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ARALFUTUR PROJECT: ENERGY EFFICIENT DEEP SEA TRAWLER FOR SOUTH ATLANTIC FISHERIES

FEDER-INNTERCONECTA GALICIA 2013 Program
ITC 20133076

CDTI Centro para el Desarrollo Tecnológico Industrial
UNIÓN EUROPEA
Fondo Europeo de Desarrollo Regional (FEDER)
Una manera de hacer Europa
XUNTA DE GALICIA
CONSELLERÍA DE INNOVACIÓN E INDUSTRIA

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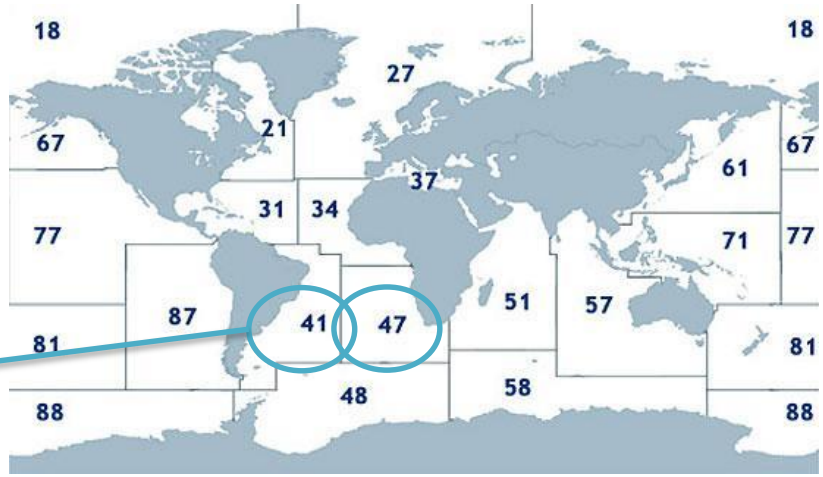
- State of the art
- The Project & Consortium
- Technologies and solutions
- Conclusions

Introduction

- Spain is the major fish producer in the EU and the number 20 in the world (2nd in value)
- In the early 60's Vigo's shipyards started to build the first freezer trawlers, allowing the exploitation of far regions.
- Creation of EEZ (Exclusive Economic Zone) in the early 80's, forcing many ship owners to establish joint ventures with partners in third countries with recognized historical rights for fishing... most of them in Southern Atlantic.



FAO 41

Situation of the fleet

- Most of vessels were already built at that time with previous conditions…
- But, even more, the newest vessel, built as late as 2004, has not represented the adoption of a new conception, and exploitation costs remain similar

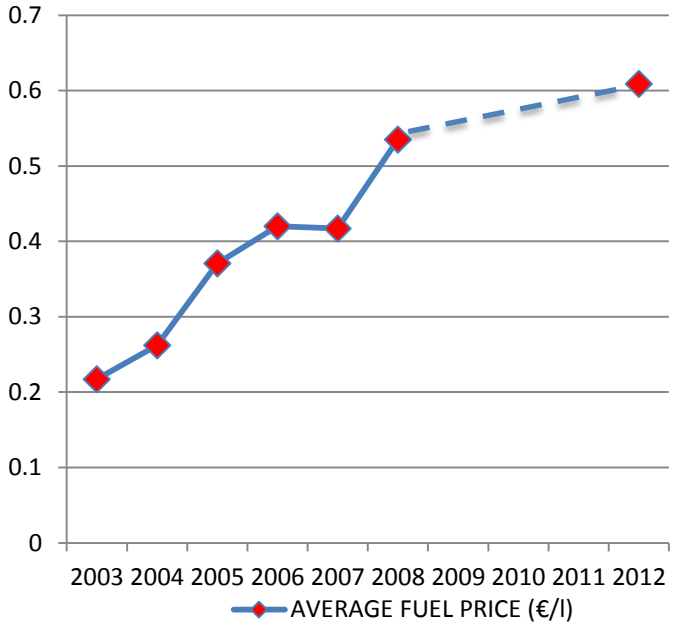
ONE OF THE OLDEST FREEZER TRAWLER STILL IN SERVICE (1974)

ONE OF THE NEWEST FREEZER TRAWLER (2004)

Situation of the fleet

In addition…

- Fuel costs increasing
- Fishing prices remains equal



OPERATING COSTS (vessel type: freezer trawler SW ATLANTIC)

