



2013 Evaluation of FCT Research and Development Units

Review process - Stage 1

Panel: 02

ESF internal Project Ref Number: 14-FCT-320

Reviewer ID: 91575

Title: Associate Laboratory of Energy, Transports and Aeronautics (LAETA)

P.I.: Dr. José Carlos Fernandes Pereira

FCT Ref: 50022

Total Score: 19 / 20

A. Productivity and contribution to the National Scientific and Technological System (NSTS): 5 / 5

- i.) Research outputs; knowledge and technology transfer activities, when applicable, giving particular importance to the registration and value of patents, models or other relevant innovation indicators;
- ii.) Contribution to the accumulation of knowledge and skills of the National Science and Technology System (expected effects and results); contribution to the advanced training of researchers; contribution to the promotion and dissemination of scientific and technological research; dissemination of results and actions to promote scientific culture, as well as participation in activities designed to promote public understanding of science, technology, art and culture; relationship between available past funding and output;
- iii.) Degree of multidisciplinary and of internationalization, when relevant.

During the 2008-2012 period, productivity and contribution to the NSTS is ranging from very good to excellent depending on the research unit examined, but can be considered as excellent overall. A major contribution to the NSTS is the number of young scientists trained by LAETA and getting annually an Msc or PhD diploma. Indeed raising the level of education and is the best way to accumulate knowledge and skills in the national context since it has for consequences to enrich university education system and make available high-level competences to the Portuguese the industry. During the 2008-2012 period an average of 1.3 Msc and 0.16 PhD per faculty member was trained, which can be regarded as a remarkable result.

The very high productivity of LAETA team is also confirmed among others by :

- The quite high average annual publication rate in international journals (2.1 by faculty member, 1.6 by integrated researcher).
- The large participation to the organization of international conferences.
- the large number of external projects conducted during the period, out of which the most significant part results from participation to collaborative projects in the context of the EU 7th framework programme and from research actions in support to the Portuguese industry.
- The non-negligible part of research actions funded by international research organizations and industries.
- The very important place taken by external funding (60% out of competitive sources) in the global budget of LAETA (in particular, 13% from EU research framework programme, 5% from international research organizations, 23% from Portuguese industry, 3% from international industry).
- Typical indicators such as the important number of patents (54) and prototypes (79) obtained during the period.

In summary, all these indicators provided in the report demonstrate that due to its critical mass, LAETA plays a strategic role for the advancement of science and technology in its own fields of expertise. They also show that LAETA is a credible partner on the international research scene.

B. Scientific and technological merit of the research team: 5 / 5

- i.) Scientific productivity and merit of the results of the Unit's research, taking into account the relevance of both current and planned research, as well as the level of internationalization of scientific activities, including publications and citations of published works or other relevant aspects;
- ii.) Skills and composition of the research team to adequately execute the proposed program;
- iii.) Ability to successfully compete for national and international research grants and contracts, including contracts with companies.

The scientific and technological merit of the LAETA research team was already discussed above (section A) regarding this quantitative output.

Worth mentioning again is the internationalization of the LAETA scientific activities and the resulting visibility obtained on the international scene.

- Only a few research groups in the entire European Union have met equal success regarding participation



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to research projects of the 7th EU framework programme.

- There is strong involvement of LAETA members in various international committees (e.g. IUTAM, IACM, AAAS), conference organizing committees (e.g. ECCOMAS).
- High importance is given to publication into peer-reviewed scientific journals and of chapters in international books to the detriment of other publication channels conferences and national journals).
- Playing the role of editor-in-chief is a prestigious but very time consuming role that five LAETYA members assume with great success.
- Co-authorship with colleagues from abroad is strongly encouraged.
- Important success has been met in getting research funding from international organizations and industries.

LAETA is in fact facing a major challenge: achieving successfully the integration of 10 different research teams of very different sizes (from 8 to 50 integrated members) along 5 thematic lines (energy, transport technologies, aeronautics and space, key enabling technologies and future emerging technologies) with different skills and competences (10 expertise areas) pertaining to 4 different institutions (IST, UP, UC and UBI) in four different geographical locations.

