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## Maine's Innovation Prospects: What the Research Can Tell Us

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# Maine's Innovation Prospects:

## What the Research Can Tell Us

by Linda Silka

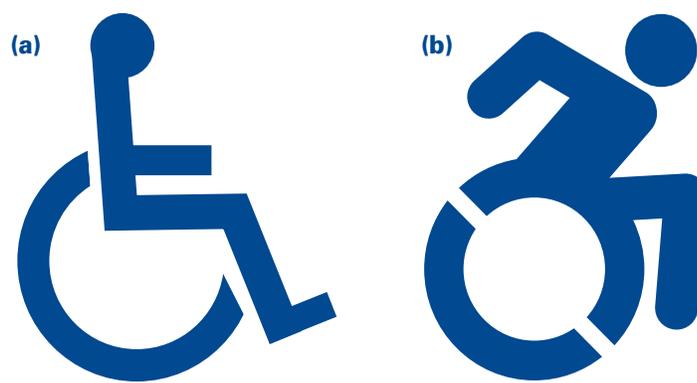
*The literature on innovation suggests Maine faces a number of challenges. In this overview article, Linda Silka discusses the literature, noting how recent findings about boundary spanning point to the importance of both individual skills and group collaboration in innovation. Silka highlights the implications for policies to jumpstart innovation and suggests the importance of looking to history, looking across topics, looking across disciplines, looking to other states, and looking to other countries to avoid becoming too short-sighted and parochial in approaches.*

Innovation can be surprisingly simple yet exceedingly complex. At its essence, it involves finding ways to see the familiar with fresh eyes. Consider something as seemingly straightforward as the signs we see everywhere marking parking spaces reserved for the disabled. The symbol has remained unchanged since 1968 (Figure 1a). Yet, the artists involved in the Accessible Icon Project (ref <http://www.accessibleicon.org>) saw what was invisible to so many others. The old image was not solely informational: it conveyed messages on societal attitudes about disability. According to an article in the *Boston Globe* (December 14, 2013), the artist felt the old symbol was “stiff, robotic, with the chair functioning as a part of, not a tool for, the human.” The artists began to re-envision the wheelchair icon and all that it communicates. Their innovation was to propose a new icon (Figure 1b). The new image is described with words such as active, abled, and engaged. In the process of creating a new symbol, the artists have spawned an international grass-roots movement about the way society portrays and views disability.

All this was the result of someone recognizing a problem that others failed to see. Innovation starts with envisioning the familiar—a resistant problem, an unfilled need, an unmet opportunity—in new ways. Innovation often involves arriving at solutions that seem self-evident once the reframing has taken place. As in the case of the parking sign, what was needed was to recognize that something was not working and then to invent new solutions. How can Maine promote such processes of innovation?

As we see in the many articles in this issue of *Maine Policy Review*, Maine has begun turning its attention to innovation and to the question of how to create policies that stimulate innovation. Policymakers have begun to envision new strategies to enhance innovation and to implement policies, such as the Maine Economic Improvement Fund (MEIF). Additionally, new innovation hubs have developed in the state, for example, the Maine Center for Creativity in Portland and the Foster Innovation Center at the University of Maine. There have been substantial results for these kinds of efforts. Research is leading to innovations in energy, infrastructure innovation, agriculture, and aquaculture.

FIGURE 1: **Accessible Icon—Traditional vs New**



(a) The traditional icon used to mark parking spaces reserved for people with disabilities. (b) The icon as revised by the Accessible Icon Project.

In today's economy, innovation is widely recognized as fueling job growth and a more robust economic future. Indeed, because of the rapid rate of change, it is no longer possible to just keep doing the same thing: In this quickly changing economy, doing the same often means falling behind. Innovation is no longer optional; it is mandatory.

