

How to write a good grant proposal

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This document is an attempt to collect together a number of suggestions for a good grant proposal. The document is specifically aimed at the staff of the Computer Science Department at Aarhus University, and it is an updated English version of

Ole Lehrmann Madsen and Michael Schwartzbach:
Vejledning i forbindelse med forskningsprojekter (Danish only)

The update is written with heavy influence, copying and pasting from various documents at the home page of

Simon Peyton-Jones - Microsoft Research

where you may find lots of useful information related to generic skills (writing a good grant proposal being one of them).

The document is a part of the general guidelines on writing grant proposals of the Computer Science Department at Aarhus University, which may be found on

How to make a research application

In particular, you will find here a guide to the specific procedures to be followed, when writing a research application as a member of staff from the Computer Science Department. In brief, you must always inform the departmental Research Committee about the application, - and the committee will assign a mentor to your application, providing assistance mainly in writing the scientific parts of your proposal. Secondly, you must always contact the

Research Support Office

providing assistance mainly in the non-scientific parts of your proposal (budgets etc.). Finally, your application must be approved (and most often signed) by the Head of Department before submission.

Approaching a proposal

The first and most obvious thing to do is to select your funding agency carefully. You can get an overview of a large number of funding agencies from the following AU page:

ResearchFunding.Net

In the process of selecting your funding agency, and before you start investing a lot of time in writing an application, we strongly recommend that you contact the our Research Committee (follow instructions on How to make...) for a discussion of your initial ideas and your choice of funding agency.

Some of the most commonly used funding agencies at our Department currently are:

Aarhus University:
AUFF: The Aarhus University Research Foundation

Danish national funding agencies:

- FNU: The Danish Council for Independent Research: Natural Sciences
- FTP: The Danish Council for Independent Research: Technology and Production Sciences
- DSF: The Danish Council for Strategic Research
- RTI: The Danish Council for Technology and Innovation
- DG: The Danish National Research Foundation
- HTF: The Danish National Advanced Technology Foundation

EU funding schemes FP7:

- EUC: Cooperation (Information and Communication Technologies)
- EUI: The European Research Council (Starting, Consolidator, Advanced)
- EUP: Marie Curie Actions

Private funding sources:

- VF: The Villum Foundation
- CF: The Carlsberg Foundation
- GR: Research at Google

However, the range of available funding agencies changes dynamically, and as you will see from the AU overview mentioned above, there are many more funding agencies available for computer science than the few mentioned above. Each of these are described in some detail on ResearchFunding.Net, and they will typically have a detailed guidance (what, how, when, etc.) available on-line. Always start by reading these carefully!

It is important to make sure that there is a good match between your ideas and the funding criteria of the agency. One important initial consideration is to identify the nature of your envisaged research relative to the criteria of agencies. Some often used overall characterisations of research and funding agencies are the following:

Pure, strategic, applied research and development: Roughly, the aim of pure (or basic or fundamental) research is to extend the boundaries of human knowledge without any view to potential applications, the aim of strategic research is to explore the potential for applications, the aim of applied research is to deliver results which may immediately be used in the development of concrete applications. Few computer science projects will fall strictly within any one of these categories, but it may still be useful to structure your ideas along these lines, e.g. to make clear for yourself to what extent you aim at blue sky research or research close to market, or somewhere in between with a short- or a long-term perspective for potential applications.

Science versus technology: Pure research may address science as well as technology. Science is about understanding phenomena in the real world. Technical research (or engineering research) is about moving the boundaries for what is technical possible. Technical research is often confused with practical applications, and of course technical research is closer to applications. Most computer science projects have aspects of science as well as technology, but for the latter it is important to distinguish practical work in construction of e.g. prototypes from the underlying technical principles being addressed in the project.

Exploratory, constructive and empirical research: Another characterisation orthogonal to the above. Exploratory research is aimed at identifying or defining problems, constructive research tests theories and hypotheses and proposes solutions to problems, and empirical research tests the feasibility of solutions based on empirical evidence. Again, many computer science projects will not strictly fall within any one of these categories.

