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Introduction

Many countries in Europe benefit from giving their most promising scientists the opportunity to undergo top-level pre- or post-doctoral training in internationally renowned and prestigious laboratories and research hospitals. It is nevertheless true that for many young scientists obtaining funding may be a daunting task.
For an outsider, the way in which decisions are made by Europe's science funding agencies can seem obscure and complex. As with any form of institutional life viewed from the outside, first impressions may however be misleading.

In this short guide, the combined experience of member organisations of the ESF's Standing Committee for medical sciences (EMRC) from several European countries has been culled to provide a clear and readable account of **how applications are appraised** in research funding procedures and a practical and straightforward **step-by-step guide** for both young scientists and science administrators. Its key points are abridged from an international workshop "Developing Competitive Medical Research Capacity", held under the auspices of the European Science Foundation in Prague, Czech Republic in 1997, attended by representatives from the ESF, the Deutsche Forschungs-gemeinschaft (Germany), the Medical Research Council (United Kingdom), the Danish Medical Research Councils, the Netherlands Organisation for Scientific Research, the Internal Grant Agency of the Czech Ministry of Health and a number of medical researchers from the Czech Republic.

Developed by experienced science administrators familiar with all aspects of how decisions are made in response to grant proposals, it offers straightforward and practical assistance to young scientists who are intending to become independent researchers. It may also be useful for young scientists in other areas of scientific endeavour or for those starting out on a career as science administrators. **Obtaining funding should not be an obstacle to talent.**

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1 Writing a good proposal

Common features

Title

The title is the flag for the proposal. It should be pithy and concise, and express in a line or two the essential goal of the project. It needs to answer the questions: What is the project about? How is it going to be tackled? Remember that the title will be cited in many documents referred to during and after the decision-making procedure.

Abstract

Referees and other assessors (such as the Chairman and members of a Grants Committee) usually read this section first. It needs to capture the **key points** of the project: its objective, methods, setting and rationale. Draft it both for an **expert** in your field (the referee) and also to be comprehensible for a scientist who is not necessarily an expert in your field and may even not be well informed about your specific line of research (a Grants Committee may contain people with widely different areas of expertise). They will want to understand your main objective, what you are going to do, and to be able to form an opinion on why / how your proposal is innovative and important.

Be informative but keep your abstract short. Ask yourself if each phrase is absolutely essential for an understanding of the project.

Tip: Ask a colleague to read the abstract without prior knowledge of its goals and determine whether he or she has grasped the salient points.

Purpose, objectives, hypothesis

Set out your **overall aim,** the problem you wish to solve.

What is the nature of the scientific problem and what is your hypothetical response?

Discuss the pros and cons of your hypothesis.

Is it fully centred on the problem?

Is existing information used to define the problem appropriately?

Is the logic of your project design likely to provide a response to your hypothesis?

Set out the **key objectives** of the project. What are the principal questions that you will attempt to answer?

Tip: Assessors will look for **focus** - the problem should be important but not unrealistically ambitious. Your overall aim should also define the bounds of your project. Do not promise to cure cancer.

Background: project setting and personal achievement

Set out the **rationale:** why is this research project essential? What impact is it likely to have? What would happen if it were not done?

Give a brief account **(review)** to set your proposal in context. Describe how it relates to other work in your field internationally, and set out your own previous contributions to the subject. You should be able to demonstrate that you are **thoroughly familiar** with your given field and able to see the project through. Simply reproducing abstracts from Medline is not adequate. Nor should you show off your knowledge beyond its relevance to your project.

It is important to make a clear distinction between (1) what others have done; (2) what you have done; (3) what your collaborators have done; and (4) what you intend to do.

Tip: Remember that vague, inappropriate or misleading statements are wasted on busy referees and will work against you. They may even be sufficient to rule out the application entirely.

Some organisations require the research description to be presented anonymously (e.g. in Framework Programme 5 of the EU).

In this situation, the instructions for proposers will tell you how to identify your and others' roles in the study.

