Action for "centres of excellence" with a European dimension

I - What are centres of excellence in RTD ?

An intuitive concept that is not easy to define ...

In practically all areas and disciplines, Europe has public or private centres where research and technological development (RTD) is performed at a very high, often world-class level. Intuitively, such "centres of excellence" may be recognised because they comprise and attract excellent researchers and developers, earning a reputation as a significant resource for the progress of science and technology and the spread of innovation. Examples from the USA, such as Stanford University (which produced Silicon Valley), the MIT (with "Route 128" spin-offs), or Princeton University, suffice to demonstrate the role that centres of excellence can play. An outstanding European example is CERN.

The concept of centres of excellence is interpreted and used in many different ways in Europe. A simple definition could be: “A centre of excellence is a structure where RTD is performed of world standard, in terms of measurable scientific production (including training) and/or technological innovation". In any case, it seems possible to list some key features which should be part of the concept:

- a "critical mass" of high level scientists and/or technology developers;
- a well-identified structure (mostly based on existing structures) having its own research agenda;
- capable of integrating connected fields and to associate complementary skills;
- capable of maintaining a high rate of exchange of qualified human resources;
- a dynamic role in the surrounding innovation system (adding value to knowledge);
- high levels of international visibility and scientific and/or industrial connectivity;
- a reasonable stability of funding and operating conditions over time (the basis for investing in people and building partnerships);
- sources of finance which are not dependent over time on public funding.

Centres of excellence in RTD evolve continuously. Together with a well-educated workforce, they are essential for endogenous economic growth as well as to attract private investment; the argument of proximity to excellent research centres is becoming a major element in decisions by multinational companies to locate production sites. RTD activity itself more and more attempts to capture and make best use of frontier knowledge in multidisciplinary dimensions (global change, food safety, learning, ageing, etc). Although physical concentration of excellent researchers is still a key factor in RTD productivity, advanced ICT tools progressively allow effective interaction in networks.

... but typologies and maps help to reflect on the needs and scope for action

There is no typical RTD centre of excellence. Still, the concept may be analysed from the following three angles, corresponding to "RTD", "centre", and "excellence":

Typology of RTD performed:

i) monodisciplinary research: top-level university departments, e.g. the Isaac Newton Institute for Mathematical Sciences in Cambridge, and non-academic research centres (e.g. Institute for Transuranium Elements, Karlsruhe);

ii) broad inter-disciplinary co-operation: e.g. Institut Supérieur des Hautes Etudes in Paris;

iii) research based on major research infrastructures (e.g. CERN), including large "collections" like the planned "Global Biodiversity Information Facility";

iv) industry-academy collaborative RTD, e.g. in Fraunhofer-Gesellschaft institutes;

v) industrial applied RTD: e.g. Philips Research Laboratories in Eindhoven.

Typology of the centre's architecture:

i) single centres: a large university department or institute (e.g. the Institute of Molecular Biology and Biotechnology in Irakleion, the Karolinska medical university in Stockholm), or a major research facility like the ESRF;

ii) networked structures composed of complementary facilities or knowledge centres (e.g. French Genopoles), including "virtual institutes".

Quantification of the degree of excellence:

RTD quality may be measured on various criteria:

– scientific publications ("bibliometry"),
– patents filed,
– post-doc positions offered,
– number of research personnel and visiting scientists,
– number and volume of commercial contracts,
– number of spin-off companies,
– participations in trans-European educational schemes, etc.

Each criterion has its advantages and drawbacks. Most current analyses are based on a single bibliometric criterion for which data are widely available. More balanced analyses may be made by crossing two or more criteria for a well defined area of science and technology. Thus, for the actual identification of centres of excellence, maps or lists are feasible and useful, when interpreted and exploited in the context of specific RTD fields, and taking account of differences in types of RTD activities and organisational architectures.

II - Why is there a need for action in Europe ?

The "critical mass" effect can be used to increase RTD productivity ...

By efficiently "combining" the various knowledge and infrastructure resources spread over Europe, productivity may be significantly increased through the effects of

– increased <u>scale</u> of the RTD effort, in fields where excellent researchers are now confronting the same problems in a dispersed manner (with the additional risk of unnecessary duplication). Scale becomes more and more relevant due to the growing <u>complexity</u> of RTD;

– better exploitation of RTD diversity available across Europe, using complementary sources of knowledge, know-how and facilities. As S&T progress comes to rely more on interdisciplinary approaches, the necessary sources are less and less likely to be found inside one country.

Increased RTD productivity is crucial for the competitiveness of European industry and the solution of other socio-economic problems in Europe. Examples: research on Transmissible Spongiform Encephalopathies, AIDS, but also RTD for future transport systems, earth observation technologies, etc.

... the direct impact of centres of excellence on the private sector and innovation in Europe may be widened ...

A number of national governments try to maximise the impact of existing centres of excellence on the national innovation system by targeting funding schemes to such centres, and by measures aiming at an efficient transfer of know-how and technology. At a European level, however, there is a significant risk that industry and service sectors in one country do not sufficiently exploit such excellent resources present in the other countries to improve their innovation performance. Inversely, national RTD policies and programmes for centres of excellence may not sufficiently take into account the potential for exploitation of the research results in industries located in other EU countries ("mismatch" problem).

