



# The early career researcher collaboration mindset

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The opportunity that lies before you is to approach collaboration as a way to develop your leadership skills, while also helping to achieve impact beyond writing and publishing papers <https://bit.ly/3HAQ2zL>

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## Abstract

Everyone knows that science is about collaboration, but the degree to which one embraces collaboration can have an outsized impact on the value one derives from collaboration. In this article, different aspects of collaboration are discussed and a list of action-oriented principles is presented to help readers understand what can be done to develop more of a collaboration mindset to get the maximal value out of collaboration.

## What is the currency of science?

A common saying is that publications are the currency of science. However, when one thinks about it more deeply, that saying does not exactly ring true. Currency is something one uses to purchase something. One could say that publications help purchase more grants or, for that matter, a degree. A better way to consider publications is that they are more like recognition. They are the reward or the proof that one has done some serious science. What then is the currency of science?

The best or most impactful publications combine multiple methods to tell a complete story. For example, they not only identify a new biomarker but also describe a series of experiments that define the mechanisms that underpin the function of that biomarker. The best clinical research makes use of large well-characterised cohorts. In both types of research, it is doubtful that one's own or even one's more extensive laboratory or clinical research unit will have the methods or the complete cohort necessary to tell the whole story. This is why most publications have a long list of authors. Most studies result from the work of three, four, or even 20 different research groups.

So, if one wants to be part of the research that leads to the most important papers, one has to be able to bring methods or assets, such as large well-characterised cohorts, to the table. Therefore, it makes much more sense to think of methods and assets as the currency of science.

## Highly valued methods and assets

Effective collaboration is about having methods that one can share with others to help them tell their scientific story, and they can, in turn, help one's own story. That means that the foundation of collaborations begins at the earliest stages of one's career. One should ask oneself: what methods and assets that one is developing will be highly valued?

To decide what methods will be highly valued, one first has to have a sense of the state of the art. Another aspect is what methods or assets can one or one's group be the best at in the world? It is not that one has to be the best in the world; just if the focus is on what one could be the best at in the world, it is much easier to reach a highly valued level. This, of course, also depends very much on the context of where one is working and what is possible with the resources available. The aim should be to be ahead of the state of the art. If the method is routine and anyone can purchase a kit to carry it out, it's hardly something one



can build collaboration around. This is equally true for assets. Assets are datasets, a cohort, a screening library, a mouse model, or even a storage facility.

Having the perspective of having been involved in many projects with leading scientists from all over the world across multiple different disciplines, it is easy to say that using methods and assets as the currency of collaboration is a common approach amongst the most successful. The most successful scientists are always seeking ways to advance the latest technology or build the best cohorts. For example, enhancing an imaging technique and then automating the analysis to be scaled up to do large volumes of work. If one built up that capability, then one is the perfect collaborator for another group that needs to perform those analyses at scale, screening many compounds or examining a large set of samples. Maybe that other group can provide the samples one needs to validate one's findings.

### **Opportunities to validate**

Aside from combining different methods and assets to answer a research question, one can also view collaboration as a way to validate one's findings. Validation in a separate cohort is now almost required for any study that identifies a biomarker. While it is clear that investing effort to repeat and validate findings is good science, it is often not done for preclinical research or basic science. However, with the growing concerns about the repeatability of research results, being able to validate a finding in different laboratories will send a very strong message about the strength of one's findings. This does, however, require that one uses the same or very similar models in different laboratories. When one successfully achieves that, it opens up a whole host of possibilities, from sharing resources and reagents to sending a strong message about one's findings. The important thing to remember is that one must find a way to work together while also advancing the specific objectives of all collaborating groups. One has to balance individual needs with the bigger goal of advancing a field. This is one of the fundamental principles that underlie all collaboration.

One way to be sure that one is getting the balance right is to think first about how one can help collaborators. One likely knows what one needs, and if one's collaborator has the same approach, both will be thinking about how to help each other. When one does this, one is likely to be finding angles or perspectives that one's collaborator may not, which just increases the value of the collaboration for them. This is how one builds synergy. Of course, one has to think about what is confidential and what constitutes intellectual property that must be protected. If one begins with a "help first" mentality, one is more likely to build robust collaborations that allow oneself and one's collaborators to achieve more towards personal own goals while also advancing an entire field.

### **Finding collaborators**

Where does one find collaborators? The first and most obvious place is one's own institution. Institutions were developed to foster collaboration [1]. Nothing is as easy as going down the hall to quickly discuss something with a collaborator. When one realizes that the best collaborations are built around trading methods and not having the same topic of research, it opens up the possibility to collaborate with multiple different disciplines within one's own institution. Some of the most impactful synergies arise between what otherwise seem to be completely separate disciplines. For example, one of the founding partners of the Human Genome Project [2] was the US Department of Energy, which one would not immediately think has much of a place to collaborate with genomics experts. A more proximal source of collaboration is groups within the same department as one's group but who work on a different disease topic. Some actions one can take to find local collaborators include attending local meetings while paying particular attention to the methods being presented, and surfing the web pages of other laboratories in one's own institution.