Study design

Set out your principal and secondary objectives systematically and in detail. Describe your approach to the problem so that the assessor can understand exactly what you intend to do. You may need to explain why you prefer one particular strategy or technique to another. Explain what you will do if an early result is negative.

Give a succinct account of special techniques. If techniques used are already established they do not need to be described in detail, but references should be provided.

Consider the following points if you intend to use new techniques. Are pilot data available? Have you evidence or modelling data that your approach is feasible, e.g. will you be able to recruit enough patients? If your study involves statistical sampling, provide an analysis to justify the sampling strategy and sample sizes (together with estimates of statistical power) and describe the statistical parameters you intend to use.

If your own research team has limited experience in the use of special methods, consider involving external collaborators. Justify any assistance required. Describe whether your intended collaborators will share materials or techniques with you.

It is usually not necessary to provide exhaustive reference lists. Concentrate on key references that show that you are thoroughly familiar with the relevant literature, and that you personally have already made significant contributions to the proposed subject. Highlight your own contributions in the reference list.

Tip: Consider asking an external scientist or expert to screen your study design before you submit it. Such informed criticism may prove very useful.

Remember that assessors will be judging whether (1) the project is worth doing, and (2) whether you or your team are able to carry out the project, and (3) whether the research project is likely to lead to publication in an international peer-reviewed scientific journal.

Funding

Set out not only the required details but also the rationale for the requested financial support. You will need to justify:

personnel: any particular kinds of expertise, individuals, technician grades and other support staff you are likely to need;

equipment: list major items required. Specific items may be determined by the funding agency you apply to.

consumables: these might include travel, training and other costs. Again specific costs may be determined by the funding agency you apply to.

Tip: Because different funding agencies and schemes have different rules about what you may actually apply for, this topic is addressed here in less depth than others. It is however crucial that your requests are well presented and logically consistent. Referees often remove funding for major items of equipment or personnel where a convincing case has not been made. Make sure that you are fully familiar with the funding agency and the scheme, and that the level and type of financial support you request matches the intended research project.

Summary points

- **Informative title**
- **Concise abstract**
- **Logical and attainable objective consistent with stated hypothesis**
- **Lucid rationale and probable outcome**
- **Personal *résumé***
- **Detailed study design**
  - **Principal objective**
  - **Secondary objectives**
  - **Techniques**
  - **Sample size or subjects**
  - **Main outcome measures**
  - **References**
- **Funding and financial aspects**

2 What referees and funders look for

Common principles – different approaches

Evaluation of research proposals by peers **(peer review)** for funding is sometimes called **assessment.** It is also known as ex-ante evaluation and is to be distinguished from the evaluation of projects or programmes after they are completed (ex-post evaluation). Remarks below refer to assessment.

Assessment aims to:

- ensure that the **best quality** science gets funded;
- ensure that proposals are **relevant** to the mission and objectives of the funding agency;
- ensure that research funds are used **cost-effectively.**

Different organisations have different approaches to assessing research proposals. Some put more weight on quality of science, others on relevance. They may differ in how they interpret what is important and in how far they are willing to support high-risk, speculative research. But all agree that funding bad science is a waste of resources.

As demand for funding usually exceeds the supply of funds, choices have to be made. Often a choice is made across widely different kinds of science (physics, biology, biotechnology, clinical medicine, etc.), and different kinds of support (research, training, networks, facilities, buildings, etc.). Assessment systems must be transparent, fair and efficient.

Internationally pre-eminent science is usually easy to identify. It is much more difficult to have to choose ("to fund or not to fund") between projects that are good but not world class (i.e. they would all merit funding were resources unlimited). How do different organisations make choices?

Scientific quality – strategic merit

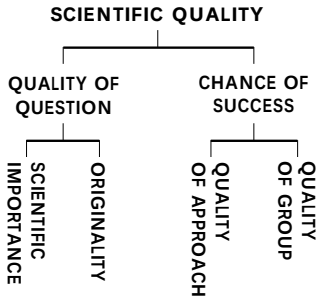
Scientific quality and **strategic merit** are two key terms whose definitions vary depending on how organisations use them and apply them in evaluation. Organisations which fund applied research with short- to medium-term research goals will usually prize relevance to specific practical problems. Many basic science funders do not explicitly apply criteria that recognise "applicability" (likely value of outcome for clinical practice) or "exploitability" (value for industry).