Despite of these obstacles, they have succeeded in developing a common strategy and establishing together a coherent research programme which allows each team to exploit at best its own expertise and share it with the other LAETA partners. Specific strengths have been identified that fit well together in the context of the overall programme of the project.

In summary, the scientific and technical merit of LAETA lies on three main pillars:

- The scientific excellence of its research teams,
- The installment good management structure tin support of well-defined objectives,
- The collaboration spirit that has developed over the years between the different teams.

C. Scientific merit and innovative nature of the strategic programme:**5 /5**

i.) Relevance, originality and impact of the proposed strategic programme;

ii.) Contribution of the scientific, technological, artistic or cultural activities of the proposed programme for a smart specialization strategy of the region in which the RD Unit is incorporated;

iii.) Degree of multidisciplinary and of internationalization, when relevant.

** The score must be based on C.i and C.iii only. However, comments on C.ii are welcome.**

The strategic programme developed by the LAETA around the five selected research lines is quite ambitious but feasible. It is relevant because it fits well with the competences available in the different groups. It is original in the way it is organized because it defines three vertical research lines corresponding to application domains (energy, transport technologies, aeronautics and space) which will all benefit from the research results in two lines (key enabling technologies and future emerging technologies) remaining lines with horizontal character. It may have strong impact at national level because it combines search for scientific excellence with technological development which may benefit even to industries outside of the selected domains of application. The objectives in terms of scientific production and expected indicators (table provided in section 7.1) are feasible because resulting from extrapolation of the results of the previous period. The management structure proposed is appropriate because it aims at promoting the collaboration between research units while preserving necessary autonomy.

The large spectrum of competences existing in the team confers to the project a high degree of multidisciplinary. Indeed many different disciplines are involved, covering fundamental research as well as technological development up to prototyping.

The workprogramme addresses topics which are of hot interest at European level as well as and internationally. The same degree of internationality as reached during the 2008-2012 period can thus be expected from the new project.



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D. Feasibility of the work plan and reasonability of the requested budget:

4 /5

i.) Organisation of the programme in terms of the proposed objectives and resources (budget, duration, infrastructures); organisation and work environment, with special focus on the adequacy of the research team's critical mass to perform the proposed objectives and on the management of resources directed to research activities, which includes supervision of postgraduate students and post-doctoral involvement in RD activities;
ii.) Adequacy of proposed budget to accomplish the proposed strategic programme;
iii.) Institutional resources (technical, scientific, organisational and managerial) of the participating entities. The commitment of the host institution in providing the manpower and material resources to implement the proposed programme is especially valued.

The total budget proposed for strategic funding during the next period (2.75M€/year), even though realistic and well in correspondence with the project objectives, corresponds to 30% increase with respect to the 2008-2012 budget (2.1 M€/year), while the number of integrated researchers participating to the project is only 10% higher than during the previous period. Such increase might nevertheless be justified both by inflation and by the fact that LAETA (as claimed in Section 12.1) is the Portuguese research group with the highest ratio of non-FCT funding (6.36 to 1) during the 2007-2011 evaluation period. If the budget had to be reduced somewhat, the part devoted to human resources should be the least affected since achieving the project objectives and meeting the expected indicators is conditioned in the first place by the availability of the human resources.

Overall Comment:

Please provide a comment to substantiate the overall grading achieved, specifying key strengths and weaknesses (if any) of the research plan

The LAETA project has the remarkable and essential quality of mobilizing a critical mass of scientists and engineers to pursue common objectives in the broad area of mechanical engineering. It is thus a project with wide visibility within the national engineering community, and is also a pool of competences in which the Portuguese industry can find adequate response to its future needs. The project is thus strategic to the country and should receive continuous and substantial support.

The team has clearly international visibility, as shown by the different indicators related to publication in peer-review journals, membership of international bodies, and participation to EU/international projects and to edition of international journals.