Such problems are more than information or awareness issues, and require a clearer view of demand and supply of RTD competence at the level of Europe. Only effective transfer of knowledge can increase levels of science and technology throughout the EU and allow the emergence of new local "niches of excellence". The benefits for the development of private sector investment and increased innovation activity need to be maximised.

Obstacles also exist to the more general spill-over effects of centres of excellence: insufficient mobility of researchers towards centres of excellence and back to other regions; lacking capabilities to use state-of-the-art networking tools, administrative or technical obstacles to the remote use of infrastructures and the construction of distributed databases.

... and indirect effects of identifying RTD excellence at European level may be exploited

Experience shows that significant indirect benefits may be drawn from enhancing the "visibility" of existing centres of excellence in Europe. Due to the fragmentation between countries of RTD itself and of the information/publicity efforts made, the world-wide reputation of a large number of RTD centres in Europe may underrate their actual level of excellence. This directly influences scientists' career choices, leading to "brain-drain" effects away from Europe. It also may have repercussions on the attractiveness of the European Research Area for extra-European researchers and for multinational companies.

Furthermore, a higher visibility of European centres of excellence would allow to strengthen Europe's role in future global science initiatives. This would offer higher chances of realising initiatives corresponding to European priorities and of obtaining a share in the location of future world-level facilities. Finally, a higher visibility towards the general public may help improve the image of science in Europe.

However, existing mechanisms are insufficient

Problems and opportunities as indicated above are of a systemic nature and therefore difficult to tackle without a common European approach. The scientific and political debate is historically fragmented according to national perspectives. Barriers exist to the pooling of resources, leading not only to missed opportunities but also to duplication without "complementarity". None of the organisations created to stimulate RTD in Europe are equipped to support centres of excellence as such. This points to the need for action on a European scale in support of centres of excellence to build upon and complement efforts in Member States.

III - What may be done through a European approach ?

Essentially, Europe needs a larger number of sizeable and well-known centres of RTD excellence with a decisive impact on the innovation system, like the USA examples cited in Part I. Such centres may be either physically concentrated, or networked structures implementing RTD activities in an integrated way.

The process to identify and support "European Centres of Excellence" should allow initiatives coming from the research community or user groupings, as well as priority actions initiated at policy level on the basis of identified weaknesses or opportunities (e.g. for nanotechnology). Analysis methods and concertation mechanisms may be developed for this purpose. In all cases, it will be necessary to clearly delineate the RTD areas concerned and to define the concept of centres of excellence appropriately.

Three parallel lines of action may be discussed:

1. To exploit the potential of the European area so as to maximise visibility effects of European Centres of Excellence world-wide, activities may be developed concerning the mapping of excellence and competence in key S&T areas, and appropriate dissemination to identified audiences (e.g. prizes, high-visibility events).

   Mapping should be applied to RTD fields narrow enough to identify the expertise, i.e. not "Physics". Mapping methods may involve: statistical analysis applied to RTD output indicators (publications, patents registered, ...), nomination by Member States (to provide an initial list of centres to be considered), and analysis by experts working in the field and intensively using the research results.

2. To optimise the Centres' direct impact on the European innovation system, activities may concern:

   – information systems allowing easier access to RTD results produced by European Centres of Excellence, with special attention for SMEs; where appropriate, the selected centres might be asked to sign a "declaration" aiming to ensure access and responsiveness to European society in general;

   – analysis of key RTD areas followed by the creation/reinforcement of specific Europe-wide knowledge and technology transfer mechanisms around the European Centres of Excellence; this may involve concertation of centres of excellence schemes between countries;

– focusing mobility schemes (host and return fellowships) of the EU and Member States on the European Centres of Excellence; at a longer term, action might be taken to value the research work done in such Centres in educational schemes: curricula, European doctorate.

3. To exploit the "critical mass" effect, activities may aim at more, and more productive, centres of excellence in Europe, by drawing together the best available resources. For each key RTD area selected, this may be done in two ways:

- measures may be taken to facilitate the physical concentration in a number of European Centres of Excellence (an appropriate degree of competition should be maintained); the latter may be new, or start from existing national centres; concentration may involve the temporary transfer of human and/or material resources;
- exploiting the potential of advanced ICT, new European Centres of Excellence may be formed as structured "virtual" networks of existing RTD centres. Such structures should achieve close personal interaction and integration of entire sets of RTD activities between dispersed "pockets of excellence" at existing institutions, while being addressable as an organisation. This may be facilitated by general action concerning the construction of appropriate high-performance electronic connections, the development/customisation of RTD collaboration-supporting software, as well as awareness-raising and training of researchers to ensure acceptance and optimal use of the technical possibilities.

A common approach for both types of activities would be based on the principles of

– excellence in RTD;

– open competition between proposals;

– temporary character of public support;

– combination of funding resources (public/private, national/regional/European).

More specific proposals for common action along these lines may be worked out in the coming months.