In practice, applying strategic criteria can be difficult. It is not easy to distinguish many aspects of "good scientific strategy" from "good science" or sound management. There is no single proven methodology for making these judgements.

A taxonomy for assessing scientific quality

The information pyramid below (adapted from the Netherlands Organisation for Scientific Research) provides a helpful structure (a taxonomy) for assessing **scientific quality.**

Taxonomy for science-driven Research



Assessment criteria

Past progress

Referees look at two different aspects when examining recent progress in a proposed research topic. The first is the applicant's own past progress in the proposed research topic; the second the applicant's overall knowledge of the recent international developments in this field.

Tip: If a young scientist does not have the age and experience to have acquired a notable scientific track record on a given topic more weight will be given to his/her knowledge, understanding and interpretation of the field.

Scientific quality

Importance and impact

Do the objectives address an important problem or question? If so, how likely is the project to make a significant impact on:

1 scientific knowledge and understanding of normal function or disease, at levels from the molecular to population-based and even including organisations (as in work psychology and health services research);
2 application: in clinical practice and more widely in healthcare;
3 exploitation: by industrial development of new inventions for the development of innovative products and processes.

Sometimes an application is described as **timely,** which suggests it is strategically well placed at that point in time to make a specific impact.

Originality

Originality is an important criterion. Sometimes originality relates to the **question** asked, sometimes to the suggested **approach.**

Approach / design

What are the chances of success? How appropriate and feasible are proposed methods and techniques?

Have key limits to advancement been identified? Have alternative strategies been suggested? In applied projects is there a clear end-point, and are there identifiable “milestones” against which progress can be assessed?

Specific strategic merit

This is more difficult to define. Strategic criteria may change, as an organisation’s priorities change. Generally, strategic merit is related to the specific case: specific contributions should be matched to specific priorities.

Cost-effectiveness

This criterion is essentially an expression of the perceived quality of science and strategic merit versus project cost. Is it possible to obtain greater benefit by investing the same money in a different project?

3 Some insight into the assessment procedure and good reviewing practice

In most European grant agencies the assessment process for research proposals follows basic rules of good reviewing practice. **Procedures can be divided into three steps, an example of which is outlined below, in which the procedure described follows that applied by the Deutsche Forschungsgemeinschaft. It is fully transparent, but is feasible only if scientific office staff and members of the scientific committees implicitly give their full support to the common goal of reaching a high standard of science.**

Tip: Obtain a copy of the mission statement and assessment procedure of the grant agency to which you are applying.

Procedures

I. Submitting your proposal to the grant agency and preparing for the review procedure

Scientific office staff will carefully check the proposal to make sure it contains all the information required and advise the applicant in the event of **formal errors** or **missing information.** Office staff cannot comment, however, on the scientific content of the proposal unless it clearly lacks important information.

II. Good practice in selecting referees

As soon as an application contains all the required basic information, referees are chosen. The number selected may vary from 2 to 4, depending on the scope and scale of the project. In many European grant agencies **scientifically qualified** office staff with a strong research background have the task of selecting referees. Principles of good practice in selecting referees are as follows:

- referees should be acknowledged **experts:** this must be **evidence-based** (e.g. from publications) and expertise should be **up-to-date**;
- expertise should be **relevant** to the proposal;
- referees should be **discriminating** in their judgement (referees for whom every proposal is either good or bad are unhelpful);
- experts previously shown to be **partisan,** i.e. who give advice on the basis of personal considerations rather than a strictly objective assessment of scientific quality, should not be selected for refereeing;
- the **range of expertise** and **number of referees** should reflect the scope and scale of the proposal itself
- the selection process should be **transparent** to the scientific community.

Who should select referees? Confidence that they have been judiciously selected depends on trust and assurance in the selection process. These qualities in turn require transparency, competence and independence.

