



Escola Politècnica Superior
d'Enginyeria de Vilanova i la Geltrú

UNIVERSITAT POLITÈCNICA DE CATALUNYA

Outboard electric propulsion system

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SUPERVISORS: Vicenç Parisi, Xavi Prats

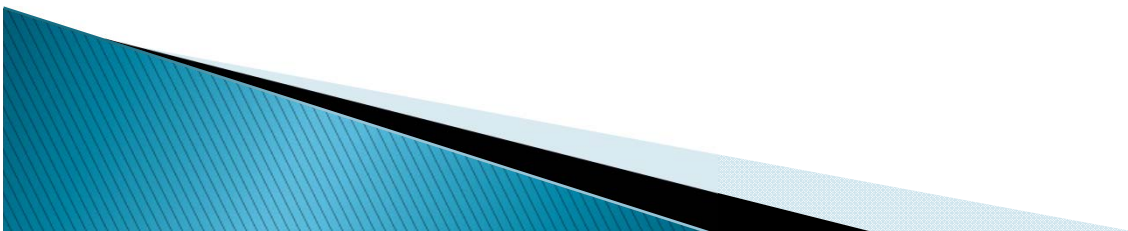
The Team

- ▶ Koen Duijghuisen
 - Netherlands, Mechanical engineer
- ▶ Joanna Marks
 - Poland, Business and technology
- ▶ Niclas Sandelin
 - Finland, Mechanical engineer
- ▶ Carles Espluga
 - Spain, Electrical engineer
- ▶ Mariona Coma
 - Spain, Design
- ▶ Niels Bulkman
 - Belgium, Construction engineer



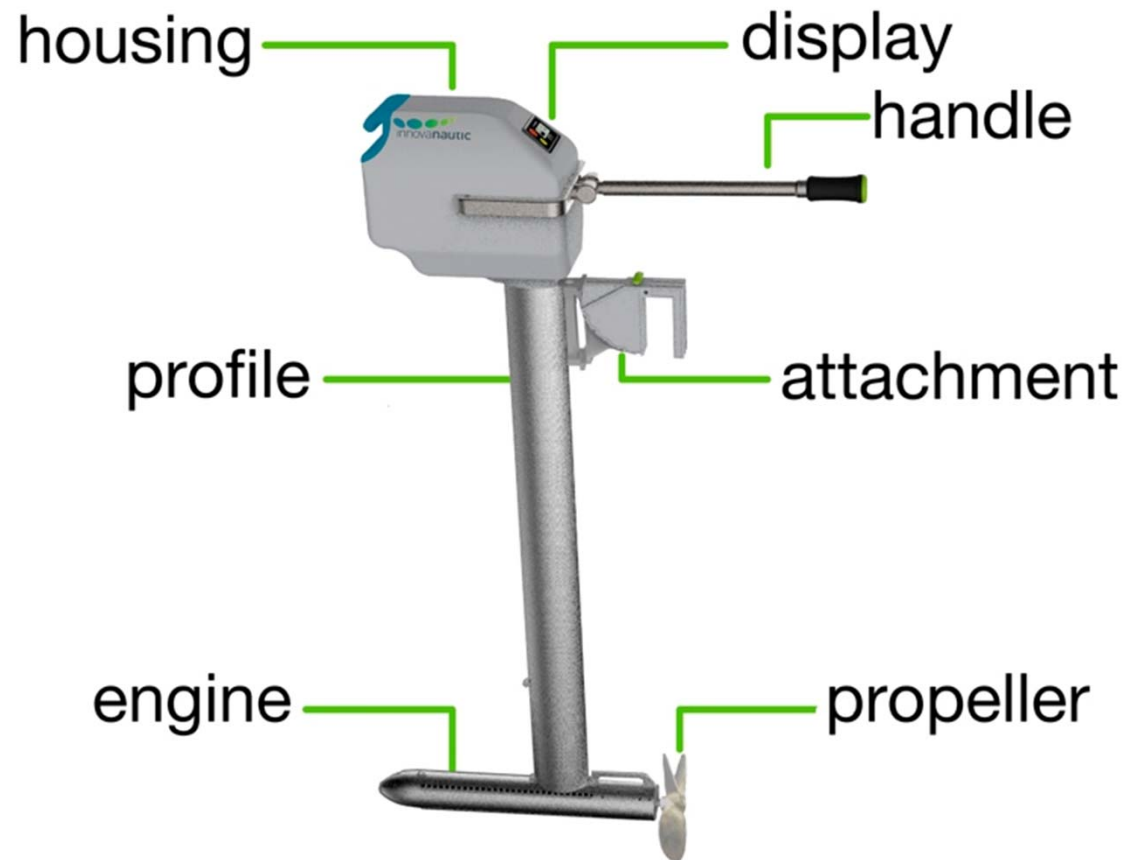
Introduction

- ▶ Who: Innovanautic
- ▶ Why: Fishing industry
- ▶ What: Small, portable, electric engine
- ▶ How: Multidisciplinary team