Discipline-oriented versus thematic-oriented agencies: A discipline-oriented agency calls for applications for funding within certain disciplines without any restrictions at all and the main purpose is to obtain new knowledge. A thematic-oriented agency calls for applications addressing specific themes often related to societal challenges. Within such a theme, there are no restrictions on the applications as long as they address the challenges of the theme.

Ideas versus cooperation: Some agencies give high priority to the quality of the underlying research idea (originality, impact, etc.), whereas others give high priority to the quality of the consortium (collaboration, interdisciplinarity, etc.) behind a proposal.

Disciplinary versus Interdisciplinary research: Many agencies pay importance to interdisciplinary research. Interdisciplinary research may involve researchers from areas within the same faculty (like ICT and bio) or areas from different faculties (like ICT and anthropology). When several disciplines are involved it is importance to be explicit about the research dimension of these areas. True interdisciplinary research is more than e.g. applying ICT in a project on energy or applying anthropology in an ICT project. It is neither an interdisciplinary research project if different research groups 'just' work on the project from different perspectives. Interdisciplinarity involves the combining of two or more disciplines into one activity. It is about creating something new by crossing boundaries, and thinking across them.

Project versus centre: Some agencies will in their calls ask for proposals addressing some major grand challenge requiring a long-term investigation with long-term impact involving the set-up of a large team of researchers – often referred to as a centre of excellence. The agency will then give high priority to potential of the team, its internal organization etc.

The man versus the ball. Some agencies give high priority to the qualities of the principal investigator (and possibly his/her team) behind a proposal (*the man*), others give high priority to the qualities of the project proposed (*the ball*).

In the process of selecting your funding agency, you have to be aware of the restrictions and the priorities of agencies.

Case for support

The most substantial part of any grant application is some form of "case for support". It is this case, which will persuade, or fail to persuade, your funding agency of the value of your proposal. The nature of the requirements for this case will vary a lot depending on the specific funding agency.

However, there are two vital facts to bear in mind for (almost) all funding agencies:

- Your case for support will, with luck, be read by one or two experts in your field. But the agency managers and most members of the evaluation panels that judge your proposal against others, won't be experts, and you *must* write your proposal for their benefit too
- Remember that agency managers and panel members see tens or hundreds of cases for support, so you have one minute or less to grab your reader's attention

Based on these facts, here are two Golden Rules:

- *Ask lots of people to help you improve your proposal.* Give it to your co-workers, colleagues working in a different field, your friends, your spouse, your dog, and listen to what they say. If they misunderstand what you were trying to say, don't say "you misunderstood me"; instead rewrite it so it can't be misunderstood. If they don't immediately see the value of what you want to achieve, rewrite it until they do. And so on.

This isn't a big demand to make on someone. Ask them to read your proposal for 10 minutes, and say what they think. Remember, most panel members will probably give it less time than that.

- *Make sure that the first page acts as a stand-alone summary of the entire proposal.* Assume (it's a safe assumption) that many readers will get no further than the first page. So don't fill it up with lots of technical details. Instead, present your whole case: what you want to do, why it's important, why you will succeed, how much it will cost, and so on.

These Golden Rules are so important that our Department not only offers a service, allocating experienced senior staff members as well as experienced grant administrators to act as readers and advisors for your proposal, but actually requires you to use this service!

Criteria for a good grant proposal

Despite their differences most funding agencies apply similar criteria to the evaluation of proposals, and it is vital that you address these criteria directly in your case for support. A proposal, which fails to meet them, will be rejected regardless of the quality of its source.

Major criteria

Here are some major criteria against which your proposal will be judged. They are formulated in terms of questions, which a reviewer is likely to ask himself or herself. Read through your case for support repeatedly, and ask whether the answers to the questions below are clear, even to a non-expert.