The same approach can be applied to conferences and meetings. The real value of events is not just learning about the advances in one's field. Conferences and meetings are outstanding opportunities to learn more about the methods, datasets or cohorts that others are using. One will also find that if one approaches potential collaborators at a conference or a meeting with a "help first" mindset, making the connection and building collaboration is easier than one might think.

The Human Genome Project was remarkable not only in the breadth of disciplines it brought together, but also in that it was one of the first notable consortium projects in the life sciences. It is best to pause here for a moment and explain how research and innovation relate to each other and why that relationship is relevant to having a collaboration mindset. The colloquial use of the word "innovative" confuses the common understanding of what innovation is. When someone says something is innovative, they typically mean that it is a novel or unique idea. Most definitions of innovation, on the other hand, position

innovation as the act of bringing something new into use [3]. For a company designing and building products, innovation happens when the product launches. Healthcare innovation happens when a research finding is put into clinical practice. This is no easy feat. When it has been studied, the average length of time to move from research finding to clinical implementation is 17 years [4]. The difficulty of translating research into clinical impact may be why there is such an emphasis on the term “research” and less on the term “innovation”. As the science and the techniques have become increasingly more sophisticated, there is an increasing call for multiple disciplines and multiple stakeholders to collaborate throughout the entire innovation process. In the past, the process of research and innovation was more siloed and linear. Researchers found a disease mechanism; then, companies identified small molecules that would address that mechanism and would then carry the process forward, bringing that small molecule to market as a therapeutic more or less on their own.

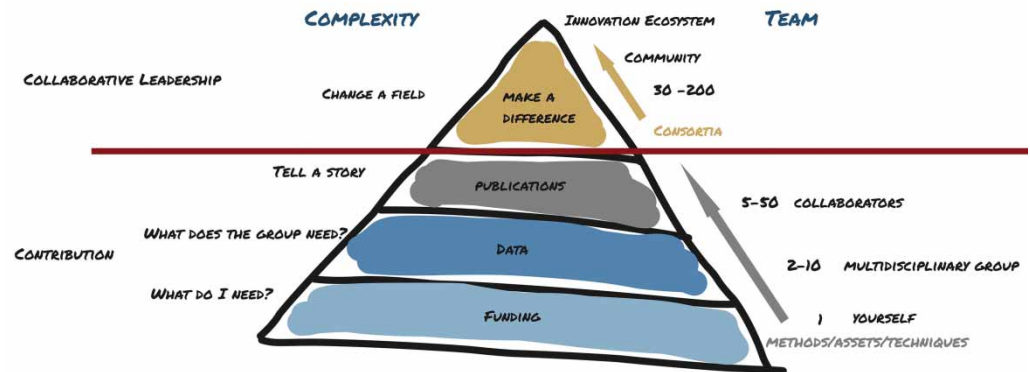
Currently, we are in an era of complexity. Many new therapies aim to modulate complex biology such as the immune system, the ageing process, or oncogenesis. Old models and processes that worked for small molecules are no longer relevant. The array of potential side-effects and the mode of action of new therapies is complicated. There is also now the ability to deploy new technology to monitor and make diagnoses, and to capture large volumes of data and make sense of that data. We are able, more so than ever before, to embrace the full complexity of biological processes. So much so, that other disciplines such as technology developers, data scientists, statisticians and artificial intelligence programmers are now part of the healthcare research and innovation process. This brings with it unique challenges and unprecedented opportunities that were unfathomable when the focus was primarily on developing small molecules. This evolution of the healthcare research and innovation process is a fundamental driver, if not the sole driver, of the rise of multi-party collaborations or what has been called “consortium science” [5].

#### **Opportunities for collaborative leadership**

Abraham Maslow described the hierarchy of human needs [6]. The idea is that we all have needs that must be fulfilled before we can obtain the next level of achievement. One has to have food and shelter before one can begin to think about having a family. One has to belong and feel connected before one can begin to achieve in one’s career. And one has to achieve in one’s career and have some degree of accomplishment before one can do what Maslow termed “self-actualise”. What Maslow meant about self-actualisation is acting on one’s own nature to make a real difference. A specific Maslow hierarchy of needs can be conceived for those working in life sciences research and healthcare innovation. It begins with funding; then come data and publications (figure 1). One can have a successful career just by gathering data and publishing papers. But to make a real difference requires more. It requires that one do what is necessary to make sure that the research delivers on the promised impact. This often means addressing bottlenecks that hold back innovation. Here again, the Human Genome Project is a good example. Researchers realised that without the sequence from the entire human genome, the ability to advance our understanding of health and disease would be limited. Think for a moment about what life sciences research would be like right now if one could not perform genomics or transcriptomics. It seemed at the time a daunting task to sequence the entire human genome, given the technology available. Nonetheless, they formed a consortium with exactly that goal. They were focused on self-actualising. They wanted to make a real difference. The best way to do that was through a big ambitious collaborative innovation project. A consortium project is a type of open innovation network. It is a coordinated effort between multiple organisations to work together over a number of years towards a common set of goals. Nearly always, consortia are focused on innovation bottlenecks. The researchers who initiated the Human Genome Project were interested in doing more than just generating datasets and publishing papers. They were doing what was needed to make a real difference. It was an act of collaborative leadership.