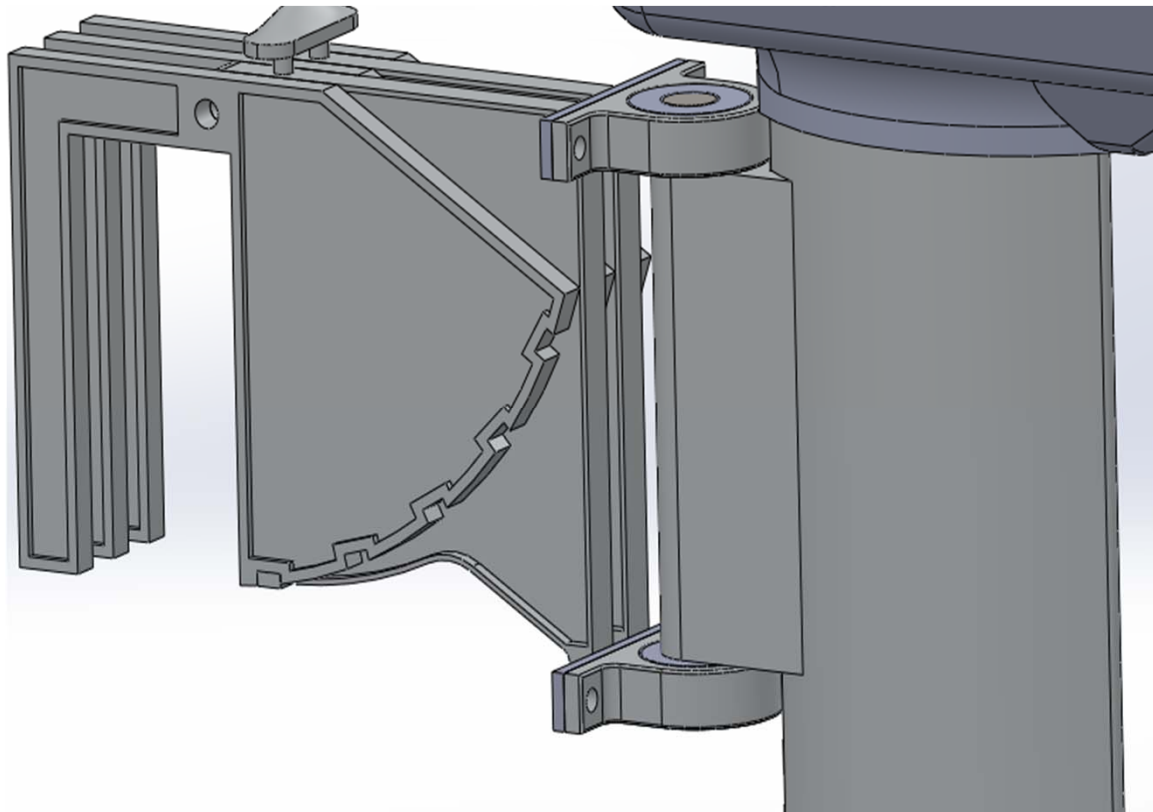


Introduction

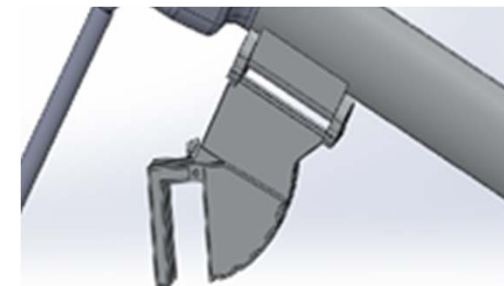
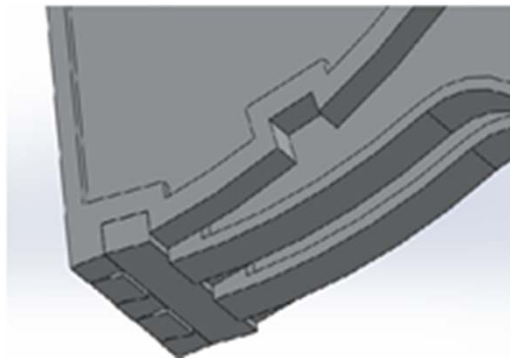
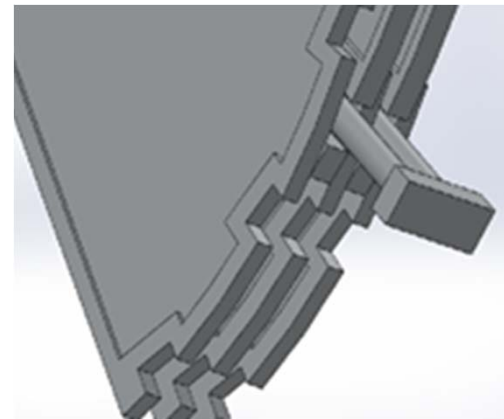
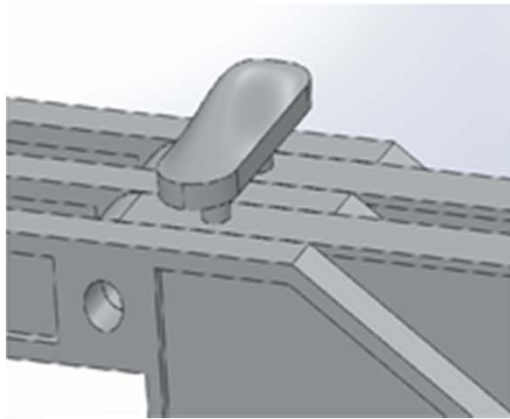
► Engine overview



Bracketing system

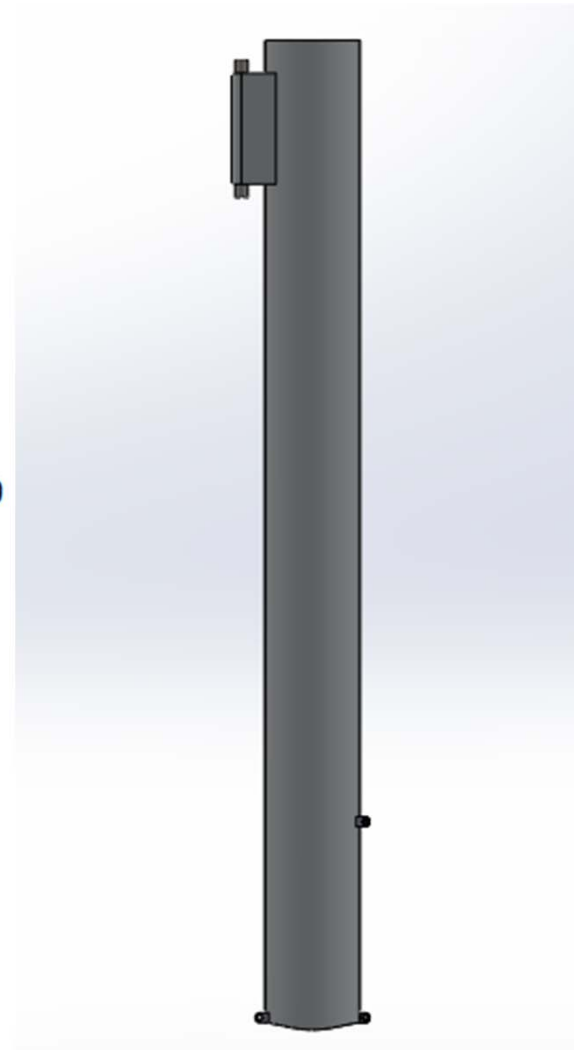
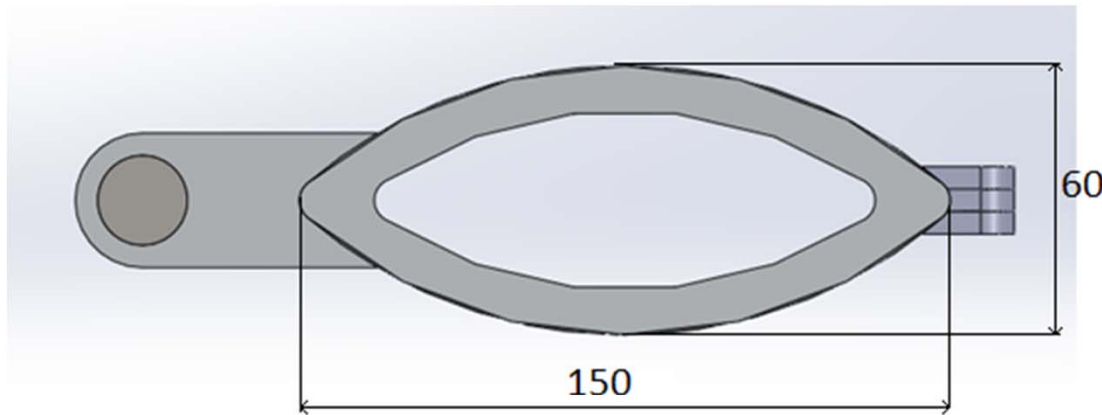


Lifting system

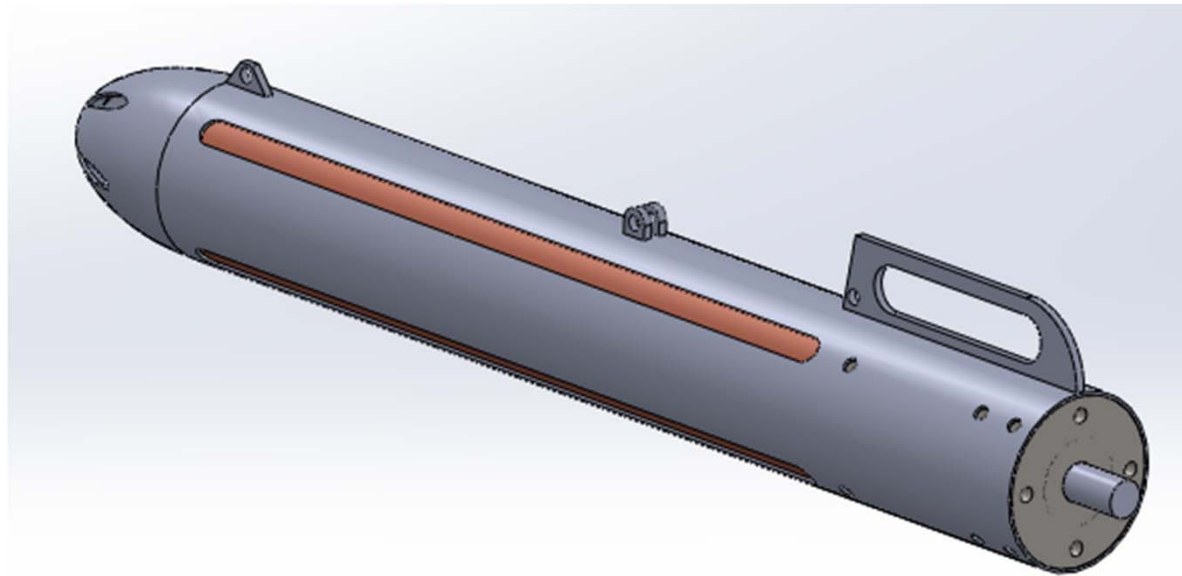


Profile

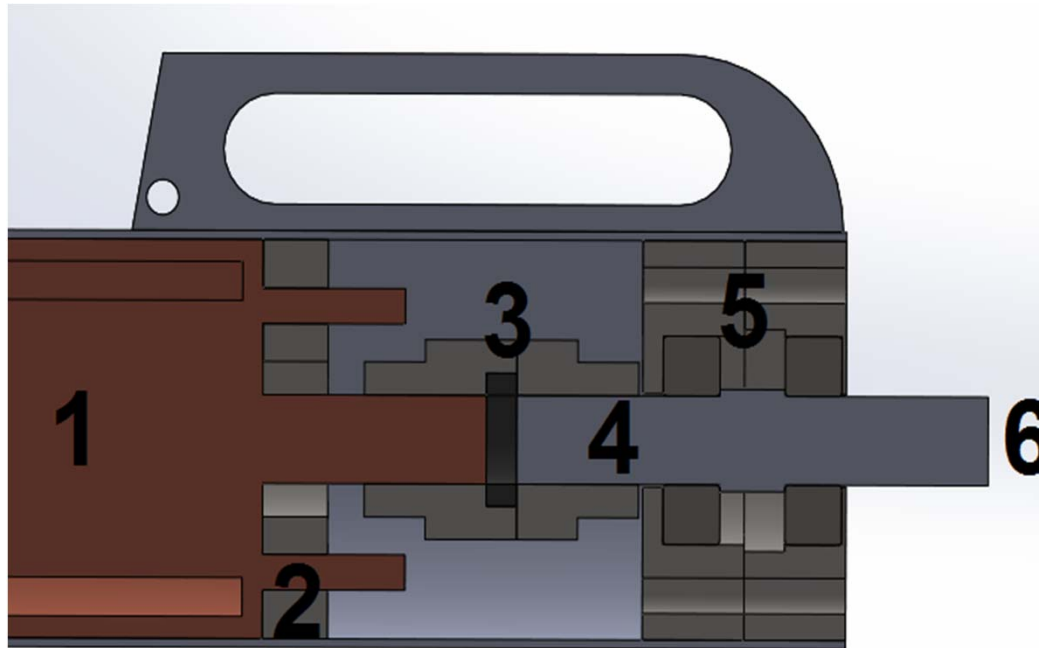
- ▶ Length: 1200 mm
- ▶ Wall thickness: 10 mm
- ▶ Aluminium



