OUTLINE

1. Brief presentation of INEGI
2. Competences and Activities in Aeronautics
3. UAV’s and Related Equipments
4. Conclusion
1. BRIEF PRESENTATION OF INEGI
LOCATION (2)
- It is a private non-profit organization and recognized by the Portuguese Government as an Institution of Public Utility.

- Shareholders:
  - 33% - University of Porto
  - 6,8 % - FEUP
  - 60,2% - 60 private companies and 3 associations representing industry sectors

- It is positioned as an institution of interface with a strong link to both University and Industry.
Contribute to the increase of industry competitiveness, through R&D, Knowledge and Technology Transfer and Training, in the fields of engineering, design, materials, production technology, energy and industrial management.
Knowledge creation and development of technologies, usually 100% funded by FCT (National Foundation for Science and Technology) and EC.

R&D projects with industry co-financed by Portuguese and European funds.

R&D projects with industry funded by clients.

Technical consulting.

Training – tailor made training programs, mostly “in-company”.

60% of total Revenues (2008)
ORGANIZATION CHART

General Assembly

Audit Committee

Management Board

Advisory Committee

Managing Director

Information and Communication

Administrative and Financial

Quality Management

Human Resources Management

R&D

ITT

APPLIED RESEARCH

LAETA*

Foundry, Rapid Prototyping & Rapid Tooling

Sheet Metal Forming

Composite Materials and Structures

Tribology, Vibrations and Industrial Maintenance

NDT and Experimental Mechanics

Instrumentation Automation and Control

Energy and Environmental Engineering

Industrial Engineering and Management

INNOVATION & TECHNOLOGY TRANSFER

New Technologies and Industrial Processes

Product Design and Development

Technologies for Sustainability

Innovation Management

New Technologies for Energy Production

SCIENTIFIC/TECHNICAL CONSULTING & SERVICES

Renewable Energies

Environmental Solutions

Rapid Prototyping and Rapid Tooling

Smoke and Fire Behaviour of Products

Tailor Made Training Programmes

Technical Design Standardization (National Commission)

*Associate Laboratory for Energy, Transports and Aeronautics

Unmanned Aerial Vehicles (UAV's) – IESM, Lisbon 15 Dec 2009
Unmanned Aerial Vehicles (UAV's) – IESM, Lisbon 15 Dec 2009
<table>
<thead>
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<th>PARTNERS (List not exhaustive)</th>
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<tr>
<td>A.BRITO (PT)</td>
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<tr>
<td>ADRIA Airways (IT)</td>
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<td>Aerospatiale (FR)</td>
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<td>AIRBUS (UK)</td>
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<td>BAe Systems (UK)</td>
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<td>ENSAM Bordeaux (FR)</td>
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<td>ESA (FR)</td>
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<td>FCT-U. Coimbra (PT)</td>
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<td>Type</td>
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<td>Permanent Staff</td>
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<td>Temporary Staff (scholarships)</td>
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<td>TOTAL BOARD</td>
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<td>Consultants - University</td>
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<td>Others</td>
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<td><strong>TOTAL</strong></td>
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**Pie Chart: HUMAN RESOURCES**

- Permanent Staff: 40%
- Temporary Staff (Scholarships): 30%
- Consultants - University: 26%
- Others: 4%

Unmanned Aerial Vehicles (UAV's) – IESM, Lisbon 15 Dec 2009
TURNOVER

- Year 2005: 3.81 M€
- Year 2006: 4.26 M€
- Year 2007: 4.32 M€
- Year 2008: 5.02 M€
2. COMPETENCES AND ACTIVITIES
- 20 YEARS OF EXPERIENCE
- MORE THAN 2000 PROJECTS
- OVER 1000 PARTNERS/CLIENTS
- BUDGET OVER 60 M€
AERONAUTICS AND AEROSPACE PROJECTS
The primary objective of the study is to develop novel composite materials using organic and inorganic matrices reinforced by carbon nanotubes.

INEGI’s role is to perform a state-of-the-art study on the inorganic matrix carbon nanotube composite materials and to perform mechanical characterisation tests on specimens.
PIBRAC: Development of the next generation of brakes for aeronautics

Development of a new type of brakes based on piezoelectric engines

PARTNERS:
SAGEM
AIRBUS
MESSIER-BUGATTI
Universidade de Paderborn
SKODA
IMMG
SAMTECH
NOLIAC
BAM
A. Brito
Description:
Development of a full autonomous Civil Aircraft Security Against MANPADS

Partners:  SAGEM-Défense et Securité
Airbus UK
EADS, etc...

Fully Autonomous System Operation
No Operator Intervention
Development of hybrid composite materials (metal-carbon) to apply at overloaded joints

Improvement of the resistance of mechanical joints made of advanced composites.

INEGI’s role is to perform the necessary analysis and simulations to evaluate the behaviour of these materials.

PARTNERS:
ESA
NASA
EADS
Air Force Research Laboratory;
HPS INVENT; KTH; LLB; DLR; MT Aerospace; Contraves;
CASA Espacio; Kayser-Threde; Saab; Ericsson Space
Progressive Failures Analysis of Advanced Composites

Development of computational models to simulate the mechanical behaviour of advanced materials.

The developed models were implemented in ABAQUS

PARTNERS:
NASA – Langley Research Center
The main purpose of EDEN is to take advantage of the emergence of the Hydrogen Economy to stimulate the establishment of a national technological and economic platform in this area. This is achieved by promoting a strong cooperation between universities, research and technology organizations and enterprises, in testing and demonstrating actual applications of the technologies related to Hydrogen, in developing new scientific and technological competences as well as by setting up a national roadmap for the development of the Hydrogen economy.