In this essay, I begin with the challenges Maine faces as a rural state and consider what the literature on innovation suggests about why urban areas are more creative. I dissect this urban advantage and suggest that much of it points to the centrality of boundary spanning. I then look more closely at assumptions about how to increase innovation: Should the focus be on finding creative people or the creation of contexts that stimulate innovations? And I then analyze the underlying policy issues and recommend ways to use the literature to develop strategies for enhancing Maine's future in innovation.

Despite what has been shown about rural states being places of limited creativity, Maine actually has a long history of innovation.

### MAINE'S INNOVATION DISADVANTAGES

Studies on innovation increasingly indicate that rural states such as Maine are at a disadvantage when it comes to innovation. Much of the evidence shows urban areas to be the hotbeds of innovation. Maine is also disadvantaged because it is an old state, with the highest median age in the country, and the literature on innovation indicates that creativity is not often associated with advanced age. Innovation is a younger person's sport. A further disadvantage is the nature of the jobs that drive Maine's economy: many are in traditional sectors (forestry, fisheries, and farming) that are not considered innovative industries. Rather, these industries often value tradition. A key challenge, then, is to find strategies that will increase the number of

jobs in these traditional industries, which face national and international trends that make it difficult to survive simply by being excellent at the practices that were applauded in the past.

The overarching question is, What the best way for Maine to surmount these challenges? How do we reinvent what we have so that Maine is not left behind? How can we keep traditions alive while at the same time changing them?

Despite what has been shown about rural states being places of limited creativity, Maine actually has a long history of innovation. (See Segal, this issue.) At one time Maine was known for its innovations around our natural resources including forests, fisheries, and even resources we no longer recognize as economic assets such as ice.

Consider ice harvesting:

Until after the Civil War, ice was largely a luxury item, used for cooling drinks. But when Americans added more dairy and fresh produce to their diets, ice-boxes became a standard feature in the middle-class home, and markets for ice expanded rapidly. Maine moved to the forefront of the burgeoning ice industry. At its heyday (1870–1890), around 25,000 men converged on the Kennebec ice fields each winter to cut and store ice. Maine's deep lakes, broad rivers, and cold winters produced a pure, crystal-blue product that set the standard for quality, and the proximity of these ice fields to the sea lanes kept shipping costs low. During these decades Maine's ice returned a wealth greater than that of California's annual gold production.<sup>1</sup>

Zillman, Walta, and Del Guavo Castiella (2009) point out that innovations in energy have long been drivers of Maine's economy, and Maine continues to lead in value-added energy innovation. The same can be said about innovations in areas such as pulp and paper and fisheries.

Knowledge of Maine's history is an intriguing starting point for envisioning innovation potential. Ted Ames and faculty at Bowdoin (Lichter and Ames 2012) have pioneered ways of harnessing Maine's history to reframe the challenges facing marine fisheries and freshwater lakes. They have unearthed stories that capture historical problem solving and highlight past innovation strategies undertaken by Maine's people. McCoy et al. (2011) recently completed research on views of wind power in Maine that also evokes the nature of Maine's innovation history. As a part of a large-scale survey to assess Mainer's views on wind power, these

researchers embedded a *framing experiment* within the statewide survey. For some participants, wind power was framed as new, whereas for others this innovation was framed as being part of a Maine tradition of problem solving. People who had reference to that history were not only more positive toward wind power, but were also more likely to regard an innovation of this sort as an opportunity to continue Maine's tradition of finding creative solutions. Paradoxically, ensuring that innovation is seen as a part of tradition—as not new—may be a way to stimulate new innovations and reduce resistance to them.

Familiarity with tradition—such as having deep knowledge of a field—has been shown to be of great importance to innovation. The literature points to the need for familiarity with traditions, but also to the importance of being able to envision those traditions in new ways. People need to draw on history but also reinvent it. Consider Maine's history with tidal power as an example. In the 1930s, a tidal power project was tried in the Bay of Fundy, where some of the world's most robust tidal energy resources can be found. The attempt failed. Recently, new attempts at tidal power generation in the area have been developed with an awareness of what went wrong in the past, but also with a re-envisioning of new opportunities using advanced technology.

