

## **GLOBAL REPORT ON THE EVALUATION OF THE RESEARCH UNITS ON CHEMICAL ENGINEERING AND BIOTECHNOLOGY**

### **Panel report**

The panel was well received by all laboratories that made significant efforts to present their work to panel members during the on-site visits or at FCT for some of the smaller or geographically distant laboratories. The overall level of science was variable but attained in several cases exceptional levels, comparable with the best international laboratories. In general the presentations were well structured for the reporting of past work and complimented the written reports which were also generally of high quality. The panel remarked that there is apparently a current obsession with citation statistics, which, as all scientists are aware, can be manipulated to say what one wishes. In some cases this presentation was excessive and often at the expense of a clearly defined presentation of the laboratories scientific strategies for the coming years. With a few notable exceptions in which the scientific perspectives were clearly defined, and new orientations justified, this aspect needs significant attention in future audits if laboratories are to be correctly assessed. The panel regretted that time was a limiting factor for the audit, limiting the discussions to a rather superficial level and being inadequate to reach in depth diagnosis of real strengths and weaknesses. Thus, while the overall exercise was feasible, the identification of individuals on site was not always easy: much of this analysis being possible only via the website system. The possibility to assess individual scientists independently from the laboratory audit would probably be a useful basis for career progression and help laboratory leaders in their task of decision making. It would also simplify and clarify the role of the panel. A number of general points were thought to be sufficiently important to justify inclusion in this report as they require action at a national level.

### **/) Future strategy**

A number of laboratories have or will shortly change their directional teams. In some cases this has not led to significant perturbations in the scientific strategies and some have used this opportunity to redefine their priorities in a more coherent manner. However, for others

this change in direction has led to what the panel hope will be transient problems in scientific coherence, susceptible to have a negative effect on the quality of the laboratory ratings if maintained. In others, this change is probably imminent and it would be useful to detail in a clear and unambiguous manner how this will modify scientific objectives in the future. In this manner the panel could give advice which could be useful to the new management concerning any proposed change in scientific priorities of the unit (inevitable when the direction changes). As mentioned in the introductory remarks, the presentation of future objectives of each laboratory were not particularly well developed for many of the laboratories seen, irrespective of possible changes of leadership, implying that no clear decisions were being made at the laboratory to re-orient some of the less productive studies to more ambitious objectives, thereby consolidating what could be considered to be strong points of each laboratory. One of the roles of leaders is to identify weak points and analyse the underlying causes. In general the panel was less well convinced of this internal analysis than it would like to be. This is unfortunate as the scientific domain is advancing extremely rapidly requiring the concentration of financial and human resources on specific objectives if international recognition is to be maintained. This is a general remark and should not be applied to all laboratories as the panel was particularly impressed with those laboratories who had significantly restructured their efforts to avoid the high degree of thematic dispersion (see below) common in the domain previously.

## **2) Scientific excellence or technical support**

Some, but not all of the better laboratories and a few of the smaller emerging laboratories have clearly oriented their research to achieve scientific excellence. The panel was rather disappointed with some of the others who appear to have privileged a different approach involving a more superficial level of investigation clearly directed towards resolving specific problems rather than obtaining the underlying scientific knowledge at a generic level. Although this was frequently justified as a necessity to meet the financial requirements this was deemed to be a short-term strategy unlikely to enable laboratories to immerse at an international level. In general, throughout Europe those laboratories which ensure a healthy financial situation are those which have attained high levels of scientific excellence and only rarely has contract-based research led to the emergence of scientific excellence. For some of the laboratories examined the work is of an adequate level but more appropriate to "Technical Centres" specifically financed to meet the requirements of local industry or agriculture rather than to undertake high level research. The position of FCT towards such Centres, useful but difficult to rate as being of a high level of

scientific excellence, needs to be clarified. Are other forms of financial support available for such centres that clearly play a useful role for Portuguese industry? Usefulness should however not be confused with scientific excellence. In a similar manner, some of the applied research programmes presented were not realistic within an industrial context and it is difficult to see what motivation exists for this applied but not applicable research effort.

### **3) Thematic dispersion**

For a large majority of the laboratories visited, extensive thematic dispersion was observed with, in many cases at least as many subjects as permanent staff. This may satisfy the individual ambitions of individuals but is not really coherent with a common focused goal for a laboratory, thereby provoking a negative image to the exterior. Thus, individuals may be recognised but it is doubtful if the laboratory as a whole will achieve international recognition. In several laboratories attaining good or very good ratings, subjects were identified of extremely high scientific potential, often due to the involvement of specific individuals of high quality, and which if encouraged good enable these laboratories to attain excellence in a relatively short period. Future development of such subjects, and by extension the laboratories, requires commitment from laboratory leaders who need to take a more active role in favouring such subjects to the detriment of others which are unlikely to achieve such levels. Strategy requires choices and in several cases the laboratory ratings should be seen to reflect the presence or absence of such decisions. Clearly this is a difficult role for laboratory leaders as some risk is involved plus internal restructuring, necessitating some degree of diplomacy, but essential if potential impact is to be improved. This clearly requires significant impetus from the laboratory leaders in consultation with staff, but is essential for the future. This also means that certain subjects which may have been considered to be of the highest quality in the past need to be attenuated (or new impetus installed) if no longer competitive to enable these emerging subjects to be adequately Consolidated.