The bottom part



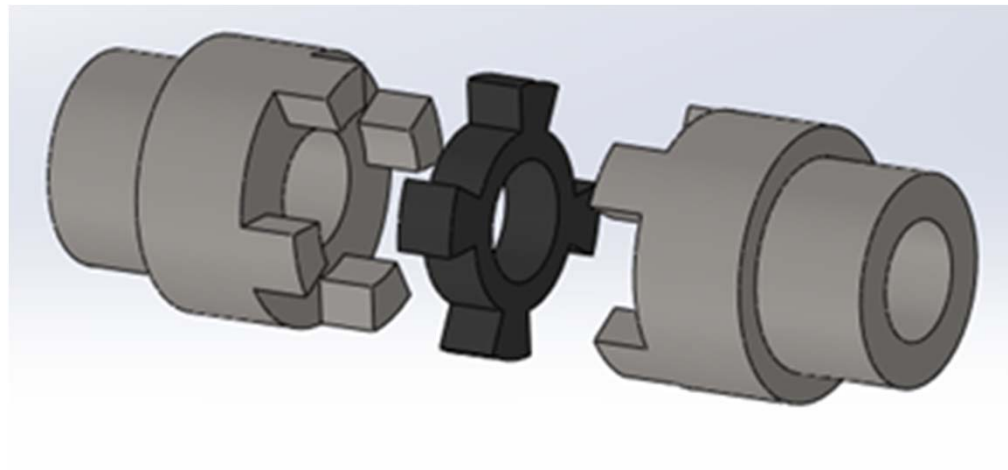
Inside the bottom part



- 1 = Motor
- 2 = Connection piece motor to outer pipe
- 3 = Elastic clutch to adapt axel diameters
- 4 = Second axel to propeller
- 5 = Shaft adapter
- 6 = propeller

