Objectives & Achievements

Unit Description

The Unit is currently composed of 61 'Integrated Members' and 34 'Collaborating Members'. The former group includes 32 PhD holders (of which, 5 pos doc), 21 PhD students and 6 other researchers, all the non PhDs having a research grant or contract or in the process o obtaining. The group of collaborating members is composed of 6 PhD students (enrolled at other institutions), 5 PhD holders (3 from Brasil) and 23 MSc students working on their MSc dissertations.

The members of the Unit are grouped in three research groups. Each group has a Principal Investigator (group coordinator) elected by all integrated members of the group, having as main functions to foster the research group and to coordinate its activities. The current Director and Group Coordinators were elected in 2011. All decisions concerning the research activity of the Unit (definition of a research policy, applications to research funding programs, development of protocols of collaboration with other research institutions and with industry, approval of research reports, approval of the activity budget, acceptance of new members), are under the competence of the Scientific Committee (SC), constituted by all integrated members of the Unit holding a PhD degree. The coordination of the Unit's activities as defined by the SC is assured by the Executive Committee (EC), which is constituted by the Director of the Unit and the Principal Investigators of the research groups. The Director is elected directly by all integrated members of the Unit holding a PhD degree. He represents the Unit and chairs the Scientific and the Executive Committees. The elected director may designate deputy Director within the integrated members holding a PhD degree, to help him in the coordination of the Unit. In 2010 the unit approved its statues, in accordance with the general guidelines of the University, which clearly define the role and duties of each one of its bodies.

The External Advisory Committee (EAC), created in 2009 and composed of three scientists of internationally recognized merit in the areas of interest of the Unit, has met for the first time in July 12 through 13, 2010. In this meeting the panel reviewed the activities, objectives and structure of the research unit. Various suggestions were discussed. The members of the EAC are: Professor Jean-Pierre Celis, Universidade Católica de Leuven (Belgium), Professor Andrés Kecskméthy, University of Duisburg-Essen (Germany) and Professor Jouni Hamalainen, VTT Technical Research Centre (Finland). Unfortunately, due to the delay by FCT in defining the funding scheme for the research centers, the EAB could not be assembled during 2011.

General Objectives

The mission of the unit is to contribute to the advance of scientific knowledge in mechanical engineering, in particular in the areas of mechanical systems, energy and environmental technologies, functionalized materials. Also, to make this knowledge available to the scientific community through its publication in international journals and conferences, and to industry, by means of the establishment of joint research projects and protocols for technology transfer. The training of post-graduate students is also within the mission of the unit, as well as the contribution to the general public awareness of science and innovation.
The general objectives of the Centre mainly remain as specified in the initial proposal for this period of activity, presented in 2007. Most of them have been corroborated by the assessment panel after the visit made to the Unit in April 2008. Good progress has been made regarding some of those objectives. The Unit will continue making efforts to accomplish all the proposed objectives to a good degree. The feedback from the EAC is of the utmost relevance to the guidance of the center.
i) Research focusing. Although the research groups are not all in the same situation concerning focusing, some progress is occurring but it is an issue that requires attention at all time. Niche areas of research have been identified, being the main stream of the research effort directed to those areas in each group. These niche areas are 'tribocorrosion', 'functionally graded materials', 'waste-to-energy' and 'energy management'. Regarding the first and the second areas, the Unit is unique in Portugal and already achieved international recognition. It is a strategic objective of the Unit to achieve international recognition in all niche areas identified as such.
ii) Regarding scientific production, the improvement of both quantity and quality of journal publications and of the number of PhD students as a whole, are objectives of the Unit. In 2011 the productivity ratio of the Unit viewed as the number of papers in international journals per PhD researcher, was kept at 1.53 which is just above the objective of 1.5 by the end of the current activity period. The ratio of PhD students to the total number of PhD MI has increased up to 0.85 from 0.77 in 2010, and 0.52 in 2009. The objective of the Unit is to push this ratio towards 1.
iii) The enlargement of internationalization of the research groups constitutes a very important objective of the Unit. The number and the relevance of the groups' liaisons with other international groups are growing. Such interaction is bringing fruits in terms of collaborative research, joint supervision of graduate students and the organization of scientific events. The collaboration in research projects the joint publication of papers, the co-organization of scientific meetings and conferences, the mobility of researchers, are all important targets whose intensification is to be pursued and, for 2012, should continue this trend.
iiii) The Unit benefits of the regular funding attributed within the Plurianual Funding Programme of FCT. In 2011 the FCT reviewed the procedures for funding its research centers which was put under the umbrella "strategic project". This process induced a significant delay in making the funds available which reduced the actual funding level to the Unit. Additional direct funding comes mainly from research projects sponsored by national agencies and industry (often co-funded by public funds). Due to the present crisis that causes the reduction of available funding making the approval of new projects more competitive, increasing the amount of external funding based on national, EU and industrial projects is a core objective.

