

INNOVATION LESSONS FROM IRELAND

America urgently needs to capitalize on the talent and diversity of its states, says a science administrator from Arizona and Ireland.

William C. Harris

OVERVIEW: *No company or nation will remain in a leadership position without continuous innovation, strategic investment in R&D, and effective means for realizing the greatest value from discoveries and technological advances and exploiting the talent of its population. Strategic incentives at the federal level can enable significant innovation in the United States and stimulate a dynamic and competitive approach to R&D and education. The Morrill Act of 1862 that created the U.S. land grant universities needs a new focus to meet today's volatile economy. Then as now, these universities should be driven by pragmatism and recognition that a focused connection between them and economic and societal challenges can create a competitive advantage for the individual states and economic regions. Demonstration projects should be initiated in 10 to 15 states so the innovation potential can be thoroughly assessed. Performance metrics and strong external boards to guide these projects—with national and international members—will ensure value for money invested.*

KEY CONCEPTS: *public policy, leadership, R&D partnerships.*

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This is a commentary about innovation and America in the 21st century; it is about capitalizing on talent and diversity in the American states, and it is about creating value for America in turbulent times (*I*). What could be more appropriate than to open my story on 9/11. I began five years of service as founding Director General of Science Foundation Ireland (SFI) on September 11, 2001 and now continue as founding president and CEO for Science Foundation Arizona (SFAz).

It is my intent here to outline my work in Ireland and Arizona with particular focus on lessons learned. The essential difference I observed in Ireland was emphasis on effective public policy and targeted implementation. Ireland takes policy-setting very seriously, involves its leaders and experts in formulating it, engages the public in commitment to it, and follows through with goal-focused execution for a decade or more. The goals that shaped implementation strategies—national prosperity and quality of life—have been broadly supported by the public in no small part because of the quality of the deliberations and participants that shaped strategy to achieve the targeted objectives.

By contrast, policy-setting in the U.S. appears now to be *ad hoc*—at least that is how it seemed from abroad. Up close, a better description of our policy-setting might be *flip-flop*. We discard policies after elections often because of “competition” and philosophical differences between Republicans and Democrats. This is a costly and highly ineffective way to set policy. It limits our ambition and our aspirations in no small part because of compounded cost to the U.S. Treasury.

Given this climate, it is easy to forget that the U.S. has led the world in research and education for most of the past century. We made education available through high school to support growth and cultivate the talent that industry needed. The GI Bill, instituted after World War II and one of the most remarkable pieces of legislation we ever passed, democratized our universities. In a relatively short period of time, nearly 25 percent of our population

obtained college degrees. This compared to approximately five percent in the rest of the world, with only a small percentage of the population holding even high school degrees. The U.S.'s unique "knowledge advantage" was a fact that we did not celebrate or fully appreciate as a nation. We could not have had a GI Bill if those GIs had not already been high school graduates.

The Morrill Act of 1862 extended the education policy picture (2). This innovative legislation created land grant institutions and fostered partnerships between the universities and industry of the day (agriculture and mechanical arts) 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 they made a huge difference for the nation, indeed the world. Consider the importance of our national commitment to invest in research, ultimately spawning the National Science Foundation and the National Institutes of Health. Vannevar Bush's short treatise at the end of World War II, *Science: The Endless Frontier*, led to a paradigm shift in how the federal government supported research, and encouraged universities to become both teaching and research centers—and a source of future talent and creativity (3).

U.S. Complacency

In the early years of this decade, the U.S. came to be viewed from abroad as complacent. And because of new visa restrictions that significantly affected foreign science and engineering graduate students' ability to remain in the U.S., it was generally believed that the U.S. would, over time, become less economically competitive. Other countries in Europe and Asia realized they could compete more effectively with our innovation system by investing at home in talent and high-quality education.

One of my favorite "philosophers," Yogi Berra, may have said it best: *When you come to a fork in the road ... take it* (4). I believe we are now at a fork in the road in the U.S.—that we are in more trouble than we want to admit and are more inclined to simply hope that things will get better as we continue to do what we have always done. But hope is not a plan or a good way to create a path to the future. My five years in Ireland gave me the opportunity to look closely at that small but extraordinarily vibrant "Celtic Tiger" and help shape its serious commitment to making smart and strategic research and innovation investments and, because of it, continue its economic growth (5).

Sean Dorgan in *How Ireland Became the Celtic Tiger* summarized how Ireland achieved its status as one of the world's fastest growing economies, a process that dates back to at least the mid-1960s (6). The government

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leaders of that era focused on key policy issues to spur economic growth and help the young nation sow success: Ireland established free secondary education and lowered taxes (7) on manufacturing to 10 percent (now 12.5 percent) to attract foreign direct investment (FDI) and draw a large number of advanced manufacturing jobs (i.e., high paying) to Ireland.

These policies were transformational and spurred impressive gains in Ireland. This strategic decision-making also underscores the value of the very active Irish democracy, where citizens know their politicians and demand responsiveness and effectiveness. This in turn creates energetic competition for elected positions among many of the best and the brightest. An important early achievement due to these policies was funding quality education at the primary, secondary and college levels to create a literate population, a highly capable workforce, and the foundation for international competitiveness.

