



Innovation and the States

By William C. Harris

One of my favorite philosophers, Yogi Berra, may have said it best: “When you come to a fork in the road...take it.” That mindset may explain why I left my position in 2001 as Professor of Chemistry and Vice President of Research at the University of South Carolina (USC) to head to Ireland. That also may help explain why I decided to come to Arizona in 2006 after serving for five years as Director General of Science Foundation Ireland (SFI).

I believe that we are at a fork in the road in this nation — that we are more in trouble than we want to admit and are more inclined to simply hope that things will get better than to make the tough choices to change the situation. But hope is neither a plan nor a formula for a better future. My five years in Ireland gave me the opportunity to look closely at that small but extraordinarily vibrant country and help shape its serious commitment to making smart and strategic research investments and, through them, continue its economic growth.

The Irish offer was a once-in-a-lifetime opportunity, as Ireland’s leaders promised nearly \$1 billion for strategic research investments by SFI — an enormous sum of money for a small country with a population only one seventieth of the U.S. More importantly, we were given a “blank sheet of paper” to design SFI as well as the freedom and flexibility to put in place a great group of people to build it. This included such colleagues as Alastair Glass, a distinguished researcher and leader of Bell Labs and a member of the National Academy of Engineering, and former National Science Foundation scientists Rich Hirsh and Gary Crawley.

It is important to understand that the Irish have a strong international focus — a special ability to network and connect worldwide — that is central to its business culture. While only a population of four million, Ireland can count approximately 40 million people with Irish roots in the U.S. and some 70 million people in the world claiming Ireland as their home country or the source of their family’s heritage. The global connectivity of the Irish encourages openness to valuable opportunities that emerge.

The SFI team experienced this practical openness firsthand. Initially we focused on getting to know university and business leaders throughout Ireland, but not long after our founding we were asked to develop a new R&D relationship with the economically emerging nations of China and India. We were intrigued by the hearty confidence required for Ireland to pursue partnerships with two nations representing a combined population of nearly 2.5 billion.

But Ireland had come a long way in a relatively short time. The roots of how Ireland achieved its status as a *Celtic Tiger*¹ — one of the world’s fastest-growing economies — dates to at least the mid-1960s. The policies from this era sowed the seeds of economic growth and success for a young nation. These policies encouraged foreign direct investment and enhanced the Irish Development Agency (IDA); established free secondary education; and lowered taxes on manufacturing to 10 percent to attract companies to Ireland. Importantly, this tax policy was highly strategic and intended to attract a large number of advanced, and high-paying manufacturing jobs to Ireland with the revenue needed for government services generated from income, sales (VAT) and property (stamp duty) taxes, for example.

¹ <http://www.heritage.org/research/worldwidefreedom/bg1945.cfm>

This strategic decision-making underscores the value of Ireland's active democracy, where citizens know their politicians and demand responsiveness and effectiveness. This intimate political culture creates energetic competition for elected positions among many of the best and the brightest; focuses on competence and performance with clearly articulated goals; and led to the funding of education at the secondary and college levels to create a literate *and* numerate population -- the foundation for international success.

The Irish experience may suggest useful insights for specific U.S. states, particularly for pursuing wise, long-term and strategic policies. The process in America today is more *ad hoc*, with decisions at the state and federal levels geared to finding quick fixes for the budget crisis of the moment. The federal actions in late 2008 seem merely an exaggerated symptom of a problem that has entrenched itself among American leadership.

Federal Government Leadership/Trends: Given the current policy climate, it is easy to forget that the U.S. has led the world in research and education for a long time. In the first decade of the 20th century, we started mandatory education through high school to support growth and cultivate the talent that industry needed. Following that, after WWII, the GI Bill – one of the most remarkable pieces of legislation ever passed – democratized our universities. In a relatively short time, nearly 25 percent of our population had obtained college degrees. This investment in talent created special American advantages, a fact that we have never fully celebrated or appreciated as a nation. We must connect the dots: We could not have had a GI Bill if those GI's had not already been high school graduates.

Add the Morrill Act of 1862 to this policy picture. That innovative legislation created land grant institutions and fostered industry-university partnerships that helped transform the U.S. from an agrarian economy to an industrial and higher-income society. Such policy decisions were not easy to accomplish, but made a huge difference for the nation, indeed the world. More recently, consider the importance of our national commitment to invest in research, which spawned the NSF and NIH. Vannevar Bush's short treatise at the end of WWII, *Science: The Endless Frontier*, led to a paradigm shift in how the federal government supported research. His report also provided a policy framework and rationale for federal research support, urging a new covenant with universities to become both teaching and research centers — and a special source of talent and creativity. Nearly three decades ago, in 1980, the most recent piece of potent legislation in this vein was passed, with the Bayh-Dole Act², which created incentives to exploit the output of federally funded research in the private sector to benefit society.