The strategic programme around the five selected research lines is quite ambitious but feasible. It is relevant because it fits well with the competences available in the different groups. As it is quite large in scope, the danger to be avoided is some dispersion that might be facilitated by the geographical distance between research groups and their belonging to different institutions. The project management has thus an important role to play for further increase of the communication and collaboration between the different teams.

An essential aspect of the project is the accumulation of knowledge and skills through the training of young researchers, which directly benefits to the Portuguese scientific and academic community and also to the Portuguese industry. The budget proposed is adequate for achieving that objective.



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P.I.: Dr. José Carlos Fernandes Pereira

FCT Ref: 50022

Total Score: 20 / 20

A. Productivity and contribution to the National Scientific and Technological System (NSTS): 5 / 5

- i.) Research outputs; knowledge and technology transfer activities, when applicable, giving particular importance to the registration and value of patents, models or other relevant innovation indicators;
- ii.) Contribution to the accumulation of knowledge and skills of the National Science and Technology System (expected effects and results); contribution to the advanced training of researchers; contribution to the promotion and dissemination of scientific and technological research; dissemination of results and actions to promote scientific culture, as well as participation in activities designed to promote public understanding of science, technology, art and culture; relationship between available past funding and output;
- iii.) Degree of multidisciplinary and of internationalization, when relevant.

The research environment seeks to encourage collaborative research through a combination of theoretical, numerical and experimental modeling. Equally, much of the laboratory infrastructure listed would be the envy of any the world's best groups. There are well-described plans and modalities for efficient knowledge and technology transfer activities, with an impressive number of patents held by members associated to the laboratory. It is clear that the laboratory contributes to the accumulation of knowledge and participates in dedicated training activities within their field of activity. The research performed is multi-disciplinary, characterised by a holist viewpoint, with a very high international visibility and participation in the international research community. The activities focussed on promotion and dissemination of the research results is commendable, though these must be carefully balanced in a way not to hinder risky and radically different approaches to learning, where very large steps are required. It is clear that the research environment is excellent by all adequate standards.

B. Scientific and technological merit of the research team: 5 / 5

- i.) Scientific productivity and merit of the results of the Unit's research, taking into account the relevance of both current and planned research, as well as the level of internationalization of scientific activities, including publications and citations of published works or other relevant aspects;
- ii.) Skills and composition of the research team to adequately execute the proposed program;
- iii.) Ability to successfully compete for national and international research grants and contracts, including contracts with companies.

Overall, the scientific quality is very good by which this research grouping must be considered as one of the top in its field of research even on an international comparison. The productivity in terms of publications is excellent, with an impressive width in the choice of the journal coverage, and the publications resulting from the associate laboratory is cited at a comparatively high level, in particular considering the field of research involved. The group has a broad funding base, ranging from basic research funding to applied and even directly from industry. The research performed has clear relevance for many industrial sectors, which is demonstrated by numerous examples of fruitful collaboration between the research groups and industry, with basic research being performed with focus on future applications. The track record related to the ability to secure research grants in competitive calls for proposals are at the top level of any engineering institution throughout the world.

C. Scientific merit and innovative nature of the strategic programme: 5 / 5

- i.) Relevance, originality and impact of the proposed strategic programme;
- ii.) Contribution of the scientific, technological, artistic or cultural activities of the proposed programme for a smart specialization strategy of the region in which the RD Unit is incorporated;
- iii.) Degree of multidisciplinary and of internationalization, when relevant.

** The score must be based on C.i and C.iii only. However, comments on C.ii are welcome.**

The proposed research programme appears to be of a high relevance with a high level of originality and a potential impact which goes well beyond the fields of research involved. It is evident from the past



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successes as demonstrated by the track record of project grants in international competitive calls, that the proposed strategic programme has an excellent potential for impact, both in the region where the laboratory is active as well as in a wider community, reaching far out into the international community. The thematic line focussing on future emerging technologies is perceived as innovative, laying the ground for new high-risk research, opening up for risky and radically different approaches to new knowledge and new innovative technological solutions to some of the global challenges facing our modern, urban society. The rationale behind the research programme is well outlined, with complementarity as well as partial, overlaps providing a critical mass in a dynamic setting.