- *Does the proposal address a well-formulated problem?*
- *Is it a research problem, or is it just a routine application of known techniques?*
- *Is it an important problem, whose solution will have useful effects?*
- *Do the proposers have a good idea on which to base their work?*
- *Does the proposal explain clearly what work will be done?*
- *Is there evidence that the proposers know about the work that others have done on the problem?*
- *Do the proposers have a good track record, both of doing good research and of publishing it?*
- *Is special funding necessary to solve the problem, or to solve it quickly enough?*
- *Is the project as described feasible, i.e. does the ambition of the project match the resources available (manpower, equipment, time allocated, etc.)?*

Common shortcomings

Here are some of the ways in which proposals often fail to meet these criteria – formulated in terms of typical comments in reviewers' reports.

- *It is not clear what question is being addressed by the proposal.*
- *The question being addressed is woolly or ill-formed.*
- *It is not clear why the question is worth addressing.*
- *The proposal does not fit with the aims of the funding agency.*
- *The proposal is just a routine application of known techniques.*
- *Industry ought to be doing it instead.*
- *There is no evidence that the proposers will succeed where others have failed.*
- *A new idea is claimed, but insufficient technical details of the idea are given for the committee to be able to judge whether it looks promising.*
- *The proposers seem unaware of related research.*
- *The proposed research has already been done - or appears to have been done.*
- *The proposal is badly presented, or incomprehensible to all but an expert in the field.*
- *The proposers seem to be attempting too much for the funding requested and time-scale envisaged.*
- *The proposal is too expensive for the probable gain.*
- *The proposers institution should be funding it.*

Often, panel members can tell from independent knowledge of the proposers or by reading between the lines of the proposal, that the criteria could have been met if a little bit more thought had gone into the proposal. As examples, they may see a clear question being addressed by the research, but the proposers failed to clarify what it was, or they may know that the proposers are aware of related research, but failed to discuss it in the proposal. Unfortunately, there is a limit to which a funding agency can give such cases the benefit of the doubt. It is not fair for referees to overlook shortcomings in proposals of which they have personal knowledge if similar shortcomings are not overlooked in

proposals which they have not encountered before. In any case, proposals which *do* meet the criteria deserve precedence.

Composing a proposal

Based on the criteria and the shortcomings listed above, you may consider the following as good overall starting point for writing *an ideal grant proposal*:

- Here is an important problem (evidence...)
- We have a promising idea (evidence...)
- We are a world-class team (evidence...)
- Here is what we hope to achieve
- Here is how we plan to build on our idea to achieve it
- Here is what we need in terms of funding in order to achieve it (justification...)

However, most funding agencies provide some guidelines and templates for how to compose a proposal, and it is vital that you follow these strictly. The following is a list of elements occurring in many such templates, along with a few concrete suggestions on how to write your application in order to address the criteria mentioned above. A particular funding agency will typically only ask for a subset of the list, but it may be a good idea to go through all the following elements anyway, in order to check that all important aspects have been addressed.

The title

Then choice of a good title for your proposal should not be underestimated. The title should reflect the contents of the proposal as clearly as possible. A short and concise title is to be preferred, but a short title with no contents is useless. Sometimes it may be a good idea to use a short and concise title supplemented by a subtitle. Using a catchy acronym is often also advisable.

The summary

This is probably the most important part of your proposal. Remember that this is typically where you should catch and convince all reviewers (including the non-experts) of the excellence of your proposal. The summary should address briefly all the main aspects of the proposal - motivation, problem, original ideas, methodology, outcome, relevance, etc., but avoid all technical details in the summary.

The aims

Describe and motivate the problem addressed by the proposal, the nature of the expected outcomes and their potential impact. The scientific aims of the proposal is likely to be an important criteria, and you should be honest and make it clear to what extent you expect e.g. a major breakthrough, an important contribution towards a breakthrough, an interesting new result, etc.

It is often advisable to conclude the aims by specifying the success criteria of your proposal, i.e. to make clear (also for yourself) exactly how to judge the success at the end of the project. And in doing so, try to be as concrete as possible in defining such success criteria, and to make it clear how one could measure to what extent the criteria will be met.

For top-down agencies it is, of course, important to make it clear that your aims fall within the theme of the call, or that they address a specific problem referred to in the call.

The idea

The aims of the proposal have to be supplemented by the specific ideas you have in order to achieve the aims. Most often this is formulated in terms of an original approach accompanied by one or more hypotheses arguing for this approach relative to the aims. The nature of the project will often be to investigate these hypotheses (verify or falsify).

