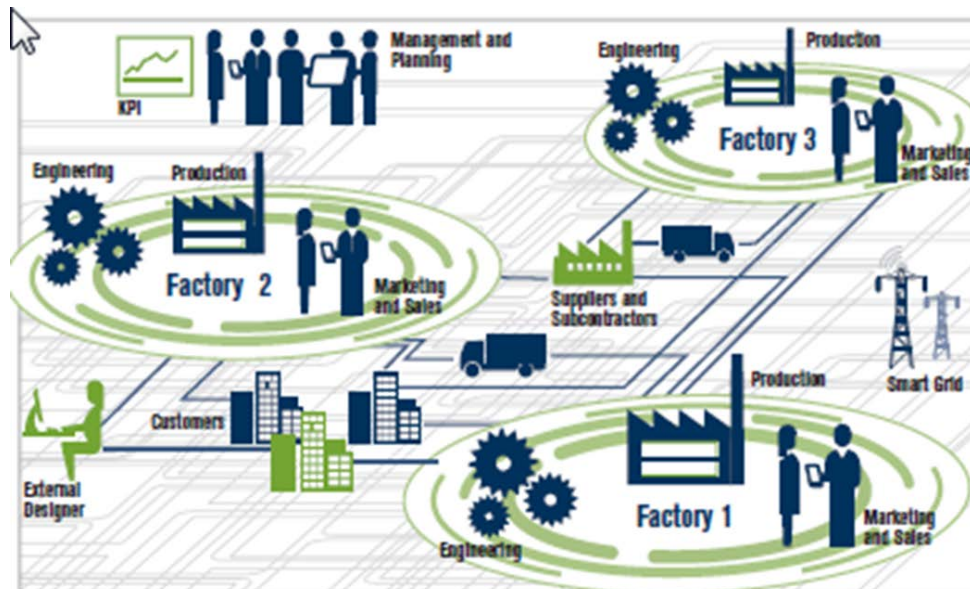
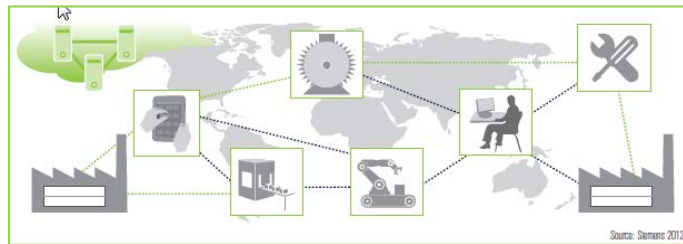
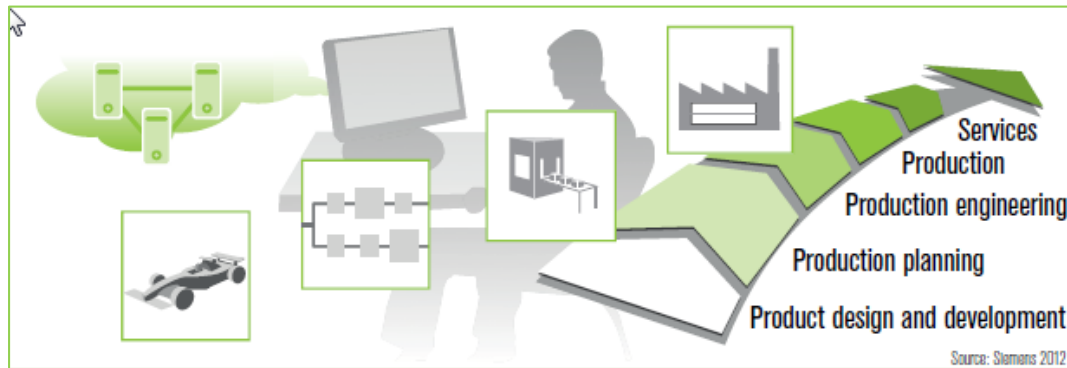
**Buque inteligente**



