CHARTING A COURSE FOR A SUCCESSFUL RESEARCH CAREER

A Guide for Early Career Researchers
2nd Edition (Updated)

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Published by Elsevier B.V.
First published June 2009, second edition April 2011.
Updated with a new foreword by Olivier Dumon, August 2012

Printed in The Netherlands.

ISBN 978-90-817200-1-4

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FOREWORD

The 21st century is an exciting time to be a researcher. The advances of the past 25 years have opened up extraordinary new vistas of scientific discovery that would have been unimaginable a generation ago. Thanks to the internet, researchers now have easier and quicker access to an unprecedented amount of information from around the world, through online research tools for science discovery, such as Elsevier's ScienceDirect and Scopus. In addition, global communications technology has removed both metaphoric and physical barriers, allowing for real-time collaboration between peers regardless of whether they are sitting across the room or half-way across the world.

But an increased open environment, as well as the rise in developing nations, has also created the most competitive research environment ever known. A higher number of grant applicants are vying for a dwindling pool of funding opportunities with many strings attached to their requirements and expected outcomes. The dichotomy is that researchers have better, broader, and faster access to more information and technology than at any other time in history, yet the funds necessary to tap into these resources and fulfill the full promise of a research career are growing leaner.

Early career researchers full of fresh ideas and perspectives can bring new energy to the research process. However senior researchers, who are finding it necessary to wear multiple hats as they juggle an increasing workload with limited staff and resources, now have less time to guide their novice peers and assemble research teams, potentially impacting development future talent



development. Without essential mentoring, younger researchers are at risk of not securing critical funding they need to publish and contribute to the productivity of their respective institution; a crucial step on the road to success.

Science research is at the core of the global economy. By providing the tools for rising talent to network within their community, publish works and validate results, evaluate the work of others', find funding and potential collaborators, Elsevier provides the conduit that drives the science research process that is helping to solve some of the world's most pressing problems.

The British geneticist J. B. S. Haldane once said: *"We cannot predict the future, but we can invent it"*. Professor Johnson's guide provides the building blocks essential to inventing the futures of the next generation of research talent.

Olivier Dumon
Managing Director, Academic & Government Research Markets, Elsevier

INTRODUCTION

Congratulations!

You have worked hard over the last few years to complete your doctorate (Ph.D. or equivalent such as, for example, the Dr.rer.nat. in the German-speaking community, or D.Phil.) or you are in the process of completing it. You now have the skills, expertise and above all the international recognition to embark on a research career.

Over the last 5 to 10 years, competition for high profile research positions has become much more competitive. Consequently, although there is no substitute for an outstanding research record, as a researcher who is beginning your research career, you must also plan and work on a number of important activities that complement your research record in order to optimise your research career. You need a plan, and this Guide outlines the major points you need to consider to formulate the career plan that is best for you.

Although the Guide speaks to Early Career Researchers (ECRs) it is also very important that senior researchers and senior research managers are aware of the mentoring and assistance that ECRs require these days. So you should either give them a copy of the Guide or pass it on to them, after you've finished reading it.

A Guide about international research mentoring must be very broad, recognising differences among research disciplines, country differences, research type differences, and

organisations. For example, different countries have different forms of doctoral training and there are international differences in the official definition of ECR. Here I do not subscribe to an official definition of an ECR, and use the term Ph.D. for all similar internationally-recognised research training awards. This Guide is written for researchers who are still planning and designing their research career, no matter how long since the award of their Ph.D.

There are of course many and great differences among the different research disciplines. Humanities and creative arts researchers tend to work on their own or in small highly focused groups. They often need fewer physical resources, such as research maintenance funding, than researchers in other discipline areas. At the other end of the spectrum, large biological science groups or physical science research Centres that require large amounts of research funding for both purchase and maintenance of very large research infrastructure, are probably most common.

Similarly, there are numerous differences among the types of research that are done within these research disciplines. The European Union uses the Frascati definition of researchers as *"Professionals engaged in the conception or creation of new knowledge, products, processes and methods and systems, and in the management of the projects concerned."* [1] And research is defined as *"Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications."* [1]

Put simply, research is often divided into the following three broad research types:

1. Pure basic research - experimental and theoretical work often called fundamental or "blue sky" research, "knowledge for knowledge's sake."
2. Strategic basic research - experimental and theoretical, but often undertaken to acquire new knowledge and lead to useful discoveries or solve practical problems.

3. Applied research - original work to perhaps determine new ways of achieving specific objectives or developing new techniques.

And the last major challenge that a relatively small internationally-focused Guide such as this faces is the fact that the different types of research within the different research disciplines are often carried out in different types of organisations. In addition to public and private universities, researchers work in a broad range of non-university institutions such as government research institutes, private research institutes, not-for-profit organisations, medical research institutes and private commercial and industrial research companies.

I accept all these differences and intend this Guide to cover the tens of thousands of researchers who may work in different research disciplines, in different research organisations, and do different types of research, in different countries. So whether you are a physics researcher in a German company, a law researcher in a Brazilian University, or an arts researcher in a Japanese government research Institute, I am sure that you will get enormous benefit from this Guide. And of course, research is an international occupation so that even if today you are a researcher in a national government Institute, next year you may take up a position in a University on the other side of the world. The Ph.D. and equivalents are internationally recognised qualifications. Having the ability to plan for a global research environment is an ideal aim for all ECRs.

CAREER PLANNING

1.

Those of you working in universities also have responsibilities in teaching, community service and internal administration. Researchers in research institutes or those working for commercial companies also have a range of other responsibilities in addition to the research they wish to carry out. Very few researchers, especially at the onset of their career, are able to concentrate solely on their research. There are plenty of other demands on your time in addition to your research but this Guide does not attempt to plan an academic or commercial career in its entirety. It must necessarily focus on the research component of these careers, but does attempt to take the other demands on your time in to consideration.

It's largely up to you to decide how much time and effort to put in to each of these other demands on your time. In fact, because of them, it is probably even more important to include them strategically as you chart your research career.

You need a plan. Stages in the plan may never come to fruition, may change quickly, experience problems or even proceed quicker than originally thought, but all of these can be addressed and the plan revised in order to help you achieve your research goals. Having a plan that needs to be adjusted over time is very much better than not having any plan at all.

Whatever you do, you must make choices about the paths you take made on informed decisions. No longer is it competitive to have a Ph.D. and let your research career “drift” based on what comes along. You must be proactive rather than reactive in how you approach your research career. In fact, even those of you who may decide to focus more on teaching, community service or commercial outcomes in research should also use a plan for those areas as well.

Perhaps the first stage in formulating a plan for your research career is to ask yourself where you want to be in 5, 10 or 15 years. Do you wish to stay in the type of organisation and research area you are in now and advance your activity in this area? Do you wish to gain entry into another type of academic or commercial organisation? Or do you wish to change research fields? These are major decisions. They are within

your control, but only you can decide what you want to do.

Your research plan and your goals need to be optimistic and challenging but they must be realistic too. The research environment is extremely competitive internationally and while success should be attainable by everyone, and certainly having a plan for your research career will bring you closer to your goals and success, it is important that your goals are achievable. The following sections will help you to achieve this balance.

It is not the aim of this Guide to go through all general personnel and management skills but perhaps one skill that should be stressed here is the ability to say “no” when appropriate or necessary. There may well be situations where you should say “yes” to avoid potential negative impacts in the future. However, “yes” does not need to be your standard answer. Again, it is a decision you need to make based on the conditions prevailing at the time. Certainly, a researcher in the academic area receives many requests to serve on internal committees or boards that may advance one's academic career but not necessarily your research career. Though these boards and committees are important in how universities, research institutes and commercial companies conduct their activities, you need to make the decision that being on that board and performing your role to the best of your ability is what you want to do, even if it detracts from your research productivity. If you are more determined to solely focus on your research career then you need to make a decision that you will not accept appointments to these types of boards or committees.

There are various boards and committees that are important to research careers. Being a peer reviewer i.e. membership of a journal editorial board or grant review panel is good for visibility and prestige (to add to your curriculum vitae [CV]). It’s also an excellent learning experience as you critically assess work of others and learn in the process how to structure your own research better, or write a better grant proposal or publication yourself.

Of course, while their research career is important, even outstanding researchers live within a social context and estab-

lishing an appropriate work/life balance is extremely important. Many outstanding researchers are excellent teachers and have busy personal and professional lives in addition to their research careers. This is often brought about as a complement to their increasingly productive research outputs and is probably facilitated by the personal and management skills they have used and honed throughout their research career.

Of course, much depends on your hard work. While work/life balance is important, it is up to you to decide how much time you allocate to each part of your research career. But no matter what type of research you do or for which organisation type, there is really no substitute for focused, well planned, and therefore very efficient, hard work. As will be explained in the following sections, the hard work I am talking about should be in the planning for excellent research, so that when the laboratory experiments, literature analysis or creative work is begun, the amount of effort required is reduced to the appropriate minimum. Perhaps it should be called working "smarter" not "harder." The information in this Guide will help you work smarter.

SELECTING A RESEARCH DISCIPLINE AREA

2.

You have spent 3 or more years often working long days and nights for 6 or 7 days a week in order to ensure the excellence of your Ph.D. You are the world expert in your chosen Ph.D. field of early Babylonian linguistics or the economic history of ukiyo-e Japanese wood block prints. Perhaps you have discovered new theories on galaxy creation in astronomy, or you are the only person in the world that knows the sequence of that specific Severe Acute Respiratory Syndrome (SARS) virus gene. Such research outcomes of your thesis are clearly very important but that is not what a Ph.D. is about. A Ph.D. is a research training degree and in understanding or investigating your specific research area you should have learnt and further developed the research skills, training and expertise to carry out research in a range of similar disciplines.

While Ph.D.s are often very specifically focused, ideally the research produced should be put in an international context. Even very specific local Ph.D. projects should be made worthwhile to at least the discipline specific community to increase its relevance to a broader group besides you, your family, and your Ph.D. supervisor and examiners. This is even more important later in your research career. Within your chosen research discipline, your research should be of interest to the wider research community and it should always be excellent research, which has impact beyond a local interest group. Excellent research should have:

- Well planned and defined hypotheses/aims
- Comprehensive and accurate technical experimentation/ data collection
- Objective data analysis and interpretation
- Innovative new findings widely accepted by at least the discipline-specific research community

While the vast majority of Ph.D. graduates continue their research career in their Ph.D. research subject or discipline area, now is a good time to reflect on whether that's exactly what you want to do.

There are many advantages in continuing your research

career on exactly the same subject as your Ph.D. program. These include the fact that you may have already published from your thesis, you are well-known in this research area, and your supervisor, fellow graduate students and even Ph.D. examiners provide a network that gives you entry to an established research environment.

However, you may have chosen the area for your Ph.D. program based on a number of factors that have now changed or almost certainly will change in the future. Across all disciplines, research is rapidly evolving and changing based on increasing competition, funding levels, importance for society, and national and international popularity. A number of countries are focusing their research areas by such activities as the Research Assessment Exercise (RAE) [the next round to be called the Research Excellence Framework (REF) [2] in the United Kingdom, the Excellence for Research in Australia (ERA) program [3], and Exzellenzinitiative des Bundes in Germany [4]. Although it may not be the major reason for pursuing these initiatives, these national and international programs are affecting how research is being carried out today and will certainly do so in the future.

Will the same opportunities and resources be available to your research discipline area and therefore you, in 5 or 10 years? Whilst you may be very happy with your environment at present, how will your research career be affected by possible changes in the area in the future?

The recent global financial crisis and its significant effects on university funding, especially in the United Kingdom, the United States, and Japan will have very significant effects for some time on research funding levels and also the areas in which funding is likely to be focused.

For example, a recent report by Universities UK [5] stated *"At the same time, university research will more transparently demonstrate its increasing connection with utility, and the way in which economic and social impact derive naturally from mission-led research in all disciplines. There is no stark choice between either academic/discovery research or economic/de-*

velopment research, but a conceptual adjustment is needed to promote the balance and feedback between them. Partnerships will change."

This is not to say that you should immediately and dramatically change your research field or discipline, although there are examples of such extreme situations. I am personally aware of some Ph.D. graduates who completed a Ph.D. in physics after finishing one in mathematics. I completed an M.A. (Hons) in technology and social change and an M.Ed.Mgmt. in educational management and leadership after my Ph.D. in parasite immunology to broaden the social science facets of my research career.