Main Achievements during the year of 2011

In 2011 the unit listed 36 active research projects and 6 industrial contract, involving a global funding for this year of approximately 957.3 k€. These projects were mainly financed by public agencies (some with private co-funding: 514.9 k€) and the FCT (17%). The direct funding by FCT represents 4% and EU funds contributed to 25% of the budget.
Scientific output: 49 papers in international journals, 9 in books (and book chapters) and 94 communications in international conferences, and 1 patent submitted. One book was reprinted (3rd edition). 3 PhD and 52 MSc thesis have been concluded in 2011. By the end of the year 25 PhD and over 30 MSc students were carrying out research in the Unit, including 4 PhD students that are enrolled at other international institutions.
- The FunMat&SP group organized the VI International Materials Symposium MATERIAIS 2011; XV meeting of SPM - Sociedade Portuguesa de Materiais, 18-20 April 2011
- The EET organized: the 2nd Iberian Congress in Solid Biofuels (June 2011),1st International Conference WASTES:Solutions, Treatments and Opportunities, Sep 2011.
- The DMS group integrates a large team involving 10 institutions of 7 countries partnering an European project. Started in 2011.
- The EET group started 3 International projects in 2011.
- J L Alves continued his collaboration with the Riken Institute (Tokyo) as invited scientist, under the VCAD Systems Research Program. 15 weeks in 2011.
- F Castro: evaluation panel of the European Eco-Innovation Programme.
- J Martins: international expert for the FP7 for the program 'Information and Communication Technologies for the Fully Electric Vehicle'.
- J C Teixeira integrates the Steering Committee of the European Technology Platform on Renewable Heat & Cooling.
- Eduardo Ferreira integrates the European pellet Council, is the director of the ANPEB where coordinates the international project Pellcert.
- Researchers of the unit acted as reviewers for 36 international journals and conferences.
- C Vilarinho and F Castro are members of the European Biofuels Technologies Platform.
- Members of the unit belong to the editorial board of 6 international journals.
- One of the young researchers of the DMS group (Margarida Machado) was elected one of 'Portuguese personalities of 2011'
- In 2011, the quality of research was recognized by the award of scientific prizes: a) Pedro Moreira - "Prize of Young Researcher João Martins" for the best paper presented at the Congresso Nacional de Biomecânica; b) Margarida Machado was awarded the best paper in the conference 'ASME 2011 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference', Washington DC; c) Maria Runa, awarded the Ken Ludema Best Paper Prize at the International Conference Wear of Materials, Philadelphia, USA.
- JL Alves: young researcher prize "Prof. João Martins" in Applied Mechanics in 2011.
- F.S. Silva - Applied Engineering Award - jewelry industry, Santa Fe Symposium, New Mexico, EUA, 2011. Honorary Ambassador of the Santa Fe Symposium on Jewelry Manufacturing Technology
- The Center promoted on a regular basis the Scientific Interaction Meetings throughout 2011: 10 sessions and 23 presentations. Extended abstracts are edited as a book.
- A newsletter; Overhaul of the web page.
- The center has also started to implement a strategy of integrating the R&D activities, with the promotion of the doctorate degree, the masters final projects and the association with the industrial sector.
- A R&D contract with Bosch has been established

This approach will foster the attraction of young researchers into subsequent advanced training that will provide added value to the economic fabric.