PARTNERS:
SRE, EDP, EEM, EFACEC, VIDROPOL, INETI, IST, AREAM
LUCIS

- Demonstration of Hydrogen Cells in Real Environment.
- This project aims to perform demonstration actions of the cell in different applications.
Product Development, Structural Health Monitoring & Manufacturing Capacities
STRUCTURAL ANALYSIS BY FEM:

FINITE ELEMENT ANALYSIS:

INEGI has significant experience in this area, gained through cooperation with companies from different sectors of activity. Currently, the development of new products uses advanced engineering techniques, among which the structural simulation by means of FEM:

- Elfen
- I-Deas
- Cosmos
- Abaqus
- Solid works

Simulation of damage in advanced composite structures
New Tools for Composites Inspection (1)
(Structural Health Monitoring)
New Tools for Composites Inspection (2)
(Structural Health Monitoring)
New Tools for Mechanical Design
(Vibration Analysis)
Conversion of prototypes in metallic parts

Types of Activities:
- Product Development
- Foundry tools design and optimisation
- Rapid prototyping LOM
- Plastic conversions in silicone moulds
- Pre-series of metallic products by investment casting
- Mechanical and metallurgical testing
- Special equipments design and prototyping

Manufacturing Facilities (1) - Rapid prototyping & tooling

LOM rapid prototyping machine

LOM prototypes and foundry moulds

Conversion of prototypes in metallic parts

Plastic injection moulds for the automotive industry
Find an alternative for the conventional resin bath on the pultrusion manufacturing process.

Eliminate the release of dangerous gases and reduce the excess of resin verified in this process.
Manufacturing Facilities (3) - RESCOMPRE

Optimization of the high pressure vessels structure using advanced calculus methods and mechanical testing like damage tolerance and durability.
Development of a new manufacturing process. The architecture of this process of resin transfer moulding doesn’t change so the name stays RTM.

The goal of this process is the manufacturing of high structural behaviour pieces.

Change the viscosity of the resin with the intervention of nanoparticles and magnetic fields.
Lusitano VIP project’s main purpose is to develop and build an innovative sailing ship with approximately 10 meters (33 feet) length, under the orientation of the shipbuilder Tony Castro. The project is being carried out by using the engineering capacities of FEUP, AEFEUP, INEGI, APDL, and with the participation of interdisciplinary teams composed by students and researchers in the following areas: materials, product development, numerical simulation and electronic sensors.
3. UAV’s AND RELATED EQUIPMENTS
SEA TECHNOLOGIES | Vehicles (1):

Development / Mechanical Systems Construction and parts

AUV / L-AUV (Light - Autonomous Underwater Vehicle)

- Offshore verification of equipments and structures
- Samples collection
- Levantamento do relevo do fundo do mar

Project Lider: ISR
SEA TECHNOLOGIES | Vehicles (2):

Development / Mechanical Systems Construction and parts

ROV (Remotely Operated Vehicle)

- Inspection and equipment assembly
- Remote observation of the deep
- Exploration in depth

Project leader: ISR
Composite materials processing techniques

OFFSHORE Floating Structures:

- Signalling and orientation
- Monitoring and atmospheric control
- Control and communication with vehicles

**Partners:** INTECMAR, INSTITUTO ESPAÑOL DE OCEONOGRAFIA, INSTITUTO DE INVESTIGACIONES MARIÑAS, CETMAR, UNIVERSIDAD VIGO, CIIMAR, INESC PORTO, FEUP, INSTITUTO HIDROGRÁFICO, UNIVERSIDADE DE AVEIRO, FCUP
UAV Systems (1):
Design/Manufacturing of airframe in composite materials

Unmanned Aerial Vehicles (UAV) Systems (1):
Design/Manufacturing of airframe in composite materials

- PITVANT
- PAIV
- STEPUAV

Partners:
FEUP, AFA, INEGI, PEMA, SPINWORKS, EMPORDEF, ETC.
UAV Systems (2):
Design/Manufacturing of airframe in composite materials

Air Cargo Challenge, Ota 9-11 September 2005
Associação Portuguesa de Aeronáutica e Espaço (APAE)

4th Place

BRUTUS
- 3.5 kg
- Carbon fibre on wood and expanded polystyrene

Partners:
FEUP, INEGI.
UAV Systems (3):
Design/Manufacturing of airframe in composite materials

FLYBY
- Gross weight: 3.7 kg
- Payload capacity: 9.5 kg

Partners:
FEUP, INEGI.
UAV Systems (4):
Design/Manufacturing of airframe in composite materials

THE FUTURE
- Prototyping
- New design
- New materials

Participants:
FEUP, INEGI, AFA, and others…
UAV Systems (5):
Design/Manufacturing of airframe in composite materials

Partners:
FEUP, INEGI, AFA, ISEP, and others…

THE FUTURE
- Prototyping
- New design
- New materials
UAV Systems (6):
Design/Manufacturing of airframe in composite materials

THE FUTURE
- Coast surveillance
- Search and rescue
- Other missions

Partners:
FEUP, INEGI, AFA, ISEP, and others…
4. CONCLUSION

Unmanned Aerial Vehicles (UAV's) – ISEM, Lisbon 15 Dec 2009
INEGI has the capacity to bring innovative technical solutions to the challenges addressed by the actual needs for UAV development, as it did in many similar situations described above.

Across the last 20 years of its existence, INEGI has always honoured the commitments in the many private, national and international R&D programmes, and associated achievements, in which it has been involved.
Possible contributions to future UAV systems

- Platform (airframe)
- Automatic Pilot
- Power/energy
- Propulsion
- Actuators
- Communications
- Safety
- Computer
- Payloads
Thank you!