D. Feasibility of the work plan and reasonability of the requested budget:

5 /5

- i.) Organisation of the programme in terms of the proposed objectives and resources (budget, duration, infrastructures); organisation and work environment, with special focus on the adequacy of the research team's critical mass to perform the proposed objectives and on the management of resources directed to research activities, which includes supervision of postgraduate students and post-doctoral involvement in RD activities;
- ii.) Adequacy of proposed budget to accomplish the proposed strategic programme;
- iii.) Institutional resources (technical, scientific, organisational and managerial) of the participating entities. The commitment of the host institution in providing the manpower and material resources to implement the proposed programme is especially valued.

The management structure reflects an awareness among the principal researchers involved which in itself conveys a high degree of confidence in the implementation of the proposed research programme. The organizational setting is well-balanced, with a adequate balance between scientific and technological objectives and the resources foreseen for their fulfillment. The proposers display a high level of awareness with respect to the critical mass necessary for the highly ambitious goals formulated. The involvement of postgraduate and postdoctoral researchers is well substantiated, and to a large extent already in place. The budget requested appears to be adequate for the research proposed with a commendable dedicated particular emphasis on the necessity of investing resources into the strengthening of the experimental resource infrastructure which is at the core of some of the research activities planned.

Overall Comment:

Please provide a comment to substantiate the overall grading achieved, specifying key strengths and weaknesses (if any) of the research plan

The LAETA consortium forms an impressive partnership both concerning the past research output as well the well-structured plans for research under the current application. A strong and competent grouping of internationally well-known and highly respected senior university and institute researchers, jointly holding a well-recognised expertise in a wide area of engineering sciences, performing at the top international level in terms of research output, and with clearly defined strategies for transfer-of-knowledge in the disciplines involved. The combined depth and broad diversity are impressive and with research topics well in line with the competence of the involved research groups. A commendable awareness, paired with a expressed commitment to develop and strengthen, the necessary infra-structural resources required for this kind of high profile, research at the front of the present level of the state-of-the-art. The combined expertise and the available resources of the partners, forms a unique setting with the necessary critical size to achieve relevant outputs and to meet the ambitious plans laid in the proposal.



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Total Score: 20 / 20

A. Productivity and contribution to the National Scientific and Technological System (NSTS): 5 / 5

- i.) Research outputs; knowledge and technology transfer activities, when applicable, giving particular importance to the registration and value of patents, models or other relevant innovation indicators;
- ii.) Contribution to the accumulation of knowledge and skills of the National Science and Technology System (expected effects and results); contribution to the advanced training of researchers; contribution to the promotion and dissemination of scientific and technological research; dissemination of results and actions to promote scientific culture, as well as participation in activities designed to promote public understanding of science, technology, art and culture; relationship between available past funding and output;
- iii.) Degree of multidisciplinary and of internationalization, when relevant.

The associate laboratory of energy, transport and aeronautics (LAETA) is coordinated by Prof. José Carlos Fernandes Pereira (Instituto de Engenharia Mecânica IDMEC/IST). LAETA is an extremely large laboratory. LAETA is an associate laboratory of 4 research institutions:

- Institute of Mechanical Engineering (IDMEC) of Instituto Superior Técnico at the University of Lisbon (UL) – 107 Ph.D. researchers;
- Institute of Engineering and Industrial Management (INEGI) at the University of Porto (UP) – 116 Ph.D. researchers;
- Association for the Development of Industrial Aerodynamics (ADAI) at the University of Coimbra (UC) – 22 Ph.D. researchers;
- Aeronautics and Astronautics Research Group (AEROG) at the University of Beira Interior (UBI) – 8 Ph.D. researchers.

