Firms Favour Academic Insights That Come From Hubs

Innovators can improve their performance by paying attention to academic science.

In 1981, in the far outskirts of Los Angeles, a start-up made a bet that would change the lives of millions. Applied Molecular Genetics (Amgen) decided to take a chance on University of Chicago professor **Eugene Goldwasser**'s research and try to clone the gene behind the hormone that spurs the body to make red blood cells.

Goldwasser had spent years trying to get pharmaceutical firms interested in his work but to no avail. Chicago was not an R&D hub when it came to biotechnology, and local pharmaceutical giants such as Abbott or Parke-Davis did not pay attention to his work. Amgen's interest meant that, finally, a firm was listening to him. Goldwasser was thrilled, and Amgen glimpsed an anaemia-fighting blockbuster on the horizon.

Amgen's tie-up with Goldwasser paved the way to the creation of Epogen, a drug that treats debilitating anaemia in kidney dialysis and cancer patients, by the end of the 1980s. As of 2018, Epogen is one of the **top selling drugs** with accumulated sales of US$108 billion, and the drug propelled Amgen in the **top 20 pharmaceutical companies** by revenue. Goldwasser was a consultant with Amgen but never patented his discovery. As he would say wistfully years later: "One percent of one percent of the drug's annual revenues would have funded my lab handsomely."

Amgen's Epogen story is a typical case of a firm successfully using academic science as a source of competitive advantage. Identify a breakthrough faster than your competitors, and you could become huge. Otherwise, prepare to be disrupted by more savvy competitors. Academic science plays a growing role for technology development and its exploitation by firms has therefore become an important frontier for strategy.

Yet, firms pay attention to only a tiny fraction of all academic findings. Less than 5 percent of all publications are cited by patents. In part, this is because the scientific literature is huge, fast-changing, and much of it is of poor quality or applicability. This begs the question: Given the volume of academic output, how do firms home in on the academic discoveries that would give them a leg up?

One word: hubs. They are geographic clusters of companies' R&D labs in specific technological fields. For example, for ophthalmic surgical instruments, the main hubs are around Erlangen, Germany; Gamag□ri, Japan; as well as the American cities of Irvine and Santa Clara, both in California, Chesterfield in Missouri, and Fort Worth in Texas. My paper "**Bridging Academia and Industry: How Geographic Hubs Connect University Science and Corporate Technology**", co-authored with **Matt Marx** of Boston University and published in

Management Science, shows that hubs facilitate the translation of academic science into corporate inventions.

Patent hotspots

We started our study with 45 million academic journal articles from the Web of Science (WoS) published between 1955 and 2017. Where possible, we allocated each scientific paper to relevant technological specialties by observing the **subclasses** of the patents citing them or citing other articles in the same field. Using inventors' location, we built patenting hotspots, i.e. cities that produce a significant number of inventions in a specific field at a specific time. We formed "hubs" with a hotspot city at the centre of a circle with a 50-mile radius. In total, we were able to link 10.2 million articles to technological specialties that had hubs, and found that 3.8 percent of those articles emerged in a hub.

Strikingly, we found that hub-based academic articles received on average 4.6 times more citations than non-hub ones from corporate patents in the five years following their publication. We then went on a quest to determine the source of this massive hub effect.

Clearly, there might be differences in the quality of hub- and non-hub papers. We found that hub papers scored on average 81 percent more paper citations and were published in more prestigious scientific journals. They were also 28 percent more "applied", as measured by the keywords associated with those papers. They logged 115 percent higher **journal commercial impact factor (JCIF)**, a measure that we introduced and that is analogous to the journal impact factor, but where paper citations where replaced with patent ones.

On the demand side, we found that firms – especially younger, more innovative and science-oriented ones – paid disproportionate attention to hub-sprung academic knowledge. But is the hub effect purely driven by differences in the type of work? Or do firms pay disproportionate attention to hubs, above and beyond what is warranted by the nature of the research produced there? To answer this question, we focused on firms' patent citations to 147 simultaneous discoveries where some of the discoverers were based in hubs and others were not.

Even after controlling for geographic distance between firms and hubs as well as subtle inter-twin differences, we found that hub papers were 10.1 percent more likely to be cited versus their "twin" whose authors were based outside hubs. This effect was robust to a number of additional analyses. Firms appear to be attracted to hub-based science both because they expect it to be more useful and because they are more exposed to it via informal interactions such as conferences.

Thus, hubs act as bridges between academic science and industrial technology, and the two pillars of those bridges are quality and exposure.

Hub hubbub

Hub-based academic science's quality and relevance means that firms have to jostle among themselves for first-mover advantage. If firms choose to hunt for scientific edge outside of hubs, they will have fewer competitors but higher search costs.

On balance, firms in fast-moving industries such as pharmaceuticals, computer science and robotics cannot afford to tear their eyes away from hubs. In fact, the pull exerted by hubs in many high-tech industries is so powerful that many firms have relocated the core of their innovative activities there. This, of course, is one key reason why European pharmaceutical giants such as Roche, Novartis and Sanofi have flocked to the Boston and San Francisco areas.

To some at least, the strategy seems successful. When Roche **made a bid for San Francisco-based Genentech for US$47 billion** in 2009, product development at its then-US headquarters in New Jersey had turned stagnant. Ten years on, Genentech maintains its independent R&D, hosts the US headquarters of Roche Group and is deemed to have benefitted Roche's wider R&D direction. Last year, group-wide net income **increased 24 percent** on the back of sales of 56.8 billion Swiss francs.

Academic science is increasingly a source of competitive advantage for firms. Yet, exploiting science is difficult. The scientific literature is extremely voluminous, fast-changing, and much of it is useless and irreproducible. Ignoring academic science altogether is not an option, however. Our study highlights that hubs produce a disproportionate amount of useful academic science, but firms should remember that gems – such as Goldwasser's breakthrough on the red blood cell hormone – sometimes emerge in unexpected locations.

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