Costs	Euros 2005	%Total 2005	Euros 2006	%Total 2006	Euros 2008	%Total 2008
Food	87.984	2,0	87.984	1,9	87.984	1,7
Oil	1.426.915	32,4	1.619.742	35,2	2.067.099	41,0
Lubricant	6.901	0,2	6.901	0,2	6.901,1	0,1
Other materials	90.096	2,1	90.096	2,0	90.096,0	1,8
MATERIALS, TOTAL:	1.611.897	36,6	1.804.723	39,3	2.252.080	44,6
GEAR:	192.140	4,4	192.140	4,2	192.140	3,8
CREW AND ASSOCIATED COST:	1.793.992	40,7	1.793.992	39,0	1.793.992	35,6
PORT CHARGES, LANDINGS, REPAIRS…	731.601	16,6	731.601	15,9	731.601	14,5
INSURANCE AND OTHER:	75.742	1,7	75.742	1,7	75.742	1,5
TOTAL	4.405.372	100	4.598.198	100	5.045.555	100

NET SALES: 4,8 M€/year

State of the art

- Current vessels were not conceived neither for long working periods –around 6 months- nor to keep in their holds very high tonnages –around 1.000 Tm-.
- This means unnecessary fuel consumption with clear energetic inefficiency.
- Despite the investments made on board in recent years, fuel is still 40% of the exploitation costs in shipping companies. ACEMIX vessels have engines whose fuel consumption is 20% higher than those of the modern ones to reach the same power.
- The old age of the fleet causes trouble and costs which increase exponentially due to malfunction and structural problems like corrosion, breaking of inner screens, communication among tanks, plate wearing out, etc.

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"Desing and development of technological solutions for deep sea trawling fleet of the future"

Program: FEDER-INNTERCONECTA Galicia 2013

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

CDTI Centro para el Desarrollo Tecnológico Industrial

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GOALS:

- To offer an advanced and viable technological answer on four basic questions about the competitiveness of the freezer trawler fleet: energy optimization, on board activities –fishing & processing- optimization, safety and ergonomics in the ship.

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PARTNERS

ARVI
Cooperativa de Armadores de Pesca del Puerto de Vigo

CHYMAR, S.A.
BUQUES DE PESCA

IBERCISA
DECK MACHINERY

KINARCA

F. CARCELLER
Ingenieros Navales - Consultores

optimar

VICUSdt
DESARROLLOS TECNOLÓGICOS

PUBLIC RESEARCH ORGANISMS

CEHIPAR
CANAL DE EXPERIENCIAS HIDRODINÁMICAS DE EL PARDO

CETMAR
CENTRO TECNOLÓGICO DEL MAR

CITIC
Centro Andaluz de Innovación y Tecnologías de la Información y las Comunicaciones

CTAG
Centro Tecnológico de Automoción de Galicia

DTE
Universidad de Vigo

BAC LUCE

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ARALFUTUR: the project

TASK 1: Development of ship design

- Integration and naval architecture

TASK 2: Technologies for energy efficiency optimisation

- Sea trials & monitoring
- Hydrodynamics
- System integration simulation & performance calculation
- Electric plant design
- Integration for new ships and retrofittings

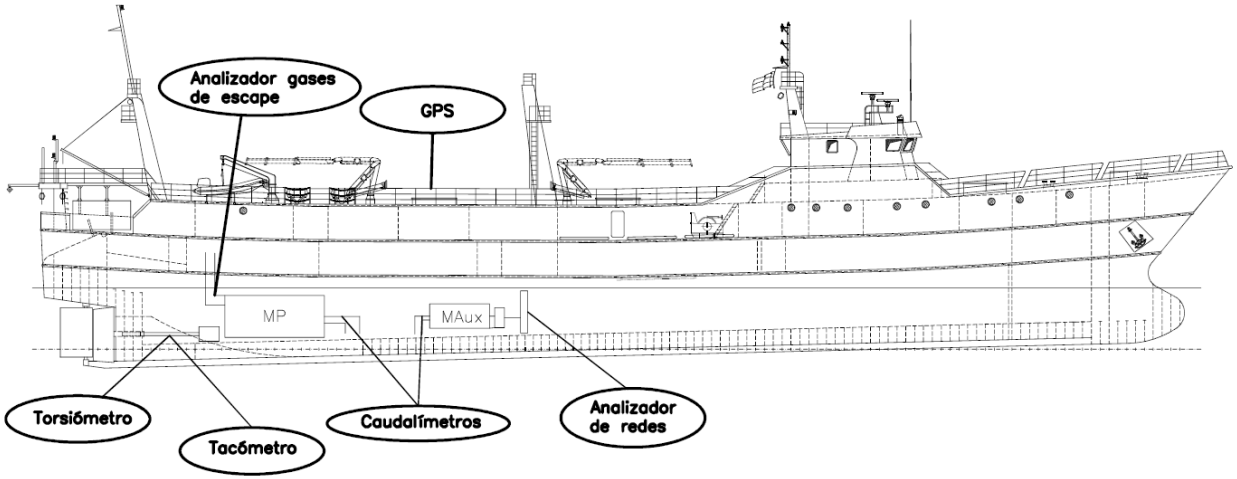
TASK 3: Optimisation on fishing gears, processing and freezing