### THE FAMILIARITY PARADOX

As states seek to enhance their innovation potential, researchers who study innovation are uncovering intriguing puzzles about familiarity: for innovation it seems to be necessary *and* it seems to be an impediment. Throughout this essay I will consider this puzzle and its implication for crafting policies. On the one hand, innovators appear to need extensive familiarity with a topic. Gladwell (2008) reports that what distinguishes those who succeed in an area is their depth of experience in the area and not necessarily some inherent creativity. Gladwell also argues that what is important is having on the order of 10,000 hours of time on task. These hours of experience, rather than some natural talent, accounts substantially for differences in success. Yet, paradoxically, more experience has also been found to stymie innovation. As Thompson (2014: 24) notes: “When you become infinitely educated in a category, you're your own worst enemy.” Evidence from a variety of studies confirms this. For example, recent studies of the generation of solutions have examined cases in

which a problem resistant to solution is presented online and people are given an opportunity to come up with a creative solution. Contrary to what might be expected, successful contributors frequently are not those in the discipline from which the problems come; they are more often from a related discipline:

When the business scholars Karim Lakhani and Lars Bo Jeppesen studied Innocentive, an online clearinghouse for unanswered questions in science and other fields, they discovered that the people most likely to solve the most complex problems weren't professionals in the discipline in question. In fact, being an expert in an area distinct from the field of the challenge was a statistically significant predictor of success. The secret ingredient was what Lakhani calls “interdisciplinary expertise”—the ability to draw connections between one subject and another (Thompson 2014: 26).

The creative answers to the questions posed on Innocentive's website came from professionals at an optimal distance from the challenge. As Alph Bingham, Innocentive's founder, notes, “You have to be close enough to comprehend the technical aspects, but not so close that you are biased by the way those immersed in the problem tend to think” (Thompson 2014: 26).

### THE SOURCE OF URBAN SUCCESS AT INNOVATION

The evidence suggests another theme that is important for innovation: collaboration between people, businesses, or institutions with different assets. If Maine is to succeed at increasing innovation, we need to understand the ways in which innovation is increasingly linked to connectedness and collaboration. Urban areas are especially well endowed with connectedness (Glaeser 2011). What, then, is it about urban areas that make them hotbeds for innovation and what does this mean for rural areas?

One of the characteristics that advantage urban areas in the realm of innovation is the diverse populations living close to each other, which enables people to encounter others engaged with the same problems but coming at them from different perspectives.

Cities bring opportunities for wealth and for the creative inspiration that can result only from face-to-face contact with others. In fact, the crush of people living in close quarters fosters the kind of collaborative creativity that has produced some of humanity's best

ideas, including the industrial revolution and the digital age. In the years ahead such collaborations can be expected to help solve the world's most pressing problems—poverty, energy shortages, climate change (Glaeser 2014: 102).

Glaeser (2014: 102) also hypothesizes about the characteristics of urban areas that make them hotbeds for innovation.

Why do cities bring out the best in us? Technology lets us hold virtual meetings, and the Internet keeps us in touch 24/7, but neither can be a substitute for the social cues—such as a facial expression signaling comprehension or confusion—shared when people meet in an office, bar or gym. Cities deliver the random exchanges of insight that generate new ideas for solving the intransigent problems....Young workers....succeed by picking up unexpected bits of knowledge from the successes and failures of those around them. By supercharging the flow of ideas, cities foster economic prosperity, innovation, better health—and even new ways to govern ourselves.

Bettencourt and West (2014: 106–107) point to other features of cities that may be important.

Cities concentrate, accelerate, and diversify social and economic activity. The numbers show that urban dwellers produce more inventions and create more opportunities for economic growth....What we can say with certainty... is that increased population promotes more intense and frequent social interactions, occurrences that correlate with higher rates of productivity and innovation.