Ireland's offer to me to serve as Director General for SFI was a once-in-a-lifetime opportunity. Government leaders promised nearly \$1 billion over five years for SFI strategic research investments—an enormous sum of money for a small country with a population only one seventieth of the United States. More importantly, we were given a "blank sheet of paper" to design SFI to fulfill goals shared by our sister agencies—for current and future economic growth. We also had the freedom and flexibility to put in place a great group of people to build it. The metrics were clear from the start: realize value from the investment (8).

The Irish experience suggests useful insights for specific states in the U.S., particularly in its commitment to pursuing thoughtful, long-term and strategic policies. Like U.S. states, Ireland is part of a broader union. But it took the initiative to develop its own R&D funding arm rather than depend solely on European Union programs, even though these are quite substantial. Ireland aimed to fund R&D relevant to its own unique needs.

International Focus

It is also important to understand that the Irish have a strong international focus with a special ability to network *and* connect worldwide that is central to their business culture. While a population of only 4 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 (9). This connectivity encourages its citizens to maintain international connections with the notion that at some point in the future a unique opportunity may emerge.

In late 2005, the SFI team was asked to develop a new R&D relationship with China and India that would help build a new economic partnership for Ireland. The SFI success was actually referenced in Thomas Friedman's book, which focused significant attention on these dynamic countries (10). We were intrigued by the hearty confidence Ireland possessed to pursue partnerships with two nations representing a combined population of nearly 2.5 billion—almost 50 percent of the world's population.

Clearly, this initiative offers a model worth emulating by U.S. states motivated to develop their own knowledge-driven economies and to compete successfully on a world stage.

States Lack an R&D Focus

Today, most state governments in the U.S. do not have a sharp focus on R&D since the federal role has been so dominant for so long. This lack of focus may have the unintended consequence of disconnecting legislators from what their state needs for economic success in the 21st century.

Investment in R&D at the state level can create a significant advantage in attracting and retaining industry and in keeping that industry competitive. Over the years, our steel and automotive industries lost their competitive edge compared to our aerospace industry, arguably, because the aerospace industry benefited from significant government R&D investments, especially from defense agencies. The U.S. aerospace sector remains the best in the world and continues the vital task of supporting both our national security and our economic competitiveness today. This would not be possible without the significant innovation in electronics, materials and other advances based on research and talent provided by the universities.

States and our entire nation must become *fast, focused and flexible* if the U.S. is to remain a leading place for innovation. Pilot R&D investment programs in states offer a competitive advantage because a monolithic

centralization of R&D in federal programs is challenged to provide the speed and diversity to compete well in a 24–7 global economy.

Arizona Meets the Challenge

To meet these new challenges, the State of Arizona has taken significant steps in the right direction—by investing in new university laboratories, the Translational Genomics Research Institute (TGEN) and by supporting an innovative approach to higher education at Arizona State University (11). For example, ASU is developing a new model for the American research university by pursuing research that contributes to the public good and assuming major responsibility for the economic, social and cultural vitality of the communities that surround it. Like many universities, ASU has added new buildings, hired new faculty and admitted new students. But, unlike many of its peers, ASU has undertaken a massive reorganization of the institution. Walls between disciplines have been removed and collaboration is encouraged among diverse units. But still more was needed to advance the state.

These broader innovation imperatives, along with the need for a more diverse economy in Arizona, were central to the creation of Science Foundation Arizona. Arizona's governor (12), together with business and key legislative leaders, wanted to demonstrate value added from a new model: a novel 501(c)(3) non-profit entity. In 2006, a \$250 million public-private partnership (50 percent state-matched by 50 percent from the private sector) was initiated to catalyze innovation. We were charged to focus on helping catalyze innovation in areas strategically important to Arizona, stimulating innovation statewide, and leveraging greater return for our state from the federal investments in R&D.

Best Practices from Ireland

Lessons Ireland offers include operating more independently, demanding excellence and achievement in education, and not relying on the central EU government to carry the whole burden of R&D. Some of the “best practices” Arizona is borrowing or adapting from Ireland include:

- *Invest strategically in university-industry partnerships.*
- *Operate opportunistically, with speed and flexibility, for Arizona.*
- *Focus on exceptional standards for STEM (science, technology, engineering, and math) K-12 education.*
- *Be business-friendly, a truly disruptive force listening to R&D-driven business entities and becoming the most IP-friendly state.*

University-industry partnerships

A growing number of states, including Arizona, will find it increasingly necessary and beneficial to invest state tax dollars to support research in areas of great benefit to its citizens. 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. To be sure, our investments are catalytic but complement and build on the NIH, NSF, DOE, NASA, and other federal R&D investments in university research in Arizona (13).

