Outboard electric propulsion system

STUDENTS: Joanna Marks Niclas Sandelin, Niels Bulkmans, Koen Duijghuisen, Carles Espluga, Mariona Coma

SUPERVISORS: Vicenç Parisi, Xavi Prats
The Team

- Koen Duijghuisen
  - Netherlands, Mechanical engineer
- Joanna Marks
  - Poland, Business and technology
- Niclas Sandelin
  - Finland, Mechanical engineer
- Carles Esplugà
  - Spain, Electrical engineer
- Mariona Coma
  - Spain, Design
- Niels Bulkmans
  - 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
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 weight: 3000 kg
- Capacity Box: 1 Battery
Motor

- 3 phase Franklin Electric Submersible motor:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Weight: 1,2 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification</td>
<td>IP66/IP67/UL 4x Type</td>
</tr>
<tr>
<td>$P_N$ [kW]</td>
<td>$P_N$ [CV]</td>
</tr>
<tr>
<td>2.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Type code</td>
<td>ACS355-03X-05A6-4 + B063</td>
</tr>
<tr>
<td>Frame dimmen- sion</td>
<td>R1</td>
</tr>
</tbody>
</table>

- 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 potenciometer softpot, 10K\( \Omega \) 100mm active length
Converter: 5000W DC/DC

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

<table>
<thead>
<tr>
<th>Rated Input Voltage / current</th>
<th>45 - 55V DC / 100 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input low voltage protection</td>
<td>44 - 45V</td>
</tr>
<tr>
<td>Output (Max 13 amps)</td>
<td>250 - 390V DC</td>
</tr>
<tr>
<td>(Max. variable -20V adjust)</td>
<td></td>
</tr>
<tr>
<td>Standby current</td>
<td>≤ 10mA</td>
</tr>
<tr>
<td>Idle current</td>
<td>≤ 200mA</td>
</tr>
<tr>
<td>Efficiency</td>
<td>≥ 93%</td>
</tr>
<tr>
<td>Instantaneous power</td>
<td>6000 W</td>
</tr>
<tr>
<td>Continuous power</td>
<td>5000 W</td>
</tr>
<tr>
<td>Weight</td>
<td>5 kg Aprox.</td>
</tr>
</tbody>
</table>
## Battery

<table>
<thead>
<tr>
<th>Technologic groups</th>
<th>Types</th>
<th>Features</th>
</tr>
</thead>
</table>
| Acid lead          | Start         | • Lot of energy for short time  
                     |                 | • Don’t allow big discharges  |
| Alkaline           | Traction      | • Good tolerance for big discharges                                      |
| Lithium Ion        | Stationary    | • 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°C

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>48 V</td>
</tr>
<tr>
<td>Capacity</td>
<td>20 Ah</td>
</tr>
<tr>
<td>Energy</td>
<td>1000Wh</td>
</tr>
<tr>
<td>Autonomy</td>
<td>30 Km</td>
</tr>
</tbody>
</table>
General system view

JOYSTICK

Active length: 100.00mm
Resistance: 1.0kΩ

BATTERY

CONVERTER DC / DC

VARIABLE FREQUENCY CONTROLLER

CONTROL PANNEL

MOTOR

PROPPELLER

Rated Input Voltage / current: 45 - 55V DC / 100 A
Output (Max 13 amps): 250-390V DC, variable Max -20V adjust
Efficiency: ≥ 93%
Continuous power: 5000 W
Weight: 5 kg Aprox.

Specification:
IP66/IP67/UL 4x Type

Nominal Voltage: 48V
Capacity: 20Ah
Maxim unload continuous current: 60A
Weight: 8,8Kg
Maxim operation temperature: 60°

3-Phase Standard 50 Hz

<table>
<thead>
<tr>
<th>P_N (kW)</th>
<th>P_N (CV)</th>
<th>I_N (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>3.0</td>
<td>5.6</td>
</tr>
</tbody>
</table>

AC - 3 phase 380 to 480 V

Thrust F [N]: 4000
Voltage U_N [V]: 400
Current I_N [A]: 5.5
Current I_A [A]: 29.8

Weight: 14.4 kg

Weight: 1.2 kg
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

A diagram showing parts of the design includes:
- Housing
- Display
- Handle
- Profile
- Attachment
- Engine
- Propeller
Design: characteristics

- Ergonomic
- Display
  - Battery
  - Speed
- Easy changing
- Safe touch system
Design: process

1. Attach the engine to the boat
2. Turn the engine
3. Rotate the entire profile
4. Down the handle
MARKETING

- Introducing a product
- Satisfying the customers’ needs
Strategic analysis

- Market investigation
- Communication Strategy
- SWOT analysis
- Competitors analysis
- PESTEL analysis
- Marketing Mix
- Cost analysis

Strategic Analysis
<table>
<thead>
<tr>
<th>Picture</th>
<th>Company name</th>
<th>Type</th>
<th>Country</th>
<th>Dealers</th>
<th>Price (in EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Electric Propulsion Innovation Corporation" /></td>
<td>Electric Propulsion Innovation Corporation</td>
<td>Whisper XT</td>
<td>USA</td>
<td>USA</td>
<td>3479.58</td>
</tr>
<tr>
<td><img src="image" alt="Parsun Marine Electric Outboard" /></td>
<td>Parsun Marine Electric Outboard</td>
<td>F4ERS 4 HP Remote Control Short Shaft</td>
<td>China</td>
<td>USA, Canada, Switzerland, Netherlands</td>
<td>1974.21</td>
</tr>
<tr>
<td><img src="image" alt="Reyelectric outboard" /></td>
<td>Reyelectric outboard</td>
<td>Reyelectric outboard system 200</td>
<td>USA</td>
<td>USA</td>
<td>4017.06</td>
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<tr>
<td><img src="image" alt="Reservoir Runner" /></td>
<td>Reservoir Runner</td>
<td>Reservoir Runner 500-T</td>
<td>USA</td>
<td>USA</td>
<td>3092.53</td>
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<tr>
<td><img src="image" alt="Minn Kota" /></td>
<td>Minn Kota</td>
<td>e-Drive</td>
<td>USA</td>
<td>All over the world**</td>
<td>3466.75</td>
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<tr>
<td><img src="image" alt="Innovanautic" /></td>
<td>Innovanautic</td>
<td>EPS Project</td>
<td>Spain</td>
<td>Spain</td>
<td>2460</td>
</tr>
</tbody>
</table>
Price comparison

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<th>Price in EUR</th>
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<td>Whisper XT</td>
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<td>EPS Project</td>
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Ratio analysis

<table>
<thead>
<tr>
<th>Product</th>
<th>Power/Price Ratio</th>
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<tbody>
<tr>
<td>Whisper XT</td>
<td>1.52</td>
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<tr>
<td>Remote Control</td>
<td>0.47</td>
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<tr>
<td>Outboard System 200</td>
<td>0.97</td>
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<td>Reservoir Runner 500-T</td>
<td>0.43</td>
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<tr>
<td>E-Drive</td>
<td>0.89</td>
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<td>EPS Project</td>
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Ratio analysis

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<th>Reservoir Runner 500-T</th>
<th>e-Drive</th>
<th>EPS Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power/Weight Ratio</td>
<td>N/A</td>
<td>88,24</td>
<td>57,58</td>
<td>31,91</td>
<td>73,33</td>
</tr>
</tbody>
</table>

MARKETING 29
Social Media Marketing
Conclusions

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

- Next step: prototype