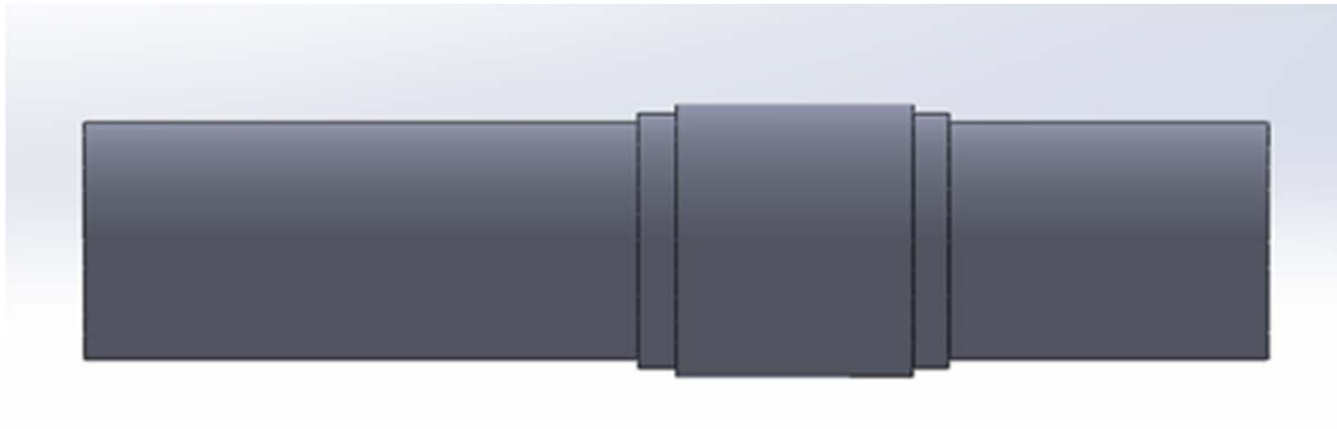
The clutch

- ▶ Diameter 15 mm – 20 mm
- ▶ Elastic



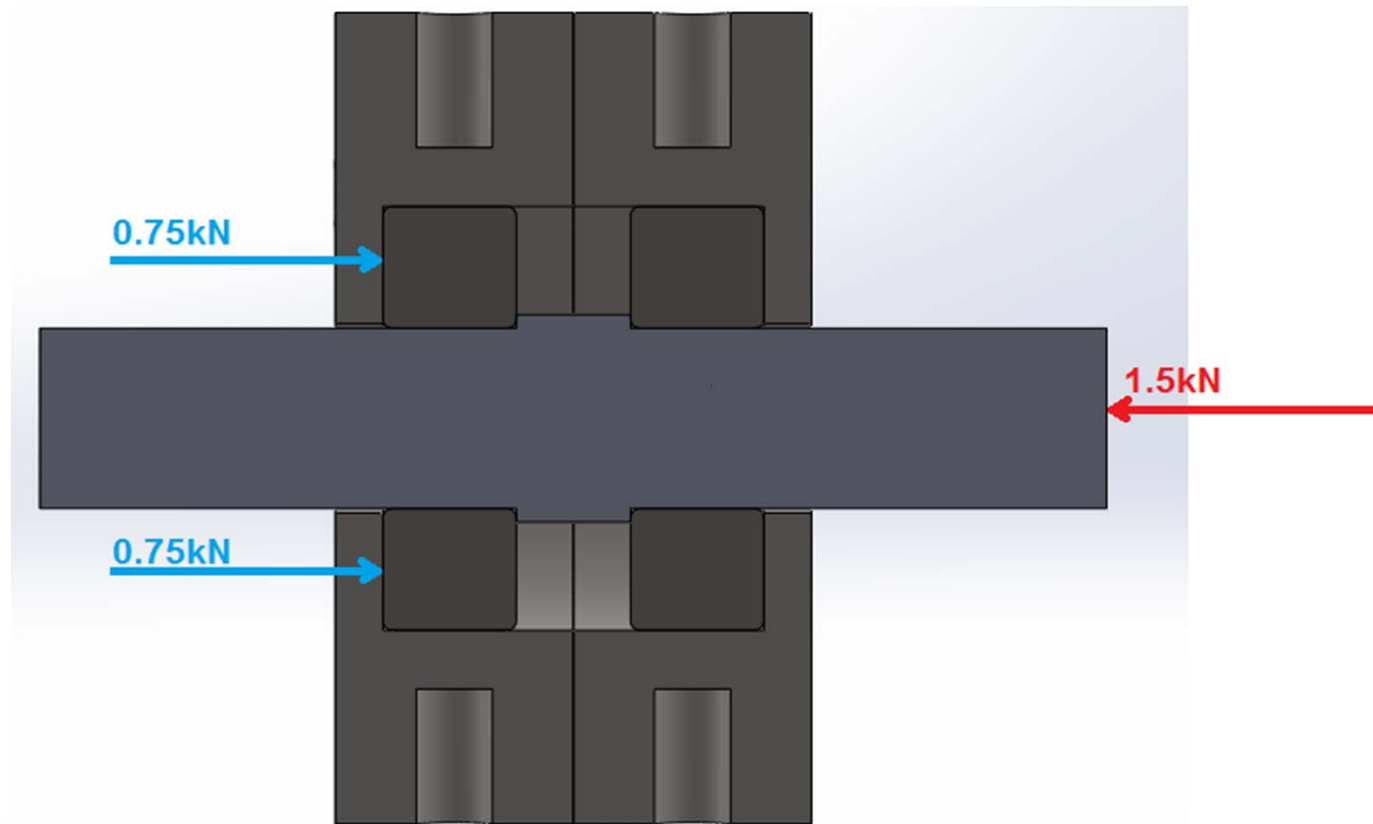
Axel to propeller connection

- ▶ Tight fit
- ▶ Maximum torque stress: 56 Mpa
- ▶ Diameter: 20 mm



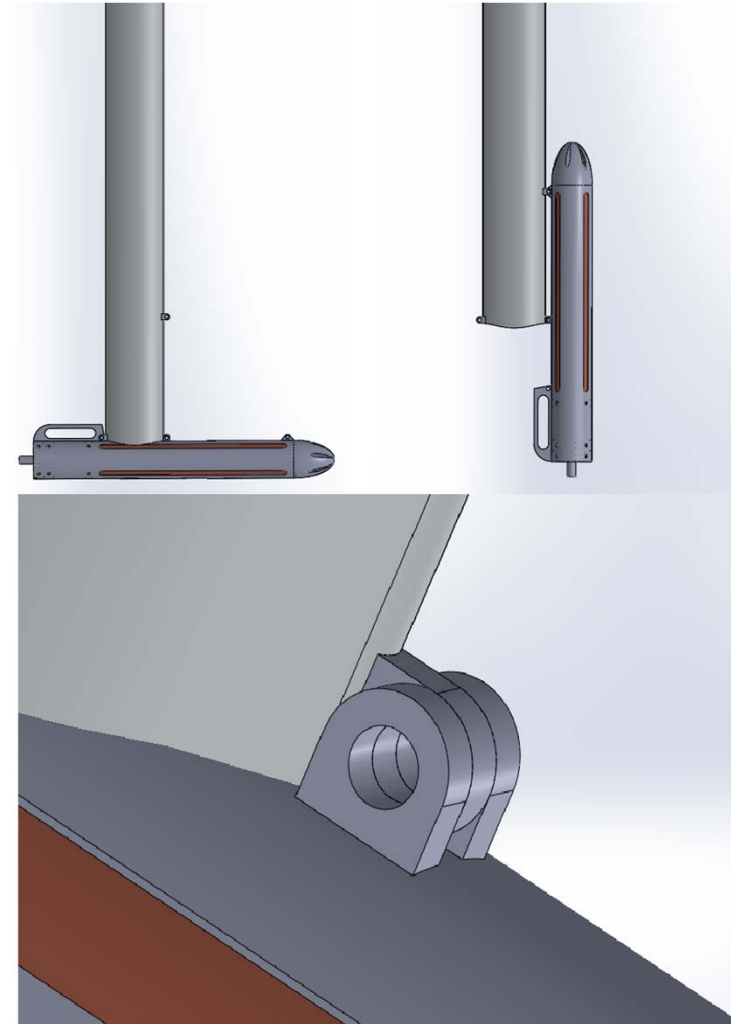
The shaft adapter

- ▶ Maximum bending stress: 34 Mpa
- ▶ Redirects all force

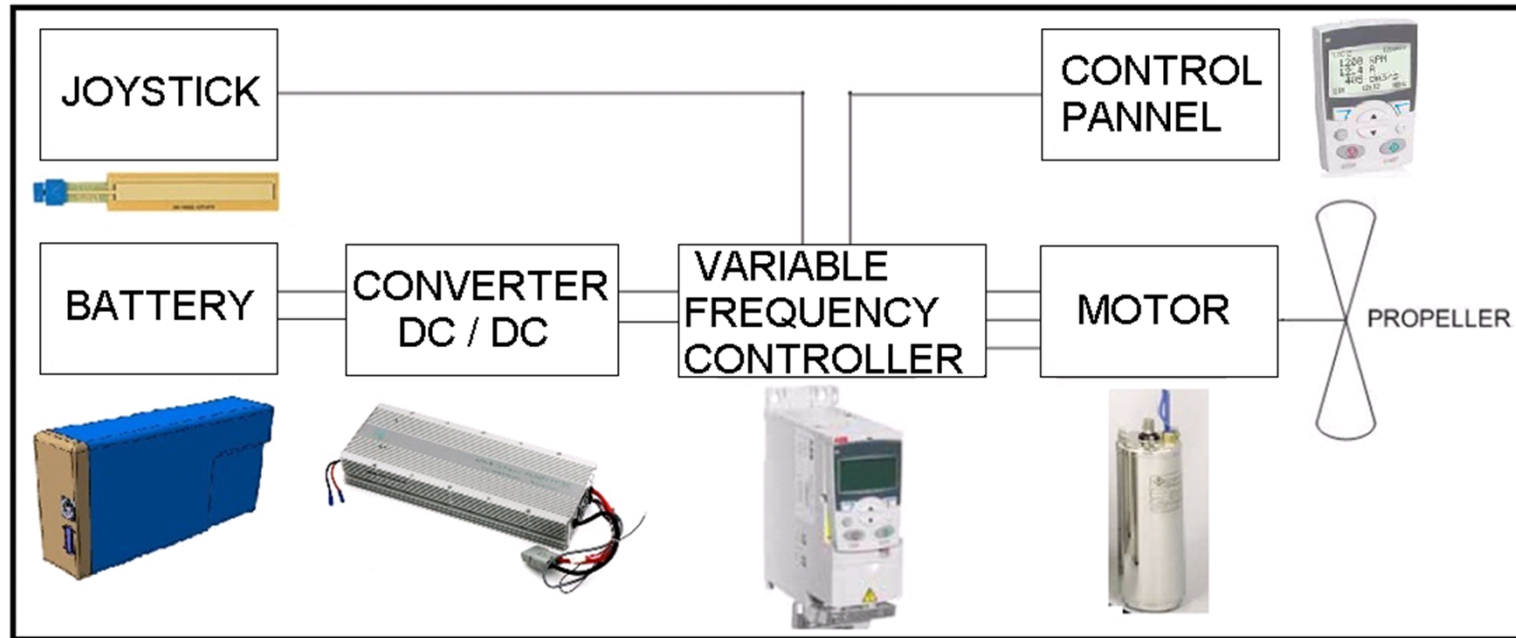


Engine flipping

- ▶ Transportation mode
- ▶ Spring hinge



Electronics



Engine environment:

- Environment: Mediterranean Sea.
- Ship: lute (7 meters Náut length).
- Autonomy: ± 30 km (18,4 miles)
- Capacity: 10 people
- Full speed: 5 knots ≈ 10 km/h
- Full weigh: 3000 kg3.
- Capacity Box: 1 Battery

Motor

- ▶ 3 phase Franklin Electric Submersible motor :

Weight: 1,2 kg

Specification IP66/IP67/UL 4x Type			Type code	Frame dimmen- sion
P_N [kW]	P_N [CV]	I_{2N} [A]		
AC - 3 phase 380 to 480 V				
2,2	3,0	5,6	ACS355-03X-05A6-4 + B063	R1

- Simply and strong mechanical
- Reversible rotation easy
- Vertical to horizontal mounting
- No need for perfect speed control

Variable frequency drive

- Control AC motor speed and torque
- Varying motor input frequency and voltage

▶ Variable frequency drive selected:

ACS355-03X-05A6 from ABB

1. Power 2,2 kW – 3 CV

2. Source 380 – 400V, 3 phases

3. Out range frequency 0 – 500 Hz

4. Drive software has to support common DC applications

5. Weight 1,2 kg



▶ It's possible Velocity Controls using a SoftPot.

- Membrane potentiometer softpot, 10K Ω 100mm active length



Converter: 5000W DC/DC

- ▶ Electrical power converter 48VDC to 380VDC
- ▶ Converter select: 21MD



Rated Input Voltage / current	45 -55V DC / 100 A
Input low voltage protection	44-45V
Output (Max 13 amps)	250-390V DC variable (Max. -20V adjust)
Standby current	$\leq 10\text{mA}$
Idle current	$\leq 200\text{mA}$
Efficiency	$\geq 93\%$
Instantaneous power	6000 W
Continuous power	5000 W
Weight	5 kG Aprox.

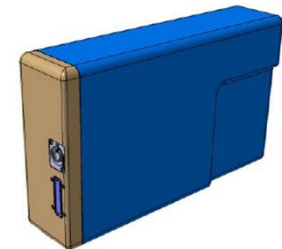
Battery

Technologic groups	Types	
Acid lead	Start	<ul style="list-style-type: none"> • Lot of energy for short time • Don't allow big discharges
Alkaline	Traction	<ul style="list-style-type: none"> • Good tolerance for big discharges
Lithium Ion	Stationary	<ul style="list-style-type: none"> • Give progressive energy during a large time period