- Research and design of drives, control, installation

TASK 4: Optimisation and technologies for safety and ergonomy improvement

Operational profile definition

- Studies of state of art: existing stern trawlers and systems on board
  - Stern trawler database for Southeast Atlantic fleet
  - Analysis of propulsion system, power plant & energy distribution and major consumption equipment



Operational profile definition

- Data collection on board:

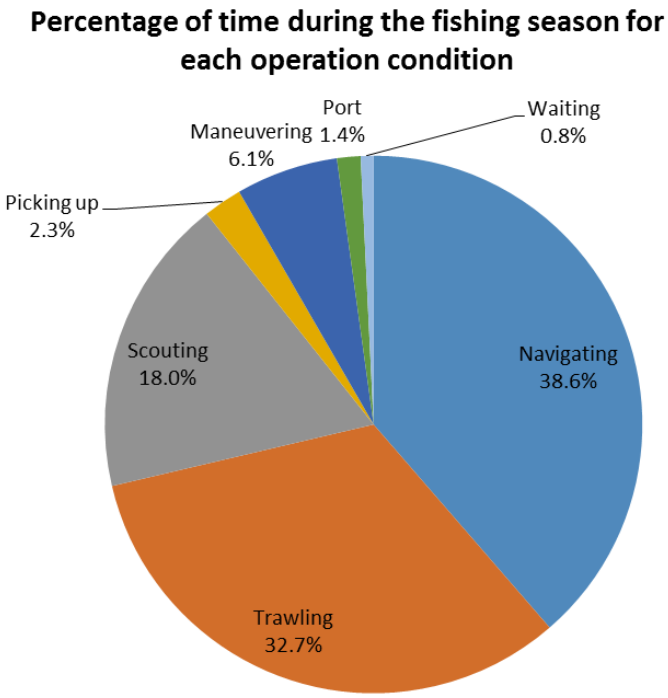
  Measurements in different vessels for different operation conditions

  Measurements manually and remotely: statistical analysis of different parameters:

- Torque
- Rps
- Fuel consumption
- Speed
- Electric power consumption
- Emissions…

