The Elements of an Innovation Ecosystem

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Abstract

While great strides have been made to understand technological innovation at the individual technology level, the ecosystems that encourage and enable the development of these innovations have not received the same scrutiny. In his seminal book *The Innovator's Dilemma,* Clayton M. Christensen defines innovation as either sustaining or disruptive. A sustaining innovation involves the improved performance of a technology based on the performance valued by customers in the existing market, while a disruptive innovation introduces a new performance measure and is first commercialized in an emerging or niche market. Christensen explores the dilemma that market-leading corporations must overcome to first identify and then adopt these disruptive innovations, including organizational structure and culture. This paper extends the elements of Christensen's original framework, increasing scope from individual corporate-level venues like Bell Laboratories and Pixar, to regional innovation clusters like Boston and Silicon Valley, to nations like Israel, Singapore, and Japan. We show that a common thread between the local, regional, and global levels is that each level fosters interaction among diverse populations of participants through deliberate organizational structure and culture, taking advantage of brilliant minds and idea generation from proximate colleges and universities and providing easy access to funding and prototype manufacturing facilities. They also deliberately develop cooperative business practices and regulatory incentives that financially encourage collaboration and ultimately innovation. The strides made to understand technological innovation provide the context to understand the barriers to disruptive innovation on a local scale, and we show that understanding the elements of an ecosystem that foster innovation provides a model to create the conditions necessary to enable this type of innovation at the corporate, regional, and national level.

Keywords: Innovation, Ecosystem, Scalability

1. Introduction

In a world in which corporations, regions, and nations compete to become leaders in innovation, victors emerge as they create disruptive technologies. Clayton M. Christensen classifies these disruptive technologies as technologies that provide "a very different value proposition" to a market than the sustaining, or current, technology[1]. These technologies tend to "underperform established products in mainstream markets," but they ultimately surpass their rivals because they are "typically cheaper, simpler, smaller, and, frequently, more convenient to use"[2]. While these innovations do not provide certainty in market success because they tend to be complex "and their value and application are uncertain"[3], the victors of innovation have been able to overcome the inherent stigma to embrace the risky innovations. At the corporate level, Pixar has led in innovation with a 2015 estimate of grossing $600 million per film[4]. Increasing the scope from corporate level to regional level, Silicon Valley thrives with its dense amount of successful, innovative companies, such as Apple and Cisco. And on the national scale, Israel has "more venture capital per capita and more startups than any other country,"[5] and Japan hosts renowned companies like Sony and Toshiba[6]. Although the scale of focus covers a broad range, each level shares common elements that enable its leading

competitors to embrace and foster innovation. These common elements that allow for an innovation ecosystem are maintaining an organizational structure and culture that foster communication and idea generation among diverse people and supporting innovation through financial encouragement and regulatory incentives.

2. Organizational Structure and Culture

Innovation does not occur within a vacuum. Starting from the conception of a disruptive technology, there needs to be a diverse base from which creative ideas can spring. Thomas S. Kuhn describes that there are various paradigms in which researchers operate and become entrenched. These paradigms are essentially the "law, theory, application, and instrumentation" that govern research within a certain field[7], and the men and women "whose research is based on shared paradigms are committed to the same rules and standards for scientific practice"[8]. This cementation of similar people to shared ideas and practices serves as a roadblock to innovation in that new ideas are generated from an overlap in disparate knowledge. In his Rede Lecture at Cambridge in 1959, C.P. Snow warned about the divide between the two poles of literary intellectuals and scientists[9]. He asserted that the lack of cross-talk among the different fields would lead to "practical and intellectual and creative loss"[10]. Applying his observation to the field of innovation, there must be cross-talk among diverse peoples of varying disciplines and background to bring about disruptive technologies.

On the corporate scale, businesses possess the ability to directly and indirectly cause interactions among their employees. Requiring minimal resources and merely coordination among the company, leadership can hold meetings among members from different backgrounds and departments so that cross-talk can occur and knowledge can flow more seamlessly throughout the company[11]. However, leading companies in innovation have gone to great lengths to increase the opportunity for accidental interaction. Stationed in New Jersey, Bell Labs made the conscious decision to house its scientists and engineers close to one another and provided technical assistants to researchers in order to facilitate idea exchanges[12]. At Pixar, the company used to separately house employees of different departments—the computer scientist would be isolated from the animators, who would be isolated from the executives, and so forth. Identifying this as a factor inhibiting innovation, Pixar created a "single cavernous office that housed the entire Pixar team"[13]. This redesign allowed for incidental interactions among employees. Similar to Pixar and Bell Labs, Google implemented a design in its New York City campus in which no one in the building is more than 150 feet from food[14]. Providing multiple restaurants in close proximity to workers from different departments allows for them to take a break, share a meal with coworkers that might have a different function and set of skills and knowledge, and potentially develop creative ideas as their diverse pools of knowledge overlap. The architectural and organizational design decisions within each of these successful companies in innovation stress the concept of interaction among diverse people.