Urban areas bring people together in ways that foster innovation. So, an important question for a rural state such as Maine is, How to create opportunities to encounter the *other*? Such encounters happen almost spontaneously in urban settings, but are there some natural advantages that rural states have that have yet to be understood in terms of their value for bringing about collaborations with people from different perspectives?

### CREATIVE USE OF MAINE'S ASSET OF BOUNDARY SPANNING

Perhaps rural states have the key ingredients for innovation, but they have not been adequately exploited. One of the advantages of rural states with small populations is that the groups tend to be manageable in

size. Could this be a natural advantage that could be developed and serve as the foundation for innovation? Several examples illustrate this possibility. A recent endeavor by Maine's Elmina B. Sewall Foundation hints at the possibilities of building collaborations. Leaders of the Sewall Foundation noted an emerging challenge: Across the state a similar scenario was playing out in which Maine's land trusts and their adjacent communities were not working together nor were they learning from each other. Indeed, there was a basic tension related to class and opportunity. Land trusts were sometimes seen as removing land from the tax records and as being places that did not welcome the activities (such as snowmobiling) that people living in nearby communities had previously engaged in. The Sewall Foundation brought together leaders of land trusts with leaders of nearby communities for a day-long retreat in a face-to-face setting that enabled the two groups to consider their common ground and identify what they could do together. This kind of innovation-spawning event could not easily happen in urban areas where the numbers are too large. In Maine, however, once someone makes it happen, groups can sit down together and develop innovative ideas that would be unlikely to emerge from either the land trusts or the communities alone.

One of the featured Maine speakers at the Sewall Foundation's retreat was Amber Lambke, who used her own experiences to showcase how to bring separate ideas together to create productive innovations. Developer of the Somerset Grist Mill, Lambke had noted that many old abandoned mills were going unused. She also saw that nearby land was not being productively used because of a lack of a market for the crops. She recognized that jobs could be created if a way could be found to use both the abandoned mills and the underused land. This led to the creation of a state-of-the-art, award-winning grist mill. The Somerset Grist Mill is not the only example of innovative reuse of Maine resources. Others have seen this as a way to encourage Maine's young people to stay or young people from elsewhere to come to Maine and make it their home (McCarthy 2013). Bjarki Gunnarson and Josh Saltmarsh have taken over a languishing mill in central Maine and reinvented it as the Wood Idea and the Wood Mill of Maine to produce high-end lumber products for markets throughout New England. These young entrepreneurs chose Maine because these opportunities did not exist elsewhere.

*Boundary spanning* is the term now used to describe this bringing together of different groups and sectors. According to the rapidly expanding literature on the subject (Easley and Kleinberg 2010; Fox and Cooper 2013; Lee, Horth, and Ernst 2012; Marrone 2010), boundary spanning is enhanced by those who cross different situations and roles. In a state with a population small enough so people can know of each other's efforts, individuals who cross boundaries have ready access to, and can interact with, individuals and groups across different sectors. They readily serve to stimulate innovation by bringing together different people with different ideas.

These kinds of boundary crossings are commonplace in the rural state of Maine. Recently a very different convening occurred to investigate ways to reduce intergenerational poverty. People in different sectors—education, faith, social services, philanthropic—in Maine had recognized the need for innovative solutions to the persistent problem of intergenerational poverty. Old solutions had reached dead ends, so people came together for a discussion of what needed to be done. Drawing on the literature, they began conversations about how to address intergenerational poverty and developed innovative plans for addressing intergenerational poverty in Maine.

Bringing disparate ideas together is an important component of boundary spanning, and it is flourishing in Maine. Putting citizen and science together is an example of this innovative approach, and Maine leads in the development of citizen-science initiatives. Abe Miller-Rushing of Acadia National Park's Schoodic Education and Research Center (SERC) is a national leader in citizen science. The citizen-science movement is built around linking two problems that have formerly been treated as being unrelated: (1) there are too few scientists to collect all the data needed to test hypotheses; (2) laypeople are suspicious of scientific findings generated through traditional, opaque research processes. Leaders in the field of citizen science saw a way to perhaps solve both the problem of too few scientists and skepticism about science, by employing the boundary-spanning theme of science democratization and involving citizens in collecting scientific data. Maine's SERC Institute is a leader in this area.