Independence

Referees are selected by people who have no close personal or professional link with the proposers (i.e. who do

not stand to gain from that relationship). Names of assessors are usually not revealed to proposers.

Competence

Referees are selected by people who know the relevant fields, both nationally and internationally.

Transparency

Applicants have right of access to written reviews of their proposals (which in most agencies are anonymised or even transcribed by the scientific staff (in DFG), the Danish MRC being a notable exception). Peer review procedures and lists of committee members are published.

Some organisations invite applicants to suggest or nominate referees: it is best to suggest someone who is evidently independent of your own team.

These principles are further strengthened by ensuring that no single person or group is in sole control of referee selection. Many agencies employ professionally qualified scientific staff with research experience to manage their business. They select referees from a variety of sources:

- personal knowledge (while avoiding favouritism);
- expert groups elected by their scientific peers (e.g. as in the DFG);
- *ad hoc* advice from committee members and the Chairman;
- suggestions from applicants themselves (e.g. MRC);
- private data bases (most agencies maintain a register of experts which needs to be regularly updated to ensure its accuracy and relevance);
- public data bases (e.g. Medline).

The scientific secretary is accountable to the relevant committee for his/her selection. This ensures that:

- **competence** is verified (both of selected experts and the scientific secretary);
- **transparency** is upheld (the person making the selection and the rationale for selecting are made known, and both can be challenged).

While selection may be delegated entirely to an agency official (scientific secretary) or the committee chairman, involving committee members in the selection procedure is likely to help ensure the confidence of the scientific community in the procedure. A three-stage process with (1) selection by a professional qualified official, (2) verification by the entire committee and (3) scrutiny by the applicant of the referees' opinions (under anonymity) is the best way to obtain maximum trust and confidence.

Referees and committee members are usually explicitly asked to declare any interest they have in any of the proposals, and may have to withdraw from the process. Conflicts of interest may arise where reviewers are (or recently were) from the same research team, department or institution, or are related to the applicant.

III. Reviewing procedure

Peer review is usually a two-stage procedure. Referees are initially consulted to obtain an independent assessment by relevant experts of the scientific quality of a proposal. The referees' statements are considered as **recommendations.** Then a broad-based scientific committee (which may have representations of key user-communities) assesses the relative quality of all proposals in the light of strategic factors.

Selected referees receive proposals by electronic or standard mail. They are expected to review all applications by referring to a set of criteria defined by the grant agency and its bodies. Usually a deadline is given. In some cases, referees may need to question applicants about the scientific content of their proposal or for important information. This is never done directly: questions are relayed to the applicants by the scientific office staff. Responses from the applicants follow the same route. Should referees criticise some aspect of the proposal's scientific approach, the applicant can comment on the criticism. Once again, scientific staff in the grant agency act as a conduit for any exchange of correspondence.

IV. Decision making

Once the grant agency has received all referees' statements and recommendations scientific office staff prepare the proposal for further consideration by the Grants Committee. Either the scientific secretary or a lead committee member may be required to set out the case for funding, or not funding, based on the referees' recommendations. Should this statement differ from the referees' recommendations, a rationale must be provided to the Grants Committee. Examples of reasons for a divergence between these recommendations would include lack of funds, misunderstanding of issues involved by the referees, etc. Referees often take a focused expert view in the context of their own field, whereas the committee has to make comparisons across a range of fields and may be asked to assess strategic merit. The Grants Committee has the final decision in regard to a grant proposal based on the referees' reviews and the funding agency's own considerations. The DFG, like many but not all funders, allows for no right of repeal if a proposal is rejected. However, considerable effort is made to inform the applicant why a particular proposal has been rejected.

Annex

Some scientific councils explained

Research council structures

The section below describes the national role and mission of four major European research organisations and how their scientific councils function in order to meet their objectives (solid peer review in particular):

- Deutsche Forschungsgemeinschaft (DFG)
- Institut National de la Santé et de la Recherche Médicale (INSERM)
- Medical Research Council (UK)
- Council for Medical & Health Research (CMHR) of the Netherlands Organisation for Scientific Research (NWO)

A word on Research Councils in the national context

Research Council organisation reflects how administrative structures and the political environment are organised nationally. Taking medical research as an example, EMRC member and related organisations vary as follows:

- the degree of close supervision or independence from government;
- lines of accountability to government i.e. whether through research ministry or health ministry, or jointly through both; to parliament / assembly; or to scientific community through "stakeholders" (e.g. DFG's "club members") ;
- whether they support medical research through their own intramural research institutes or through grants to university employees, or both.