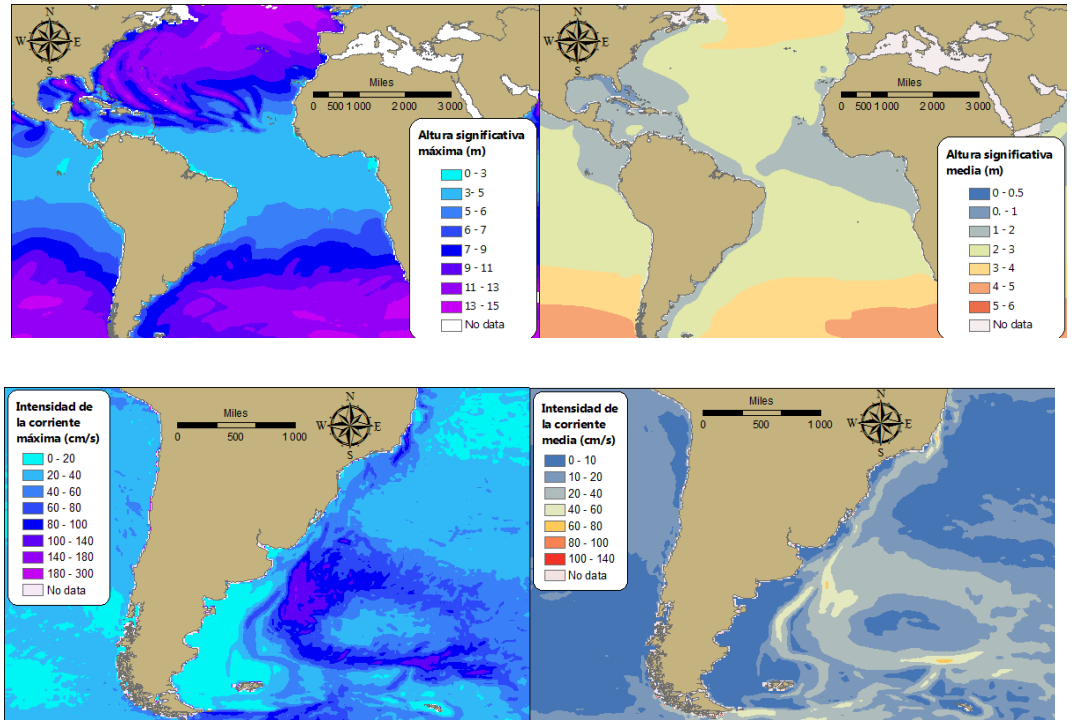
Operational profile definition

- Basis to take into account for optimizing:
  - Base ship: Stern trawlers usual configuration and operation
  - Socioeconomic and political requirements



Operational profile definition

- Basis to take into account for optimizing:
  - Sea conditions in the route and fishing areas:
    - Waves: significant height and period
    - Wind: intensity and direction
    - Currents: intensity and direction



Operational profile definition

- Operational profile and specific requirements:
  - Establishment of operational profile:

Operational profile for Southeast Atlantic fishery							Electric power plant	
Operational condition	Speed	Proppeler loading	Average consumption			Time	Auxiliary power generation	Shaft generator
	kn	%	l/day	l/h	l/naut mile	days	kWe	kWe
Navigating	10,5-13,5	90-95	6500-17000	270-710	28 -33	20-25	>60	>60
Trawling	3,5-5,2	80-85	6750-15000	280-605	64-173	50-80	>240	0
Scouting	10,5-13,5	90	6500-17000	>270	>22	-	>240	-
Picking up	≈0	30	7980-16000	330-660	-	-	>240	-
Waiting	≈1	-	<17000	<700	<700	-	>240	-

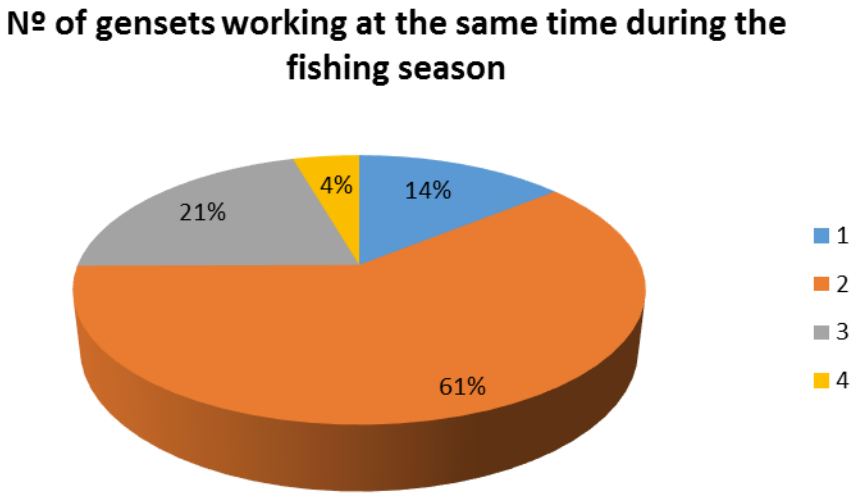
Estimated captures:
60t/day

Operational profile for Southwest Atlantic fishery							Electric power plant	
Operational condition	Speed	Proppeler loading	Average consumption			Time	Auxiliary power generation	Shaft generator
	kn	%	l/day	l/h	l/naut mile	days	kWe	kWe
Navigating	10-12	85-100	7200-8000	300-333	25-33	16-24h	>140	>60
Trawling	3-4	72-85	6600-10000	275-417	69-139	24h/día (30-45días)	>380	>260
Scouting	10-12	85-100	-	-	-	-	-	-
Picking up	≈0	-	-	-	-	-	>600	-
Waiting	≈1	-	-	-	-	-	>600	-