Most successful researchers who have obtained substantial funding and published a whole slew of articles eventually come to the realisation that if they want to make a real difference, they have to do more than run studies, collect data, and write papers. It takes more than that to deliver innovation. And innovation is what is needed to change the lives of individuals suffering from a disease. This is why one sees researchers that are in the later phases of their career become highly interested in consortia. However, this does not mean that consortia are not for early career researchers. On the contrary, consortia and other forms of multi-party collaborations are a great source of opportunity for early career researchers.

Since the Human Genome Project, consortium projects have become steadily more prevalent as a way to achieve innovation. The U-BIOPRED project [7], for example, was focused on identifying subphenotypes of asthma. Everyone working in clinical asthma care and research knows that asthma is a heterogeneous disease and what holds the field back is the fact that in clinical studies, different types of patients were being clumped together, which means that the average result obscures beneficial effects or discriminatory



**FIGURE 1** Pyramid depicting the hierarchy of needs in healthcare innovation. Both complexity and team size increase as one moves towards making a difference, which is the equivalent of Maslow's "self-actualisation". The complexity increases from simple straightforward questions ("What do I need?") to changing a field at the top. The team size begins with the individual researcher and then increases to a consortium, then a community, and eventually an innovation ecosystem where all the multitude of stakeholders interact to effect a real change. Throughout the process, the driver or the currency of research are methods/assets/techniques, which require increasing levels of collaboration as one advances towards the pinnacle. There is a transition, the red line, where one moves from contributing to a field to becoming a leader. Prior to reaching the red line, the focus of one's efforts is making a contribution to the literature. Above the red line, the focus is on collaborative leadership in an effort to make a difference. Copyright ©BioSci Consulting 2022. Reproduced from [11] with permission.

biomarkers in subpopulations. U-BIOPRED is a consortium that started out with more than 39 partners and aimed to create the largest well-characterised severe asthma cohort, including multiple different types of molecular profiling. This was achieved, and now, nearly 8 years after the funding period of the project, the consortium continues to work together on what has turned out to be a highly valuable dataset. Perhaps equally important is the fact that several early career researchers leveraged their U-BIOPRED experience to launch or accelerate their career trajectory.

### Don't let a consortium project pass by

One might ask oneself: what role does an early career researcher have in a high-profile consortium project? First, one should view a consortium project as a perpetual conference that is a fountain of knowledge and collaboration opportunities. Just like developing a smaller scale collaboration, watch for opportunities to be helpful with the techniques or assets that are available. When a consortium project is highly interactive, and the partners are meeting regularly to collectively solve problems, there are lots of discussions about methods. More importantly, the type of problem-solving that happens is not what is typically written about in methods sections of papers. It is more practical and implicit. There is no better source of that kind of knowledge than the discussions that happen in consortium projects. So this alone should be enough of a reason for one to attend as many consortium meetings as one can. Pay attention and think about the methods and assets at one's disposal and how one could help solve problems or move the project forward.

It is the ambitious nature of consortium projects that opens up opportunities for early career researchers. There is often more to do in a consortium project than there are people to do the things that need to get done. Plus, during the course of a successful consortium project, new ideas and opportunities continually emerge. A new finding leads to a new idea to investigate something further or develop a new protocol or standard operating procedure. In this context, there are many opportunities for early career researchers to engage. A good example of this would be developing a common protocol for a type of research so that all the studies or experiments performed by different groups will be more directly comparable. Another example is helping to structure and organise the data or the knowledge that is being generated in the project. It can start with a simple outline or a rough draft of a document. Don't get hung up on it being perfect. Even if it is completely off track, it will stimulate others in the project to come forward to either revise the document or work together to make it better. It may also be something like writing the first draft of a standard. Standards can have a huge impact on the pace of innovation. What is particularly important about these types of subprojects is that they often require the engagement of multiple different disciplines

and even different types of stakeholders. For example, the work that is needed could be around an effort to change the perspective of regulatory authorities allowing the acceptance of a new type of clinical study design as evidence to register a new therapy or to gain approval of a new biomarker. Somebody needs to serve as the connector.

