



Promoting an environment of innovation: A university scientist's view

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KEYWORDS:

culture of innovation; debate; networking; critical mass; financial support

HOW TO CITE:Wingfield B. Promoting an environment of innovation: A university scientist's view. *S Afr J Sci.* 2017;113(11/12), Art. #a0240, 2 pages. <http://dx.doi.org/10.17159/sajs.2017/a0240>

Innovation is a central driving force towards achieving excellence in science. Yet I believe that we often fail to think much about what innovation really is or how to actively promote it. The Wikipedia definition – 'Innovation differs from improvement in that innovation refers to the notion of doing something different rather than doing the same thing better' – provides some insight. Nevertheless, to define innovation clearly requires us to contemplate the difference between innovation and invention. Again, Wikipedia describes this difference well: 'Innovation differs from invention in that innovation refers to the use of a better and, as a result, novel idea or method, whereas invention refers more directly to the creation of the idea or method itself.' Much for us to consider in seeking to be more effective in our research!

A special aspect of innovation is that it requires us to be in a 'special' place where we can think and experiment freely. It also requires critical mass, engagement and an exchange of ideas. Innovation seldom occurs in environments that are 'straight jacketed' by rules and bureaucracy. Unfortunately, the scientific community is subjected to increasing levels of bureaucracy – a feature of the society in which we live; a feature that is not necessarily bad, but it needs to be managed. Provision of a work place that stimulates innovation requires flexibility and agility at all levels. To illustrate this I will share a personal story. When I joined the University of Pretoria in 1998, I brought my computer (an Apple Macintosh) with me. I very soon learned that the University (at that time) did not provide support for Apple platforms. Yet I continued to use my Mac and (often frustratingly for our IT Department) I bought additional units to enable my students to succeed. When I eventually raised this matter at the highest level, I was asked why I was insisting on being difficult. The answer was actually quite simple; I needed these computers for my research and to be able to access programs that had been written only for Macs. The upshot here was that my computer should be categorised as a highly specialised piece of equipment essential for my research; the fact that it looked like a computer, operated as a computer and in fact, was a computer seemed beside the point. But this little story simply illustrates the point that research is conducted in an experimental space that needs considerable flexibility if it is going to be novel and innovative. It cannot be containerised nor packaged by administrators who commonly fail to have the background to understand this issue. To be innovative, scientists need to be able to think and experiment freely in the absence of unreasonable and unnecessarily bureaucratic restrictions. Moreover, in this regard, the best administrators of researchers must be successful researchers who understand where reasonable boundaries lie.

Innovation is what scientists should be doing every day. In many ways, it defines our training: pushing the boundaries of knowledge. Why is it then that some research programmes are more effective and innovative than others? And how can we more actively promote innovation? I certainly do not have all the answers. But after a number of decades of leading a successful research programme, I have developed opinions on some things that work and others that certainly do not. I share seven of these below.

1. Attend national and international meetings

Substantial knowledge of one's field and keeping up to date regarding the latest literature is essential. Participating in and attending talks and seminars provides a strong foundation to connect with the latest work in one's field. Here, an important aspect is attending relevant conferences globally. Ironically, in the perceptions of some organisations or research leaders, international travel is seen as a luxury; sometimes a reward for having achieved some goal. I contest this approach strongly and I view direct engagement with colleagues globally as an essential part of producing effective scientific outputs.

Understanding the value of interdisciplinary research and the need for diversity is a driving force of innovation. It is important to not limit one's reading and research horizons to one's own (often quite narrow) field. The growing – rather overwhelmingly and rapidly – body of literature can make this task seem difficult or even unattainable. I find that one of the easiest ways to deal with this challenge is to attend talks outside of my own field. In this regard, it is quite disappointing to see rather low numbers of researchers attending the many public lectures that are presented on our own campus and other campuses. Those in attendance are commonly close colleagues of the speaker. The question I commonly find myself asking is: Are we talking to only ourselves? How can we change this situation and benefit from exploring the 'bigger picture'? We learn increasingly that the world's most powerful and influential science is emerging from international collaboration, research at the intersections of disciplines and deeper levels of interdisciplinarity – from whence great innovation originates. Yet we commonly seem to be 'missing the boat' in our actions.