These initiatives *allied* national interests with investments in the American university system. As a result, this system emerged to combine research and education and produce top-notch graduate students able to tackle difficult issues and move boldly into new fields of inquiry and exploitation, transforming talent and opportunity in ways that continue to replenish the system itself – as well as the economy. This system became the envy of the world.

Yet, despite such successes borne out of government policies, we have stood by while our educated technical workforce declines which may require U.S. companies to move engineering

² http://en.wikipedia.org/wiki/Bayh-Dole_Act

(wealth creation) activities offshore to find the talent needed. In fact, the research effort of our federal government is decreasing as a percentage of GNP and has fallen below that of other countries³. More than that, our trade balance in high-technology goods is negative and our total public indebtedness has grown from \$5.9*Trillion* to a staggering level of \$10.6*Trillion* during the past 8 years.⁴

State Government Leadership/Trends: Unfortunately, the same *ad hoc* approach to policy and strategic investment that seems to define federal actions is also evident in our states, though there are signs that many Governors and legislative leaders now recognize the need to respond to the challenges of the 21st Century economy more innovatively. One of the challenges at the state level is accepting the opportunity/responsibility to support *competitively* reviewed strategic R&D activities in order to leverage more effectively current Federal investments made in their states. It is useful to recognize that a large number of smaller countries (i.e., the size of many US states) in Europe and Asia understand the advantages created for their economies through strategic R&D investments as it gives them the ability to adjust more quickly to new opportunities and to make sure they are focusing on supporting the most effective business environment for innovation and new products – or wealth creation.

Perhaps the disconnect between the state and federal R&D policies and responsibilities is simply due to history – that is, in the post-WWII era it became *accepted* that a sharp focus on R&D was the federal role – mostly for national security reasons. While national security remains a critical federal responsibility, it may be time to encourage or create appropriate incentives so that state governments begin a serious focus on R&D – to help create an economic competitive advantage in their state for existing and new industries and benefit more significantly from the huge federal R&D investments now in their universities.

It is possible the assumption that R&D was a federal responsibility for more than 50 years helped disconnect legislators in some states from what their state needs for economic success in the 21st Century: agile and well-educated people that are truly ‘world class’ and measured as such. Economic challenges now require states to question whether the *monolithic* central or federal model works in the 21st Century -- in the 24/7 global work environment. Speed and greater agility are needed. If the nation is caught in an endless cycle of short-term, bureaucratic fixes, then states must be fast, focused and flexible and create the policies effective for their economic success – for their children and grand children.

Ireland and other small nations may offer lessons that U.S. states can borrow to develop knowledge-driven economies capable of competing successfully on the world stage. These lessons include operating independently, demanding excellence and achievement in education, and not relying on the federal government to carry the *full* burden of R&D. In 2006 Arizona – a state that had not previously invested directly in research – established a \$135M public-private partnership to help catalyze a focus on innovation. The state had already taken significant steps in that direction by investing in new university laboratories and pursuing an innovative approach to higher education at Arizona State University (ASU).

³ <http://www.aaas.org/spp/rd/prel08p.htm>

⁴ <http://www.treasurydirect.gov/NP/BPDLogin?application=np>

The need for a more diverse economy in Arizona was central to the creation of SFaz. Arizona's governor, business and key legislative leaders wanted to demonstrate value-added from a new model — a novel 501c3 entity. But this entity could not be provincial in a global era. Instead, to help provide a clear focus on innovation of national and global significance, notably within areas of strategic importance, SFaz established a twelve-person board of directors⁵ with six members who live outside of Arizona. This board expects SFaz to explore new ways of stimulating and enhancing innovation statewide, including by leveraging federal R&D investments within the state.

What best practices from Ireland and other successful small countries do we hope to borrow or adapt for Arizona? This short list establishes the essential framework:

- **Be business friendly** — to be a truly disruptive force, the foundation must listen to business and help make Arizona America's most IP-friendly state;
- **Invest strategically in industry-university partnerships** — the foundation must pursue projects that will create a competitive advantage and take advantage of the Bayh-Dole provisions;
- **Operate with speed and flexibility** — the pace of competition requires that the foundation work far more quickly and opportunistically for Arizona;
- **Shape new federal-state partnerships** – The impact of every dollar must be maximized, and the foundation stands at a special juncture between the two entities to catalyze innovation by bringing talent and resources from both together; and
- **Focus on exceptional standards for K-12 education** — the foundation must keep dialogue and pressure on the fact that *proficient* is no longer sufficient; world-class must become the standard.

A focus solely on federal R&D investment will simply not work anymore. The need to nurture talent above all else raises three ideas related to both the gravity and the potential of our current situation.