These examples of emergent boundary spanning beg the question: Must we just wait for boundary-spanning projects to develop on their own, or are there ways to encourage this behavior? Maine's Sustainability Solutions Initiative (SSI) is an example of intentional action to

systematically build interconnections into a research program that involves more than 100 faculty from throughout Maine in an attempt to address Maine's sustainability challenges. The central focus of SSI is bringing together diverse academic disciplines to allow their differing expertise to be integrated in order to solve long-standing problems (Silka et al. 2012).

**Bringing disparate ideas together is an important component of boundary spanning, and it is flourishing in Maine.**

#### WHAT IS NEEDED TO ENHANCE INNOVATION

The literature on boundary spanning allows us to recast the findings from urban innovation studies to point to Maine's untapped assets. Boundary spanning calls attention to both individual skills and group functioning, suggesting the need to bring groups into stimulating, productive contact and to enlist individuals with particular boundary-transcending skills. But which should receive the greater emphasis—the individual or the group? Within the literature there are two divergent views of how to best increase innovation: one emerging from cognitive psychology and one from corporate studies of innovation. They represent two competing assumptions: one that sees innovation as tied to improving how individuals think and one that sees innovation as a consequence of improving how groups work. Examining this distinction more closely will be an important step in selecting strategies to improve Maine's innovation prospects.

Within the cognitive psychology literature, Hofstadter and Sander (2013) make a strong case that innovation is associated with the ways individuals think. Nobel Prize-winner Daniel Kahneman, in his award-winning book *Thinking Fast and Slow* (2011), argues that we need to recognize the central importance of analogical and metaphorical thinking. This type of thinking helps bring disparate possibilities together in inventive new ways. Consider how this idea is encapsulated in the familiar metaphor of the light bulb:

For more than a century Americans have regarded the creation of the incandescent light as the greatest act of invention in the nation's history, and the light bulb has even become our symbol of a great idea. We associate the bulb with a "eureka" moment, the modern version of an ancient metaphor linking light with insight (Freeberg 2014: 2–3).

Strategies for encouraging creativity emphasized by psychologists implicitly tap into analogy, metaphor, and history and raise questions about how to make this kind of thinking more widespread. In contrast, students of corporate innovation focus on the kinds of collaboration that are the basis for innovation. They often critique the idea of innovation coming from an individual genius:

Many of us think of invention as something that springs from an individual mind. It's a romantic view, but it bears little relation to the creative process behind the technologies that are shaping our world. That process is increasingly collaborative—not so much a single light bulb going off in someone's head as many light bulbs in a social network of diverse minds (DiChristina 2013: 57).

...policy recommendations [for stimulating innovation] continue to bounce between efforts aimed at persons and efforts focused on groups and situations.

The corporate literature identifies the importance of conditions that enable collaboration and the growing connectedness of work. Fagerberg (2003) notes that every new innovation, rather than coming from a single individual, consists of a new combination of existing ideas, capabilities skills, and resources. Others studying corporate innovation note that "popular folklore notwithstanding, the innovation journey is a collective achievement that requires key roles from numerous entrepreneurs" (Van de Ven et al. 1999: 149). And many other researchers point to the particular ways in which groups function. Groups need to have absorptive capacity (Cohen and Levinthal 1990), that is, groups

must be able to take in new ideas and be open to different and competing ideas (Van de Ven et al. 1999). In other words, collaboration is crucial.

In short, two thoughtful bodies of research take us in different directions with regard to how to increase innovation. One emphasizes individual skills while the other emphasizes the need to analyze situations that enhance collaboration. How then can this information be used to inform the development of policies that increase innovation and create a more robust economy?