2. Avoid limiting interactions at meetings to friends and researchers already known to you

Talks presented at congresses are important. But it is the 'one on one' discussions at poster sessions and during breaks that really define the important outcomes of meeting attendance. This networking is essential and it is where one truly has the opportunity to discover what colleagues (sometimes competitors) are currently doing, often only to be seen in publications months later. I find it amazing to observe members of research groups huddled together at meetings rather than engaging more broadly. It might be perceived as a little dictatorial, but my students are instructed to not spend time with each other at meetings, and to rather engage with others and thus to derive the

real benefits which meetings can bring. And this is one of the strongest arguments for face to face (as opposed to web-based) meetings.

3. Debate ideas constantly

My experience has been that a 'flat' management style enhances innovation. Inordinate levels of hierarchy deter constructive discussion. 'Real' discussions require debate, often prompted by disagreement on issues being discussed. One of my greatest pleasures is finding that the best PhD students disagree with me at increasingly regular intervals as they move towards the completion of their degrees. Likewise, many of my closest research colleagues disagree with me much of the time. Sometimes they are correct, and sometimes not, but this is how we develop strong hypotheses and how we design research to test them. None of us can be correct all of the time and the best possible situation is one in which there is sufficient debate to promote the highest levels of innovation.

It is essential to have the time to talk and especially to disagree until everyone has agreed on a way forward. I set aside my Fridays to talk with students and collaborators. Some weeks we just talk about the results and the next experiment, other weeks we debate some points, and yet others we get very excited about some result or the realisation of a new hypothesis or idea. Thus, my Fridays are both exhausting and energising. Sometimes very little progress is made at these meetings and other times huge advances are made. Sometimes a whole programme can be completely turned around after a 30-min discussion, other times we try for years, unsuccessfully, to answer the same question.

4. Cultivate a stress-free research environment

Stress kills innovation. This is not to say that people who are hardworking and busy cannot be innovative; it all depends on whether they are happy and focused. One cannot be innovative when one is worrying about some or other issue. My example here is that postgraduate students need to know that they have the finances to cover their fees and reasonable board and lodging. At a certain level, this is the responsibility of the supervisor. But granting agencies can also provide support by, for example, providing scholarships on time. Likewise, administrative staff need to understand that many months of potential innovation can be destroyed in situations in which they do not understand that doing

their jobs efficiently is an essential part of the innovation process. And researchers need to know that they will have the support they require in terms of dealing with their finances and budgets.

In many ways, whether one feels stressed is a state of mind. The important issue is to work out how to get to that 'mind space' in which one feels free to innovate. I do believe that this is an advantage that researchers in more developed nations have over those of us working in developing world countries. Unfortunately for South Africa, the recent protests on university campuses have not helped to provide a stress-free environment, and this situation must set back innovation.

5. Apply for financial support but do not make money your goal

Money does not drive innovation. But having sufficient financial support for research is needed to provide the space and tools required to drive innovation. What drives innovation is the perception of the space and freedom to do whatever one wishes.

6. Try to achieve critical mass

To attain an environment of innovation requires critical mass in terms of human capacity and experience. My view of such critical mass is that once we establish a technique or some technological process, we always have someone in the group able to sustain that technique and to teach it to others. In essence, we are not continuously re-inventing the proverbial wheel. This is much easier to achieve in a research institute in which there are permanent staff. In the university environment, we rely on postgraduate students and post-doctoral fellows who are, by definition, temporarily present, which presents a special challenge for maintaining critical mass.

7. Have fun

The fun and excitement of being a scientist is that one gets to do new and different things. One has the privilege of pushing the boundaries of knowledge; to go where no one has gone before. This sounds like something out of a science fiction movie, and in a way it is. Promoting innovation is complex and time consuming. I do not pretend to have all the answers, but when one *does* get it right, it is a very good place to be in.