What I am suggesting is that you should at least consider the current circumstances in your research field and try to assess what is likely to happen in this area in the next few years. It may be that you decide, as most ECRs do, to continue and expand on your original Ph.D. research. But it may not be.

Obviously, a dramatic change in your research field may not be appropriate. There are now a number of previously defined and distinct research areas coming together in cross disciplinary ways. Recent Ph.D. graduates who have learned and perfected a range of research skills during their research training Ph.D. program should not be restricted to continuing their thesis work, but can expand their research career into another series of different but related areas.

Whatever you do, it is up to you to make an informed choice. It will be too late in 10 years to say "I wish I had gone into that area rather than this one". Clearly it is not easy to accurately "crystal ball gaze" the specific future of research areas, but one can make reasonably informed judgments based on commercial and policy developments in your country or other countries where you may wish to work in the future. Which research areas are your major national funding agencies exploring? What are your Ministers of Science/Arts/Education stating in their press releases? Where are your country's major commercial companies investing their research funds?

There are numerous differences, such as resources and

time, among research fields that can affect your selection of a productive, enjoyable and rewarding research career. Some research areas are highly popular in the lay community and attract publicity and consequent government and commercial investment. Others are more specifically defined and may not be considered as "hot." Although they may be very well grounded, highly structured and highly regarded research disciplines that have produced outstanding research outcomes over the last few hundred years, they may have "gone out of fashion."

> You can use Scopus to analyse citations for journals and authors, it allows you to gauge the impact of research areas and the influence of authors and journals have on research trends today. Scopus is the abstract and citation database of peer-reviewed literature and web sources with tools to track, analyse and visualise research. www.Scopus.com

Research trends do wax and wane, and can be, perhaps appropriately, focused in some countries more than others. This could provide advantages or disadvantages for you but it does highlight the great diversity of resources among research areas, and how you should be aware of this possibility when planning your career.

Experiments in some areas such as astronomy require enormous infrastructure resources and can take years to complete. Even in biological areas there is significant diversity in timelines. Veterinary science involving large animal field trials or large scale ecology studies can take much more time, possibly even years, than laboratory bench-based molecular biology studies which can be productive in months or even weeks.

Most Ph.D. graduates start their research career in an area that they are interested in and passionate about. This research area will remain their main focus, but their interest and passion may evolve over time beyond their Ph.D. project area.

Obviously, if you are working in a commercial company or government research institute the projects that you are given to

research may have drivers behind them other than your personal interest and passion. This is often balanced by increased relatively easily obtainable internal resources and a more permanent employment situation. Academics in universities do have academic freedom in their choice of a research area, but as mentioned above, academic research is often balanced with teaching and administration duties. These are all very important issues that you need to take into account when strategically planning your research career. As a minimum, try to weigh the advantages and disadvantages of continuing your research career in the same area for perhaps the next 10 or 20 years because it is much easier to make a change now than in 5 or 10 years time.

Perhaps the last major factor of importance in your research career is to consider whether you wish to work in large teams or work more independently. There are advantages and disadvantages to both approaches. It depends on where you do your research, and above all who pays for you and your research. However, if you have the opportunity, you need to seriously consider the size and type of research team with which you work.

There is now detailed research showing that team or large group approaches are becoming almost the norm in science, engineering and technology, but they are also becoming much more common in the humanities and social sciences.

The percentage of single-author publications in astronomy, physics, chemistry and biology has fallen exponentially over the last 40 years [6] as increasingly complex research questions in science have required more multidisciplinary expertise and/or resources applied to find solutions to specific research questions.

For example, many universities world-wide have Climate Change Research Centres, Social Policy Institutes, Cancer Research Centres and Centres for Agricultural Innovation, on the understanding that such large research questions demand the input of researchers from many different research disciplines.

This move to the formation of research groups and the increasing size of research groups is widely known and accepted in science. However it has also been occurring in mathematics,

economics and sociology. Perhaps even more surprisingly, the growth rates of social sciences and arts and humanities team sizes have been almost as large as those in science and engineering research [7]. The formation of larger teams in research disciplines as diverse as social psychology, economics, ecology and astronomy evolves with time, probably up to an optimal size [8]. There are now major areas of international research in to what, why and how research teams form and evolve [9,10] and tools are being developed to analyse scholarly networks [11].

For example, there are certainly good general arguments concerning research and scale – *"First the intellectual environment created; second the per capita marginal costs of research administration and support personnel; third, the cost of major equipment and facilities; fourth, synergy and overall acceleration; and fifth, the supportive research training environment"* [12]. However, as recorded by an analysis for Universities UK [13], *"Size alone is not a barrier to performance and there is no universal pattern in our data that links better research with bigger units. Big units on average carry out better research than smaller units, but the average for small units includes some that perform at a standard comparable with the largest. –– There is no general evidence to support the widely held supposition that bigger units necessarily do better research." "There may be an optimal size for research units at the level of teams and an optimal group size around 5 – 8 may be common. This optimal group size appears to hold for a very wide range of information processing systems"* [14,15].

However, establishing the structure and organisation of a research team, though challenging and highly worthwhile, will still depend largely on the people and processes used within the structures to produce the research results [16].

This Guide does not have the space to go in to the sociology of research team formation or function. It is mentioned here only to highlight the fact that nowadays, no matter which area of internationally competitive research you work in, or where, it is very likely that you will need to consider your role and position on such a team, if you do choose to belong to one. It is another major

decision you need to make when planning your research career.

And we should also bear in mind that not all great research is done by large teams. Many of the extremely socially and economically productive web based "spin off" companies were developed by a handful of researchers, some whom had not even graduated at the time of their inventions. Also, *"size isn't quite as essential for many innovative activities as it is often portrayed. Internationally, it remains true that most Nobel prizes go to researchers for work done in laboratories about the size of a small extended family – say, six to a dozen people. And many of the most interesting and globally successful technology companies have started out with a mere handful of staff. Fortunately, in the creation of ideas, being clever still counts for more than being big."* [17]

Each government or industry research team and university research centre or institute has a Director or Head. Whether it is this person, or a research team leader who reports to the Director or Head, you will have a research Supervisor. You need to give significant thought to which team you join, and how it's Head, who will be your research Supervisor, may affect your research career.

Supervisors may not all be "super" but they should at least, based on their own personal experience and expertise, wisely "advise."

SELECTING A SUPERVISOR

3.

Your Ph.D. has been a research training degree, and to some extent you have undergone an apprenticeship in learning and improving your skills in carrying out research. However, even after you are appointed to your first position as a postdoctoral researcher, as a researcher in a research organisation or as a junior Lecturer/Assistant Professor you are still very much considered to be an apprentice. This applies no matter what the research discipline area you work in, although there are subtle differences in this among the various disciplines.

My comments so far have been about choosing your research discipline, research area and whether to join a large team or conduct research more independently. However, a major factor, and perhaps the prime factor to consider in planning your research career, is selecting your research Supervisor.

Your Supervisor could be your Ph.D. Supervisor, and often is. Your Ph.D. Supervisor has worked with you for a number of years. You have developed a successful working research relationship, as demonstrated by the fact that you were, or are about to soon be, awarded your Ph.D. You may have published and presented at conferences together and a mutual respect has developed between you. When your Ph.D. Supervisor either gets commercial funding for a new position or perhaps gets a research funding agency grant, you are well-prepared both personally and research-wise to fit into their program quickly and easily. This of course also indicates that you have decided to continue your research career in the same area that you did your Ph.D. in or some similar area since they are both supervised by your Ph.D. Supervisor.

However, it is often the case that some Ph.D. Supervisors, especially the more successful ones, have more students than they can accept for paid research positions. Many Ph.D. Supervisors like to see their Ph.D. students move organisations and to take up postdoctoral positions in high profile organisations or universities overseas.

Perhaps in considering a Research Supervisor you should consider what Robert Merton identified as the “Matthew Effect” in as early as 1968 [18]. It is the phenomenon that fame

breeds fame, that cited papers often get cited more often, and that influential authors gain more influence. This phenomenon has been tested across many different disciplines using a number of different parameters to measure success in research such as citations to publications [19,20], quality and number of publications and research funding success [21,22]. Applied mathematicians or engineers would consider the Matthew effect as a positive feedback effect and if you can get in to a position where your Supervisor is someone who is internationally highly recognised, then the benefits of the Matthew effect are likely to be positive for you and your research career. Although there is never any substitute for research excellence, the understanding of some of these sociological aspects of research can be a major benefit to your career.

However, as Tol [23] suggests *"The results confirm that it is a hard journey from being an unknown upstart to a famous economist. Famous elders hog the limelight, and their share of the attention is only partly due to superior quality; some are rather famous for being famous. However, it is not uphill all the way; it is uphill only for most of the way. At a certain point, one crosses the threshold and is then propelled to fame."*

As an Executive Director of the Australian Research Council (ARC) and more recently as the Managing Director of Research Management Services International, I have worked with a number of international grant funding agencies and liaised with numerous high profile internationally recognised researchers. Tol's comment regarding elders hogging the limelight is unfortunately not as rare as one might think and so the personality and style of your proposed research Supervisor certainly needs to be given much consideration.

Some elder researchers push their younger researchers very strongly, which helps the ECR's career substantially. Other Supervisors may use their ECRs to increase their own profile often in a symbiotic way, but unfortunately occasionally to the detriment of the ECR's career.

If possible you need to find out about your potential Supervisor's training profile. Perhaps the clearest and most obvi-

ous way to do this is at interview or while talking with them and raising the issue in a sensitive and appropriate way. “I am keen to build a high quality research career from my working relationship with you. Could you please describe your supervision and personnel management style, to help me optimise our working relationship.” If asked appropriately and at the right time it is a question that a reasonable Supervisor should be happy to hear and can reasonably answer. A good potential Supervisor should be appreciative of the fact that you are thinking about these wider aspects of your research career and see it as being a positive indication of your desire to do well.

In addition, you can see potential supervisors in action during conferences or other international forums either personally and directly by attendance at those forums or indirectly via feedback from people who attended the conference and listened to them.

Your Ph.D. Supervisor may also know personally or indirectly your potential new Supervisor and be able to give advice on your future career plans. It is also theoretically possible to seek comments from other ECRs already working with the potential Supervisor, and perhaps even better, from those who might have left and moved on from working with the Supervisor. Clearly this must be done sensitively, cautiously and in an appropriate way. I am certainly not suggesting that if a high quality, high profile position is offered to you that you make indiscrete or inappropriate attempts to investigate the personnel style of the potential Supervisor. However, it is certainly something that you should attempt to gain some general information on or at least consider. While it may be a high profile position, a strained relationship with your Supervisor is not likely to let you excel in that position despite your high quality hard work that you may put in to it.

In this case perhaps you might be better off in a team, organisation or university department where you can, by your own hard work and high quality achievements excel without having personnel relationship problems and baggage to overcome.

In addition, although the vast majority of research Supervisors are ethically above reproach, there are unfortunately too

often cases of high profile research fraud [24,25,26,27]. Appropriate enquiry in to the research team, organisation or University department you are planning to tie your research career to will be worth the effort.

What I am suggesting is that you perform due diligence on jobs for which you apply, and not necessarily take the first job offered to you. You must be proactive in seeking a job and not reactive. This also gets back to the question of whether you prefer to work by yourself in your own research area with more freedom in your academic pursuits or join a larger team and be more likely subject to directed collaborations and team procedures and policies.

A Mentor would be an ideal person to advise you on this.

SELECTING A MENTOR

4.

A good Mentor who is prepared to give free and open but critical advice on your research career is invaluable. They are rare so not every outstanding researcher has reached their high level of achievement with the help of a Mentor. However, if you are able to gain the support and commitment of a Mentor it is highly likely that your research career will be more effective and reach greater heights than if you do not have one.

There are mentoring organisations in some countries that work on a fee-for-service basis, and while these may be effective for short term advice, they are not ideal for a longer term relationship.

