# What Makes a Good Research Environment?

June 2023 Kurt Marfurt, Carl H. Sondergeld

As faculty, we are often questioned by graduate students interested in a career in research as to whether they should choose industry or academia. New graduates are slightly biased toward academic research, partly because of familiarity, and partly because they perceive that academia provides greater freedom and opportunities to pursue their passion.

Both of us recently read a book on the Bell Labs Research Center written in 2012 by Jon Gertner, "The Idea Factory: Bell Labs and the Great Age of American Innovation."

It made us recall many of our similar experiences we enjoyed while working at Amoco's Tulsa Research Center from 1981 to 1999. We asked each other if we knew of others who spent half their career in industry research and half in academia. We could think of few – which, we decided, made us uniquely qualified to compare the two career paths.

Most energy resource companies use a behavior-based interview process called "targeted selection" in which a given position is defined by a suite of "dimensions." For example, creativity is a critical skill for a new research geoscientist, whereas time management is nice, but less important. In contrast, time management is a critical skill for a drilling engineer, but we want them to follow rigid safety protocols and not be overly "creative" at the drill site. Targeted selection works in both directions, and we encourage geoscientists interested in a career in research to ask potential employers questions that address our following subjective list of "dimensions."

## Funding and Support Staff

Both industry and academia research funding run in cycles, although the cycles in industry are more frequent than in academia. Nevertheless, even in today's cost-constrained environment, industry research and technology labs provide better equipment and more technical support staff than academia. In industry, you can prototype an instrument or an algorithm, and if it shows value, there are skilled technical staff, machines shops and computer scientists to bring it into production. In academia, technical support is a separate hire financed by your research expenditures such that you need to be good with a soldering iron or good at computer programing to get your idea beyond the prototype stage. Although you are welcome to hire professionals to help out, you need to find the money to support them yourself. Don't count on graduate students to do your dirty work – they need to have an opportunity for research, training or publication to be ethically used in this manner. Even parking comes at a cost in academia, and you are not guaranteed to find a space.

## Freedom to Pursue your Passion

The freedom to pursue your passion is arguably the biggest attraction to a career in academic research. In industry you are instrument-rich but personnel-poor, whereas in academia you are instrument-poor and personnel (graduate student)-rich. Freedom to pursue your passion comes with a "freedom" to find your own funding, research equipment, data and support staff, none of which will be given to you after you have joined the university. In addition, you have a full-time teaching load, with lectures to prepare, papers to grade and theses and dissertations to edit. Surprisingly, there are far fewer meetings in the university than we experienced in industry, but in industry we had four days a week to do research. Although industry research problems were business-driven and rarely ones that we directly chose, we had near total freedom as to how we went about trying to solve them. Industry provides a direct connection to real-world problems with the opportunity to see your research products used. The business funding cycles lead to constant change. At Amoco we seemed to reorganize every two years, driven by the dropping oil prices and the latest new book on management – resulting in being asked to do research in a totally new area where you (and possibly no one else) have little experience. At the end of 20 years in industry, we both emerged with a very broad range of skills that uniquely prepared us for a career in teaching. In contrast to industry, obtaining funding in academia requires demonstrated expertise in the research project you are proposing, leading to a much narrower opportunity to broaden your skills over time. In academia, the tenure process requires highly focused expertise and external funding requires an established publication record. For these reasons, it is not uncommon for academics to spend 40 years in the same narrow field of investigation.

## Peer Groups and Peer Recognition

After reading Gertner's book on Bell Labs, we realized that this is the part of industry research we missed most. Our most common exchange of ideas came during the enforced coffee breaks, enforced lunch times and enforced walks on the grounds after lunch. At Amoco, a given research team – whether it be rock physics or seismic attributes – consisted of about eight to ten professionals. This team was augmented by a group of 20-40 "customers" in the business units who used our research and provided valuable data, guidance and feedback. In academia, most schools might have only one exploration geophysicist, petrophysicist or petroleum geologist (you!) with only a few having as many as five. In academia, you need to find your peer group outside your work environment, either at other universities, or if possible, with industry. In industry, collaboration with academics and service providers/customers/partners is generally encouraged, whereas collaboration with competitors is limited to interactions at professional society meetings. In both industry and academia, the most valued recognition is from peers at a competing institution rather than from the dean or the company vice president, neither of which we felt were qualified to evaluate our work.

Typically, industrial research enterprises held annual technical reviews showcasing advances and accomplishments coupled with strong team-building activities. Such parallels do not exist within most academic institutions. Amoco being an international enterprise provided an exposure to global geology and cultures, broadening both personal development and scientific perspective.

## Freedom to Present and Publish

Like the freedom to pursue your own research, the freedom to express your ideas is overrated by folks outside academia. True, in the university environment you are free and highly encouraged to publish any scientific findings you and your work team might make in the peer-reviewed literature. However, unless you are an Officer of the institution, you cannot represent the university in other ways without explicit permission from upper administration. The ability to publish your research varies across the industry. Almost all companies will want to vet the paper to make sure it reflects positively on the company and is aligned with their business plans and doesn't compromise any potential scientific advantage. Another avenue for disseminating research progress and gaining recognition takes the form of internally offered courses. Service companies want to showcase their technology, with many not only encouraging publication, but providing financial incentives to those who successfully do so. For energy and mining companies, your strategy should be to show management how publishing your work may enhance the company's opportunity to be a preferred operator or a strategic partner with resource owners and competitors.