Expanding the idea of diversity cross-talk to a regional level, the interplay of the corporate sector and proximate colleges enhances a region's potential for innovation. One forum for this interaction to occur is through incubators. These incubators provide "internal experts on idea generation" that can help students and aspiring entrepreneurs push their ideas into the business world. They combine "new companies, experienced business leaders, faculty researchers, government officials, established technology companies, and investors" to teach people how to transform their promising ideas into plans[15]. Within colleges, which are considered a regional asset in the context of innovation, design decisions are being geared toward enhancing the potential for innovation. A classic example of an innovative college space was Building 20 of the Massachusetts Institute of Technology. Created haphazardly out of necessity in order to support the Allies during World War II, Building 20 housed 4000 researchers from 20 different disciplines[16]. The confusing layout of the building led to accidental conversations and friendships as residents got lost and wandered from room to room. The parties hosted within the building held no class divides as the janitors drank alongside the technicians[17]. These interactions led to collaboration projects, and from this building sprung innovations such as "the development of high-speed photography, modern-theory linguistics, single-antenna radar and the development of the physics behind microwaves"[18]. Seeking to replicate the interactive success of Building 20, other colleges have incorporated pieces into their designs to enable diverse discussion. Some of these design decisions include having glass rooms to stimulate curiosity, huddle rooms for meetings, writable walls to illustrate ideas, centralized cafés to mingle, wide hallways and staircases for people to linger, flexible seating for people to shift around, and dorms of mixed majors and genders for increased exposure to diversity[19]. Regions that interact with the already hardworking colleges to further innovation have more success in leading with disruptive technologies. In Boston, a hub for innovation, the region places an "importance o[n] collaboration among the startup community with corporations, universities, foundations, and local government"[20]. A dense center for universities, Boston draws on the intelligence of students and faculty from colleges such as MIT, Harvard, and Boston University. Revered for its technological

advances, Silicon Valley draws upon the brilliant minds of schools to include Stanford and Berkeley, and Toronto, likewise, has Seneca College and the University of Toronto at its disposure.

Expanding to the national level, Israel, despite its size, has more scientists and technical professionals than other countries in a comparatively smaller area[21]. Beyond having the intelligent minds to innovate, Israel has the added advantage of having a highly diverse population. Composed of the Edot, Ashkenazim, Sephardim, Oriental Jews, Olim and Sabras, non-Jewish minorities such as the Arabs, and other groups, Israel houses a range of people with wildly different backgrounds and beliefs[22]. This concentration of diversity, however, allows for unique ideas to form as different cultures collide, and innovation blooms from these collisions. While this is inherent in Israel's population, other nations that lack diversity within their borders could potentially increase their international interactions in order to capitalize on the diversity around them.

Spanning from the corporate-level to the national-level, a key theme in enabling innovation is to have the interaction of diverse groups of people so that unique ideas can form and technologies can develop. While this manifestation looks different at each level, actions can be taken to replicate the success of the innovator leaders. At the corporate-level, companies can intersperse its departments among each other, hold cross-departmental meetings, and design common areas to attract workers from all departments. At the regional-level, there can be an increase in collaboration between companies and colleges through forums such as incubators, as well as the development of colleges as innovative hearths. And at the national-level, countries with diverse populations can capitalize on their cultural wealth to foster new ideas, and countries lacking in diversity could potentially look to interact with surrounding nations to counteract their deficit.

3. Financial Encouragement and Regulatory Incentives

While diversity is essential in fostering idea generation needed for innovation, the development of disruptive technologies is not inexpensive. With limited resources to allocate to various projects, businesses encounter what Clayton M. Christensen describes as the "Innovator's Dilemma." He explains how company leadership, tasked with having to determine which projects to invest the company's time and resources into, face larger risk when choosing to back a disruptive innovation. These potential projects tend to "generate no value within the established network"[23], and with their potential niche market being unknown, there is not much reassurance in the profitability of investing in the technology. Because companies are "captive to the financial structure and organizational culture in the value network" that they compete in, most leaders do not choose a risky investment over improving a sustaining technology demanded by customers[24]. The corporations, regions, and nations that successfully overcome this dilemma financially encourage innovation and construct regulatory incentives to enable innovation.

Christensen addresses the solution to overcoming the "Innovator's Dilemma" by suggesting that companies create independent organizations "whose survival [is] predicated upon successful commercialization of the disruptive technology"[25]. Pixar captures this idea through having independence among its products. Directors of films can get help from the company's "creative brain trust of filmmakers" as a peer-based form of assistance, but directors maintain a certain level of autonomy from higher[26]. Beyond autonomy of the innovative projects, companies must provide adequate resources to the projects for them to be successful. Within Bell Labs, the company invested in the further education of its employees, its human capital, through offering challenging courses in its Communications Development Training Program. Bell Labs also ensured that its projects had the technology required to work and a steady stream of money to support the efforts[27].