It is theoretically possible that your research Supervisor could be your Mentor. It is unlikely though, and there are a number of reasons why this is not a good idea. Your research Supervisor, who is intricately involved in the productivity and outcomes of your research, may not be able to provide you unbiased advice that is best for you personally as it may not be optimal for your joint research outcomes. The best Mentor is someone who may not even be in the same research discipline or even the same department or organisation. They do not need to have experience in your specific research discipline, just a general understanding of the broader research environment, as they need to be able to give general personal career advice.

Of course, a Mentor can only give you advice and suggestions. The path you eventually take is up to you. However, a person who knows you, but is not directly involved in your research can raise comments or suggestions that you may not think of because of your closeness to the work.

The most important factor in identifying a Mentor is that they are able to, and will, provide essential critical comment. You and they must have a mutual respect so that they can advise or suggest to you that you may be wrong or your ideas or focus may be incorrect. Your Mentor may suggest that you need to find another job, that you should be establishing a better work/life balance, or that your research Supervisor could be giving you more research freedom or support.

This is perhaps why finding a good Mentor is so difficult. There are no obvious reasons for your Mentor to spend time and effort with you and perhaps provide advice that is not consistent with a continuing uneventful but not especially productive job. What do they get out of it? In the short term, most mentors really do not receive much in the way of incentives for their time and effort. But elders who have made significant achievements over their career, often with the help of their own Mentors, may be happy to act as Mentors for a small number of ECRs.

It is not essential that you find one, but should the opportunity arise, I strongly suggest that you do spend some time trying to find an appropriate Mentor. I think their input and how you use it will substantially assist your research career.

RESEARCH COLLABORATION

5.

Research collaboration is an essential part of networking. It is so important that I am devoting this section to it and covering the rest of networking in the following section.

Collaboration is a major component of most research productivity. However, it is essential that you collaborate because you have decided that you want to do it and that you have calculated that the advantages outweigh the potential disadvantages. You must ask yourself why you want to undertake this particular research collaboration and be specific about the aims, process, timelines and common objectives. If you are not going to get sufficient advantage out of it, do not undertake it, as there will be many more opportunities for positive research collaboration throughout your research career. It is much better to be involved in a few very positive collaborations than a large number of ones that are of little value and could even be detrimental to your career.

There are a number of very good reasons for considering research collaboration. It may provide you access to new tools, information, and skills and it may give you an international perspective that may take years for you to develop working on your own.

> You can use SciVal Experts to identify potential collaborators and new relationships. The tool also allows you to find information about where authors have published and the grants they have received. www.SciVal.com/Experts

You may need expertise to complement your own skills. Do you need a Spanish speaker to work with you on your research on the economic history of Cuban cigars? Do you require the gift of a monoclonal antibody to a specific cancer you are trying to cure. Would you benefit from the input of an architect on your studies on the social culture of Mayan temple use?

Research collaborations may also assist you in extending your research into other research discipline areas as de-

scribed in an earlier section. Collaboration with an individual or a group of international renown will certainly raise your profile both nationally and internationally. Mutual research collaboration could create synergies for you and your collaborators, thereby exponentially increasing the research outputs of both groups.

If it is potentially so valuable to collaborate in your research, then why am I suggesting that it requires serious analysis before you commit to it or undertake it? Of course, much depends on whether you initiated the collaboration, or whether the potential collaborator approached you because of your skills and expertise. Will it be a mutually beneficial collaboration or will you and your work be taken over and subsumed?

As an ECR you are still presumably working in a relatively small group or team or even with just yourself and your research Supervisor. Either way, you may be the first author on a two author paper or the second author of a two author paper if your student is the first author.

Author order in such cases is relatively uncomplicated [28]. The importance given to the order of placement of authors in publications is crucial in many areas of research, especially science, engineering and technology [29,30], although author order concerns are not unique to the sciences [31]. Determining who should be listed as an author on a publication, and in what order they should be listed, can be problematic. What many researchers often don't realise is that there are internationally accepted protocols *already in place* to determine who should be credited as an author. These are called the *Vancouver Protocols* [32] and recommend that authorship credit should be based on (1) substantial contributions to conception and design, acquisition of data, or analysis of and interpretation of data; (2) drafting the article or revising it critically for important intellectual content; (3) final approval of the version to be published. Authors should meet conditions 1, 2 and 3. The Authorder process builds on these protocols and is a simple tool that can be used by anyone to allocate author order. Authorder provides a rational and accountable framework for assisting

co-authors determine author order, and is freely available [33].

The success of your future career path may depend on, or at least be significantly influenced by, your authorship placement in your first half dozen publications. If you undertake a research collaboration involving more people, then you may become the fourth author on a six author paper. In national and international assessment exercises such as the REF, ERA, and New Zealand Performance Based Research Fund, the placing of authors in a list of those contributing to a publication is given very strong consideration. Similarly, author order is given very serious weight when you apply for research grant funding in your own right. It is difficult to claim accurately and legitimately that the bulk of the research in a publication is yours if you are in the middle of six authors, even if you were responsible for most of the work.

The decision you need to make, and be happy with, is whether to try to maintain your high profile in a small group or play a lesser role in a larger research collaboration. Obviously if you are approached to collaborate because of your skills and expertise, then the potential for you to be the first author in the publications of a much larger group should be considered, and will be much more worthwhile for you.

However, whatever you do with respect to research collaboration, it is essential that such things as authorship, ownership of intellectual property, presentation at conferences etc are established and agreed upon **before** the work commences. While this might sound overly officious and you may be worried that your international high profile collaborators may not be happy with such detailed arrangements, I believe that productive research collaborators will appreciate the fact that you are just ensuring, as much as possible, that the research productivity of the collaboration is going to be optimal for all involved.

If you are an ECR employed as a postdoctoral fellow or in a commercial industry organisation, you will need approval and advice from your research Supervisor or industry team leader before either approaching a potential research collaborator or agreeing to work with one that has approached you. What role,

if any, will your Supervisor play in the collaboration? Is your Supervisor and organisation happy for you to provide potentially very academically or financially valuable information to people outside your organisation? What sort of official paperwork, such as a Materials Transfer Agreement or Confidentiality Agreement, does your organisation require before you can pursue a research collaboration?

In addition, if you are approached to participate in a research collaboration then you should certainly apply the issues raised earlier regarding seeking a research Supervisor with respect to potential research collaborators. What is their background? How do they carry out their research processes, and will it be beneficial or even possible for you to work collaboratively with them?

Many research collaborations are extremely productive for all involved, and last for extended periods. Other collaborations may be of a more defined nature with shorter time frames and may involve the donation of laboratory reagents or translation of social texts. Healthy productive research collaborations may wax and wane so whatever collaboration you enter into during your research career, it is essential that you have strategically thought through the overall benefits to your career.

Networking on the other hand, is something that usually lasts much longer and is much less tangible, but is also essential for your career.

NETWORKING

6.

I don't think it's possible to overstate the value of a productive and worthwhile network to an ECR. I have mentioned four major network participants already, your Ph.D. Supervisor, your research Supervisor, research collaborators and your Mentor. There are also many others who you will benefit from and you will give value to, by being part of your network.

It is important to establish a strong and worthwhile network early, as it will certainly assist your research career. It is not important to have a very large network, as a few stronger but perhaps smaller networks will be much more worthwhile than numerous weak networks or a very large weak one. In addition to the four categories of people mentioned above, members of your network may include Ph.D. students you have worked with while completing your thesis, your Ph.D. examiners, members of professional societies you work with, fellow conference attendees you may establish a rapport with, people in your immediate research teams or in your wider organisation, staff of your organisation's library or research office, or the editors of journals you may send papers to on a continuing basis. In short, it can be anyone who is significantly interested in or can be of benefit to your research career.

While this Guide is all about strategic planning, often networks cannot be planned. However, when the opportunity arises, I suggest you consider with whom you wish to network. There are a number of tools available such as, LinkedIn, Facebook, Twitter, Myspace, Plaxo and YouTube to facilitate this. Usually, a network evolves naturally over time as your Mentor, research Supervisor, and collaborators introduce you to other potential network members.

Depending on their position they may be of significant benefit to you now, or later in your career. For example, you may need tangible direct assistance such as references for another position or a Fellowship, and your network can be of great value indirectly by "singing the praises of you and your work" to others. There is certainly nothing like establishing the high quality of your international research by publishing in the most prestigious journals and presenting at the highest level

conferences. But it can take time to reach these achievements so even then the impact of having others spreading the word on how good you and your research are cannot be overstated. This is not a bad thing and will certainly facilitate your research career.

I would not like to give the impression that the only reason for establishing a strong network is to benefit your own career, although this should naturally be one of the major outcomes of being part of a strong network. You have skills, advice and expertise to contribute to others in your network and as you advance and mature in your research career you will be able to provide more input to others. Networking should be a fair give and take process. In the earlier stages of your research career you may need to take more than you give, but this will probably be reversed as your career progresses. So it all evens out and is quite fair and reasonable in the end.

ETHICS AND RESEARCH INTEGRITY

7.

The giving and taking of research expertise and skills as part of your network over time could be seen to be a reasonable approach to research ethics. Research ethics are an essential part of your research career and one I will not dwell on greatly here because the highest standards of research ethics are a given. The research you carry out must be honest, accurate and ethical.

In particular, there have been many national and some international initiatives to ensure that research carried out is of the highest ethical standards. Many countries now have national policies and procedures to ensure research ethics, and recently an international initiative called the "Singapore Statement on Research Integrity" has been developed as part of the 2nd World Conference on Research Integrity, 21-24 July 2010 [34]. It has four principles:

1. *Honesty* in all aspects of research,
2. *Accountability* in the conduct of research,
3. *Professional courtesy and fairness* in working with others, and
4. *Good stewardship* of research on behalf of others.

The Statement also has 14 Responsibilities, and although it is not a regulatory document and does not represent the official policies of the countries and organisations that funded and/or participated in the Conference, these guiding principles do provide an excellent overview of the area.

In addition to what I have termed research ethics and integrity, there are several other facets to ethics which you may need to consider during your research career. I will term these animal, human, and bio/radiological ethics.

There have been enormous advances in animal ethics over the last few years and a policy of "Reduce, Replace and Refine" is one that is widely used and promoted. It is not the role of this guide to comment on the need for the use of animals in research. However, if you and your fellow researchers have determined that the appropriate use of animals is essential for your research then it is absolutely essential that you follow your or-

ganisation's rules and policies for it. Research must never start until it has been accepted and approved by your organisation's animal ethics committee. This is despite the fact that there is often a very large amount of paperwork to do in order to receive ethics approval. It is essential that this is done, not only to ensure minimal or no adverse effects for the animals, but also that you stay within the legal requirements for such research.

Animal ethics committees often require voluminous amounts of documentation and this should be seen as what it is, necessary planning to ensure that the project to be carried out is appropriate. The animal ethics committee is not there to get in your way, but to almost act as a broker for you and your research, ensuring the best for the animals and for you.

Similarly, human ethics committees have become a very essential part of not only biological and medical research, but also much social science research. It is essential that the rights and privacy of all human participants in any research you may carry out are protected and your organisation's human ethics committee will assist you in ensuring that this happens. Even procedures as potentially innocuous as telephone interviews may have significant impacts on human ethics and thus they require approval.

The last facet of ethics I will discuss is what I call the bio/radiological aspects. While it may only apply to a very small percentage of researchers, this is extremely important and these days it even attracts security oversight. It is therefore essential, once again, that before you even think about commencing any research in these areas, you have the approval of your organisation's appropriate committees, which may even involve them requiring national approval.

While the approach to these three different facets of ethics may have different emphases from country to country, with some countries focusing more on one or two components than other countries, you must conform to the rules and regulations applicable to your organisation at the time.

Should a question ever arise about any aspect of your research, your animal, human or bio/radiological ethics

committee(s) which have approved your research, may well become your best friend. It is up to you to ensure that you have their approval and that your research conforms to what they have approved.

This is the "right" thing to do for many ethical and social reasons and it makes good sense to plan and carry out your research in this way.

CHOOSING YOUR PUBLICATION'S STYLE AND FORMAT

8.

You should never undertake a piece of research just to have it published in a particular specific format, but there is much to be said for identifying a format for publication of the research output early on, or even before the work begins.