Estimated captures:
40t/day

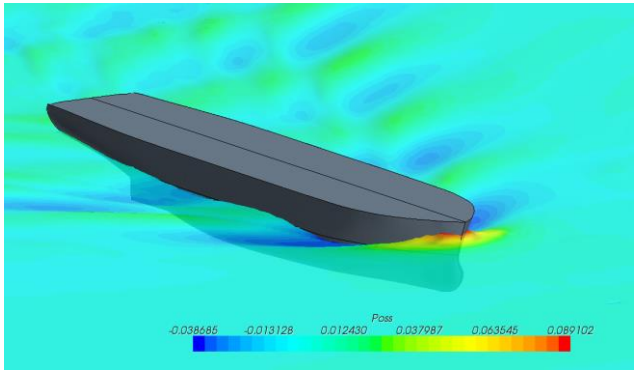
Operational profile definition

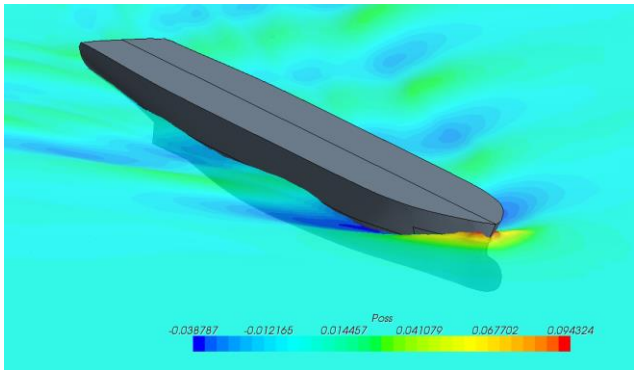
- Operational profile and specific requirements:
  - Establishment of specific requirements:
    - Related to power generation, accommodation, estimated captures, trawl system, principal dimensions, fishing equipment, etc.



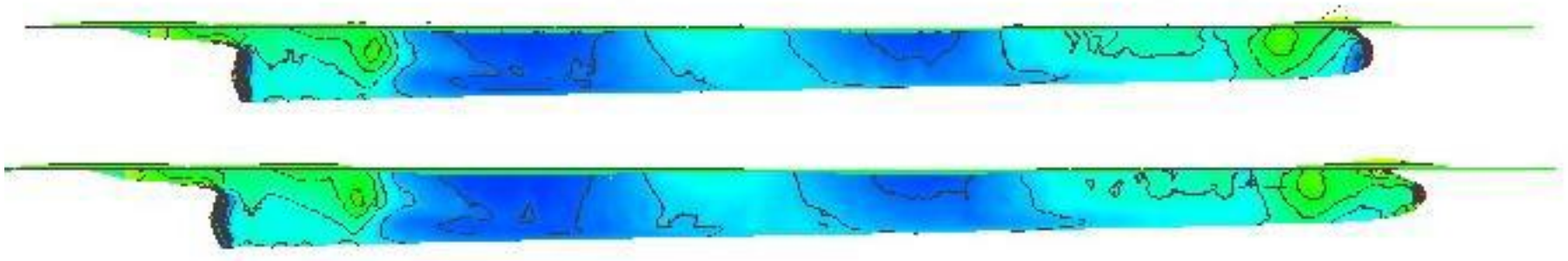
Optimization of hull and propulsion

- Parametric study of principal dimensions.





- Bow and stern shape design.



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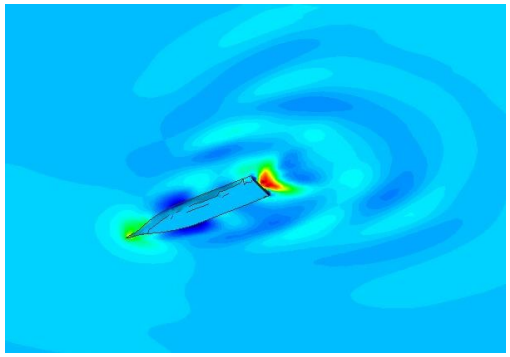
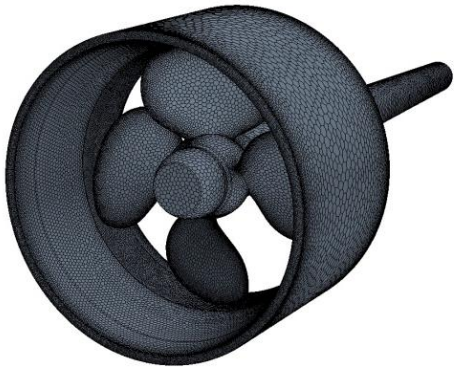
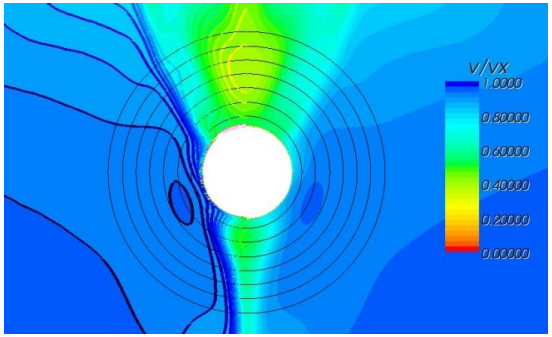
Optimization of hull and propulsion

- Seakeeping and maneuverability.