The originality of your approach is essential, and you have to convince the reviewers (and yourself) that you are on the one hand truly trying something which has never been done before, and on the other hand that you have some justifiable belief that the approach is feasible and will lead to success.

The proposal must explain the idea in sufficient detail to convince the reader that the idea has some substance, and should explain why there is reason to believe that it is indeed a good idea. It is absolutely not enough merely to identify a wish-list of desirable goals (a very common fault).

Typical examples of bad phrases in this context are "I want to work on..." or "I want to develop a theory of...", whereas a good phrase could be something like "We propose X technology as a novel approach in solving Y, and our hypothesis is..."

The scientific methodology

This is where you describe the scientific methodology you intend to apply in order to investigate your hypotheses, another important part of your proposal. This is probably what you will find an easy part, because it is closest to "what you intend to do" during the project, and hence a common mistake is to focus solely on this element of a proposal. The scientific methodology must be related directly to the other parts of the proposal, in particular how they relate to the proposed approach and hypotheses.

The risk

One could argue that if a proposal has no risks, in the sense that (parts of) it may fail, then it is not a research project. So any good research proposal is to some degree risky, and hence it is often a good idea to make the risks explicit for the reviewers as well as yourself. Examples of such risks could be unexpected difficulty in recruiting researchers with critical expertise, faulty equipment, unexpected falsification of a hypothesis, etc. Needless to say, that it is advisable to have clear plans addressing all the identified risks, and to make these explicit to reviewers as well as yourself.

The workplan

Many agencies request a detailed workplan for your project, with individual work packages and a description (typically a diagram) of their interdependencies, allocation of responsibilities, manpower, time and other resources, and with individual milestones. Even if not requested, it may be advisable to draft a workplan for your project anyway.

The state of the art

This is where you put your proposal in the context of the international state of the art. It is important that you show the reviewers that you are familiar with all existing relevant research, and to explain how your proposal distinguishes itself. It is advisable to be broad in your interpretation of "relevant research", - being too narrow could be interpreted by the reviewers as ignorance on your behalf. In particular, you should make clear how the proposed research distinguishes itself from your own past research.

The relevance

It is increasingly important to argue for the relevance of your proposed research. This can take the form of making it explicit who would be interested in and who would benefit from the outcome of the research. Sometimes it may be advisable to have some external support for the relevance of your proposal.

The impact

Related to the issue of relevance, it may be a good idea to address the potential impact of your proposal, i.e. its short- or long-term potential effect. For computer science proposals, the impact of the proposed research will typically be some potential innovation, but it could also be of a more general societal nature. For some agencies the impact of the proposal on the career of the principal investigator, or the strategic development of the research institution, could also be relevant.

The innovation

For some agencies and proposals it may be advisable or even necessary to address the innovative aspects of a proposal explicitly, i.e. the concrete potential for exploitation of new knowledge in new products or services.

Collaboration

Most research proposals these days involve some form of collaboration among researchers - some funding agencies even require this as an element of proposals. In any collaborative proposal, you should argue carefully why this was chosen, as well as the explicit role of the particular collaborators. Most often collaboration is argued in order to establish the necessary range of expertise for the project, but it could also be aspects of e.g. establishing close links to new international or industrial partners, mobility of researchers, etc.

Industrial partners

In case of collaboration with private companies, you should be aware of a number of special issues. First of all, some agencies will have specific requirements in this respect, ranging from ordinary collaboration, where the companies contribute with research, knowledge, case-studies and so on, to the development of a concrete innovative product for the industrial partner(s).

In all such cases, you should always be aware of and address (as early as possible in the process of writing of a proposal) all questions of intellectual properties (IP), i.e. questions of e.g. copyrights, trademarks, patents, trade secrets etc. And it is highly advisable that you contact the appropriate legal office at your institution to assist in all such matters (in the case of Aarhus University, the appropriate office is the Technology Transfer Office).

Training of young researchers

Many funding agencies require or encourage proposals to include training of new PhD-students or post-docs.