Publication of your research is essential, whichever format you choose. If you do not publish your research outcomes no one will ever know of its existence. Producing publications is not easy and it is not in fact research but it is essential to your research effort, as future grants, promotion, and other job opportunities will depend upon the substantial high-quality research outputs documented in your CV. Unless you have documentation of the acceptance of your research outputs by your peers, then you will be unable to prove to potential grant funders, promotion panels or new employers just how good your research output is, or indeed, even if you have been productive at all.

Each major research discipline group is usually identified more with a particular format for publication. Humanities and social science researchers tend to focus on books or other monographs. Science, engineering and technology researchers focus on publishing in journals. Computing science and information technology researchers see electronic publication or conference presentation as being important formats in which to publish their research. Performance artists such as musicians, painters and sculptors have their pieces of art as their publication, but even then it should be documented in some format such as the exhibitions where it is presented or other permanently documented ways to identify to your peers the impact of the research behind the work.

Another section will describe in more detail the factors you need to consider in publishing your research in journals, but in this section I am urging you to consider what style and format to publish in. For example, whether it is a book, monograph, journal or electronic publication, or a conference presentation, will you publish in English or in your own national language? English is becoming much more readily accepted as the international language of research publication, and the

disadvantages of publishing in languages other than English in journals are well-known [35,36,37,38]. However, there may be reasons why you wish to have your research recognised by your national peers, which may require you to publish in your own language in a local format.

There are advantages and disadvantages in publishing in international formats in English compared with national formats in your own language. However, whichever format and language you choose to publish your research in, it should be a decision that you have worked through. It may be that sometimes you publish in an international English format and other times in a national local language format. Often you might begin your research career by publishing in local language national formats and expanding to international publications in English later when your career has evolved. The decision is yours, informed by your research Supervisor, colleagues in each piece of research and possibly your Mentor.

Parallel to your decision to try to publish locally or internationally is whether to publish with an international publisher of journals and books or with a local potentially lesser known publisher. These sorts of decisions are often based on the quality of the work you have done and on your research discipline area. However, a major question in publishing you research outcomes is whether to try to publish a small amount of possibly lower impact work sooner (see below regarding the Least Publishable Unit [LPU]) or whether you carry out additional research so that you can publish a more major higher impact study later.

There are numerous advantages and disadvantages to both of these options, and you may alternate between these strategies depending on the circumstance prevailing at the time. Are you trying to complete and publish some work before submission of your Ph.D. or before the end of your current post-doc? Are your research colleagues and Supervisor suggesting that you complete additional work before publishing? Does your Mentor believe that you should spend time writing a book rather than trying to publish a few journal articles? It

is up to you to decide on how you commit your most valuable resources, your time and effort.

In many of the workshops I give to ECRs I am often asked the question "should I aim for quality or quantity in my publications" and my answer is always the same – "yes, you should aim for lots of good quality publications". Ideally your research career should be producing a large number of high quality publications. Clearly this is not easy and takes a substantial amount of hard work. As suggested above, you may be forced to consider an LPU (a publication that contains the minimal amount of research to just be accepted by an internationally refereed journal), or worse, a "salami"-like publication ("salami" publications are those where a piece of research is "sliced up" to give a larger number of publications whereas a smaller number of higher quality publications would be possible [39]). Consider these for only real and justified reasons. In other cases, you may be able to publish your work from an extended very large high profile research project. It's all up to you. However, as your current long-distance, remote virtual Mentor, I should point out that the current REF and ERA-type assessments, tend to focus on an identified selected small number of your publications in order to assess your productivity. This practice, which is also often used by appointment or promotion panels, is likely to easily identify the chronic production of "salami" publications [40].

Consequently, my strong advice to you is to always aim for quality whenever possible if you have to make a choice between the quality and quantity of your publications. One can often measure the high profile of a research group by the work that they choose not to publish (e.g. LPUs and "salami" publications), rather than the work that they do publish. Quality is always of prime importance, and it is being focused on more and more. Although the definition of quality is open to debate, there are increasing attempts to rank various types of publications. For example, in information and computing technology areas, the COmputing REsearch and Education Association of Australasia (CORE) [41] an association of university depart-

ments of computer science in Australia and New Zealand has a four tier ranking of about 1,400 information and communication technology conferences in 2008. These rankings were incorporated in to the Excellence in Research Australia exercise recently finalised for 2010. CORE is taking the opportunity to refine its metrics and update processes for conference rankings and these will be published on their website when available. Humanities researchers are planning to rank book-form publications and non-traditional publication formats for 15 areas of humanities as part of the European Reference Index for the Humanities (ERIH) project initially jointly sponsored by the European Science Foundation and the European Commission [42]. The aim of the ERIH is to enhance the global visibility of high-quality research in the Humanities across all of Europe. In the next phase of ERIH's work, it is intended to include monographs and edited volumes. The revised ERIH list is expected in the first quarter of 2011.

Having taken all these points on different publication formats into consideration, journal publication is certainly the most recognised format. To which journal should you submit your high profile research outputs for publication?

WHERE TO PUBLISH

9.

Having made the decision to publish the outputs of your research program in an internationally peer-reviewed English-language journal, there are a number of factors that you should consider before even starting to write a paper for submission.

Perhaps one of your major considerations is whether to send your paper to an open access journal or a journal published by a traditional subscription based publisher. Open access journals have become very popular over the last few years, especially with the advent and global spread of the World Wide Web. They offer the advantage of relatively easy access to potential readers for free. This has gained the support of a number of international funding agencies which have mandated or at least recommend that you make all publications arising from work funded by them available in an open format. Such papers are accessed more than papers published in traditional journals, but it is possible that some authors submit their most popular articles for online presentation [43]. Also, although open access publishing may reach more readers, there is no evidence to suggest that they are more highly selected for citation than subscription access publishing [44,45]. Another potential disadvantage is that you will be responsible for paying for open access publication which would be a charge to your personal research funding. In addition, some subscription publishers are now making their publications open after a period of time or are providing other services to allow free access [46].

There is a very strong continuing debate on the merits of open access publication over traditional subscription based publication with respect to the citations that both types attract. A major reason to publish the results of your excellent research is to have your peers accept and use them, and citations are a major way to measure this. Consequently, there is much debate on this, and the OpCit (Open Citation Project) is a major bibliography on this debate [47]. The OpCit project was funded by the Joint NSF-Joint Information Systems Committee International Digital Libraries Research Programme. It contains the Abstracts of dozens of papers published on the sub-

ject of citations to open access publications and comments by individuals to each of the publications. Accessed on 18 March 2011, portions of three of the latest additions to the OpCit literature probably summarise the debate to date;

"—This study discovers that: there exists citation advantage for open access articles, in this case 138.87% higher over non-open access ones: different subjects have different citation advantage for open access, and Humanities journals in Oxford Open have even a negative citation advantage for open access; Oxford Open Journals with lower impact factors have stronger citation advantage than those with higher impact factors" [48];

"The results of this experiment suggest that providing free access to the scientific literature may increase readership (as measured by article downloads) and reach a larger potential audience (as measured by unique visitors), but have no effect on article citations." [49]; and

"The open access advantage is real, independent and causal, but skewed. Its size is indeed correlated with quality, just as citations themselves are (the top 20% of articles receive about 80% of all citations). – The open access advantage is greater for the more citable articles, not because of a quality bias from authors self-selecting what to make open access, but because of a quality advantage, from users self-selecting what to use and cite, freed by open access from the constraints of selective accessibility to subscribers only." [50]

And there are apparent contradictions among even these three findings. However whether you choose open access or subscription publishing, there are a number of factors common to both types of publishing that you need to consider before beginning your paper.

Although a number of countries including South Korea, China and Pakistan pay their researchers to publish in high profile international journals [51,52], the receipt of funding should never be a reason for choosing a journal in which to publish. Of course there are many valid and worthwhile reasons for publishing your high-quality research outputs in the best possible journals.

It has been suggested that in science, engineering and technology areas the journal's prestige and the makeup of the journal's readership are usually of prime concern [53] although these characteristics may be of less importance in social science journals covering education than characteristics such as *"clarity/coherence/well written", "thoroughness", "research method"* and *"appropriateness to Journal"* [54]. My focus in this Guide is to encourage you to aim for quality outputs, but how do you identify prestigious journals in which to publish your research?

There is no doubt that since 1955 when he first described its use, Garfield's impact factor has gained international recognition. Not only in science, engineering and technology but also in social sciences and the humanities, journals identify their prestigious nature and their quality by their ranking according to journal impact factor. Impact factor does have many uses but it also consistently attracts criticism, and Garfield often highlighted the potential for its misuse (for example see [55]). There are also many technical factors that must be taken in to account when using impact factor for accurate comparisons [56].

With the announcement of and request for consultation on the assessment and funding of higher education research post the 2008 British RAE [57,58], making greater use of quantitative information-"metrics"-than the current arrangements, led to a series of criticisms to the use of metrics alone to measure quality [59,60,61,62]. Now, for the 2014 REF British institutions will be invited to make submissions to be assessed in terms of (1) the quality of research outputs, (2) the wider impact of research, and (3) the vitality of the research environment [63]. The quality of research outputs will continue to be the primary factor in the assessment, accounting for 65% of the total, and it is expected that some of the expert panels will make use of citation information to inform their review of outputs.

I strongly recommend the appropriate consideration of a journal's impact factor when making your selection for your future publications, but the potential disadvantages of the im-

pact factor have led to the invention of a number of other ways to measure the quality and prestigious nature of a journal. Although there is neither space here, nor is it the aim of this Guide to give a detailed description and comparison of other ways to measure journal quality, you do need to be aware of some of the options that can be used to confirm the status of the journals in which you publish the outcomes of your research.

For example, the ERIH mentioned in the previous section has already established expert panels which have ranked journals in 14 sub-disciplines of the humanities such as anthropology, gender studies, philosophy and psychology, based on three tiers. The lists are not bibliometric tools. The ERIH steering committee and the expert panels advise against using the lists as the only basis for assessment for promotion, for appointment or for application for research grants [64]. Perhaps not surprisingly, the ERIH criteria have been criticised [65], however the rankings are public and are the subject of continual evolution. I believe that the ESF should be applauded for this initiative to at least open debate on other ways of ranking humanities journals other than impact factor.

The policies of preparation and use of journal rankings do come in for significant debate, especially from the humanities and social science communities. They can be used as tools as both political instruments and scientific apparatuses [66], in Europe, France and Australia, but their wise and appropriate use to assist your research career is, I believe, an excellent thing to do.

Similarly, there have also been attempts within the business and economics communities to rank journals using a range of indicators to establish their quality and prestige. For example, the Aston University Business School in Birmingham has ranked about 800 journals into three key groups after evaluation by senior academic staff in their school and other international business schools [67]. The Business Academic Research Directors Network (BARDsNET) jointly sponsored by the Australian Business Deans Council and the Australia and New

Zealand Academy of Management have ranked about 2,000 journals in 11 sub-discipline groups such as Accounting and Finance, Marketing and Market Research, and Economics into four levels [68]. Several research groups in economics have also developed ranking systems for journals using a range of alternative criteria [69,70]. Harzing.com [71] has recently published the 37th edition of it's Journal Quality List, a ranking of about 900 journals in Economics, Finance, Accounting, Management, and Marketing using 19 sources, and excluding impact factor.

CORE has not only ranked ICT conferences as described in the previous section, but they have ranked about 800 journals [72] in the area of their membership according to four tiers. Although not an exact match, this four tier ranking has also been chosen by the ARC as a way of ranking journals across all areas of research for their ERA exercise.

In July 2008 Agence d'evaluation de la recherché et de l' enseignment superieur [73], the French Agency for Evaluation Research and Higher Education published a list of journal rankings and the ESF ERIH has been mentioned previously. In June 2008 the ARC commenced an expansive and inclusive public consultation to establish a list of unique peer reviewed journal rankings for the 2010 ERA assessment process. The ARC believe that a journal's quality rating represents the overall quality of the journal defined in terms of how it compares with other journals and should not be confused with its relevance or importance to a particular discipline. The 2010 ERA was carried out using a list of 20,000 journals ranked in to one of four tiers (A* top 5%, A next 15%, B next 30%, C next 50%). Scopus was the citation data provider for ERA 2010.