## POLICY MAKING TO STIMULATE INNOVATION

The policy options for stimulating innovation will depend on our assumptions about innovation's scarcity. Is innovation scarce because individuals with the potential to innovate are rare? Or is innovation rare because of the scarcity of the conditions needed to bring out innovation? In other words, should policy efforts be directed at individuals or at creating the right situations to produce greater innovation? Not surprisingly, policy recommendations continue to bounce between efforts aimed at persons and efforts focused on groups and situations. I will briefly summarize the complications to be considered before we start creating such policies. Since the issues are more complex than can be fully analyzed in this short essay, I recommend Brzustowski's (2012) book *Why We Need More Innovation in Canada and What We Must Do to Get It*.

### *Focusing on Individuals*

When innovation is considered to be a consequence of individuals' attributes, attention turns toward identifying people who are naturally creative. Although creativity has often been treated as something inborn within the individual, a growing body of literature suggests that the key characteristics associated with innovation are varied. Winner (1996) and Drake and Winner (2012) studied children with a creative edge. The researchers describe the children as distinctive in having "a rage to master" and that it is this mastery impulse that is centrally important to their success. Others have hypothesized that cognitive disinhibition rather than creative thinking may be the major contributor to creativity. Carson, Peterson, and Higgins (2003) hypothesize that genetic variation make some people's brains more open and responsive to ideas or feelings that may be blocked by most people's mental filters. Still others point to having a diversity of interests as

important, with creative individuals exhibiting “unusually wide interests and hobbies, often contributing to more than one domain of expertise” (Simonton 2014: 23). Simonton, author of dozens of books and hundreds of articles on creativity, has summarized much of the literature by arguing that “practice, training and exposure to unfamiliar ideas and experiences play essential roles in shaping creativity” (2008: 30).

Before we can develop policies to encourage innovation, we need a deeper understanding of which are the most important individual attributes. We need to consider whether creativity is inborn or can be learned. Should policies focus on how to detect the resource or on how to create the resource? In all of this, we are cautioned by Burkus (2014) to avoid the *Lone Creator Myth*. Burkus notes that such a myth directs us toward the magic bullet of creative individuals who can be the source of the next invention. We can exhaust limited resources searching for these individuals rather than enhancing features of situations that would promote everyone’s capacity to innovate. If we see innovation as something that does not only reside in the rare creative individual, then we turn focus our attention on of the kinds of contexts that make a difference.

### *Focusing on Situations and Conditions*

The term *combinatorial innovation* is used in the literature to describe the conditions that make some companies creative and others not. Innovations typically come from the right combination of existing ideas. Brynjolfsson and McAfee (2014) in *The Second Machine Age* describe conditions for combinatorial innovation as a new approach to group problem solving. “What science and engineering companies need, therefore, are smarter ways to collect and grade all these potential ideas combinations” (Thompson 2014: 24).

Important resources are appearing that propose blueprints for policies that would create the right conditions for innovation-strengthening collaboration. One such resource is Brzustowski’s book on the need for more Canadian innovation (Brzustowski 2012). Out of the book’s discussion emerge 10 principles for an innovation policy along with a framework for innovation and four models for industrial innovation. In similar ways, leaders in Maine have begun to write about innovation potential in Maine’s traditional industries and ways to bring people together to enhance innovation potential (see, Stone, Benjamin, and Leahy 2011a; 2011b).

### *The Challenges of Bringing the Two Together*

A few policy analysts have begun the difficult task of integrating the two perspectives of creative individuals and collaborative environments. Amabile’s (1996) book *Creativity in Context* is an instructive resource, as is Wagner’s (2012) *Creating Innovators: The Making of Young People Who Will Change the World*. The books differ in the degree of emphasis on person vs situation, but each is an in-depth look at the two factors that are key to enhancing innovation. They lead us through various ideas on how to combine person and situation to create innovation.

As Maine develops policies to enhance innovation, it will be important to learn from new efforts and experiments—and remain aware of possible ambiguities in their impact and suitability. New strategies are being tried and new conclusions are being reached. To make progress in formulating policy, we need to scrutinize these efforts while recognizing that key factors may be outside of the frame of reference.