SFAz connects the dots—between discovery and use—to create advantages for Arizona and the United States. Examples of these new R&D partnerships in Arizona include the Institute for Mining at the University of Arizona that has 15 significant industry partners; the Solar Technology Institute that has initiated programs from concentrated solar energy to energy storage; a strategic investment at Arizona State University that is transforming algae to jet fuel; a spin-off company started by a private investor to demonstrate the value of the R&D program for private airlines and the DOD; and the Critical Path Institute (C-Path) transforming drug development through the work of its three consortia that include more than 500 scientists from the 30 largest global pharmaceutical companies, the FDA and its European counterpart, EMEA.

Operate with speed and flexibility

Unlike the Cold War era, the U.S. now faces global markets with billions of new people in the market and significant universities in Asia and Europe. Our bureaucracies need refinement, if not wholesale redesign at the state and federal levels. We need agencies that are nimble and energetic. We need to create a more dynamic system in which strategic R&D investment decisions can be made in weeks, if not days. In the 21st century, R&D decisions that take nine months to a year or more should no longer be acceptable.

In Ireland, the emphasis was on getting things done. Government agencies acted to ensure that industry could be fully successful and the leadership focused systematically on issues related to economic performance, education and innovation. In the U.S., unfortunately, beyond national security, we seem less able to recognize the importance of working together to advance our economy and education systems. We are drifting and we may be missing the opportunity to lead critical sectors such as “energy technology” (14). Maybe we really do need a new Sputnik (15).

STEM K-12 education

While the federal government has the prime responsibility for our research infrastructure, the states and localities have that responsibility for the K-12 education system. And although the K-12 system is crucial to our

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competitiveness and well-being, it does not rate our high school graduates highly in science and mathematics when measured by international standards.

A significant number of countries are now considerably better than the U.S. at K-12 science, technology, engineering, and math education and, as a result, are producing more and better talent. With many Asian countries producing extraordinarily able scientists and engineers, we can no longer count on their top talent moving here. This takes away an advantage American universities and industry have long enjoyed.

An expressed state R&D investment strategy would inform state legislators about the need to focus on science, technology and math education in K-12 because it is connected to economic prosperity. SFAz has initiated a number of investments that connect education to “hands on” experience; thus, students understand the “what and why” driving the course work. And we are focusing with significant success on the Hispanic American communities in rural Arizona and growing our own talent pool so that high-technology employment centers—such as Fort Huachuca (16)—will have the talent they need (17). The work is a partnership with Cochise College and the local K-12 school system.

In addition, SFAz supports a program with area businesses like Raytheon and the science and math teachers in Tucson. It gives teachers “real world” experience in the summer while earning a master’s degree from the University of Arizona during this three-year program. Our pilot programs are successful because of the concern the business community has for the region’s future.

Business-friendly

Our national rhetoric suggests we are business-friendly but our bureaucratic systems continue to grow and lose

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direct connection to our economy, our industries and their challenges. Imagine if we “re-invented” the land grant university model for the industry and education challenges of the current era with state and regional institutions focused on state and regional challenges and opportunities.

We should continue to recognize the value of the 1980 Bayh-Dole Act and the opportunity it gave to universities and others to exploit discoveries supported by government funding (18). After almost 30 years’ experience with Bayh-Dole, it may be important to experiment with approaches to our execution of modern R&D partnerships so that we have the speed and focus now required to translate innovation to effective public use.

In Ireland we found U.S. industry R&D leaders anxious to work with Irish universities because they and SFI seemed less bureaucratic than U.S. counterparts and because Irish legislation supported exploiting discoveries in Ireland (19).

In an ideal world, the states would take the initiative to invest in strategic R&D on their own in response to explicit strategic priorities—just as Ireland did. However, in view of the current economic crisis, a federal investment program may be needed to stimulate strategic state R&D initiatives.

I believe the 21st century can continue as the “endless frontier” for the United States. Yet, to expand our horizons and gain ground will require bold experiments at every level. The alternative world, one in which the frontier is closing, is unacceptable. We have it within our reach to retain our nation’s strength in education, research and innovation. The nation would be well served by the federal government initiating a series of competitive pilot programs—perhaps in 10 to 15 states—to encourage innovation by connecting the business community and strategic assets of a state or region to the universities in new ways. It is time to engage. ☺

References and Notes

1. Some of the themes in this paper are explored more fully in my forthcoming book, co-authored with Steven Beschloss: *Adrift: Why America Must Commit to Hard Work, Excellence and Purposeful Action Now*.
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5. Ireland’s economy has been hurt by the ongoing worldwide recession but the citizens are highly educated and resilient; thus, Ireland remains a *guide* to policy setting and “joined up thinking” for many U.S. states.
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11. <http://www.asu.edu/inauguration/address/>
12. The Governor now serves as U.S. Secretary for Homeland Security.
13. For two years in Arizona, SFAz benefited from a strong public-private partnership that created a dozen new companies, unique R&D partnerships that focused on solar energy, environmentally sustainable copper mining, and seeded a significant algae-to-jet-fuel program, etc., which are on the SFAz web page (www.sfaz.org). While the SFAz model offers an approach for other states, it depends on the integrity of the public-private partnership. SFAz suffered from state legislators renegeing on the promise of public funding (50% of total); yet SFAz continues to demonstrate its value because of continued investment from the private sector.
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