Deutsche Forschungs-gemeinschaft (DFG)

In Germany, publicly funded basic research enjoys a high degree of independence from government. The Deutsche Forschungsgemeinschaft (DFG) serves all fields of science and the arts, including biomedicine, in universities and publicly funded institutes. Grants to these centres are used to strengthen university research priorities. The DFG does not run "in-house" research institutes. By contrast, the Max-Planck-Gesellschaft (MPG) serves as an umbrella institute for "cutting edge" research where university support is difficult to come by, either because of the cost involved or the amount of multi- and inter-disciplinary activity required.

The DFG can be regarded as a "club" whose members include the universities and MPG. Both organisations are autonomous bodies of the German scientific community and are legally registered bodies. Their funding base is complex, involving the federal government, the governments of the 16 German Länder (regions) and some private funding. Health services and applied clinical research receive direct support from the ministries for education and science, research and technology (BMBF) and health (BMG). DFG, MPG and the various ministries

involved co-ordinate their activities informally through the German Health Research Council (Gesundheits-forschungsrat).

DFG's review procedures are tailored to the particular kind of activity for which funding is sought. Central to the process are specialist committees (e.g. paediatrics or internal medicine), members of which are elected by the scientific community. Their activities usually include assessment of individual grant applications (reviewed in writing by three independent referees), on-site visits to evaluate grants, and evaluation of national priority programmes (involving collaboration between scientists from different institutions). Their recommendations are considered by a central grants committee, which decides on funding. This is competitive, at several levels:

- among proposals in the same specialist field (assessed by a speciality committee);
- among proposals in a wider field, e.g. clinical medicine (several speciality committees form a committee for that field and elect a chairman);
- among proposals from different fields, e.g. mathematics, medicine, engineering or social sciences (assessed by the grants committee).

Considerable weight is given to supporting young scientists. Researchers are entirely responsible for designing their own projects, and no direct influence is exerted by the DFG office or political institutions.

Institut National de la Santé et de la Recherche Médicale (INSERM)

Created in 1964, the French National Institute for Health and Medical Research is a public science and technological organisation. It is overseen and financed by the ministries for research and health. INSERM's mission is to promote health for all. INSERM promotes and funds research across the broad continuum from basic biology and cognitive science to applied medicine and public health, thereby enabling it to improve understanding of human diseases, and to ensure that patients, the clinical community and national and international partners are able to benefit rapidly from the latest research findings.

INSERM supports research primarily through its 275 intramural research laboratories, organised as 250 operative units distributed across the biomedical and public health research spectrum in France. INSERM units bring together teams which work independently of universities, institutes, research centres or other public institutions. Each unit has a mandate for four years, which can be renewed twice. After a maximum of 12 years, the unit is closed.

INSERM's Scientific Council is responsible for examining and proposing future scientific policies. It is also responsible for a second, higher level of research performance

and new proposal evaluation. It relies on the advice of eleven Specialised Scientific Commissions (SSC), one for each main scientific specialisation: these commissions provide the first level of evaluation, i.e. they audit laboratories every four and researchers every two years. New SSC members are selected every four years.
This process allows the bottom-up scientific perspective of the Specialised Scientific Commissions to be combined with the top-down strategic overview of the Scientific Council. It is flexible and allows structures to be reshaped in response to performance and new needs. Mechanisms also exist which allow INSERM to address priority objectives, e.g. recruitment of younger researchers, etc.