Dissemination

Most funding agencies put more and more emphasis on the dissemination of its funded research, and hence it is increasingly important for research proposals to have a strategy for dissemination. The most common and important form of dissemination is the publication of research papers in international journals, conference proceedings, etc. But particularly large grants (e.g. centres of excellence) are also required to have a strategy for a much wider dissemination also to the public, in the form of newspaper articles, web pages, advisory boards, workshops, public lectures, exhibitions, etc.

The principal investigator

Many funding agencies give high priority to the documented qualifications of the principal investigator, typically in the form of a short or a long cv. And it is highly advisable to spend some time in updating your cv, and to make sure that all the relevant qualifications are documented in the number of pages allowed. Don't oversell yourself ("I am the leader world wide..."), but state modestly but also firmly why you have exactly the right qualifications for leading the proposed project.

Some of the most common relevant qualifications to be covered are

- publications: list of publications, number of publications registered in international databases, most significant papers etc.
- citations: number of citations, h-index. i10-index, etc; it is recommended always to have an updated Google Scholar Citations Profile available
- grants: number and type of grants, amounts granted, etc.
- awards: awards from prestigious societies, elected memberships of prestigious societies, best paper awards from conferences, etc.
- leadership: experience with leadership of research teams, centres of excellence, etc
- training: experience with training of undergraduate students, PhD-students, post-docs, etc
- industry: experience in working in or with private companies
- internationalisation: experience with international formal collaboration, long-term employments abroad, etc.
- academic services: experience with memberships in advisory boards, panels of research funding agencies, editorial boards, conference program committees, etc.

The research team

Sometimes the excellence of the principal investigator needs to be supplemented with some documentation also for other key members of the research team behind the proposal.

The budget

Rules and regulations for composing the budget are often technically complicated and difficult to understand for a common researcher. Hence you should always compose the budget in close collaboration with administrative experts from the university.

Some of the common items in a budget for a research proposal are

- (parts of) your own salary
- salaries and other expenses for senior and junior researchers
- salaries and other expenses for PhD students
- short-term visitors
- traveling
- equipment
- technical and administrative support
- overhead

Always make sure that there is a balance between amount applied for and the promises made in the proposal, and that each item in the budget is clearly and individually justified. Otherwise, your proposal is likely to be rejected, or at best to be granted with a reduced budget. Remember that your proposal will be in tough competition with many other good proposals, and funding agencies are always looking for ways of saving money.

Some final comments

Submission of a proposal is sometimes just the first step in the granting procedures of a funding agency. Some agencies work with two-step application procedure, where all proposals making it in the first round will be asked to submit a second and typically more detailed proposal in a subsequent round. Also, some agencies supplement written proposals by a round of interviewing selected principal investigators. The performance at such an interview is crucial for the agency making its final decisions, and hence it is vital that you prepare yourself extremely well for the occasion. How to perform well at interviews is beyond the scope of this document, but you may find useful advice on the home page of Simon Peyton Jones mentioned above. In brief, the most important pieces of advice are again to follow the two Golden Rules: (1) seek help and rehearse your interview again and again with as many colleagues as possible, and (2) simplify your presentation and your answers.

After having spent a lot of time and effort on writing a good proposal, of course you are convinced that it will be granted. However, always prepare yourself mentally that this will not necessarily be the case. Numerous good proposals worthy of acceptance are rejected every day. When this happens to you, read the reviews carefully, and try to learn as much as possible for your next proposal.

You will also inevitably have a proposal rejected based on what you consider to be a bad and unfair review. When this happens, forget your ego and leave the review for some time before reading it again and reacting. In general the best advice is to respond constructively, and not to start fighting with your reviewers, but instead try to learn even from bad reviews - from the assumption that reviewers are always right (which is actually almost always the case).

Finally, remember that writing a grant proposal is a continuous process and not something, which is done just before deadline. Good researchers will often have a number of half-baked proposals in the oven, continuously working on them. Also, writing grant proposals is not a one-man's job. Seek help in the process from as many colleagues and friends as possible. And conversely, when you are invited to help someone else in writing a proposal, accept the invitation - you may learn a lot from it yourself.