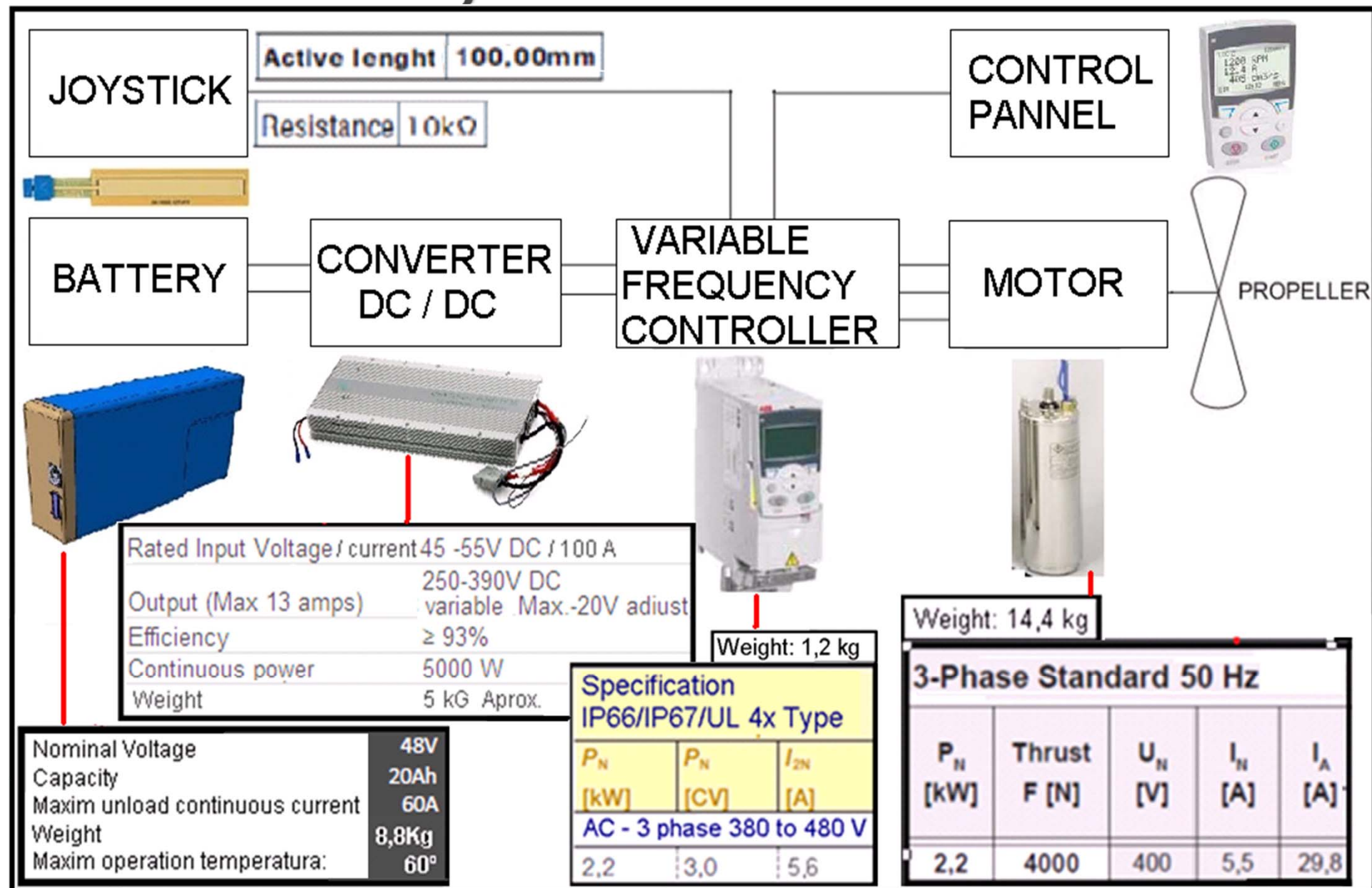
► Battery select: EBOX-1000 Rechargeable lithium-ion

- Maintenance free
- High reliability
- Weight 8,8 Kg
- Work temperature 10 -60°

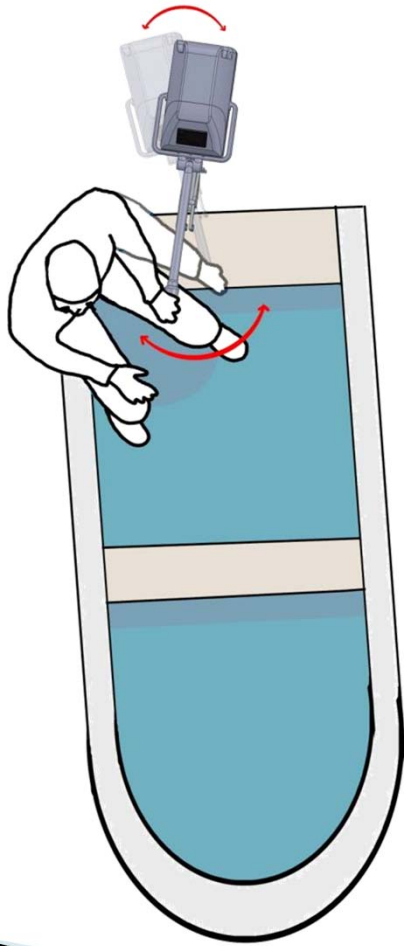
Voltage	48 V
Capacity	20 Ah
Energy	1000Wh
Autonomy	30 Km