In a similar manner, some degree of inter-laboratory planning was deemed to be necessary as considerable overlap exists between subjects often treated in various laboratories with only minimal staff input. The result is that no real contribution to the overall subject is arising from this dissipated effort, despite the use of an overall high level of human resources at a national level. Although some degree of competition between laboratories is useful to maintain high quality, taken to extreme cases the result is rather disappointing. Some subjects were observed in many of the laboratories visited (a good example is the various aspects of

bioremediation), without any of the teams reaching international levels of excellence. This is clearly undesirable and requires some degree of coordination at a national level if cost-effectiveness is to be attained.

#### **4) Role of small laboratories**

While the panel does not necessarily wish to give the expression that big laboratories are more efficient (indeed, in virtually all the big laboratories visited a number of poor subjects were seen), the role of small units needs some thought. A number of the small laboratories seen during this audit were clearly identified as having high visibility either due to a confined scientific thematic or by careful horizontal development around a specific and well-mastered technology. Many of the others were unable to defend adequately a scientific project. It is clearly in these laboratories that the tendency towards problem solving and thematic dispersion was the most worrying. Such units do not yet possess the necessary critical mass to assume the same function as the larger units. An additional problem was observed in those laboratories whose university structure is limited to the formation of technical personnel. None of these laboratories have the research infrastructure or access to the student resources necessary to attain scientific quality despite in certain cases the identification of individual scientists with good ideas. As the system stands at the moment, these structures are unlikely to achieve in the foreseeable future ratings which will allow them to retain their FCT label and as such their possibility to exist as a research unit is probably compromised. The panel recommends that the more dynamic individuals within such structures be encouraged to affiliate with the larger laboratories whose scientific expertise is coherent with the domain being studied and that some form of association be made possible. Clearly this possibility should be used with discretion as not all the personnel seen in such laboratories can pretend to merit recognition for their research activity and would be best treated on a case by case approach. In some of the bigger centres this should not be a problem and restructuring to incorporate outlying activities would be profitable for both partners.

#### **Overall remarks**

The laboratory infrastructure remains satisfactory with both the necessary apparatus and the dynamic personnel necessary to achieve high level results. Although the technical support remains a problem less emphasis was made concerning this point by the laboratory leaders probably indicating that they no longer believe that this can be solved

via FCT. The gap between the excellent/very good laboratories and the good to poor laboratories is increasing however, making it potentially difficult for younger scientists to immerge if they are not "captured" at an early stage in their careers by the better laboratories. While the panel approves the fact that limited additional financial support is better concentrated in those laboratories best able to exploit this bonus, in the long-term this could have a negative effect. Thus, individual assessment of scientists should enable high quality scientists located in less good laboratories to be identified for specific support. The panel strongly advises that a more effective form of national coordination is necessary to avoid unnecessary dispersion of resources on projects lacking focus or in multiple competitions between laboratories. Portugal might take the Netherlands as a good example of how this type of internal coordination within a relatively small country can optimise resources and lead to an overall level of scientific excellence difficult to better in other European countries. Actually the situation in Portugal is such that most of the laboratories seen have a wide range of subjects making it difficult to associate individual laboratories with specific themes. This is probably due to the close coupling with teaching but is harmful to impact at an international level. It would be important to discourage dispersion of effort and to stimulate the emergence with clearly defined specific fields of scientific excellence. Relatively few laboratories seen during this audit are moving towards this concentration of effectives on a more restrained number of subjects. The current movement at the international level is clearly towards a multidisciplinary systems approach, which is only feasible with good integration of the various disciplines on a restrained number of examples. Some of the research laboratories have initiated this type of approach but this remains relatively rare and needs to extended rapidly to other laboratories having the capacity to undertake such research if the generally high level of competitiveness of Portuguese laboratories is to be maintained. The less demanding role of horizontal dispersion lacking any real multi-disciplinarity is no longer sufficient to maintain international impact and will be a potential limitation in coming years. As mentioned above, scientific strategy requires that laboratories make choices as to which subjects can be adequately defended in the competitive world stage. The absence of choice is not an acceptable option to maintain current ratings. The laboratories who wish to acquire (or to retain) high ratings need to seriously consider this question if current rating criteria (which the panel found to be acceptable) are retained. The panel has confidence in the overall level of scientific quality within Portugal and encourages laboratories to be more ambitious in their future strategies.