The first idea relates to the ways that vital societal duties have been assigned. The federal government has the prime responsibility for basic research and is the main beneficiary of its results. But in areas of sustainability, education, aerospace, biosciences and agriculture, some states – such as Texas, New York, Ohio, Pennsylvania and yes – Arizona – find it beneficial to invest state tax dollars in strategic areas of knowledge generation. In Arizona, for example, it is solar and wind energy, sustainable mining, personalized medicine, and new materials and software related to our computer chip and aerospace sectors. Such investments, moreover, complement NIH, NSF, NASA, DOD and other federal R&D investments in Arizona. SFaz links discovery and use to create advantages for Arizona and the U.S.

As to the fear of duplication of effort between states, at SFaz we would argue that competition might be desirable because it can *spur* excellence. Competition for the best in research is hardly

⁵ <http://www.sfaz.org/about-sfaz/our-leadership.aspx>

a zero sum game. It produces new ideas, it pays economic dividends, and, most importantly, it is the best way to develop human capital – the fuel of innovation.

The second idea is to recognize a fact at the core of any R&D plan, as the Bayh-Dole Bill or Morrill Act⁶ (Land Grant Act), among many other examples, reflect: While the federal government has the *primary* responsibility for the research infrastructure, states and localities are primarily responsible for the educational system that touches more lives than any other, the K-12 system. America’s K-12 education system clearly does not match up to the world’s successes, not least compared to that of many of our trading partners, as numerous comparisons show.

Again the past is instructive. Could elements of the Land Grant Act of the 19th century, which created our public university system and focused on promoting “the liberal and practical education of the industrial classes in the several pursuits and professions in life,” suggest a more effective approach to our K-12 predicament?

Consider, for example, within this context the Science, Technology, Engineering and Mathematics (STEM) centers that evolved recently from a focus on innovation by the National Governors Association (NGA). Using the STEM centers with elements from the land-grant model, could we engage the scientific and engineering *disciplines* in new ways in the preparation of science and math teachers? Could colleges of education explore new models – perhaps even borrow the land-grant model – and create extension centers in communities throughout the state where they would be the source of support, innovation and problem-solving? Can we establish national standards – pointedly, not federal standards – in science and mathematics and use the STEM center to inspire success as measured by international comparisons? These suggestions are not meant to be prescriptive but to inspire new thinking. Unless models emerge to give the U.S. a new global advantage, the continuation of current trends will make us increasingly less competitive and successful.

In a similar spirit, a third idea arises from the problems with the model we are following in higher education. While our top 25 research universities offer the U.S. an innovation advantage, not every state can boast such an institution given the resources required to perform at such a level. Moreover, our nation needs diverse types of institutions given the complexity of our economy and society. But this diversity can become costly if there is not thoughtful and effective integration of the many institutions involved. Students must be able to move from one institution to another depending on their performance, progress and interest, not be impeded by rigid institutional practices unfit for the global competition in which every student, and thus every state, is involved.

We have models in place that provide a good starting point. California, for example, has arguably the best model. In addition to outstanding private universities, it has the University of California (UC) system, and is home to the largest state university system: California State University (CSU). The CSU system includes, for example, Cal Poly San Luis Obispo, which excels with a “learn by doing” approach that enables it to produce outstanding graduates with scientific and technical backgrounds.

⁶ http://en.wikipedia.org/wiki/Morrill_Land-Grant_Colleges_Act

This CalPoly approach -- or the model of Arizona State University, which is focused on being the New American University⁷ and invests in programs explicitly connected to state goals -- represent exciting visions of how public higher education can be performance driven within a complex economic ecosystem. They offer a promising complement to our top 25 and exceptionally well-endowed research universities and could help inspire a state-level culture of innovation – akin to the impact of the land-grant model on the agrarian society.

The days when the U.S. possessed a clear and present competitive advantage are over. Many of our global competitors have learned our old game and are now playing it better than us. Some countries are considerably better at K-12 education and are producing more talent. Many Asian countries are producing extraordinarily able scientists and engineers; we can no longer count on their top talent moving here. Unlike during the Cold War era, the U.S. now faces global markets with billions of new people as well as significant universities in Asia and Europe. Perhaps current economic conditions create the kinds of pressures necessary at last to inspire new approaches, including state-level R&D entities that can operate as strategic arms of our national enterprise.

I am encouraged that the leadership of Arizona sees the 21st century as the “endless frontier.” This vast landscape promises enormous opportunities for exploration and fresh design. But it will require bold experiments at every level if we are to expand our horizons and gain ground. The alternative world, in which the frontier is closing, is one into which America seems to be staring complacently. That is unacceptable. We are at a fork in the road, and we should take it.

⁷ <http://www.asu.edu/president/inauguration/address/>