Integrative/multidisciplinary activities during the year of 2011

The multidisciplinary activity of the unit is present in the research projects in which it is involved. Some key facts:
- Two externally funded projects in biomass combustion systems (DMS and the E&ETech groups), as well as researchers from IST, Lisbon.
- Also, work on fluids in biomechanics involves the collaboration of the DMS and the E&ETech groups. It is focused on both the dynamics of blood flow and respiratory systems. Additional collaboration of the hospitals of Braga and Gaia and the Faculty of Pharmacy at the University of Lisbon.
- The FMG and EET groups negotiated a project with Bosch group to develop novel systems for water heating. Other industrial sourced projects that are in the proposal phase with Bosch Audio involve the collaboration of two R&D groups in the Center.
- A large project on "Assessment and development of integrated systems for electric vehicles" involving researchers from centres in three major Portuguese universities is running. Project financed by the MIT-Portugal/EDAM Programme, coordinated by a member of the unit.
- The ongoing work on biomaterials for dental restorations and dental implants involves multidisciplinary teams from the areas of materials science, medicine, biology, mechanical engineering, physics and chemistry. A network of Dental Schools from Portugal, Belgium, Brazil, USA and Japan is being created to support this activity.
- Members of the unit in coordination with Center for Residues Valorization (CVR) and the industrial company W2V, S.A., transferring knowledge on extraction metallurgy, waste management and chemical technologies.
- Members of the unit continued their participation in three other projects coordinated by private companies (UNICER, Derovo and Decorgel) also financed by QREN. These projects involve researchers from other research centers of Minho University.
- Unit members from two groups participate in a project funded by two industrial companies (W2V, S.A. and Indutex, S.A.) aimed at developing a process to recover chlorine from PVC mixed plastic wastes, and recover energy by pyrolysis gasification rout. This project involves a PhD project.
- An interdisciplinary laboratory has been created to respond to industrial needs in the development of scientific and technological solutions in the fields of functionalized materials and surface coatings. It includes researchers of the FMat&SP group of CT2M and of the coatings group of the Physics Research Centre of Minho University.
- The Center also participates in the Institute for Bio-Sustainability (IBS) that was formally approved in 2011. This collaboration involves the development of bio inspired materials.
- Optimization of energy systems is a research area that has developed a strong partnership with other groups due to its multidisciplinary nature.
- Joint research collaboration with industry (Company Sodecia) between the FMG and DMS groups is developing technologies for the Automotive Industry.
- The center has been promoting various initiatives that aim to gel the various dispersed competences into integrated initiatives. Amongst those one should mention: a) newsletter; b) Scientific Interaction Meetings on a regular basis. These are becoming open to external researchers; c) enhancing the industrial collaboration that promotes an interdisciplinary approach to problem solving; d) social events.

Outreach activities during the year of 2011

Unit members have participated in actions and events directed to the general public, calling their attention to the benefits of science and innovation and to the contributions of this Unit in specific areas of knowledge. Other actions were intended to foster the motivation of young secondary school students to the academic courses in which members of the Unit are involved.
The main activities carried out in 2011 are as follows.
i) Visits of high school students to the laboratories of the Unit. These visits, involving more than 150 students from various schools in the region, were organized by the University with the support of members of the Unit. The visits started with the exhibition of a short video film (of about 20 minutes), showing mechanical engineering applications in day-to-day life. Students were then guided on a tour through the laboratories, where specific demonstrations were staged to highlight the relevance of physics and engineering.
ii) The Center has been involved in the elaboration of proposals for three actions that are aimed at providing specialized training in the areas of energy management in industry and buildings and systems automation. These are scheduled to be offered at renewed historic facility in the town of Guimaraes, known as the "Couros".
iii) In the context of our involvement in the development of electric vehicles' studies, it has been possible to motivate the local municipality towards the promotion of urban mobility. This is being materialized during the European Capital of Culture (Guimarães, 2012) with the purchase of electric vehicles for the support of the event. This partnership also includes a sponsorship for the participation of the University of Minho in a international event with a low consumption vehicle. This prototype involves the participation of a dozen of undergraduate students. Also, the Universidade do Minho is assisting the municipality to promote the event "16th Energy Cities' Annual Rendezvous, - Mind-boggling ideas for a new energy culture", during which an electric car parade will take place. The expertise gained in the development of electric cars enabled the help of local industry to develop electric vehicles. In fact, in Guimarães there are a couple of manufacturers of electric vehicles and our team is enrolled in the development of some of these vehicles.
iiii) The dissemination of the Newsletter through a wide variety of personal contacts and institutions (private and public) contributes to the enhancement of the Center's visibility throughout the society at large.
v) Members of the unit (indicated by the institution and subsequently designated by the court) acted as experts in around a dozen criminal court cases, mainly involving the analysis and simulation of road traffic accidents and structural analysis of equipment (P Claro, J Martins, J Meireles, AM Pinho, L Martins)
vi) Various workshops and invited speeches have been organized throughout 2011.
vii) The interdisciplinary laboratory previously referred has protocols with an University Design School (ESAD-Escola Superior de Artes e Design – Matosinhos, Portugal) and with a group of companies (8 companies). In the framework of these protocols company employees and design students join in the lab in order to do a collaborative work. The aim is to link research, design, and production.