General system view

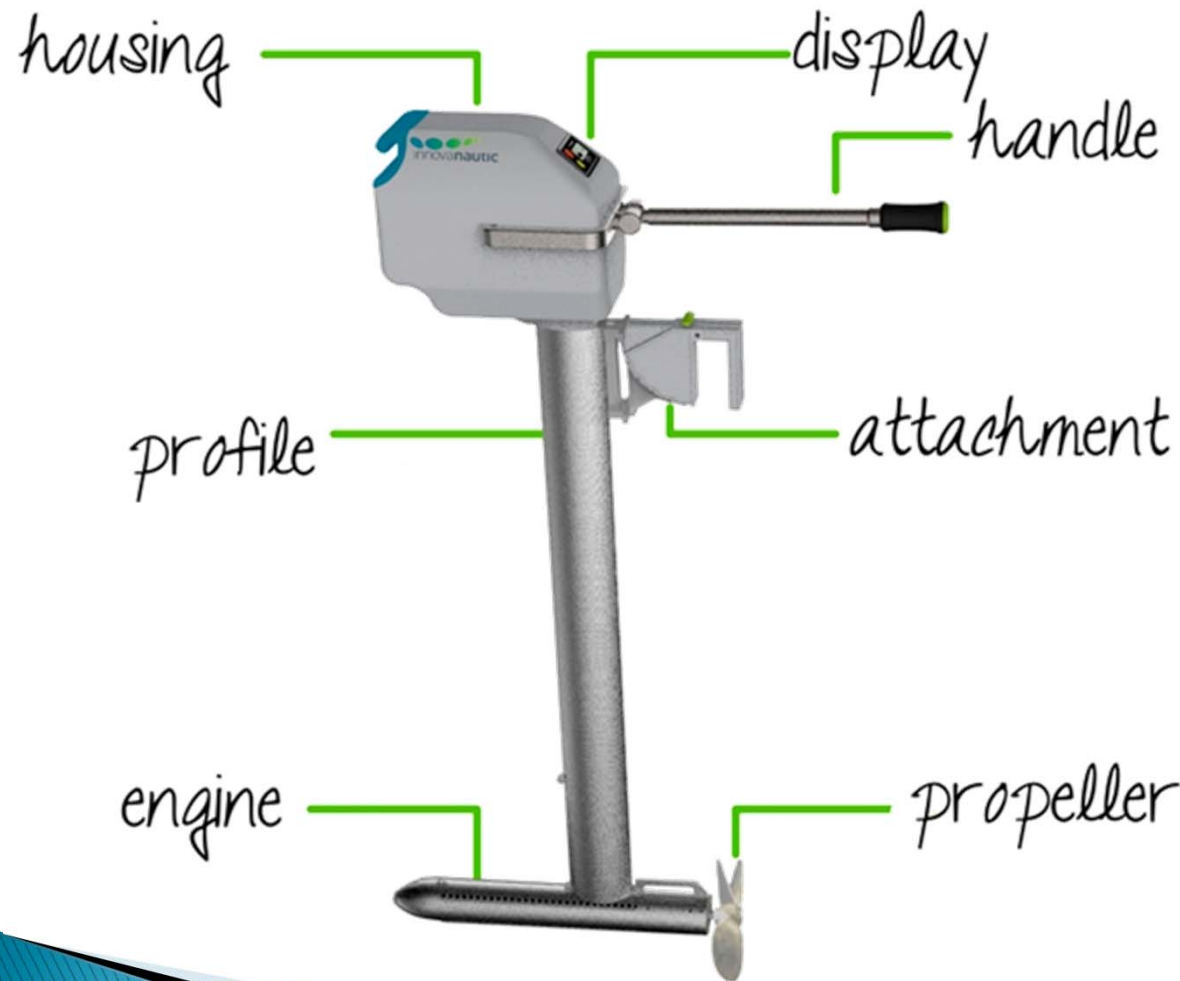


Design: users



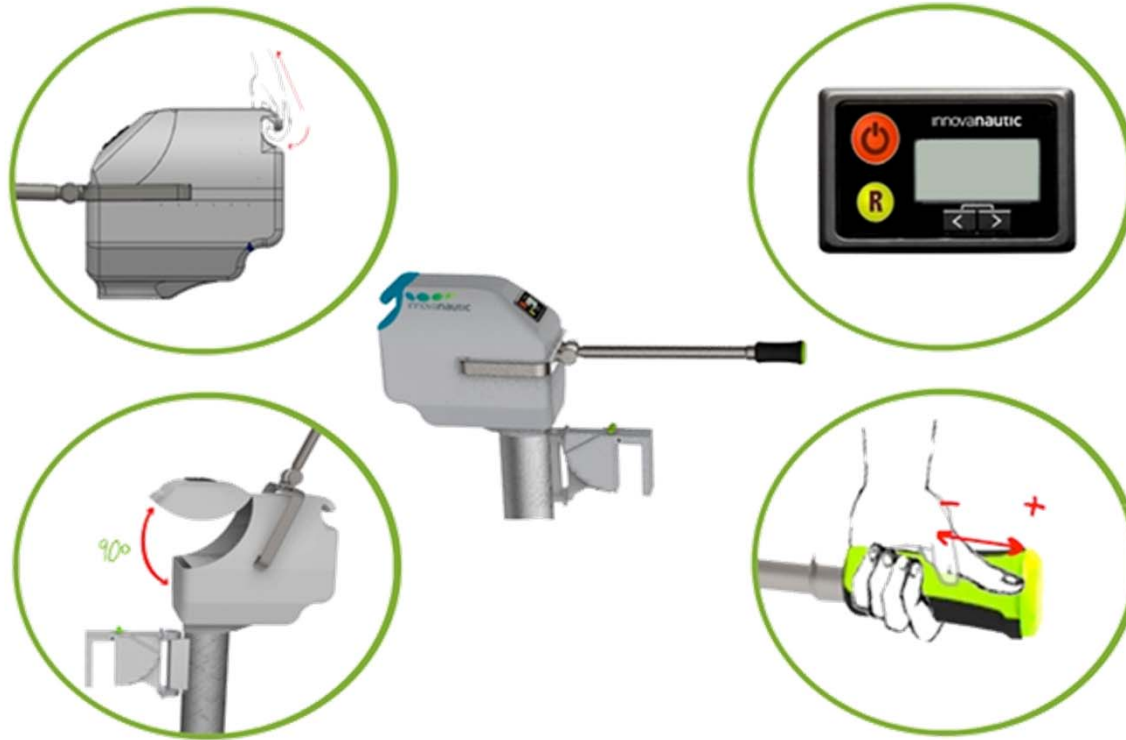
- ▶ Context of use:
 - Europe
 - Professional application
 - Short distances
 - Flashing time of use
- ▶ User's characteristics
 - Experience with boats
 - Occidental nationality

Design: parts



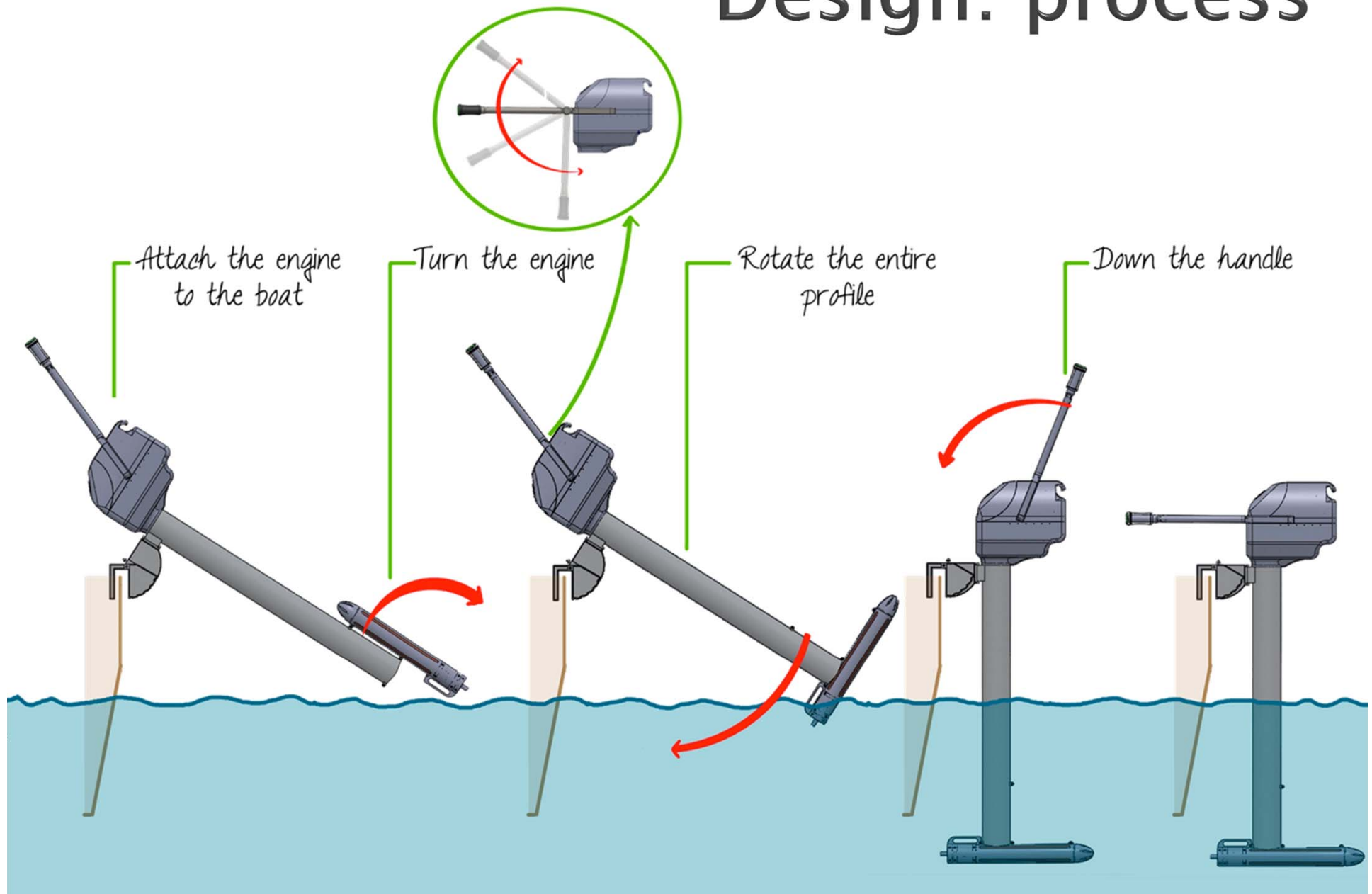
- Display
- Handle
- Housing
 - Battery
 - Inverter
 - Variable frequency

Design: characteristics



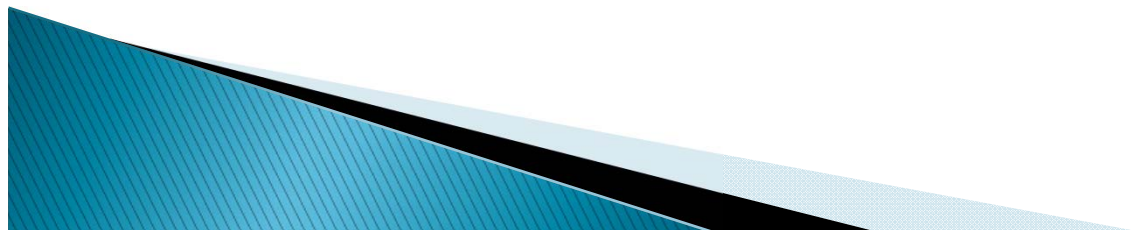
- ▶ Ergonomic
- ▶ Display
 - Battery
 - Speed
- ▶ Easy changing
- ▶ Safe touch system