### *Can Competition and Prizes Encourage Innovation?*

We should not leave the topic of innovation without considering one of the most common policy strategies for increasing innovation, the use of prizes and competitions. According to the article by Thompson (2014: 27):

In the past decade, the federal government has embraced ideas generated by open prize-based challenges to block illegal robocalls, improve local air-pollution measurements, adapt public-transport systems to self-driving buses, map the universe’s dark matter, design a better astronaut glove, mop up oil spills, and design more-fuel-efficient cars. Kalil thinks the government has barely tapped the potential of challenges. “Prizes,” he said, “are great public policy,” with several benefits. They increase both the number and diversity of potential solutions, fostering the sort of combinatorial innovation that can produce radically new ideas. And they’re cost-effective, since they reward only the winning solutions.

Such an approach seems to have many elements to recommend it: it can be cost-effective because many potential innovators can be tapped essentially for free as only the prize winner is paid, and low-cost competitions are made feasible because of the availability of the Internet and information technology. As it turns out,

however, the use of competitions is more complex than it might seem:

Designing a good challenge is not as simple as posting a question and waiting for a response. There are three key elements: asking the right question, offering the right prize, and having the right team of experts evaluate the proposed solutions. Vague questions are ignored, good questions go unanswered without sufficient rewards, and if you don't have proper oversight to evaluate the answers, crowd-sourcing is just one big, useless guessing game (Thompson 2014: 26–27).

### *Policy Making and the Innovation Life Cycle*

Important as it is to develop innovation-stimulating policies, it can be hard in the short run to know if these policies have succeeded. In the case of innovations in technology, for example, a misleading impression may result if one uses just a snippet of time to decide whether new policies have produced lasting innovation. In his *Mastering the Dynamics of Innovation* (1994), Utterback turns to the topic introduced earlier in this essay—the history of ice harvesting—to illustrate the misleading impressions that can result if the full life cycle of a technology is not taken into account. He notes that at one point natural ice harvesting held a commanding lead over other technologies, but it was eventually made obsolete by other ice-making technologies. Without taking into account the full life cycle, which frequently includes the emergence of competing technologies, one would have been tempted to see traditional ice harvesting as doing well and getting even better:

Here we investigate the case of the American ice-harvesting industry and its subsequent decline in the face of machine-made ice. Far from being an arcane historical curiosity, this case provides a look at a familiar process technology over its full life cycle. This long-term perspective helps us to see how a competing technology emerged....We also observe here how one generation of technology applied to a commonplace requirement (cooling) gave way to others. Thus refrigeration using harvested ice was rendered obsolete by machine-made ice—an innovation based on a radically different technology—which in turn was superseded by electromechanical refrigeration (Utterback 1994: 147).

The performance superiority of the established technology may prevail for quite some time, as was the case

for harvested ice relative to machine-made ice in most locations for the last quarter of the nineteenth century, but if the new technology has real merit, it typically enters a period of rapid improvement—just as the established technology enters a stage of slow innovative improvements. Eventually, the newcomer improves its performance characteristics to the point where they match those of the established technology and rockets past it (Utterback 1994: 159).

Careful attention to recurrent patterns made evident in life-cycle analyses—particularly ones that look at many different innovations through many eras—will be important in the design of innovation-promoting policies. To avoid drawing misleading conclusions about policies based on brief glimpses at single points in the cycle, it is important to examine the full life cycle both when framing policies and when evaluating their success. The ultimate danger is that states will use the complexity of the data to avoid creating policies because of the difficulties of determining what should be done. Attending to life-cycle analyses provides a better solution by showing how to embed policies in evaluations that take the complexity into account.