Scopus Journal Analyzer enables you to search for journals within a specific field, identify which are the most influential, and find out who publishes them. This will help you to decide where to publish to get the best visibility for your work and how to prioritise your submissions. www.Scopus.com

The ARC are now undertaking an extensive review consisting of public consultation and then contracted peak body/disciplinary group review of the 2010 ranked journal lists in preparation for the 2012 ERA. The ERA 2012 ranked journals list is due for release in September 2011 [74]. Hence, there are a number of internationally available journal ranking systems for all research disciplines that you should seriously consider using, perhaps in addition to or instead of, impact factor, to highlight the quality of the journals where you publish the outputs of your research.

Of course, these systems all rank the quality of the journal in which you have published, and it is assumed that top quality journals publish top quality papers. It is possible however that even top quality journals publish papers that are individually not highly cited, and conversely, journals that are not necessarily considered top quality by ranking systems may publish papers that are very highly cited. Although these situations may be relatively rare, if your paper receives numerous citations, then another, perhaps even more specific measure of the outstanding nature of your research outputs, is to quote appropriate statistics on the citations received by your papers. There are a number of email alerting systems such as Scopus available via the web that will notify you of papers that cite your papers. You should certainly avail yourself of these services, and document the notifications on your CV.

The increasing use of the World Wide Web is also leading to the wider use of the Web for the quantitative study of Web related phenomena. This is based on the realisation that methods originally used for bibliometric analysis of citation patterns to journal articles can be applied to the Web using commercially available search engines providing the raw data. This relatively recent, more electronic based journal ranking has been termed "webometrics" [75,76].

Even more recently, a new open access Internet database lets users calculate a paper's impact factor using a new algorithm similar to page rank, the algorithm Google uses to rank web pages. This SCImago Journal rank analyses the citation

links between journals in a series of iterative cycles, using a citation window of 3 years [77].

SCImago Journal Rank (SJR), is a measure of the scientific prestige of scholarly sources: value of weighted citations per document. A source transfers its own 'prestige', or status, to another source through the act of citing it. A citation from a source with a relatively high SJR is worth more than a citation from a source with a lower SJR. Learn more at www.info.Scopus.com/journalmetrics

The Source Normalized Impact per Paper using Scopus measures contextual citation impact by weighting citations based on the total number of citations in a subject field. The impact of a single citation is given higher value in subject areas where citations are less likely, and vice versa [78]. Although this has led to debate about such systems [79], this type of analysis is certainly likely to continue and become more commonly used in the future. In addition, even the *h* index which is usually used for assessment of personal productivity and will be described as such in a latter section, has been suggested as another measure to assess journal quality [80].

Clearly, ranking journals using a range of diverse analyses and tools to define their quality is here to stay and such use is likely to increase with time. I strongly recommend that you use all available appropriate resources to validate the high quality and impact of your research outputs to your peers.

Although the quality of the journal should be a prime consideration for submission of your paper, there are certainly other factors that you should weigh up before starting to draft your paper. What is the speed of acceptance of papers in the journal? Is the area of your research similar to that which the journal normally publishes? Perhaps most importantly, is the quality of your research really at the level that is typically published in the journal? Certainly we would all like to publish

in only the top two or three journals in our discipline but if for whatever reason you have decided to publish this particular piece of research, is it really at the level of the top three journals in your field? What does your research Supervisor think? What does your Mentor say? An honest accurate appraisal of the level of the research outputs you intend to publish now may save a lot of time and anguish later because the work is either inappropriate for, or not at the level of, papers normally published by the journal. Although I recommend that you aim to produce the highest possible research, your choice of the journals you submit to must be realistic.

The range of factors that identify a good paper worth publishing does vary from field to field. The science, engineering and technology areas may focus on the journal's prestige and the makeup of the journal's readership but the innovative and novel nature of the work should ideally be highlighted for all discipline areas.

The outputs should clearly be the result of the excellent planning and design you undertook before commencing the research, but having identified a journal you wish to submit to, what do you now need to focus on with respect to writing your paper?

The major issue in submitting a paper to a journal for publication is to first read, understand and comply with the Instructions to Authors. This is essential to ensure the most efficient processing and reviewing of your paper, and should be done before you start drafting it. I then recommend that you start from the Title and Abstract and write a complete, even if rough, draft of the paper. Having the core of the paper outlined even in dot points facilitates the writing process. Making a complete draft avoids getting stuck on a point that prevents or delays documenting the rest of the paper. Often you might move sections of Introduction to the Discussion and vice versa, so making each section perfect before you do the next section, is usually inefficient.

At this stage it is probably also worth obtaining the input of a native English speaker if English is not your first language,

as errors in grammar and proper expression (which are not especially easy even for native English speakers) can disadvantage the review of your paper [81,82]. There is also clear bias towards English language papers in citing [83]. AuthorAID is a free international research community [84] that helps researchers in developing countries to publish or otherwise communicate their work. It also serves as a wider global forum to discuss and disseminate research. It is a pioneering program based at the International Network for the Availability of Scientific Publications, supported by the Swedish International Development Cooperation Agency, the Norwegian Agency for Development Cooperation, and the UK Department of International Development. It undertakes training workshops on scientific writing, and provides access to a range of documents and practices on best practice in writing and publication. The best known text to improve publication skills for established researchers is "How to Write and Publish a Scientific Paper" [85] and the recently published "Writing Scientific Research Articles: Strategy and Steps" [86] is focused on ECRs wanting to hone their skills as an author and a mentor, and scientists interested in using English more effectively, as a first or an additional language.

Your title, which is the main "publicity banner" for your paper should contain the fewest possible words (ideally less than a dozen) that accurately describe the paper's content. It should express only one idea or subject and start with a few important words. The increasing webometrics-type analyses mentioned above make it essential that your key words highlight the main content of the paper and can be easily understood, indexed, and retrieved by a database search.

The Introduction should begin with concise description of essential background to the problem, hypothesis or area of scholarly activity being researched. You should then state the objective of the research and clearly establish the significance of your work, especially in relation to what was previously know about the area.

The Methods section should always be accurate, de-

scribed in sufficient detail to be able to be fully reproduced, and for quantitative studies, have well documented and appropriate statistical tests.

Results must be clear, statistically valid if appropriate, and presented in the manner prescribed by the journal in Instructions to Authors.

Organise your Discussion to go from a specific focus to a general one, and relate your findings to the research literature, to theories, and to practices in your research discipline. Restate the hypothesis you were testing or scholarly question being addressed and provide answers for questions asked in the Introduction.

Support your answers with accurate, clear and validated Results. Explain succinctly and clearly how your results relate to expectations and to the research literature on the topic.

Discuss, evaluate and offer plausible reasons for conflicting results. Discuss any unexpected findings and provide a few recommendations for further research, but do not over extrapolate or make claims that are not definitively confirmed by your results.

In summary, your paper should describe excellent (novel and innovative) research, be well described and not over extrapolated, with accurate statistics if appropriate, and follow a succinct logical progression convincing the reader of its quality. Abstract and key words are essential. Ideally begin by writing a comprehensive first draft.

A number of journal publications along these lines will certainly provide you with a good base for convincing funding Agencies to assess your grant applications highly.

PREPARING A GRANT FUNDING APPLICATION

10.

The research you have done to date has been organised and funded by others. Your Ph.D. Supervisor, your research team leader or the head of the group in your company provides the funding for you to do your research. However, there will come a time, probably sooner if your research career is advancing at the rate at which it should be, when you will want to apply for research funding in your own right as a Chief Investigator.

Before you put pen to paper, or even consider applying for research funding, you need to ask yourself several questions and be satisfied with your answers, as research funding is generally very competitive and to apply seriously can take a significant amount of your time.

You should certainly think about the planned research funding application in the whole context of your professional career as you don't always need to get money to do your research. What is the relationship between your aspirations to do research and the availability of funding? Why are you applying for funding? Why do you need funding? What is the minimum funding you need to ensure the success of the research project you are asking to be funded? When you are satisfied with your answers to these questions and you understand that applying for research funding is a very major commitment, only then should you start to prepare your application.

It is essential that you must believe in the importance of the research you are proposing to do, so that you can convince your peers of its importance. Until now I have talked about publishing work you have already done, but now you must convince and persuade your peers that it is worth entrusting you with significant amounts of funding, rather than giving it to another research group who will also be putting up a very convincing case.

If you do need money, where can you get it?

Most countries have national and some even have state research funding agencies. Some of these such as the Deutsche Forschungsgemeinschaft (German Research Agency – DFG), Ministère de l'Enseignement Supérieur et de la Recherche (French Ministry of Higher Education and Research), and National Science Council of Taiwan, accept applications in all

research disciplines. Others such as the Indian Council of Social Science Research, National Sciences and Engineering Research Council of Canada, the British Research Councils and the US NSF and National Institute of Health focus on specific research disciplines.

Their websites and public portals to their programs are very comprehensive and easily accessible. There are also a number of websites that provide comprehensive information on grant applications for multiple funding agencies. There is a one-stop free resource to find funds for research and training in the sciences at GrantsNet [87]. Grants.gov [88] is a source to find and apply for US federal government grants. Research.gov [89] and science.gov [90] provide information about research and development results associated with specific grants. Grants.gov does include information on NSF grants, but the NSF also has its own service [91], that will alert you via e-mail on updates on projects and grants funded by the NSF, as soon as they are announced. The DFG even has international representation in Beijing (Sino-German Center for research Promotion), Moscow, Delhi, Washington and Tokyo.

There are also funding agencies that foster multi-country research programs, perhaps the largest one being the European Union's programs. The current program is the 7th Framework and it has calls for research funding in areas such as "People", "Capacities", "Cooperation", and "Ideas". It also has an email notification service which will notify you of new calls in areas you have registered for [92]. Another example of a multi-country funding application is the Human Frontier of Science Program (HFSP) [93] which promotes world-scale research in the life sciences through Research Grants, Fellowships and Workshops. HFSP grants are awarded for novel collaborations involving extensive collaboration among teams of scientists working in different countries and in different disciplines. Recently seven (Italy is not participating) of the Research Councils of the G8 countries (Canada, France, Germany, Japan, Russia, United Kingdom, United States), announced their first joint call for proposals for multilateral research projects in their

participating countries. The programme's medium-term goal is to establish a large pool of multilateral projects which can be supported by the national programmes of the participating organisations at any time. This first call encourages scientists to not only collaborate with existing scientific research groups on a bilateral or trilateral basis, but also create entirely new and productive multilateral research constellations. The first call focuses on high-performance supercomputing [94], but later initiatives are planned in health, food security and agriculture [95]. Although you are just beginning your research career and these multi country mega initiatives are probably beyond your capacity at present, you should certainly be aware that over the next few decades, i.e. your working research career, they are likely to become much more common. It is also clear that the global pattern of research focus is likely to change over your working research life [96].

But do you really need that much money? In the early stages of your research career, perhaps a smaller budget request that could be funded even internally by your own host organisation may be an appropriate way to go, allowing you to build up to some of the more prestigious and much larger national or international research funding schemes later. This is one of the important questions that you need to answer before commencing an application, as mentioned above.

But be it a small internal research application or a mega application to an international funding agency, there are certain principles and procedures that you must follow in order to ensure your application is as competitive as possible.

Having decided that you are going to apply for funding, you should firstly undertake an exercise where you write down a 100 word summary of your proposal and show it to your research Supervisor and Mentor and talk about it with them. What is the research aim of your 3 year project? What will you deliver at the end of this project? It is important to be realistic here and not overstate what you and your co-investigators can actually do during the period of the research funding. While it is important to be productive for the funding being sought, grossly overstating

the outcomes will not make your application more competitive. Similarly, you need to decide whether it will be just you applying alone as Chief Investigator or whether you will need co- Chief Investigators in order to justify to the grant funding agency that the relevant skills and expertise to ensure the success of the project exist among the applicants.

In funding schemes where the track records of the Chief Investigators are very important, you should seriously consider whether your track record shows sufficient quality and quantity to justify the time you will commit to this application, or whether you should wait to build up your track record before applying? Your Supervisor and Mentor can advise here. If you do decide to proceed, do you need co-Chief Investigators who have track records that can "lift" yours? If so, then it is always a good idea to have worked previously with these co-applicants and ideally published with them before. This will show that this is a longer term relationship, not one that has only come together to "get some money" and the more senior researchers may not contribute much to the project once the application is funded.