Medical Research Council (UK)

The Medical Research Council (MRC) is one of seven UK research councils. These councils are independent of government, but accountable to Parliament through the Office of Science and Technology (OST).
The OST monitors overall strategy and value for money. The MRC supports basic biomedical research and health services and public health research through its own institutes, e.g. like the Max-Planck-Gesellschaft (MPG), and by awarding grants to universities and medical schools (similar to the DFG). Universities receive most of their funding from the Higher Education Funding Councils. This support incorporates a research component. In addition, the National Health Service has its own – more applied – research and development (R&D) programme. There is no equivalent of the German Gesundheits-forschungsrat.

The MRC has written agreements ("concordats") with several government departments, in particular the Department of Health, which define responsibilities and co-ordinating structures. Senior health department (HD) and National Health Service (NHS) officials contribute to MRC's key decision-making and advisory bodies, and there is reciprocal MRC representation on HD and NHS bodies. Senior decision-makers from industry are similarly involved, particularly when developing the Council's research strategy.

The MRC has four thematic research Boards, which assess research proposals based on written advice from referees and on-site visit reports for MRC's own in-house units.
Each has a defined scientific remit: molecular and cellular medicine; physiological medicine and infections; neurosciences and mental health; and health services and public health research. The Boards assess major programmes of research and help to develop scientific strategy. A fifth board, the MRC Advisory Board, acts as the "college" of referees and "virtual committee" members. Specialist committees help to assess

multi- and inter-disciplinary research activities, research training fellowships and some other kinds of awards. The recommendations of these advisory Boards and committees are examined in competition by a single high-level advisory committee, the Awards Advisory Group (AAG). This ensures that the same standards are applied across the Boards and that the Council's published priorities are addressed. Current scientific priorities include (1) post genome research; (2) the health of the public. Policy objectives include (1) establishing talented youngsters in their careers; (2) strategic partnerships with universities; (3) equipment and infrastructure; (4) promoting the innovative aspect of basic research, and (5) multi- and interdisciplinary approaches, especially in cutting-edge or neglected research.

Council for Medical & Health Research (CMHR) of the Netherlands Organisation for Scientific Research (NWO)

In the Netherlands, fundamental and strategic biomedical research is supported through the CMHR of the NWO. The CMHR-NWO is independent of its funding bodies, principally the ministries of education, science and culture, and welfare, health and sports. The CMHR-NWO supports biomedical, clinical, health care and health services research in universities, teaching hospitals and independent institutes. Health Care Research Netherlands (ZON) supports strategic and applied health care and health services research. In 2001, MHRC-NWO and ZON will be integrated into a single organisation.

The CMHR-NWO funds and manages special initiatives separately from its response-mode programme. Key stakeholders in the initiatives, including patient organisations, are represented in the bodies set up to deal with these initiatives. Examples, many of which have dedicated ("ring-fenced") budgets, are nutrition and chronic diseases, addiction research, and innovative drug research.

There are two forms of response mode: **open** and **targeted**. There are four divisions to the open response mode: molecular and cellular medicine and infections, physiological medicine, endocrinology, neurosciences and mental health, and public health research. These divisions are responsible for regularly reviewing scientific developments, providing mid-term evaluation of long-term programmes, and assessing new response-mode proposals.
The targeted response mode addresses predefined issues involving science and society. Funds are derived either from NWO, the government, or from special contracts with industry or charitable foundations, and a programme committee manages each programme.

The Council (of the CMHR) is responsible for initiating and implementing research policy and for resource allocation. Independent experts assess proposals for their scientific quality and relevance. Scientific excellence and relevance are key criteria for initiatives and for targeted response mode.

Conclusion

Organisations have different missions. As a result they also have different structures. DFG is the closest to "science for its own sake." By contrast, the CMHR-NWO caters most for end-users in its special programmes. Biomedical and health research may be integrated as separate components within the full spectrum of "science" – as the term is broadly understood by the ESF – in both DFG and NWO, whereas INSERM and MRC are autonomous bodies primarily focused on biomedicine and health. All four have "multi-layer" evaluation mechanisms that combine expert scientific assessment by peers from the same field, provide a means of ensuring equality of approach to different fields and recognising and acting on new scientific opportunities or tendencies, while redressing gaps in pre-existing research.