This huge associate laboratory with 253 Ph.D. researchers (230 integrated researchers), 495 researchers, 47 Ph.D. (very low!!!) and 30 administrative / technician exhibits of course overwhelming research outputs figures. For example 54 patents were awarded to LAETA over the period. This makes 0.2 patent/integrated researcher. The number of research contracts with industry is also impressive: 380 while the number of contracts with national of international bodies goes up to 830! All that makes 4.7 contract/integrated researcher over the period. This is almost 1 contract per integrated researcher per year.

The contribution of LAETA to knowledge accumulation is also huge. Several professors and researchers of LAETA are Editor in chief of international journal have very high responsibilities in national and international decision boards. Consequently these positions together with the overwhelming force of strike of LAETA make this laboratory one of the major ones from an international point of view to attract funds from every source. One researcher of LAETA was Portuguese minister of science and higher education and direct principal advisor of the president of European council E. Barroso for science, higher education, research policy, environment and energy!

Listing the journals for which the members of LAETA are editors in-chief enable to define the scientific outline of the associate laboratory: Multibody Systems Dynamics, Campsites Structures, Journal of Adhesion, Journal of Railway Technology, Journal of Computational Vision and Biomechanics. Those two latter journals were recently founded and consequently haven't got any impact factor.

From the international relationship point of view, it can be noticed that 23% of the papers have been published in collaboration with international researchers from 40 countries, among which USA, Brazil, UK, Spain, Canada...

The size of LAETA enables the researches to be multidisciplinary and internationalized through many cooperations.



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B. Scientific and technological merit of the research team:

5 /5

- i.) Scientific productivity and merit of the results of the Unit's research, taking into account the relevance of both current and planned research, as well as the level of internationalization of scientific activities, including publications and citations of published works or other relevant aspects;
- ii.) Skills and composition of the research team to adequately execute the proposed program;
- iii.) Ability to successfully compete for national and international research grants and contracts, including contracts with companies.

The scientific production of the associate laboratory is equally huge. Some figures given in the report enable to get an idea of the size effects of LAETA. The scientific production of LAETA researchers represents about 2% of all the R&D Portuguese scientific production. Even if the ratio Ph.D. student/integrated researchers can seem low, the number of Ph.D. thesis produced by LAETA corresponds to 2% of the national average. Nevertheless it could have been interesting – since LAETA has access to numerous national data on research – to replace the laboratory within the Portuguese landscape by showing how big LAETA is in comparison with other large Portuguese research units. Results and figures given in the report show (if it was still necessary) that LAETA has reached the highest level from an international point of view. The gathering of these already large-size laboratories (i.e. IDMEC + INEGI + ADAI + AEROG) results in an exceptional panel of competences in the fields of advanced manufacturing, aeronautics and space, biomechanics, energy, engineering design and engineering systems, fires and detonics, materials and transport technologies. In each one of these numerous fields, LAETA has various cooperations with industries on a national but also on an international scale. With almost 1400 papers published in international journals between 2008 and 2012, the staff of LAETA is also very active in the organisation of major international large size conferences enabling thus to increase the influence of the laboratory. Concerning the issue about the ability of LAETA to successfully compete for national and international research grants and contract, only one figure give the best possible answer: the amount of the total funding of LAETA during the period is almost 52 M€. This represents almost 42 k€/researcher (253)/year.

C. Scientific merit and innovative nature of the strategic programme:

5 /5

- i.) Relevance, originality and impact of the proposed strategic programme;
 - ii.) Contribution of the scientific, technological, artistic or cultural activities of the proposed programme for a smart specialization strategy of the region in which the RD Unit is incorporated;
 - iii.) Degree of multidisciplinary and of internationalization, when relevant.
- * The score must be based on C.i and C.iii only. However, comments on C.ii are welcome. **