Having done all this you then need to decide which funding Agency you will approach. Ensure that the aim of your application is consistent with the Agency's goals and objectives. There is little point in applying for funding from an Agency that does not see the type of research you are proposing as an important focus for its funds. This sort of information is usually detailed in the description for the funding Agency, but it is also a good idea to look at the topics and summaries of successful applications funded by that particular Agency over the last few years. What type of research does that funding Agency promote?

SciVal Funding, created to support researchers in the pre - award stage, can help you analyse the funding environment. You can access award data for funding performance measurement, evaluation, and strategic planning, learn what publications are linked to certain funding programs, gain insight into funding history to see which re-

searchers and research received funding in the past, and find collaborators and learn about potential competitors. www.Scival.com/Funding

It is now essential that you read and understand all of the information put out by the funding Agency on the scheme to which you are about to apply. Perhaps the most important point to ascertain is the closing date for the next round of applications in that scheme. Competition is so great for most national and international Agency funds that unfortunately they are just not waiting for your application. They receive many more applications than they can possibly fund and those applications will conform to the Agency's rules and regulations and be submitted before the closing date. To be competitive, yours must as well!

When beginning to write the application it is a very good idea to keep the assessment criteria for this particular funding scheme in mind. What percentage of the selection is based on the Applicants' track records? How important is the novelty of the idea? How many pages do you have available to describe the approach and methods? Does this funding scheme focus on 'blue sky' research or is it much more applied with an industry partner being involved? These are all important policy considerations in making your application as competitive as possible.

There are also a number of more administrative or specific points that identify a good quality application. You should:

- highlight your strong, promising track records
- present problems and/or controversies and explain how you will solve them, rather than a collection of data.
- explain how the momentum of the subject demands funding now,
- show how your work fits in to the current international picture (don't describe "backwater" research without momentum),
- back up compelling claims with evidence and judgments by others,
- carefully temper challenging goals with plausible approaches,

- display evidence of responsible but often daring approaches to the problem,
- not make grandiose and implausible claims about outcomes,
- ensure that the outcomes you describe are really achievable in the term of the grant,
- show you are involved in national and international research networks,
- avoid the use of excessive technical jargon,
- have no spelling or grammatical errors or unedited nonsense in the text,
- present excellent progress reports on previous grants (if applicable)

Following the strategy and guidelines described above will certainly improve the competitiveness of your research funding application and a successful application will certainly add to the profile and continuing evolution of your research career.

COLLABORATING WITH INDUSTRY AND ACADEMIA

11.

Unlike the rest of this Guide, which is written to give tips and advice to ECRs no matter which type of organisation you work in, this section is divided into two components. One for ECRs who work in universities, Medical Research Institutes or Government Research Institutes (for ease of discussion here now termed academia). The other is for those who work in commercial or industrial companies.

If you work in academia, then there are a number of reasons why you might consider forming collaborations with industry and industry partners. Whilst there is much to be said for carrying out 'blue sky' basic or fundamental research, these days and probably even more so in the future, governments are finding it increasingly difficult to fund such work and there is certainly an international focus on leveraging your results towards commercial outcomes. The Japanese government's series of sangaku renkei (university-industry collaboration) in the mid 1990s and the Finnish Government's efforts to encourage university-industry collaboration, certainly appear to have been worthwhile [97,98]. The Brazilian government has also recently announced a similar exercise, the National Movement for Innovation [99], and there is a new national movement in Canada, "One Million Acts of Innovation", formed to revitalise the country's spirit of innovation [100].

In addition to potentially adding to your country's wealth, this sort of activity brings a number of benefits to you personally should you pursue it. The production of patents and licenses and involvement in the setting up of commercial spin-off companies can provide ECRs working in academia not only funding to employ staff and carry out further research, but also a significant personal financial gain if your organisation's policies allow it. However, these positive outcomes are not without disadvantages. The commercial secrecy surrounding such activity can lead to delays in carrying out the research, increased paperwork for commercial transfer agreements, and perhaps most significantly of all, delay in submitting your work for publication because of the necessity to keep it confidential during the patent application process.

But, similar to all the other aspects of your career described in this Guide, if you make a strategic decision to collaborate or work more closely with industry, you need to know how to go about it. The establishment of a strong long-term relationship with an industry partner can take a great amount of effort and time. So, how do you identify a project and a partner? There are three major routes for this:

1. You have a research idea and seek a partner that will be interested in supporting this research. This approach requires very significant time and effort by you or possibly staff in your organisation's Business Development Office or Commercialisation and Technology Transfer Office. You need to identify a potential partner who would be prepared to work with you because your research will add value to their desired commercial outcomes;
2. You know a potential partner (through networks) and ask if there is research that they want to undertake but are constrained (for whatever reason), to do. This approach is one that could arise from your established networks and is perhaps more of a “known” approach than the “cold” approach listed above. This latter approach is more likely to be successful in a shorter period because the industry partner knows you, or at least knows of you, via your research networks which emphasises again the importance of having a good research network;
3. The potential partner is already doing something and you can add value. Because of your networks and good reputation in this area, possibly through high profile publication of your basic fundamental research, the potential partner approaches you to assist them with their research. Also, most universities and many Medical Research Institutes and government funded research organisations have areas on their websites where staff list their commercial expertise and potential availability to work with commercial and industrial partners in various research sub-disciplines.

Naturally, each of these approaches may be used in various projects you may undertake with industry and whilst these cover the broad spectrum of possibilities, there is naturally the potential for a relationship to develop based on a compromise of these activities. Whichever way your relationships with industry develop you should ensure as much as possible that all collaborators, including your academic colleagues, but especially the industrial and commercial partners, benefit from this mutually symbiotic and ideally synergistic relationship. Such partnerships can assist your research career enormously, but as suggested above, are not without potential disadvantages that you should be aware of and accept, before pursuing such commercial industrial relationships.

If you are employed by and therefore carrying out research for a commercial industrial company, there is also a range of very positive potential outcomes but some significant potential disadvantages, in participating in university-industry relationships. At the personal level, the expanded academic input may lead to you becoming much more widely published in academic outputs, and many universities have the ability and in fact want to, confer honorary academic positions on their long-standing highly regarded industrial partners. If you are working in a commercial company, your appointment as an affiliate Associate or full Professor by a major research university provides you a personal cachet and academic recognition that would not be possible working exclusively within your commercial environment. This is likely to lead to a promotion within your organisation and also offers the possibility of periods or a permanent place in academia at a later stage. Commercial and industrial companies often value staff such as yourself being given honorary academic appointments and being involved in university research projects, because it shows that your company is highly regarded by the academic community and is seen as one worth working with.

Unfortunately, working with academics is not without disadvantage as they often, because of constraints such as teaching and administration obligations, carry out research at

a pace slower than commercial companies or industry would like. Their goals and aims in the research are often more academically focused than industrially or commercially focused. However, through establishing a mutual respect and a shared commitment to the mutually synergistic success of the joint project, then the development of a strong long-term relationship has very positive aspects for all involved and should be highly sought after and pursued.

ATTENDING CONFERENCES

12.

Congratulations again. You have just won an all expenses paid week – long holiday on Hawaii, in New York, on the Italian Riviera, or the Australian Great Barrier Reef. Now, clearly the week in some exotic location has been chosen for a conference that will bring together key researchers at either a national or international level. Your organisation has nominated you to attend, or you have some budget allocated that will allow you to attend. This should always be seen as a privilege not a right and you should get maximum benefit out of it.

Before packing your luggage, you need to ask yourself some questions. "Why do I need to attend? Will I really get something out of it? Could I use the time more efficiently at work? What will I get out of taking this week or two off, probably flying halfway around the world and interrupting my research workflow?"

These are important questions because conference attendance in the early stages of your career is not something that is common and happens often to everyone. You should decide that if you are going to attend a conference, you should get the maximum value out of it. And just being at the conference is not necessarily a positive for your career; it will take a lot of hard work to ensure that. So if you do decide to attend, you need to plan well.

Clearly, there are many types of conferences and what you can get out of them will vary greatly on what the individual conference is and what it has to offer. But this is precisely what you must look at and consider. Early in my research career I was fortunate enough to be invited to attend a conference of less than 20 people in a New Hampshire ski chalet. Many years later as a senior university research leader I attended a more generalist conference along with more than 10,000 other people. There is no doubt that I achieved much more at the small boutique conference with regard to my own personal research career than I ever could have by being surrounded by thousands of other attendees who often filled the available lecture rooms to overflowing. But I went to the latter conference wanting to achieve very different goals than the ones I had held many years earlier.

Now with proper planning you can certainly make attending a conference more worthwhile, but you need to weigh up the advantages and disadvantages of attending. What will you contribute to the conference and what will you get out of it?

While there may be benefit in attending a conference without presenting, there is always added value in presenting a worthwhile, up-to-date and exciting talk on your research. But are you really ready to attend? Will you be giving away "hot" new results from your latest research that will prevent you applying for patents and potentially give your competitors a very significant edge in publication just to impress the audience ? Alternatively, are you just going to restate work you have already published and that will be less interesting to your audience in order to avoid the patenting and publishing problems? Or will you be in a position to give a review of your work, the work of your research team, or perhaps also include the work of others?

To some extent what you can present depends on whether you are invited to participate in a symposium where a review/overview talk might be appropriate, or whether you are submitting your work for presentation that would need to be more specifically and recently focused. Will you be content with presenting a poster if your presentation is deemed to be more suited to that format? If you attend the conference, you need to make sure that you leave a lasting positive impression on your audience so that others may talk with you and about your work. You need to impress them and make sure that you are invited back. If you are unable to do this well at the present time, you should consider skipping this conference and attending the next one, when you are better prepared.

It is important that you are selective about which conferences you attend and what you present. I have been on a number of promotion panels and while conference attendance can be the major format of presentation for some research sub-disciplines, in most cases applicants who have three or more times conference presentations than published papers or books or chapters are often perceived as spending more time on holidays than actually doing work. Hence if you are going to

go to a conference and present your new work, it must certainly be followed up shortly after with a publication in either a journal or other written refereed form.

Perhaps the most important reason for going to a conference is the networking opportunity it can provide. This can be either at the conference through discussions with other attending researchers or with researchers who you may visit on the way to the conference. As with your research career, strategic planning and early thought will pay dividends. Conferences are usually advertised at least a year in advance so you should determine where you might make a stopover on the way. This will allow you to meet potential new collaborators or catch up with existing colleagues thereby expanding or strengthening your networks.

Read the conference program as soon as it appears on the Web or as soon as it is available in hard copy. This way you can determine who will be presenting their work and perhaps arrange to meet them at the conference. It can be difficult to meet a person even with a prior arrangement at a conference with 10,000 attendees. In addition, early review of the conference program will allow you to determine which presentations you will listen to and thereby allow you to plan your meeting schedule.

There is no doubt that conference attendance is an excellent way to increase your network with national and international researchers, depending on the type of the conference. But obviously this must be done appropriately and with as much planning as possible. Do you need someone you know at the conference to introduce you to one of the keynote speakers or will you be able to meet and introduce yourself directly without appearing to be brusque or inconsiderate? About 90% of all collaborations begin face-to-face [101], so your outstanding performance at the conference may lead to a number of very positive collaborations for you.

If you do decide to present the results of your work, then you must conform to the rules of abstract submission both in style and length, but also within the timeline requested. Having decided to attend, you must register and ensure payment is received before the due date or decide to register at the con-

ference, if that option is available, although it is usually more expensive.

I have assumed that your organisation is paying for your attendance at the conference. However, should your career be at such a stage that you are invited by the organisers to participate and they fund part or whole of your attendance costs, then naturally your input should be the highest quality and quantity possible in order to justify their confidence of investing in you.

Having highlighted the importance of putting significant effort into your conference attendance to ensure that your presentation and participation is highly regarded by the other attendees and is also of benefit to you, you should take the opportunity during program breaks to take in some of the culture of the country you are visiting. Perhaps later you may be approached by students from that nation to work with you or even be offered a position in that country, so if you are at least briefly familiar with the country you will be better equipped to make informed decisions on what to do. International travel can be tiring, especially if you make a stopover on the way, so try to arrive at the conference venue a day or two early both to overcome jetlag and also engage in a little acculturation. Your participation in the conference will be better for at least feeling like you're in the time zone in which you are presenting.