### *Policy Levers*

Finally, sometimes the most important policy levers remain outside of our range of attention: for example, patent laws. As David Kappos (this issue) notes in his introductory essay, patent laws that protect intellectual property are an often-unheralded impetus for America's leadership in innovation. Companies know they can accrue enormous upfront costs for the research and development necessary for innovations and the payoff will not be seen until well into the future. Because of patent laws, companies need not fear that their development costs will simply enable some other company to benefit from the innovations. The importance of patent laws and related policies becomes evident when there are gaps in what intellectual property laws cover. Recent discussions of whether states such as Maine should use tax credits to promote new energy technologies for the development of offshore wind power, for example, raise these issues. By doing so, will Maine underwrite the development costs only to have future jobs move to other states once the technical innovations are devised? Can Maine design policies that keep this from happening but that do not serve as barriers to innovators coming to Maine in the first place?

## CONCLUSION AND FINAL RECOMMENDATIONS

This essay began with the simple story of the redesign of the accessibility icon, an example that illustrates that there are many targets for innovation. Sometimes it is something as simple as an icon. Other times the target is complex, such as revolutionizing the way we produce and use energy in our homes, workplaces, and automobiles. Whether the target is simple or complex, however, the processes of innovation often run counter to our assumptions that it is the result of individual inventors creating something from scratch on their own.

We are surrounded by images and sayings that reinforce popular folklore about innovation. Calls for innovation charm us with familiar images such as a Eureka light bulb above a person's head. As we work to strengthen Maine's innovation capacity, we must not be seduced by these familiar images. The complex story of the invention of the light bulb is a useful reminder of innovation's intricacies. The light bulb was not the result of a single brilliant inventor, Thomas Edison, working alone; rather it was the culmination of contributions from many contributors over time that made the invention of the incandescent bulb possible (Freeberg 2014).

Other familiar sayings may further obscure the many types of innovation that are needed. We are constantly told "we need to create a better widget" or "we need to create a better mousetrap." The phrases cast innovation as being largely about creating the next better tool or object. Yet, the need for innovation extends well beyond creating things. Increasingly, we need to use innovation to solve social problems, create new processes, and address logistical challenges. Many emerging needs will focus on changing processes such as energy distribution networks. Policies to strengthen innovation capacity will need to be aware of the rich variety of innovation needs in Maine.

As we tackle the problem of enhancing Maine's future, we will need to learn from the ever-growing literature on the subject of innovation. But here is the final challenge: There are now thousands of articles and books on innovation, and it is nearly impossible to absorb even what is available at this moment. Trying to discern what the literature recommends for best practices is a daunting task, made even more daunting the contradictions that pervade the literature. In light of the sheer size and complexity of literature, I offer five brief

recommendations for how to organize the literature to guide Maine's future policy development.

1. *Look to the history.* To avoid getting caught up in the innovation fad of the moment, look to what has been written about past innovation successes and failures. By looking at full cycles of innovation and development, there is a greater possibility of discerning patterns of interest. This longer time perspective can be an antidote to the rushed conclusions arrived at from high visibility contemporary innovations.
2. *Look across topics.* Innovation recommendations are held hostage by their particular topic (for example, energy, poverty), often resulting in a narrowing of focus. Considering alternatives from entirely different topics can open up possibilities.
3. *Look across disciplines.* Individual disciplines get caught up in particular approaches to problems. By considering how different disciplines have addressed the same problem, we can begin to see new alternatives and new opportunities.

...the processes of innovation often run counter to our assumptions that it is the result of individual inventors creating something from scratch on their own.

4. *Look to other states.* A range of ideas for promoting innovation can be gained by looking across the practices in other states (those that are similar to Maine, as well as those that are different). The policy contexts are different, but some of the ideas hold promise for Maine.
5. *Look to other countries.* Policy discussions in other countries provide a different view of the issues and opportunities for promoting innovation. Attention to these discussions can provide guidance beyond the rhetoric and framing in the United States.

To a large degree, these recommendations encourage boundary spanning and analogical thinking and thus mirror the policy advice articulated earlier. As we move forward, it will be important to find ways to expose ourselves to many different models of what might be possible and draw on them to promote innovation. 🐙

## ENDNOTES

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