**EL CLIENTE ve todo**



## Industria 4.0



Desde el  
taller  
hasta la alta  
dirección

Más allá del  
astillero

# Industria 4.0

Internet  
de las  
Cosas

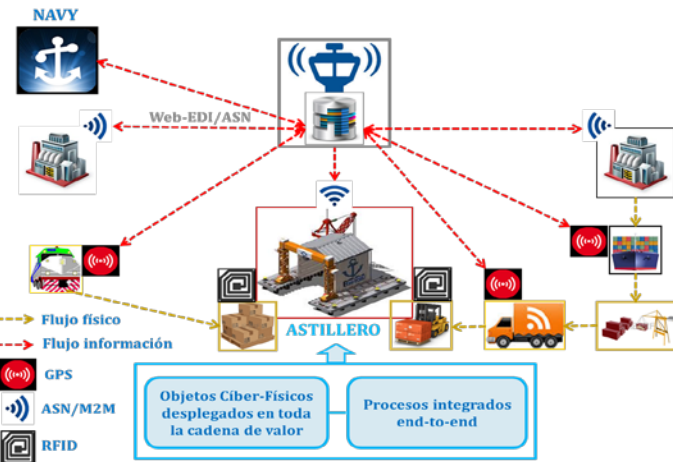
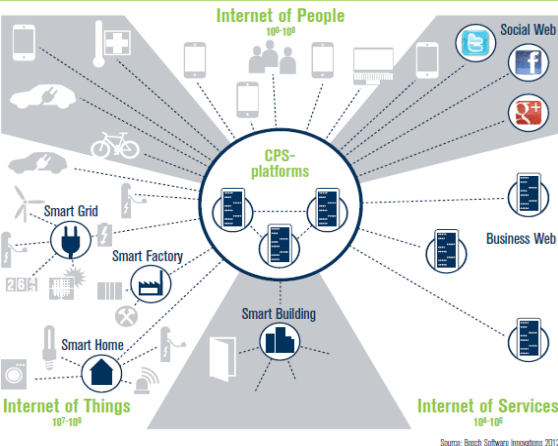
Big data