At the regional-level, incubators serve as a financial encourager for innovation. They provide "inexpensive space and business advice for new companies" and help "early-stage technology companies to get their first round of funding"[28]. This bridging source between the corporate world and aspiring entrepreneurs provides the footing necessary to develop disruptive innovations and step into the market. In the unparalleled success of Building 20, the engineers and residents within the building were able to manipulate the cheap building in order to meet their needs[29]. The building's walls were plywood, so residents were able to cut through them and take free water and electricity to support their projects[30]. In addition to financial support, regulations can stifle or support innovation. During the 1950s, New Jersey was a hub for innovation. It was conveniently located, positioned with New York City to its north and Philadelphia to its south, which gave the state "eas[ier] access to Wall Street financing, transportation, and industry headquarters"[31]. However, despite success in creating disruptive technologies and housing companies such as Bell Labs, anti-competitive laws prohibiting workers from branching-off and making new companies within the state caused key innovators such as William Shockley, the inventor of the transistor, to move west[32]. Silicon Valley's success is supported by the converse of New Jersey's situation. In California, state law prohibits noncompetitive regulations, which essentially means that any attempt to prevent workers from branching away and forming new

companies would be nullified. Silicon Valley focuses on "advancing technology for a region, not any single company's technology"[33], and its cooperative regulation reflects this sentiment.

Expanding to the national-level, countries and governments can take similar measures to improve the potential for innovation. In Israel, the government and private enterprise both encourage innovation. Entrepreneurs help one another, and the nation hosts a building called the SOSA, which stands for "South of Salame." This building stands in south Tel Aviv and houses 2,500 startups, 400 partners and members, 45 professional investors, and 150 global delegations annually[34]. This sponsored building serves as a collision ground for brilliant minds aspiring to innovate, and eases the roadblocks for the connections that could provide funding for projects. The nation also directly funds innovation through the "[d]istribution of grants and financial support for innovative-technological" research and development[35]. Japan, another major actor in the world of innovation, has a state-backed innovation fund that it just extended for an additional nine years, known as the Innovation Network of Japan (INCJ). The INCJ will continue to invest in areas that need long-term financial support, such as biotechnology, and other "risky, long-term investments" that would promote new industries[36]. Likewise, Singapore plans to invest $19 billion in its science and technology over the next 5 years. This will offer financial support to researchers at the National University of Singapore and the Nanyang Technological University[37]. A less direct regulation that has helped Israel rise to its prominent position as an innovation leader is its laws requiring its citizens to serve in the military. Men have to serve for 3 years, and women have to serve for 2 years. This compulsory service provides the young men and women with teamwork and decision-making skills that can translate directly into entrepreneurship[38]. Additionally, the act of shared service allows for more connections to form in the corporate-level through people having a common ground to relate to each other.

Across the corporate-, regional-, and national-level, financial encouragement and regulatory incentives prove invaluable in fostering innovation. Within the corporate sector, organizations can provide isolation for the development of innovative projects by granting them autonomy and providing them with the appropriate amount of funding necessary. They can also invest in their human capital in order to further their employees' capacity to innovate, and provide their autonomous projects with peer-like expertise to aid in the progression of the projects. At the regional-level, incubators can aid in bridging the gap between entrepreneurs and potential financial supporters in order to aid in the development of the potential products. Colleges, like MIT with its Building 20, can provide residents and students with access to cheap resources in order for them to prototype their ideas and products. And regions and states can also enable innovation through regulatory incentives such as prohibiting noncompetitive laws so that workers with brilliant ideas can leave their current job and branch away to create a new company or product. On the national scale, countries and governments can provide the infrastructure to enable the interaction needed for innovation, or directly pour financial support into desired fields of innovation. Embracing Israel's indirect model, nations can create regulations that require citizens to undergo developmental experiences and form a common ground among each other, such as compulsory military service. While the actions taken at each level differ, the underlying reasoning for the actions are similar.

4. Summary

Analyzing companies like Pixar and Bell Labs, regions like Boston and Silicon Valley, and nations like Israel, Singapore, and Japan reveals that the key elements to innovative success are not limited to scale, as illustrated in Table 1 below. The need for interaction among diverse coworkers in restaurants of Google and the huddle rooms of colleges does not differ greatly from Israel's need for its diverse population to interact and innovate together. The development of a diverse organizational structure and culture provides the potential for diverse ideas to overlap and for innovation to rise from these interconnections. But, beyond fostering the creation of ideas for innovation, financial support and regulatory incentives are need to aid in the development of the disruptive technologies. At the corporate-level, this manifests as corporations isolate innovative projects and provide them with financial and resource support, and on the national-level this involves countries giving grants to universities and other innovative corporations. These elements of an innovation ecosystem provide a scalable framework to replicate success across all levels.

Table 1. Scalability of the elements of an innovation ecosystem

Scale	Diverse Organizational Structure and Culture	Financial Encouragement	Regulatory Incentives
Corporate: Pixar	x	x	x
Regional: Boston	x	x	x
National: Israel	x	x	x

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