## Career Advancement, Continuing Education, Training

Career advancement in academia is quite linear. Most North American universities follow the tenure system. The "union card" to enter a career in teaching is a piece of paper with "Ph.D." written on it. After that you start as an assistant professor with a heavy workload, high expectations, and only moderate support from administration and more senior faculty. If successful, you progress to an associate professor with tenure, where you may stay for the rest of your career. Those faculty with strong publication and external funding credentials become full professors. One way to accelerate this slow progression is to switch universities, which disrupts family, incurs moving expenses and can negatively impact retirement benefits. Money is king at universities, but be aware that upper administration falsely think that federal funding is "competitive" and industry funding is "easier" to obtain. There is no formal technical training for faculty in the university. Although you can sit in classes taught by a colleague, the more common way to broaden your skills is to co-advise a graduate student with a colleague, whereby each of you learns many of the skill sets of the other. Furthermore, there is little to no support for team or co-teaching; faculty evaluations are biased towards individual performance weighted by research expenditures rather than by stellar teaching. University faculties can be internally competitive and less than collegial, with "the knives being so sharp because the prize is so small." In contrast to academia, most industry research labs have a well-funded and highly encouraged continuing education program. Week-long geology field trips with research colleagues, management and business unit customers were high points of our time at Amoco. Most careers encounter a dry period where you feel trapped. In industry it is common to rotate out into a technology group or a business unit, providing new experiences, skills and perspective while maintaining the same financial benefits as in your previous research position. Unlike academia, not all research scientists in industry hold a doctorate. At Amoco, half of our professional staff rotated in from the business units, bringing with them the critical hands-on skills in seismic processing, well log analysis and interpretation as well as a perspective on how technology under development can be applied. They brought valuable experience-based observations to help market technologies that needed clarification on its use, as well as insights into competitive technologies.

## Job Security, Salary, Career Earning Potential

Job security in an early academic career is tenuous. The tenure process can be brutal and works against scientists starting a family. Career-long employment with any one company went away with Bell Labs in the 1970s. Career-long employment in any one sector of business is also a thing of the past. Cycles in industry have become shorted over time. The paternalistic industrial environment was shattered in the 1980s. Industry researchers need to be fungible, willing to take on tasks in which they are not the expert and learn new skills for the next stage of their career, with or without their current employer's help. Industry salaries are significantly higher than academic salaries. This has a direct consequence on the salaries offered to support staff and the resultant capabilities. This salary discrepancy is partially compensated by the increased job security of a tenured academic position. In the end, it all balances out, with the professional career earning potential being the same – with industry researchers working from age 30-55 (perhaps with one- or two-years' hiatus) and academic researchers working from age 30-70!

## Concluding Thoughts

Our perspective is biased by our experience in Amoco's Tulsa Research Center. The research environment was rich in feedback and professional synergies. We were fortunate in the early years to have had one of the best vice presidents of research we have experienced. We had renowned leading scientists who fostered and supported "research." Research was different 40-20 years ago, with our first 10 years focused on fundamental "value added" problems and the second 10 years on problems provided by the business units. Even in this latter business-unit focused stage, like at Bell Labs, 10 percent of our time was charged to a serendipity project where we could chase ideas we thought might be useful. Our focus is also North America-centric. Academics in many countries enjoy much greater prestige than academics in North America. Depending on the country, this prestige is not matched by salary, with many young faculty leaving academia for industry in order to pay for their children's private schooling so that they too can have the opportunity to become a scientist. The choice of career path is highly personal, and not always under individual control. In our case, we didn't leave industry research. Rather, industry research left us, with an oil company merger. This turned out to be a better career path than we could have imagined at age 25-30, with the first half of our career conducting well-funded research within a large peer group, developing the skills and contacts needed in the second half of our career in sharing these skills through teaching and conducting industry-funded research.

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Carl Sondergeld was professor and Curtis Mewbourne chair at the Mewbourne School of Petroleum and Geological Engineering at the University of Oklahoma. He earned a doctorate in geophysics from Cornell University and his bachelor's and master's in geology from Queens College, CUNY. He spent 19 years at the Tulsa Research Center of Amoco Production Company where he conducted research in petrophysics and rock physics, developed a portable wellsite core analysis system and developed a full waveform sonic logging tool. He held 14 U.S. patents. He has been at the University of Oklahoma for 17 years teaching petrophysics, intro. to petroleum engineering, geological well logging, petrophysics of unconventional resources, and seismic reservoir modeling. He is a two-time winner of the Brandon Griffin award and four-time winner of the SPE Student

Chapter Professor of the Year Award. He conducted research on unconventional reservoir rocks, in particular shales, and in the areas of microstructural characterization, anisotropy, NMR, petrophysics, hydraulic fracturing and seismic reservoir modeling. He passed away late last year at the age of 75 after a long and courageous battle with cancer.