Realidad virtual

Realidad aumentada

Impresora 3D

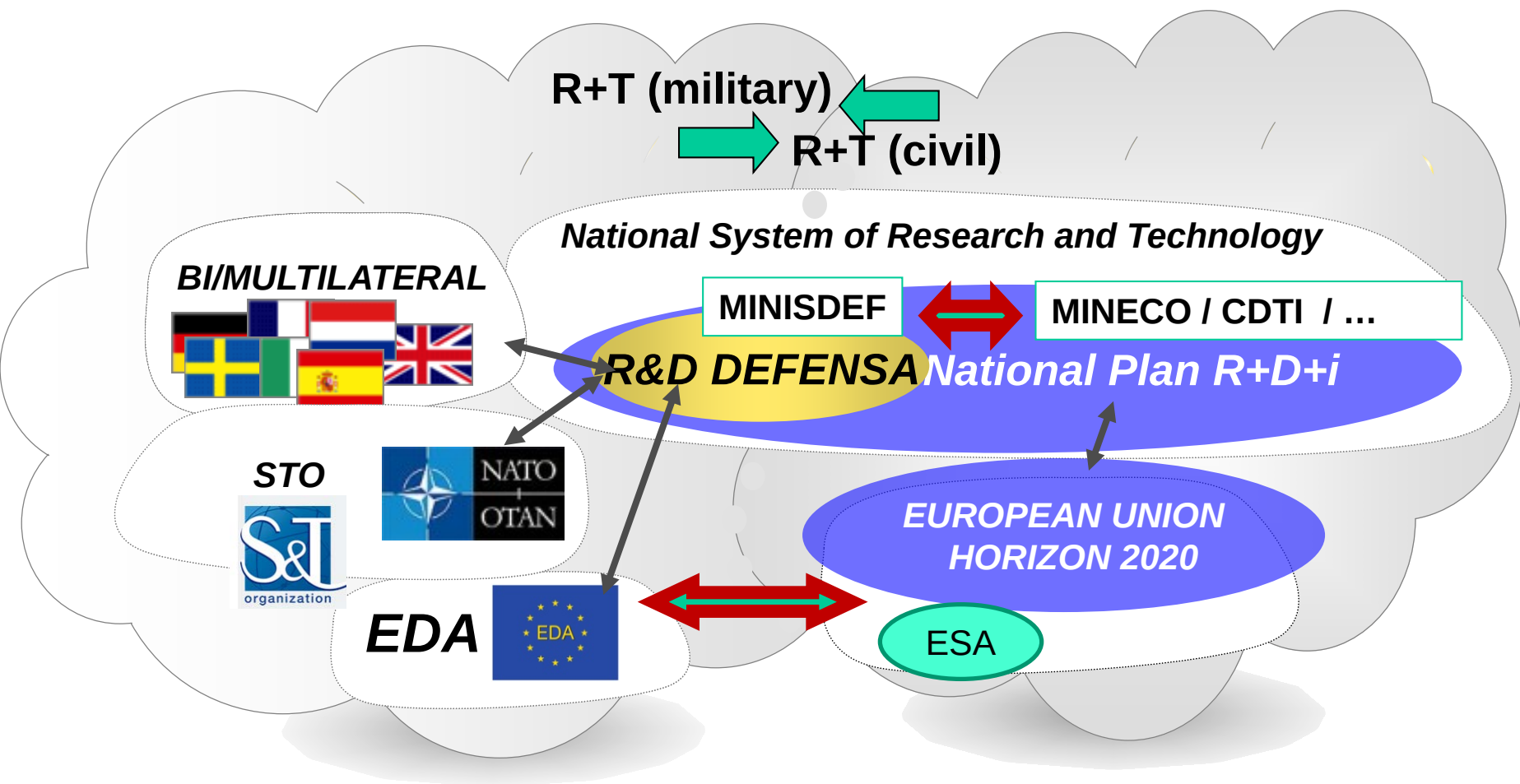
Mantenimiento 4.0



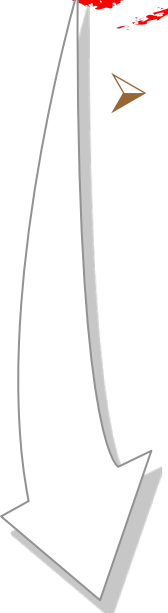
¿Invertir en  
I+D+i...

...o comprar  
**Producto?**





# Misión del I+D de Defensa



- Satisfacer las necesidades de las FAS

- Contribuir a conformar la base industrial del sector defensa.