Design: process

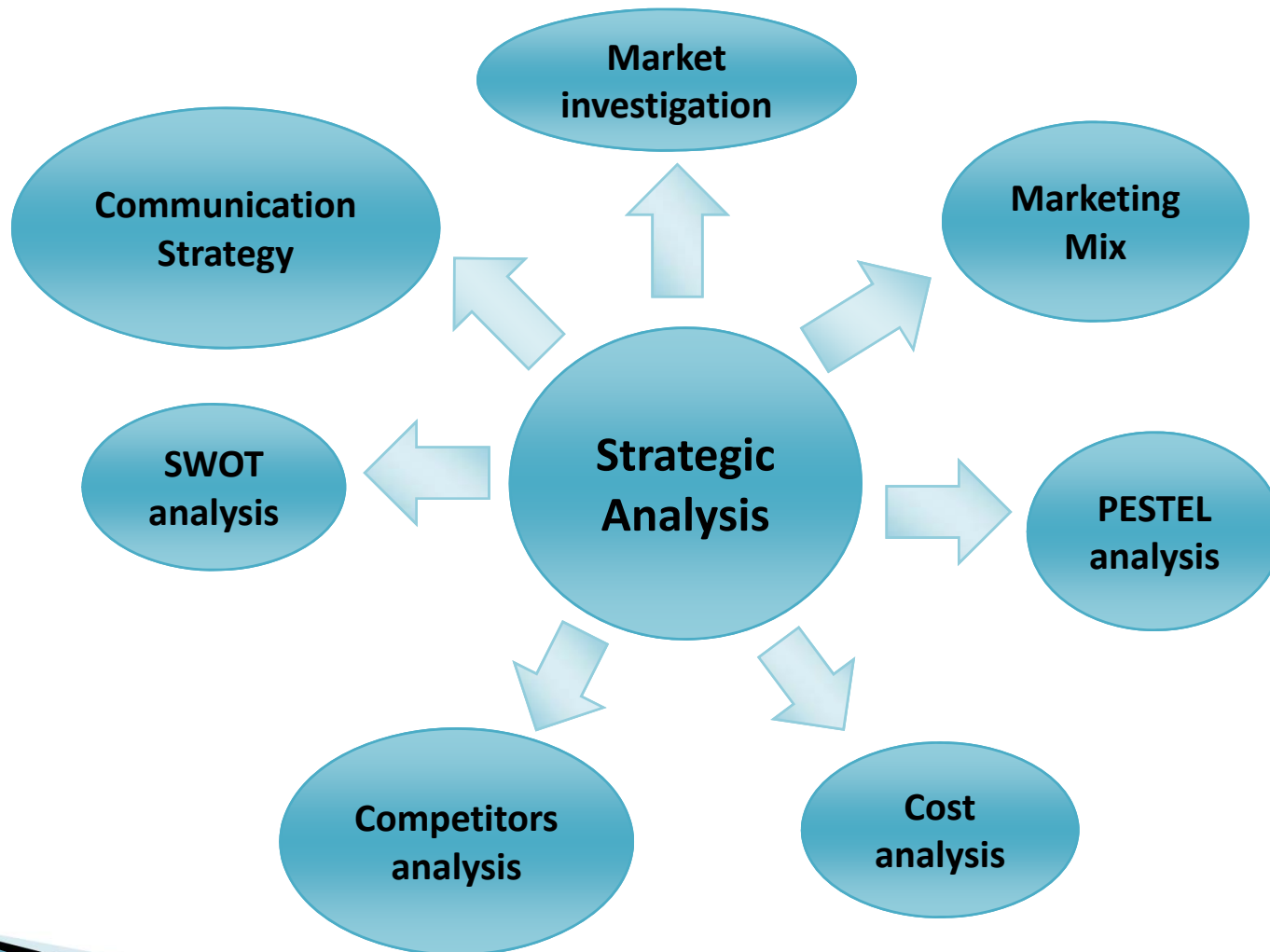








MARKETING

- ▶ Introducing a product
- ▶ Satisfying the customers' needs

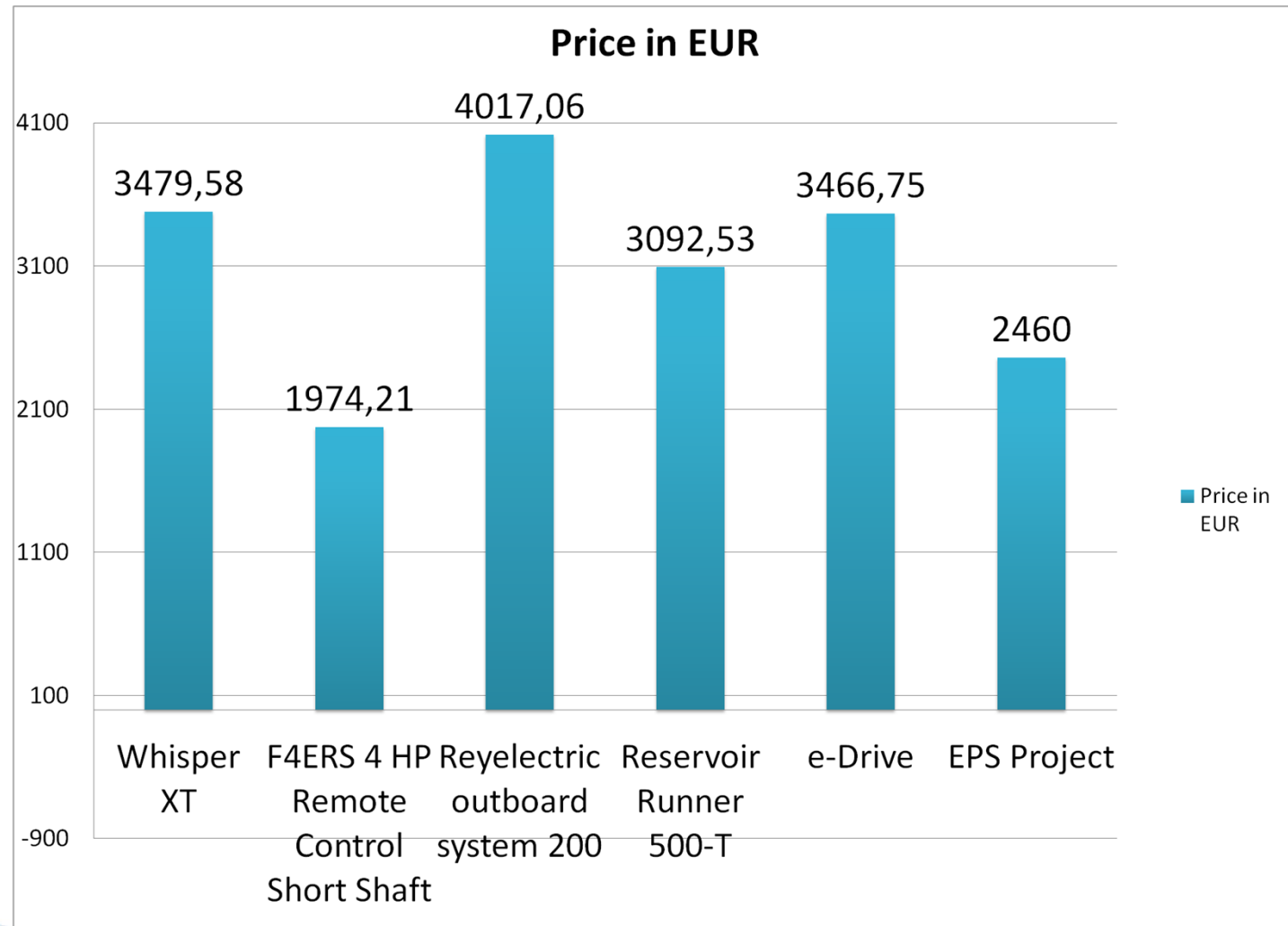


Strategic analysis

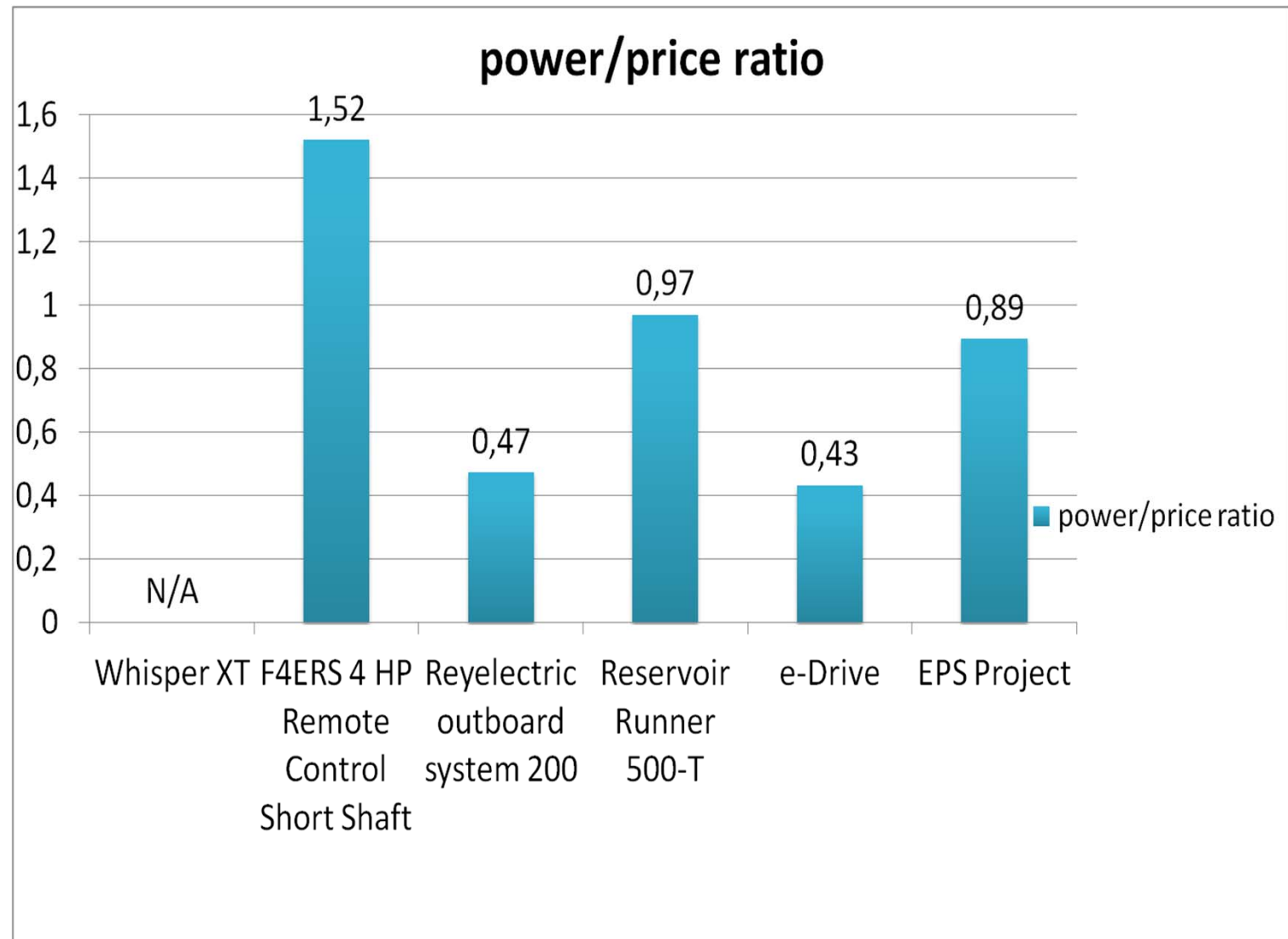


Picture	Company name	Type	Country	Dealers	Price (in EUR)
	Electric Propulsion Innovation Corporation	Whisper XT	USA	USA	3479.58
	Parsun Marine Electric Outboard	F4ERS 4 HP Remote Control Short Shaft	China	USA Canada Switzerland Netherlands	1974.21
	Reyelectric outboard	Reyelectric outboard system 200	USA	USA Canada	4017.06
	Reservoir Runner	Reservoir Runner 500-T	USA	USA	3092.53
	Minn Kota	e-Drive	USA	All over the world**	3466.75
	Innovanautic	EPS Project	Spain	Spain	2460