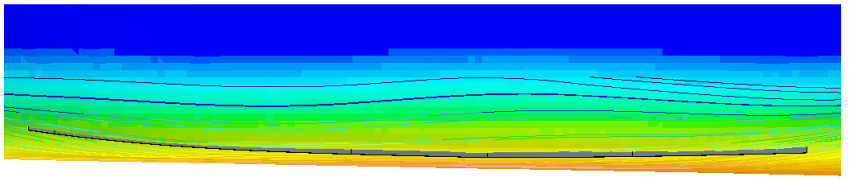


- Propulsion system.

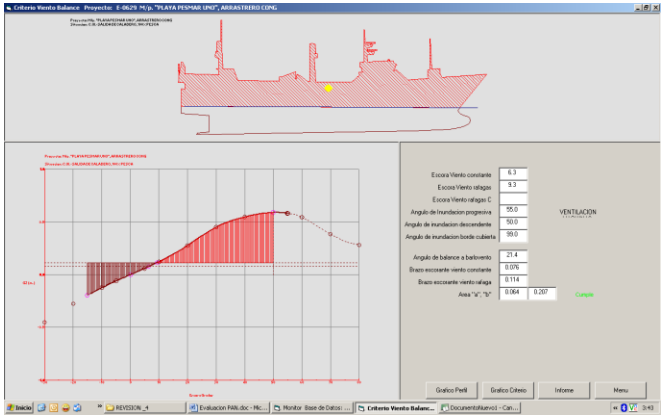




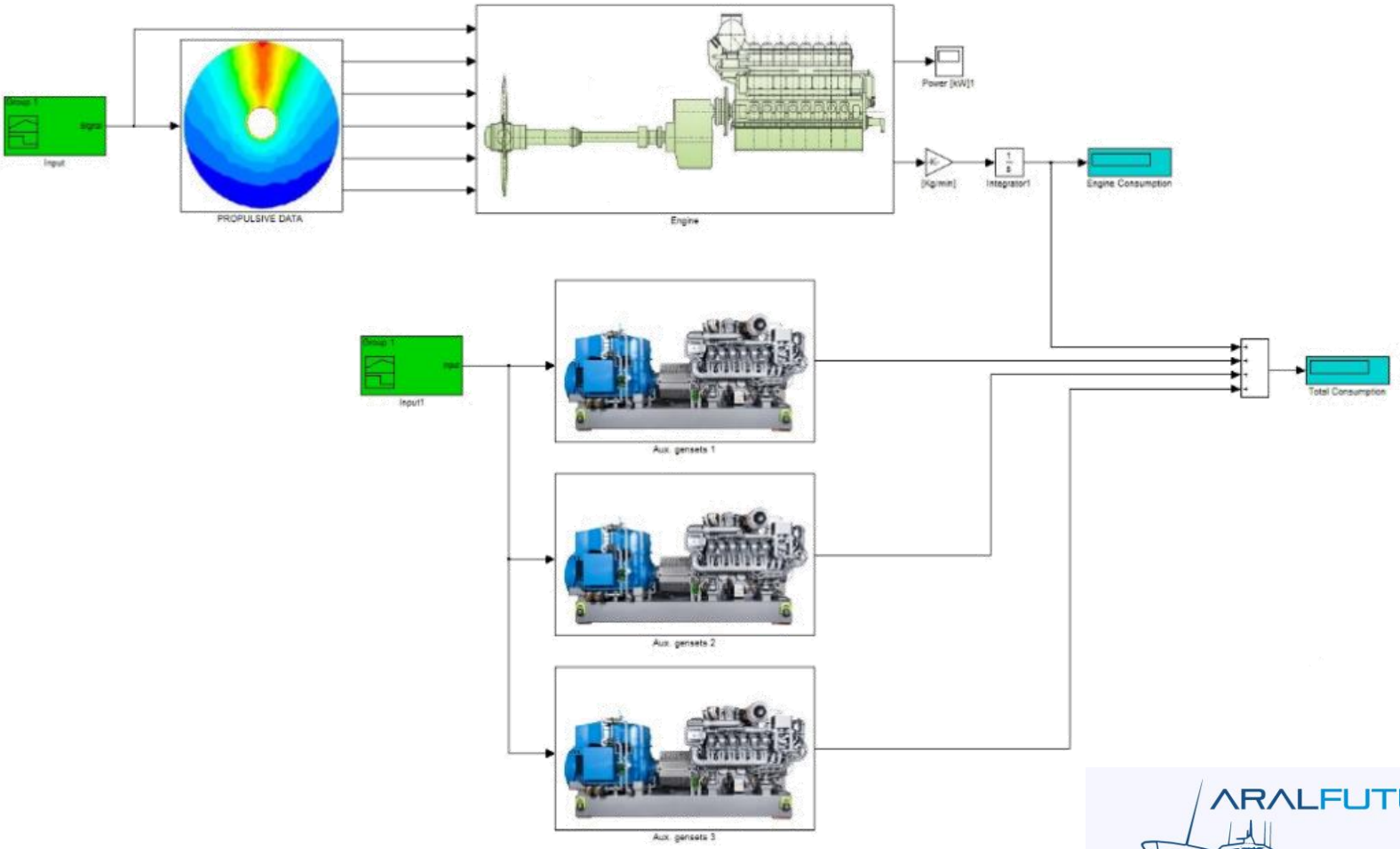
- Streamlines and appendages.