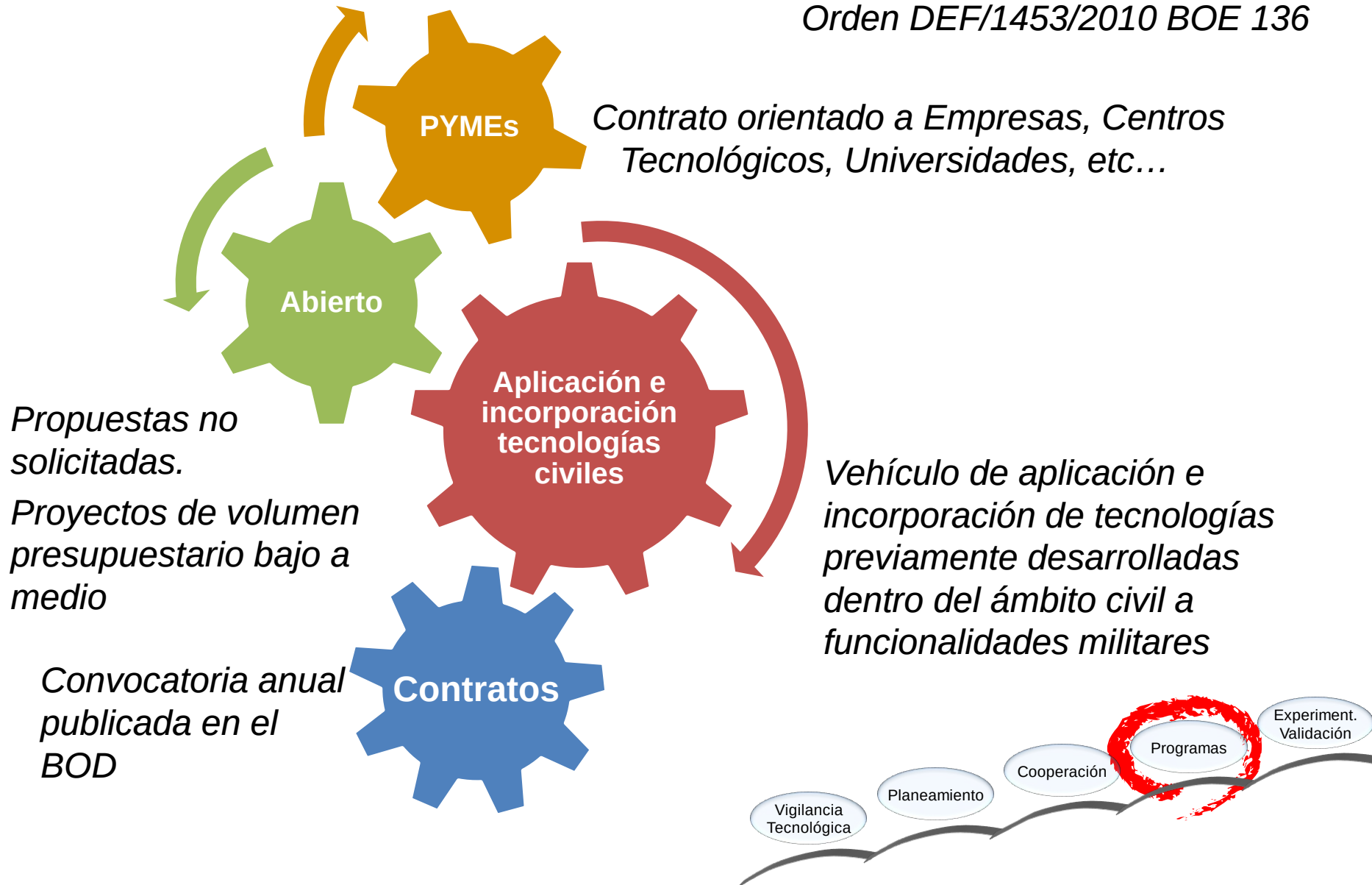
**El I+D de Defensa es FINALISTA**



# Programa Coincidente

**COINCIDENTE:** Cooperación en Investigación Científica y Desarrollo de Tecnologías Estratégicas.

*Orden DEF/1453/2010 BOE 136*





## CapTechs

- Foros técnicos de coordinación y seguimiento de proyectos
- Orientados a capacidades
- Cubren todo el espectro tecnológico
- Con participación de la industria, los gobiernos y representantes de la EDA.
- Coordinador nacional (CNC) por cada CAPTECH
- Receptor de proyectos originados por necesidades de capacidades (top-down)
- Generación de ideas y nuevos proyectos (bottom-up)
- Participación en la identificación y definición de las tecnologías prioritarias para la inversión común

22 áreas tecnológicas preliminares de la Estrategia de I+T de la EDA

Más información en:

<http://www.eda.europa.eu/rtcaptechs.aspx>

Boletín Difusión Información Tecnológica en Defensa nº19

- IAP 01 Components.
- IAP 02 RF Sensors system & Signal processing.
- IAP 03 Optical Sensors Systems & Signal Processing.
- IAP 04 CIS & Networks.
- GEM 01 Materials & Structures.
- GEM 02 Energetic, Missiles & Munitions.
- GEM 03 Ground systems & their environment.
- GEM04 Guidance & control.
- ESM 01 Naval systems & their environment.
- ESM 02 Aerial systems & their environment.
- ESM 03 Systems of systems, Space, Simulation & Experimentation.
- ESM 04 Human Factor & CBR Protection.