Your participation should not end when you board the plane or train to return home. You should consider keeping notes on the discussions you've had with senior researchers attending and take the opportunity to follow up the initial discussions by email or other correspondence. If you are the only person attending from your organisation you should prepare a brief written report on the conference describing what you got out of it. This will not only justify your attendance to your colleagues and highlight the worth of having sent you, but also give guidance to others who may consider attending that conference the next time it is held.

These follow-ups add to your network both locally and internationally and certainly assist the advancement of your research career. Most conferences are organised or at least fostered by a Society. Are you a member? If not, why not?

SOCIETY MEMBERSHIP

13.

There are many advantages to being a member of a society and I strongly recommend that you consider them. Possibly the only disadvantages are that being a member of too many societies can mean a large financial cost to join them all, and a CV is not enhanced by a long list of society memberships.

Perhaps the first society you join will be an unofficial one but it's possibly the most important. Attendance at the weekly or fortnightly research group presentation of your organisation's Department or your discipline is essential for many reasons. Participating in this "society" not only allows you to learn and hear about the latest research results of your colleagues but also of the areas in which they are working. Your presentations at this "society" also expand your network and build your reputation in the eyes of your colleagues and local peers. Applications for promotion or internal funding are often facilitated by your participation and long term commitment to the local "society." Often senior ECRs may be asked to organise the meetings, and if your Department has a travel budget and you can bring in invited speakers from other cities or countries, this can add significantly to your research network.

There are also many national and international official societies. They are all important and many provide very significant advantages, but you must be selective in which ones you join.

National societies generally hold an annual conference that brings the people working in your country together. They often have national prizes and many sponsor a national or international journal. Some have professional-type exams or assessments that identify you as a professional in that discipline. Society membership lists are promulgated which allow you to find out who in your country is working on what aspects of research. Attendance and participation in these societies can have long-term benefits and the award of one of their research prizes can certainly boost your research career.

International societies are also very important and obviously work at a much more global level than National societies. They also hold international conferences and many publish their own journals that have advantages similar to those mentioned

above for National societies, but on a global scale. The award of prizes from these societies and other activities such as invitations to present keynote papers at the International Society meeting are indicators of the high level of your research activity and will certainly benefit your research career.

Up to this point I have concentrated on you being an active researcher who participates in the society as an ordinary member. However, should you wish to expedite the formation of your network, get more nationally or internationally known, or do something to help your research discipline and its society from an altruistic standpoint, you might consider running for election to be a society office bearer. This should be done only after serious consideration because if you are going to become an office bearer then you must perform well in order to highlight your research capability and organisational capacity. Accepting the position and not doing a proficient job is not good advertising for your research career. However, despite the hard work that is required for these roles, the networking, praise and acknowledgement you will receive for a job well done can make the effort put forth very worthwhile. Like everything else described in this Guide it is a matter of strategically planning what part you wish to play in the society and committing the appropriate time and effort.

Regardless of the role you take in these societies, you must aim to do the best job possible. And if you do wish to stand as an office bearer and represent the members of a society in an official capacity, then it is a good idea to be able to appropriately sell your accomplishments.

SELLING YOUR ACCOMPLISH-MENTS

14.

There is never ever any substitute for a long list of high quality research outputs, but in today's competitive international environment it may not be sufficient to just have the outputs. One must be able to appropriately sell their achievements. However, there is nothing worse than someone who tries to sell achievements that are not at the level at which they are selling them. How do you determine the level of your achievements?

Clearly, your research Supervisor, Mentor or other senior members of your network can give guidance and advice. In addition, there are a number of quantitative measures you can apply to assess your productivity's level of international competitiveness.

The potential problems with the impact factor were mentioned earlier and the eigenfactor [102] has been proposed as an alternative. This method ranks journals by measuring the importance of the citation by the influence of the citing journal and therefore puts more weight on the importance of the journal containing the citation than is measured using the impact factor. But despite this, the eigenfactor still only provides a measure of the journal containing your publications, not a specific measure of the quality of your publications.

Refereed international journal publications are now being increasingly assessed by your *h* index [103] and a variation of the *h* index termed the m index, which takes in to account years since first publication and therefore is more attractive to an ECR. The importance of the use of parameters such as the *h* index along with the fact that the *h* index itself has come in for criticism, has led a number of groups to publish analyses defining potentially more useful indices, one of which has been termed the *g* index [104], another is described as a generalised *h* index [105] and another modified for self-citations is termed the sharpened *h* index (h_s) [106].

In addition to these assessments describing the most productive core of the output of a researcher and telling us the number of papers in their core output, there are now also other indices that depict the impact of the papers in the core. In order to really assess the significance of your published outputs you

should perhaps consider one index from each of these two types [107]. However, it is not so important that you go in to too much detail in this regard, but that as an ECR you are familiar with what is possible, and what is more likely to be used in the future.

The most interesting aspect of a number of these citation index modifications is the fact that they can also be used to give reasonable comparisons of productivity across a broad range of science areas from agriculture to mathematics to physics and tropical medicine [108,109,110,111,112]. There is not space here to go in to detail on the use and worth of these modifications of the *h* index, but it does show that there is much research being carried out on how to overcome the potential problems of such assessment formats. It is therefore highly likely that over the next few years the *h* index or its refined successors will be even more widely used than they are now to assess quality. You should therefore take every opportunity to use these assessment formats to determine your level of quality over your research career. This will be mentioned later in following sections, but how do you make sure that you have maximised and appropriately sold your assessed quality outputs once you have established your research quality?

For example, if I go to your organisation's website and search for your name, will I be able to find accurate and up-to-date information on your productivity? Industries looking for academic collaborators with specific expertise often use an organisation's website to identify appropriate individuals and it is important that you are not only listed, but are listed accurately with the most current information.

The Web is now an invaluable international resource and you must be listed appropriately and accurately but also as widely as possible. Several studies focusing on legal scholars and information science researchers [113,114,115] found that high profile academics, at least in these discipline areas, were no more famous than famous non-academics when assessed using aggregated media mentions. This possibly suggests that even very high profile academics do not sell themselves sufficiently compared with the non-academic general population. However,

what I do find interesting with these research projects is the formats in which the authors were able to make the comparisons of Web mention. These varied from conference abstracts or conference proceedings to external homepages, listserv emails, syllabuses and even newspaper and magazine files using the LexisNexis academic university news files for the previous 5 years. These studies were carried out before the recent almost exponential use of such web facilities as Facebook, YouTube, Plaxo, Myspace and LinkedIn so perhaps the web exposure of researchers, and especially young ECRs, may increase in future.

What these studies suggest is that perhaps all researchers should be more proactive in advertising their high quality outputs. You should certainly do it to ensure that your career expands and rises as quickly as it should from your hard work and high quality outputs. There are numerous ways to do this such as making sure you are represented on your organisation's website and taking every opportunity to describe your research outputs in newspapers, magazines, radio, TV, your society newsletters, professional magazines etc. In fact, while I have been focusing on these formats as areas to further improve your research profile, the altruistic way of looking at this is to suggest that if your research is funded by public money, then you have a duty to report your results to society in a number of these formats. We concentrate very much on publishing to inform and impress our research peers and perhaps we should also be focusing more on reporting our results to the society that funds us? Such reporting would need to be in lay language that will clearly explain your research to people who are not familiar with your normal research terminology, but it should always be accurate and honest. It will be worth your effort.

In this section, I have only emphasised selling your research achievements. However, now and certainly in the future, with most national governments increasing their focus on the social, economic and environmental (SEE) impacts of publicly funded research, you will need to bear these SEE impact achievements in mind as well. While publication of your research achievements in the best possible journal that receives

hundreds of citations would be an outstanding achievement, nowadays governments are also asking researchers to show how society benefitted from that research.

As mentioned earlier, 65% of the assessment of the 2014 REF will be based on research outputs. In addition, it is planned for a weighting of 25% to eventually be based on impact given due recognition to the economic and social benefits of excellent research. However, given that the impact assessment in the 2014 REF will still be developmental, the weighting of impact in the first exercise will be reduced to 20%, with the intention of increasing this in subsequent exercises [116].

The problem is that such SEE impact achievements are still not clearly defined or necessarily accepted as they cover numerous potential outcomes, and are difficult, though not impossible, to measure accurately. The major challenge with the widespread use of SEE impacts to measure the worth of research outcomes is lack of agreement on what should be included, and how they can be accurately measured and verified by sufficiently large numbers of researchers in each research discipline, academic or industrial group.

However, I have no doubt that in time both public pressure and the need to justify further public spending on research will make the use of such SEE impacts much more wide spread and you should at least be aware of the variety of them that might impact your research.

For example, the Research Quality Framework (RQF) exercise that the then Australian Government was planning to carry out contained many examples of possible SEE impacts, asking researchers to assess whether their research had been used for example:

- to generate new policies, products, processes, attitudes, behaviours or outlooks,
- to contribute to a policy outcome that has produced a measurably significant or outstanding benefit,
- in public debate that has influenced public opinion,
- for creation of spin-off companies, marketing, commercialising new products, technologies or significant co-invest-

ment in commercialisation by investors or end-users,
- in creation of processes that led to improved outcomes and productivity in industry or policy,
- in creation of a new process, method, product, analysis or theoretical tool which becomes standard professional practice resulting in measurable benefit,
- to transform international perceptions of culture, as indicated by growing interests of international audiences, artists and performing art industries leading to measurable benefit,
- in historical research that has led to the preservation of media or other cultural artifacts,
- for significant cost savings or has substantially raised productivity for industry or government,
- to improve health outcomes through improved effectiveness and efficacy of a device, procedure or drug as indicated by increases in well being, life-span or survival ratio of patients,
- to improve quality of care resulting from adoption of better clinical practice or procedures as indicated by decreased mortality or morbidity,
- in new procedures and behaviours that have reduced treatment time and costs resulting in significant or outstanding benefit to society,
- in relevant national or international legislation, legal judgments, committees of inquiry or policy statements,
- for teaching or training materials,
- for collaborative community events, festivals, artworks and social interventions, or
- as drama and applied theatre in educational, community, cultural or social contexts.

The newly elected Australian government terminated the RQF exercise when it came to power in late 2007, and I believe that the lack of agreement among Australian universities on SEE impacts significantly hastened the termination of the RQF by the new government. Interestingly, although the 2010 ERA

that replaced the RQF did not assess these SEE impacts directly, the Minister responsible for the ERA recently suggested that the 2012 ERA might include looking at the indicators of research excellence around research uptake or engagement [117].

This section of the Guide started by saying that there is never ever any substitute for a long list of high quality research outputs. That certainly is true, but if you have used the research contained in that long list to improve SEE impacts as described above, then your research will be seen as even more worthwhile.

CURRICULUM VITAE

15.

When you do start attending conferences and expanding your network, you will probably give away business cards as an easy way of introducing yourself to new colleagues. In some countries the proper presentation of your business card is almost a ritual. Your business card contains your contact information but you should also have a much more detailed format to inform others of your career highlights and success.

It is essential to have a CV that not only contains quality outcomes but is also presented in a manner that publicises your outcomes in a clear and distinct manner. It must be accurate and up-to-date. While you must be selective in what goes in to your public official CV, I strongly recommend you also have an unofficial version that contains records of everything you do. The talk you gave at another university last month, the newspaper item that featured your research group's outcomes last year, or the full details of last year's preliminary patent application are events that you will eventually need to accurately document. The only way to do this effectively is to record events at the time they occur. This of course means that you have a very large amount of information that could be far too detailed for a public official CV. But having the information available in an unofficial format, which can then be transferred to sections of your official public CV when necessary will ensure that your research outputs get the best judgment possible.

Your official CV must not only be accurate and up-to-date, but also it should be succinct, informative and understandable to readers from a range of backgrounds and cultures. So avoid the use of abbreviations or at least explain them fully, use language that will be understandable to colleagues who may not use your language as their first language, and above all make it an honest CV. By this I mean in regard to such things as publications. There really are clear differences between a publication in an internationally refereed journal with an ISSN number and a proffered non-refereed presentation at a conference. Both have their worth and both are worth pursuing, but include headings that identify what each is so that it does not appear as though you are claiming that publications are at a different level than

they actually are. Readers greatly value accuracy and clear definition over having to wade through pages of often unclear material to try and determine the worth of a CV that covers 20 or 30 pages. In order to assist your readers, always provide evidence of claims and specific details wherever possible.