For consortium projects to succeed in achieving their ambitious objectives, there needs to be leadership at all levels. The type of leadership that is required is collaborative leadership. Collaborative leadership is about leveraging the diversity of a group to solve problems and make progress. This can be thought of as collective or emergent creativity [8]. By seizing upon the opportunities that arise during the course of a consortium project and volunteering to be the one that moves the subprojects that fall outside of routine research forward, one will not only learn a lot and help the project achieve its goals, but also demonstrate one's ability to be a leader, which will open up career opportunities.

There are numerous examples where students and postdoctoral researchers have accelerated their career trajectory by taking on a collaborative leadership role in a consortium project. For example, in one of the earliest consortium projects I worked on, an individual who was a postdoc came up with the idea and crafted an outline of what would be a "knowledge portal" that received heavy use during the project to structure different analysis workflows and served as a basis for the collaboration between different partners. Later he received a position in the industry. Another example is a PhD student who stepped forward to perform a pilot analysis for a federated analysis platform of real-world data. Working with real-world data and using a federated analysis approach is a relatively new and cutting-edge approach. He, too, moved forward with a position in industry in which his work on the early analysis had helped him build the relationships that led to the job offer. These opportunities are also a great way to get mentoring from multiple different leaders in a given field. If one has drafted a paper in a consortium project, there is no doubt that multiple people will review it. Perhaps most interesting is that those reviewers are not limited to academics or industry. In both the instances described above, patient stakeholders were involved. Patient involvement in research is more than just a passing trend, and getting their feedback in other settings outside a consortium project is not so straightforward.

To put it in simple terms, collaborating in a consortium project is about the basic principles of collaboration and exhibiting leadership. Engaging as an early career researcher in a consortium project is a great opportunity for both learning and building relationships that can accelerate one's career trajectory.

### **Responsible research and innovation in collaborations**

A concept that has emerged is that of responsible research and innovation (RRI). It includes ethics but takes a wider view. The concept of RRI is defined by STILGOE *et al.* [9] as "taking care of the future through collective stewardship of science and innovation in the present". The responsibility can be further divided into four dimensions: anticipation, reflexivity, inclusion, and responsiveness. The authors propose this as a framework for embedding the deliberation on responsibility within the innovation process.

An important point to note is that this framework incorporates the concept of inclusion, which means engaging with stakeholders and society as a whole. In other words, wide collaboration is an important part of RRI. All of the problems of RRI are potentially deepened when it comes to collaboration. When one collaborates with someone, one has a responsibility to ensure that one's collaborators are following ethical principles. A good practice when one has a large-scale collaboration is to produce an RRI charter that everyone agrees to and ideally signs. However, many collaborations do not require such a formal arrangement. Nonetheless, frameworks like the one proposed by STILGOE *et al.* [9] can serve as a guide for applying RRI and ethical principles.

Building up one's knowledge and literacy on the important ethics issues is worthwhile. As science advances, more and more ethical issues will arise. For example, should we reprogramme cells *in utero* to cure diseases, or does that risk other unethical uses of the technology? It is also a principle of RRI that, as a researcher, one should be wholly informed about the implications of one's research. When one is literate about these issues, opportunities will arise where one can be a leader because of one's knowledge. Lastly, when the ethical issues are relatively new or subject to new regulations, what one can and cannot do can be unclear. Having a degree of knowledge about a topic such as Europe's General Data Protection Regulation (GDPR) may help one to be able to move forward with a line of research that one may otherwise stop because of a misunderstanding about what is ethical. There are six areas where ethics issues commonly arise: 1) authorship, 2) conflicts of interest, 3) data acquisition and management, 4) human protection, 5) industry collaborations, and 6) producing good quality work [10]. Use these areas, as well as the RRI

framework proposed by STILGOE *et al.* [9], as a learning syllabus for proactively developing RRI and ethics literacy. Then apply the acquired knowledge to become a resource for oneself and one's collaborators.

### Action-oriented principles of a collaboration mindset

It goes without saying that collaboration is an essential skill. The opportunity that lies before one is to approach collaboration as a way to develop one's leadership skills while also helping to achieve impact beyond writing and publishing papers. Here are six action-oriented principles one can use for both small-scale and consortium project collaborations: 1) clarify for oneself, with one's principal investigator and with one's group, what methods and assets one has that can be offered as the basis of collaboration; 2) seek out others who have methods that would be useful to one's research projects, regardless of whether or not they work in one's field, and approach them with a "help first" mindset; 3) consider collaborating with others doing research similar to one's own as a means of validating one's findings and their findings; 4) look for opportunities to engage and take the initiative to get involved in collaborative leadership opportunities beyond research; 5) listen and learn in meetings that are focused on solving problems that arise in project implementation; and 6) become an RRI and ethics knowledge resource for oneself and one's collaborators.

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