|      |                                          |
|------|------------------------------------------|
| AVT  | Applied Vehicle Technology Panel         |
| HFM  | Human Factors and Medicine Panel         |
| IST  | Information Systems Technology Panel     |
| SAS  | System Analysis and Studies Panel        |
| SCI  | Systems Concepts and Integration Panel   |
| SET  | Sensors and Electronics Technology Panel |
| NMSG | NATO Modelling and Simulation Group      |
| IMC  | Information Management Committee         |

# EVOLUCIÓN DEL MARCO DE I+D

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

## HORIZON 2020

### MARCO TECNOLÓGICO



Tecnologías  
**DE** Defensa

Aplicación de  
Tecnologías **A**  
Defensa

### MARCO ESTRATÉGICO



Aplicación de los  
avances tecnológicos de  
**manera rápida, flexible y  
sostenible**

### MARCO POLÍTICO



Coordinación  
Defensa / Seguridad  
/ Espacio







## POSIBLES ROLES EN LA PARTICIPACIÓN

Advisory Board



Socios



Usuario Final



Coordinador / Entidad Líder



# ACCIÓN PREPARATORIA 2021- 2027



## Proyecto piloto



# Direcciones de Interés

- Plan a Largo Plazo de Armamento y Material
  - [www.mde.es/Galerias/politica/armamento-material/ficheros/DGM\\_Plan\\_largo\\_plazo\\_PLPAM\\_2008.pdf](http://www.mde.es/Galerias/politica/armamento-material/ficheros/DGM_Plan_largo_plazo_PLPAM_2008.pdf)
- Plan Director de Armamento y Material
  - [www.mde.es/Galerias/politica/armamento-material/ficheros/DGM\\_Plan\\_director\\_PDAM\\_2008.pdf](http://www.mde.es/Galerias/politica/armamento-material/ficheros/DGM_Plan_director_PDAM_2008.pdf)
- Programa Coincidente
  - [www.mde.es/areasTematicas/investigacionDesarrollo/programas/programa-coincidente/](http://www.mde.es/areasTematicas/investigacionDesarrollo/programas/programa-coincidente/)
- SOPT – Información y Publicaciones
  - <http://www.mde.es/areasTematicas/investigacionDesarrollo/sistemas/>