- Global behavior analysis.

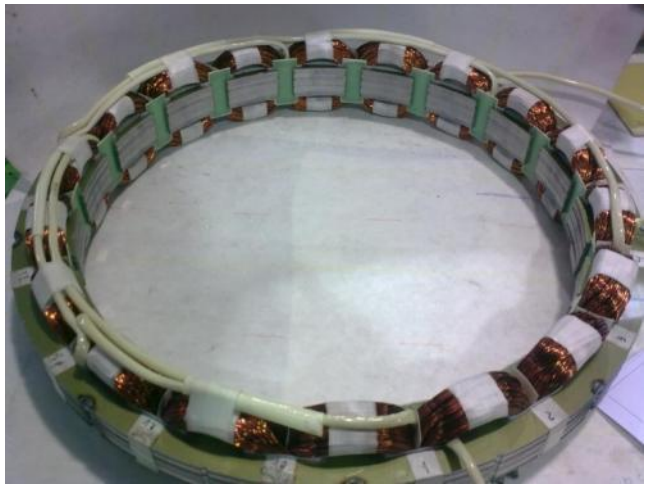


Performance simulation tool



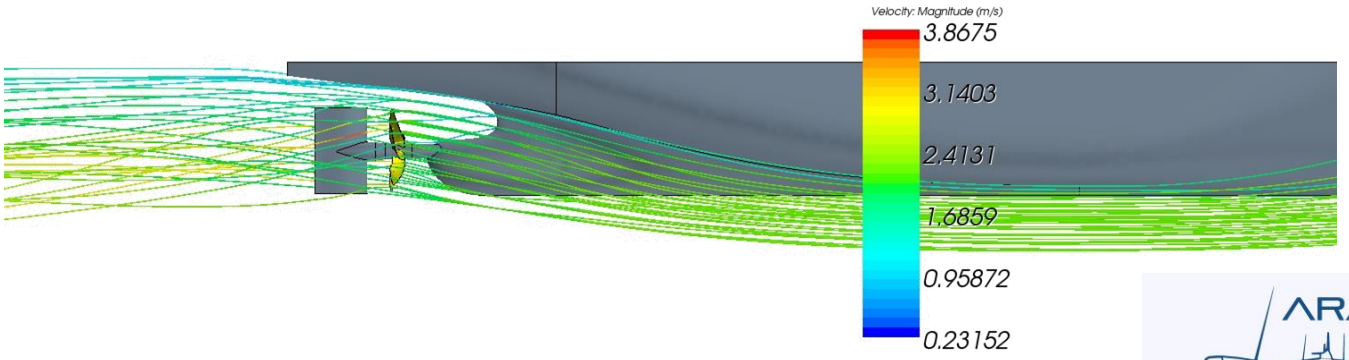
Technologies for electric power plant improvement

- Development of electric distribution networks, energy storage, generation system of electricity, electric drive and conversion of electric power for the energy efficiency improvement.