As for the current evaluation period (2008/2012), LAETA plan for the next 5 year to carry on its research activities varying from fundamental to applied research and to industrial applications. Skills of LAETA staff enable them to settle links between basic (fundamental) and applied research. This strength was at the origin of several patents awarded to LAETA between 2008/2012 and will remain at the origin of planned patents for the next period: more than 50. The amount of planned publication is also ambitious for the next 5 years: more than 2300 in international journals. The strategic programme specifies that LAETA will remain fully involved in 3 large economic domains: Energy, Transport Technologies and Aeronautics and will contribute to the development of the 3 Portuguese regions in where LAETA staff and facilities are located (Lisbon and Tage Valley, Porto North, Coimbra and Covilha, Centre of Portugal). LAETA plays an important role in the Portuguese economy with its long standing cooperation between the various research units and a series of Portuguese companies LAETA will increase its activities in its specialization fields (previously cited – item B): advanced manufacturing, aeronautics and space, biomechanics, energy, engineering design and engineering systems, fires and detonics, advanced materials and transport technologies. LAETA strategy in terms of innovation is fully detailed and passes through several coherent steps such as ensuring the adequacy and renewal of human resources, promoting the creation of high-quality knowledge and competence in Portugal and the efficient transfer of knowledge created elsewhere for our own use and



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lastly accelerating the exploitation of knowledge and expertise. The approaches proposed by LAETA state as follow: first, the arising of new ideas coming from fundamental research activities; second, use the skills within the specialization field with the aim to develop prototypes, pilot and to write patents.

D. Feasibility of the work plan and reasonability of the requested budget:

5 /5

i.) Organisation of the programme in terms of the proposed objectives and resources (budget, duration, infrastructures); organisation and work environment, with special focus on the adequacy of the research team's critical mass to perform the proposed objectives and on the management of resources directed to research activities, which includes supervision of postgraduate students and post-doctoral involvement in RD activities;
ii.) Adequacy of proposed budget to accomplish the proposed strategic programme;
iii.) Institutional resources (technical, scientific, organisational and managerial) of the participating entities. The commitment of the host institution in providing the manpower and material resources to implement the proposed programme is especially valued.

No question of critical mass with LAETA. The 253 researcher are synonymous of valuable contributions to national industrial competitiveness and technological breakthroughs. The governance structure upon 3 entities which are the executive council, the scientific council and lastly the advisory council. In this system, all people seems to be elected by the researchers except the members of the executive council for who the designation mode is not specified. The overall budget for the next 5 year is of 16.5 M€ with an amount of 8.5 M€ dedicated to human resources and almost 2 M€ for equipment. Since LAETA has facilities located on different geographical sites its needs in terms of technicians are strong. This is also the case for the renewal of research staff who is becoming older and who has not been renewed for more than 10 year as a consequence of Portugal policy in terms of research and higher education. The requested budget is detailed research unit by research unit and is thus dependent of local factors. Effectively as functions of Portuguese and European (FEDER?) policies, some research unit located in what can be called "well-doted areas" did not managed to get new equipment or to update their equipment for several years while some other unit located in more favorable regions have updated their equipment. In fact the strategy for equipment acquisition even if fully justified is a function of the unit history and location. Anyway the scientific and technical equipment considered are in perfect agreement with the scientific aims of the associate laboratory.

Overall Comment:

Please provide a comment to substantiate the overall grading achieved, specifying key strengths and weaknesses (if any) of the research plan

LAETA was born of the association of numerous famous and renowned researchers which are involved in highest level decisional organisms. There are strictly no doubts about the scientific level and the quality of research performed in this "research cartel". LAETA can be seen as the "weapon" of Portuguese research landscape in the international competition. Its visibility has become exceptional from an European point of view and sometimes can even gloss over smaller Portuguese laboratories working in the same fields. The report of the laboratory is extremely dense and very informative and shows that LAETA has fully and perfectly defined its aims for the next 5 years. It remains the problem of the somewhat low number of Ph. D. students for such a big associate laboratory which is not really explained even if people from LAETA are involved in numerous Ph.D. and MSc programmes. Even in the section 12.2 of the report "Human resources rationale" the recruitment of MSc student for starting Ph.D. studies is not clearly shown.