TABLE 1: DATA SUMMARY

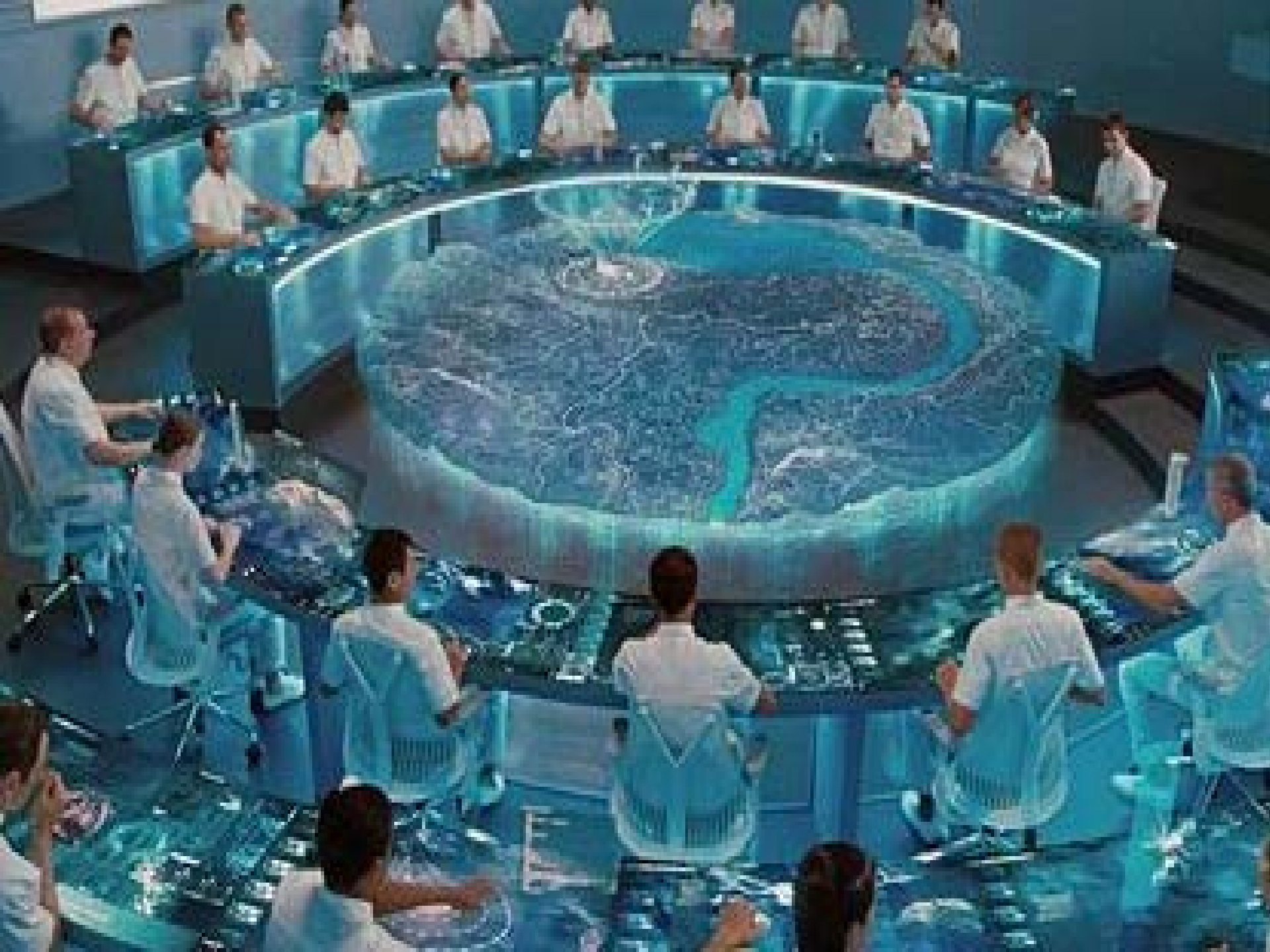
| ITEM    | VALUE | UNIT |
|---------|-------|------|
| ITEM 1  | 100   | KG   |
| ITEM 2  | 200   | KG   |
| ITEM 3  | 300   | KG   |
| ITEM 4  | 400   | KG   |
| ITEM 5  | 500   | KG   |
| ITEM 6  | 600   | KG   |
| ITEM 7  | 700   | KG   |
| ITEM 8  | 800   | KG   |
| ITEM 9  | 900   | KG   |
| ITEM 10 | 1000  | KG   |