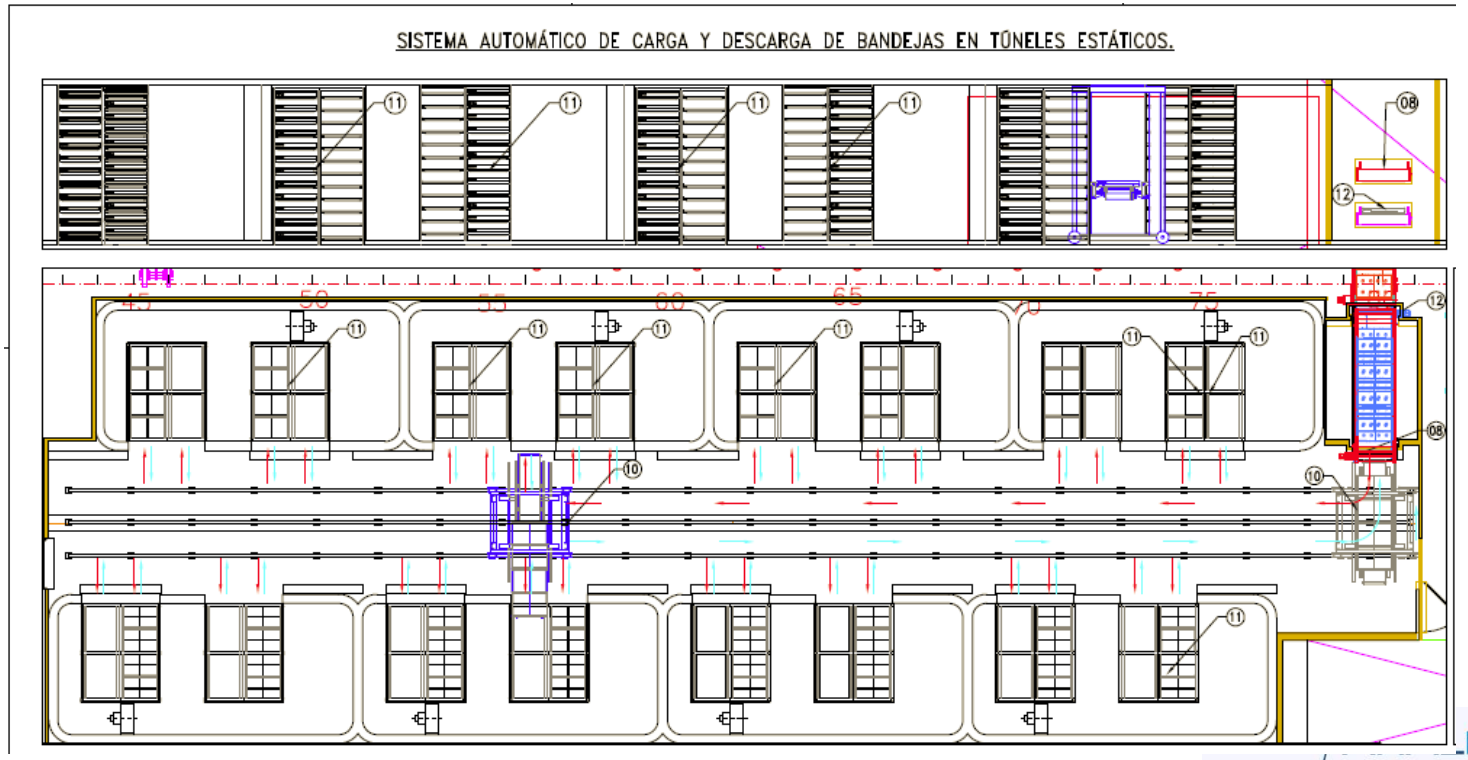
Integration: Propulsion + hydrodynamics

- Global analysis of different configurations:
  - Hull with single screw.
    - With bulbous bow.
    - Without bulbous bow.
  - Hull with twin screw.
    - With bulbous bow.
    - Without bulbous bow



Processing plant

- Static freezing cabinets located in an isolated area
- Automatic system for loading and unloading static tunnels



Conclusions

- Advantages of a wide view approach of the problem

  Coordination of different areas covered with specialized companies…

  …over a specific scenario
- Shipowners directly involved in the project
- Importance of sailings from Spain to FAO-41 area in the operational profile of the vessel
- Promising results in the first half of the project

Thank you for your attention