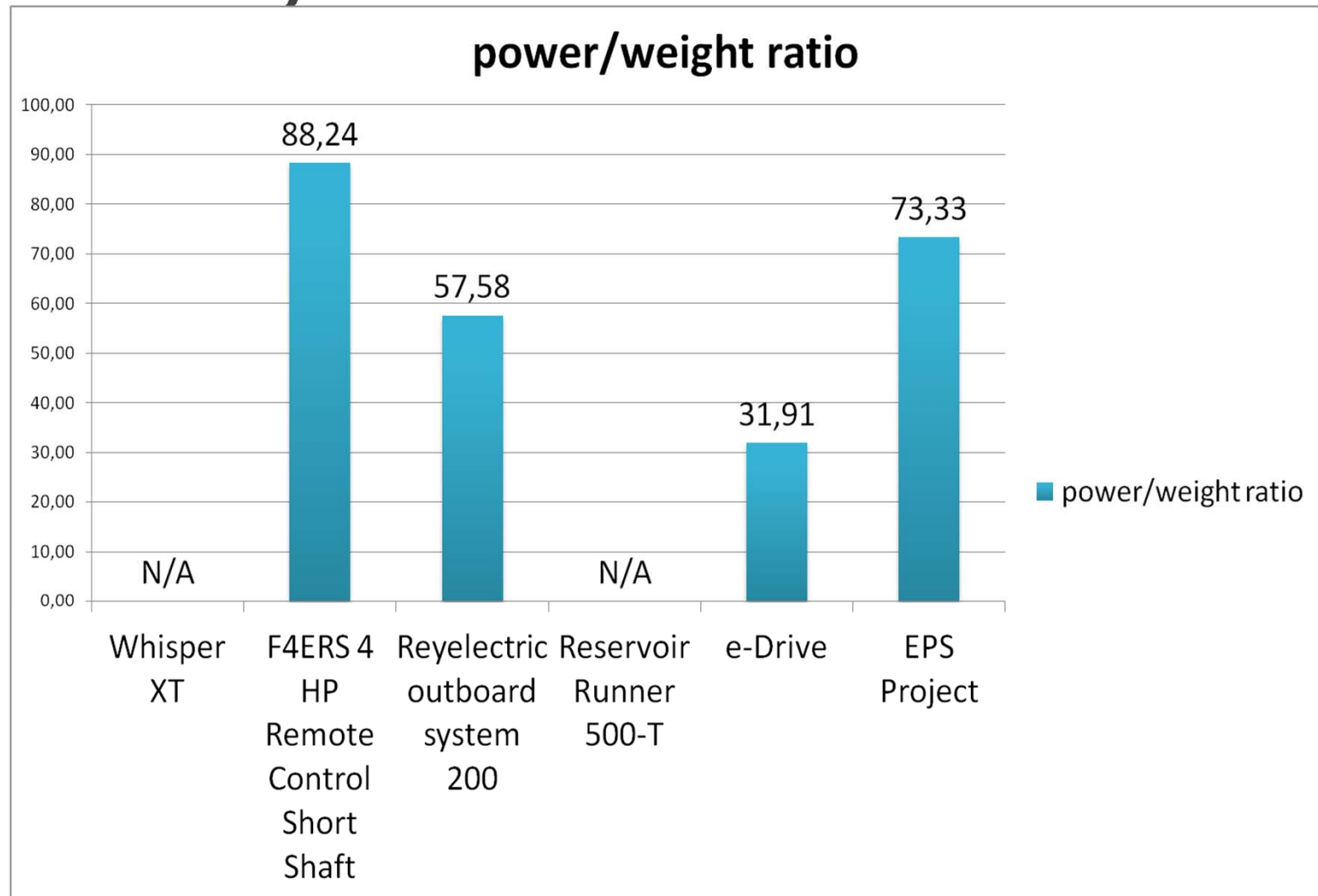
Price comparison



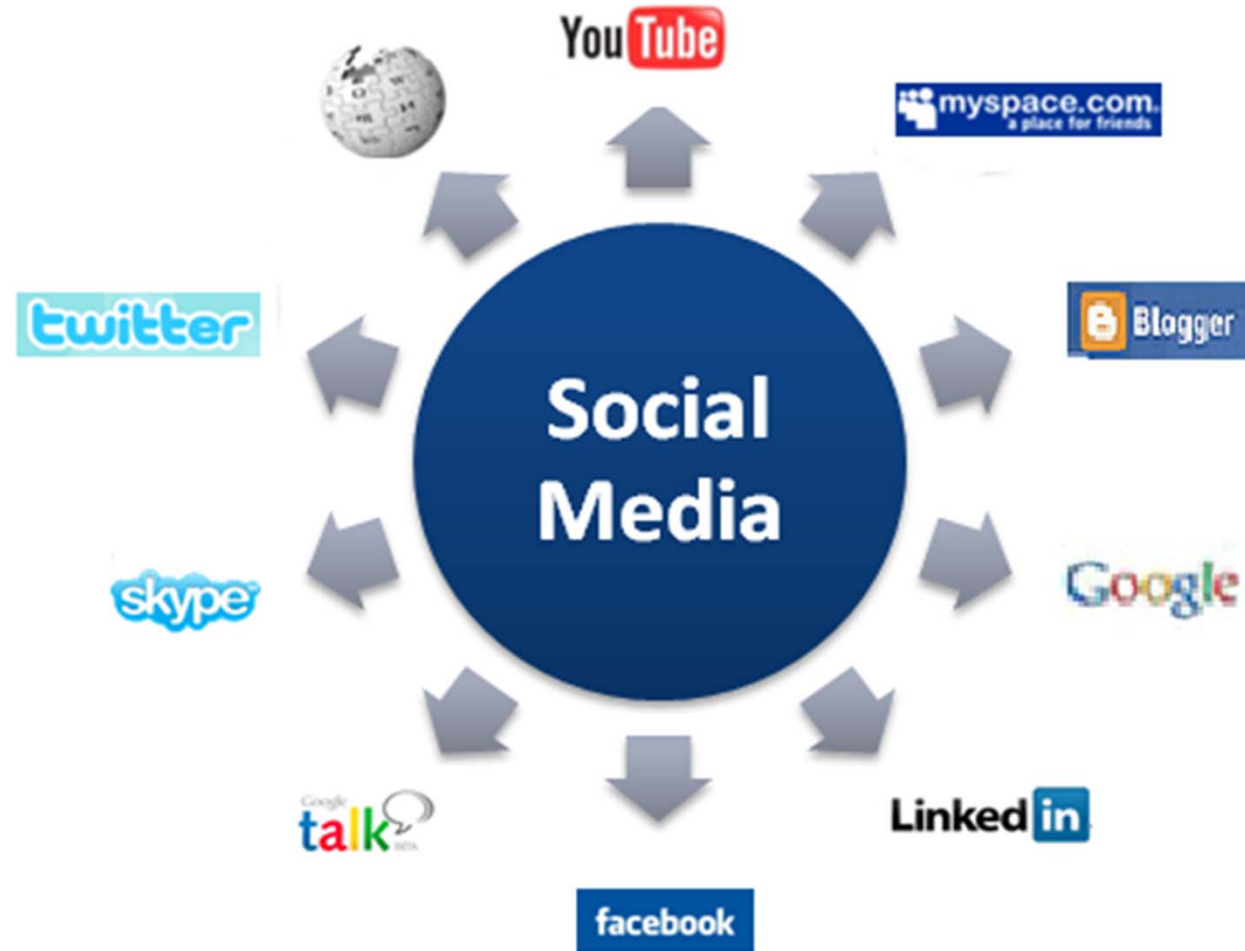
Ratio analysis



Ratio analysis



Social Media Marketing



Conclusions

- ▶ Adjustments:
 - Clutch
 - Shaft adapter
 - Ball bearings Vs. Roller bearings
 - Spring washers
 - Drawings
 - Cover pipe

- ▶ Next step: prototype