TABLE 2: DATA SUMMARY

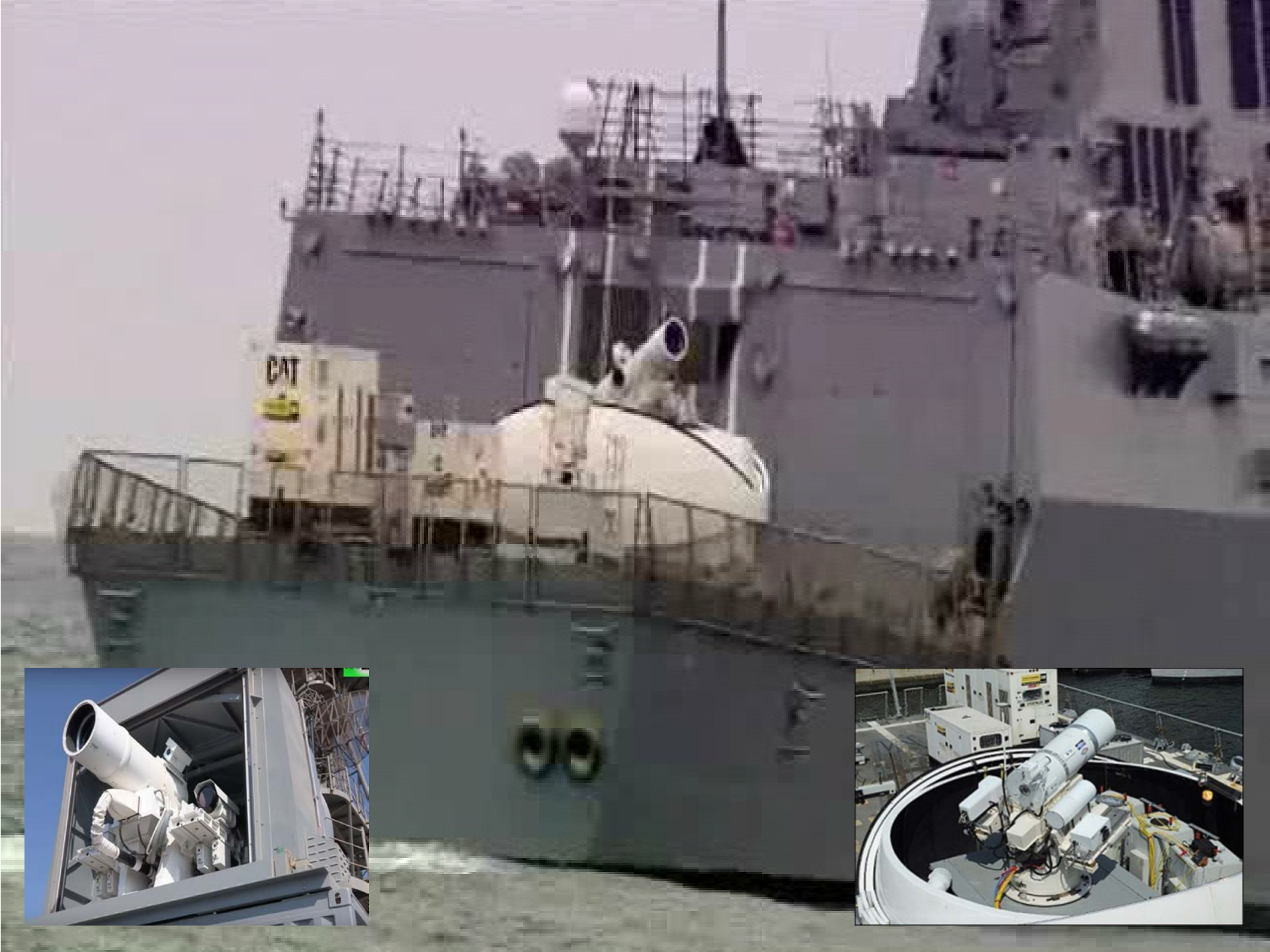
| ITEM    | VALUE | UNIT |
|---------|-------|------|
| ITEM 1  | 100   | KG   |
| ITEM 2  | 200   | KG   |
| ITEM 3  | 300   | KG   |
| ITEM 4  | 400   | KG   |
| ITEM 5  | 500   | KG   |
| ITEM 6  | 600   | KG   |
| ITEM 7  | 700   | KG   |
| ITEM 8  | 800   | KG   |
| ITEM 9  | 900   | KG   |
| ITEM 10 | 1000  | KG   |