Your organisation may have a standard CV format to be used when applying for things such as internal promotion or grant applications. If so, then you should certainly use what is recommended or deemed essential. However many organisations do not mandate CV styles so I have listed below example headings that you may consider for your CV. At present you may not have information to include in each category, but over time you probably will generate career outputs in all of these categories. While a CV covers all aspects of your career including teaching, community service, administration and leadership, industrial productivity, and business activity, the headings depend on the type of organisation employing you. The CV example below is naturally more focused on research, as this is a guide about mentoring your research career.

Example CV headings

i. Tertiary education
ii. Honours and awards
iii. Employment
iv. Current role and responsibilities
v. Academic committees
vi. Professional committees
vii. Teaching experience
viii. Theses examined
ix. Commercial/industry collaboration
x. Academic management/leadership courses attended
xi. Editorial responsibilities
xii. Referee for
    1. Manuscripts:
    2. Research grant applications:
    3. Professorial promotions/appointments:

xiii. Research grants received
xiv. Presentations at international scientific meetings
xv. Presentations at national meetings
xvi. Publications
    1. Books
    2. Book chapters
    3. Refereed journals
    4. Refereed conference publications
    5. Publications in the lay press (newspapers, magazines) or scientific magazines
    6. Abstracts, letters to the editor or conference proceedings

As mentioned in earlier sections, author order is very important. Such things as the order of the authors in publications, including perhaps your percentage input and role in grant funding applications and research programs are good things to list.

Naturally, the headings in the example CV above are not necessarily exhaustive, and you or your organisation may have others to add. However, no matter what style or format you use for your CV, it is essential that you have one and that it is accurate, up-to-date and relatively easy to absorb by someone who wishes to determine the quality of your research career outputs.

APPLYING FOR FELLOWSHIPS

16.

Whether you have a relatively new university academic appointment or are employed by a commercial research organisation, it is likely that you have a number of other responsibilities in addition to your research activities. While these other activities are important and indeed may be the reason that you receive a salary, they do require effort and expertise that you could be contributing to your research career. Postdoctoral Fellows and researchers in medical research institutes may be able to focus more on just their research, but in any case there are many reasons for applying for a full-time research Fellowship.

Full-time research experience in an environment other than your usual organisation adds greatly to your skills and expertise and allows you to focus as much as possible on your research alone. Clearly there are many positives in receiving a Fellowship to work in a research environment overseas. Not only will you pick up skills and expertise that may not be present in your own country but you will also expand your network and list of international collaborators. Such experience in organisations overseas adds significant kudos to your research career that should stand you in extremely good stead should you return to your home country or decide to stay in the country where you have taken up the Fellowship. For example, the United States, as the world's technology leader, is obviously a great and powerful attractor of talent. It has been estimated that about half of all the science and technology personnel in the US are foreign-born, with about a quarter of US science and engineering PhDs having been born outside America [118].

Because of the numerous advantages associated with being a Fellowship holder they are very competitive and you will need to work very hard to both apply for and be awarded one. However, having followed the advice given in this Guide, you should be well equipped for preparing your Fellowship application. Your previous research Supervisors, collaborators, and your Mentor are ideal people to seek references from and you will have all necessary information available at your fingertips in your well-documented and up-to-date CV.

Some Fellowships are associated with research projects in the proposed organisation and you will need to collaborate with the potential supervisor in order to apply. You will need details on a proposed research project that the new Supervisor will be happy for you to carry out in their organisation. Some Fellowships fund only your salary while others are much more comprehensive and include salary, travel and research maintenance in the new location.

Fellowships such as the Churchill, Fulbright, Marie Curie, Rhodes, and Von Humboldt are internationally known and they advertise widely for applications. You should certainly look out for these, as they are very prestigious and very worthwhile. Other Fellowships are more locally focused and may allow you to carry out full-time research at organisations in your own country.

Some Fellowships such as the ones listed above are partially or fully "open ended" in that you can use them to go to any organisation, while other Fellowships are offered by specific organisations and are available for research at only that organisation. Many databases such as ResearchProfessional [119], COS (Community of Science) [120], IRIS (Illinois Researcher Information Service) [121] and SPIN (Sponsored Programs Information Network) [122], have detailed and up-to-the-minute information about thousands of government and private international Fellowship funding opportunities, usually on a fee subscription basis. A number of the databases listed in other sections of this guide also list Fellowship opportunities. Your research office or staff employed to facilitate your organisation's research should be able to assist you in determining the deadlines and requirements for these Fellowships. It is very prestigious for an organisation to have their staff awarded these Fellowships and your organisation will benefit greatly when you return.

Having spent time in another organisation, or possibly another country, you will have learnt skills and expertise that are not available locally. Hence your organisation is likely to provide significant support for your application.

However, like much of the work described in this Guide that will advance your research career, applying for Fellowships is time-consuming and hard work. In addition, potentially moving to another part of your country or even overseas may involve significant family upheaval, so it is essential that you determine that your academic career is at the level it should be to compete against other Fellowship applicants. You must decide that you are prepared to put in the time and effort and undergo the potential family upheaval in order to do the absolute best in carrying out the Fellowship. I was very pleased and honoured to be awarded a Fulbright Fellowship that allowed me to carry out full-time research at the US Department of Agriculture Research Institute. So naturally I strongly recommend fellowships to you as a very significant part of your research career. They certainly are a very strong platform from which to catapult your research career. Good luck with your application.

APPLYING FOR A JOB OR PROMOTION

17.

Although there are clear differences between applying for a promotion or applying for a job, there are many similarities too so I will discuss them both together. And in fact, often the best way to get a promotion is to actually apply for a job at a higher level in another organisation.

If you are working at a university, then obviously you have a number of other very important activities to consider, such as teaching and administration services, as well as your research activities. If you are working in industry or a medical research institute, you will still have other responsibilities in addition to your research to take in to account when applying for promotion or another job. These are all very important activities but this Guide is focused on your research career only which, whether you are in a university, a commercial research organisation or a government medical research institute, should still be your major focus.

You have followed the advice given in this Guide, published in high-quality journals, received research grants and been on a Fellowship overseas. You now feel that it is time to apply for promotion. However, it is very important that you do not apply for a promotion or a new job too early, as there is a very large amount of work that needs to be completed for both activities, and being unsuccessful in either can be quite defeating. Obviously not everyone gets promoted the first time around and only one person can be successful in obtaining the job, but it is important to be near the level required for either the promotion or the job, to at least make the application worthwhile.

You may need excellent references from your research Supervisor, your Mentor, and probably senior members of your network, so it is important to get their advice and opinion as to whether they believe your research career is at a level at least worthy of the promotion or job. This is where critical comment is invaluable as continued requests for references from a Supervisor, Mentor or network member who does not suggest that more work might be required, can cause a negative reaction, that will in time decrease the value of your relationship with them.

In addition to general input from colleagues, how can you determine whether your research career has reached the point where a promotion or new job is the next logical and achievable step?

Steps of promotion or jobs at certain levels usually have general standards of research productivity associated with them. As your research career progresses you will see colleagues promoted and given jobs and you will naturally get a feel for the level of productivity required to take your next career step. Each applicant is different and everyone should be judged on their own individual merits, but selection or promotion committees sit and make decisions based on their general experience in the area.

Many publications, some of which have already been mentioned earlier in this Guide say that promotion, job selection or presentation of awards should not be based simply on quantitative analysis of one's publications. And I am certainly not suggesting that this should be the case. However, quantitative analysis of your research publications can be used to provide you with an approximate idea of whether your career is at a level consistent with an application for a promotion or a job, and I believe that more and more committees are using quantitative analyses as extra information in the decision-making process.

I am certainly not suggesting that because one of your colleagues was promoted to Associate Professor with only 15 publications and you have 22, that you should immediately apply for and be guaranteed promotion to that level. There are numerous other factors that come in to play in an assessment for promotion or a job with regard to things such as author order and quality of the journal. However, I do believe that you should use analyses with the various formats I have described here, to evaluate alongside the information you receive from your colleagues and peers to determine whether your career is at the right stage to apply for a promotion or a job. The *h* index has been used to identify top scientists in such areas as physics, chemistry and computer science [123] and give a base level for the selection of winners of the Price medal for outstanding

contributions to the field of qualitative studies of science [124].

Clearly, very few ECRs are at these levels but studies have also been done investigating the *h* index of non-prominent physicists and promotion levels of Assistant and Associate Professors in psychology [125,126]. Both of these studies highlight the potential pitfalls of using the *h* index for definitive specific personal comparisons. However, I believe that they do in fact show that you can use such analysis tools as the *h* index to get an at least general approximation of the level of your research productivity. You are then able to use it for your own private comparisons with the results of peers who you know are at the level of promotion you are considering.

Once you have decided to apply for a promotion or a job, then you should put considerable time and effort into the process.

The suggestions I made for grant funding and selling your accomplishments in earlier sections also apply here. Keep your CV accurate and up-to-date and above all when applying for promotion or job, do not over embellish your accomplishments. Your productivity should certainly be highlighted and presented in a positive light, but it must be done accurately and honestly. Make sure your application is submitted within the timeline required.

Be specific about applying for a job and do not send out what amounts to spam. During my academic career I used to get numerous letters addressed to "Dear Respected Sir" that had obviously been sent out to many other potential employers, who I am sure, also showed no interest. Such bulk mailings would actually be offensive to female recipients. If you are applying for a job, make sure that you know as much as possible about the position, the organisation and the people that you would be working with so that you can perform at your best in both the application and at interview. There is merit in asking several close peers to give you a mock promotion or job interview so that when you attend the real interview you are as well prepared as possible.

A career in research is an exciting adventure. You are fortunate to have been able to make the most of the opportuni-

ties presented to you and earned a PhD. Hard work and always aiming for high quality outputs will allow you to succeed and indeed thrive in the research environment. A research career is a most worthwhile calling in life as you add your new knowledge to advance humankind.

Good luck, and I hope to see you present your outstanding results at a conference somewhere soon.

Alan Johnson

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ABOUT PROFESSOR ALAN JOHNSON

Emeritus Professor Alan Johnson AM, has 30 years of experience in research, research management and research training in a range of organisations, including universities, Australian Government agencies and international research organisations.

He obtained his Bachelor's degree in biomedical technology from the South Australian Institute of Technology, followed by a Ph.D. in parasite immunology from Flinders University. On secondment from the Flinders Medical Centre during 1985-1986 he was a Fulbright Postdoctoral Research Fellow at the United States Department of Agriculture. He was awarded the 1989 Bancroft-Mackerras Medal of the Australian Society for Parasitology for outstanding research. In 1996 he was awarded a Doctor of Science degree in protozoan biology by the University of Wollongong. He was nominated "Ehrenmitglied" (honorary member) by the German Society for Parasitology in 1999 because of his outstanding research record and the fact that he trained a number of German postgraduate students and postdoctoral scholars in his laboratories.

During his research career he published over 100 internationally refereed journal articles and received over $3.5 million in competitive grant funding.

Professor Johnson was awarded an M.A. (Hons) in technology and social change from the University of Wollongong in 1989 and an M.Ed.Mgmt in the use of citation indexing to measure university department performance from Flinders University in 1991.



In recognition of his service to science in the field of molecular parasitology, to scientific research and education, and as Editor-in-Chief of the International Journal for Parasitology (published by Elsevier Science Ltd) from 1997-2003, he was made a Member of the Order of Australia in 2006. In 2007 he was made a Distinguished Alumnus of Flinders University.

Between 1992 to 2002 he was Professor of Microbiology and Chair of the Academic Board and a member of the governing Council of the University of Technology, Sydney.

In 2002 he was invited to be a member of the Australian Research Council's (ARC) College of Experts, and from 2003 to 2006 he was seconded to the ARC as Executive Director for Biological Sciences and Biotechnology.

Under Professor Johnson's leadership as Deputy Vice-Chancellor (Research) and Vice-President at the University of Adelaide in 2006 and 2007, the university's annual research revenue exceeded $100 million for the first time.

In 2007 he established an international consultancy business, Research Management Services International Pty. Ltd (www.rmsinternational.com.au) and now works extensively in Europe, The Middle East and Asia as well as Australia.

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