REMOTE CAMERA FC-84

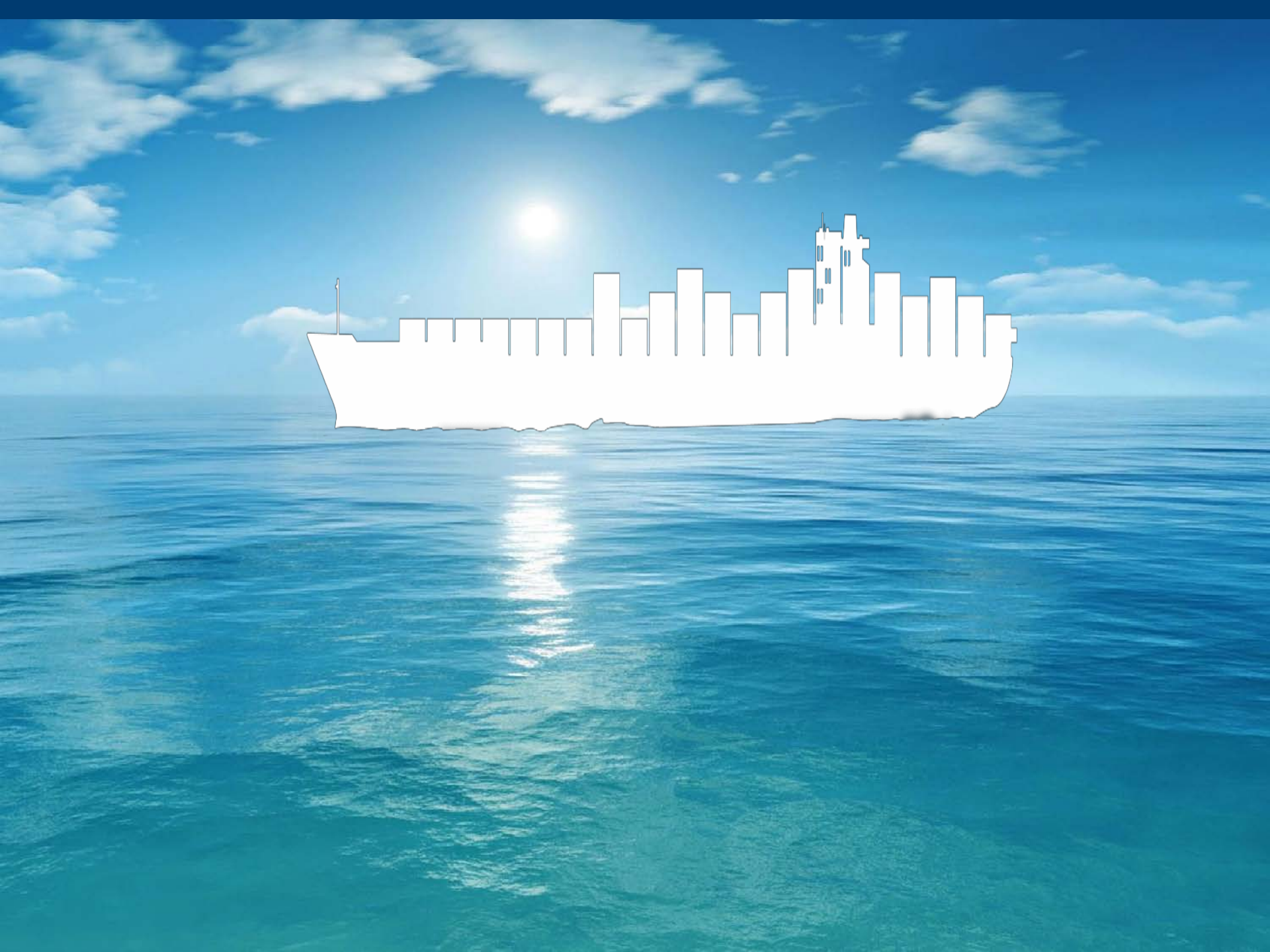
US GREEN  
BASE OPS















Impresión 3D









- La Armada necesita **reemplazar a las fragatas FFG Clase Santa María**, que a partir de 2022 empiezan a cumplir 35 años de servicio
- El **programa F-110 constituye un auténtico reto tecnológico** y una oportunidad de avance hacia el futuro modelo de Astillero 4.0. No es sólo un buque, es un proyecto de desarrollo industrial nacional. Se están desarrollando **Programas Tecnológicos** que permiten incorporar a la fragata F-110 las últimas innovaciones tecnológicas.
- En base a los estudios hidrodinámicos y desarrollo de tecnologías para el SICP, nuestra ambición es conseguir que la plataforma de esta fragata sea la mejor jamás hecha .



**Santander**  
**26.05.2017**

**[jriorod@fn.mde.es](mailto:jriorod@fn.mde.es)**