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When Academia and Industry Collaborate, Innovation Accelerates

A guest perspective on turning scientific discovery into real-world impact

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Technologies develop in leaps and bounds when industries collaborate with academia.

Scientific progress on a broad front results from the free play of free intellects but it is essential that industry and academia work together to turn discovery into useful applications."

— Dr. Vannevar Bush, Founder of the U.S. National Science Foundation Report (1945)

Report: "Science, the Endless Frontier"

In his 1945 report, Science, the Endless Frontier, which he wrote for the U.S. government after World War II. In that report, Bush argued that basic research (often done in universities) should be the foundation of innovation, industry ought to play a key role in turning discoveries into practical technologies, and government must support and help connect and sustain both sectors by ensuring long-term investment in research and development.

The Malaysian Minister of Higher Education's recent call for stronger university-industry collaboration echoes my PhD experience at a major US university. The first couple of years of the PhD programme in the US consist of high-level course-work and seminars. One of my course-mate was a senior Japanese scientist from an electronics company who, despite already holding a PhD, was enrolled in a master's course to learn advanced catalysis techniques. His company sent him specifically to attend Professor George Hess's lectures and to learn about the professor's pioneering laser pulse photolysis method aiming to innovate biomedical equipment. Similarly, researchers from a famous American photographic film company and from South Korea spent months learning basic molecular biology in my professor's laboratory to generate novel proteins. These examples show how American, Japanese, Korean, and other industries drive innovation: immersing skilled employees back into academia to absorb frontier knowledge, then accelerating development.

A feedback loop between discovery and application

The idea that technological progress accelerates when industry collaborates with academia is not just a slogan. Advances in my field of study, molecular biology and genetics, during the last few decades provide compelling evidence for this. These fields, which sit at the intersection of basic science and applied innovation, offer some of the clearest examples of how such partnerships can transform theoretical discoveries into real-world applications at remarkable speed.

At its core, academia is driven by curiosity and the pursuit of fundamental knowledge, while industry focuses on application, scalability, and commercialization. When these two sectors align, they create a feedback loop: academic discoveries feed industrial innovation, and industrial needs guide academic research toward impactful directions. In molecular biology and genetics, this synergy has led to breakthroughs that would have been difficult, if not impossible, for either sector to achieve alone.

What genomics, CRISPR and PCR teach us

1987 - 2003 *Human Genome Project*

One of the most prominent examples is the Human Genome Project. Initiated in 1990 and completed in 2003, this massive effort to map the entire human genome was a collaboration between government-funded academic institutions and private companies. Academic labs contributed deep expertise in genetics and sequencing methodologies, while industry partners brought automation, high-throughput technologies, and computational tools. Academic researchers and companies (such as ABI, Illumina, 454 and Oxford Nanopore Technologies) each played a competitive and complementary role, pushing innovation forward through rivalry and collaboration alike. The result was not only the sequencing of the human genome but also a dramatic reduction in sequencing costs, laying the foundation for modern genomics, personalized medicine, and diagnosis.

1987 - Present *CRISPR Gene Editing*

Another transformative example is the development and application of a gene editing tool called “CRISPR" that has received world-wide acclaim as a phenomenal technology that enables precise DNA or gene modification in living organisms. CRISPR which stands for "Clustered Regularly Interspaced Short Palindromic Repeats' was initially observed by a team of Japanese scientists in 1987. As a genetic tool, it is like a “cut-and-edit” mechanism for genes by precisely changing their DNA sequences. Scientists use it to target a specific piece of DNA sequence inside a cell, cut it, and then remove, or change, or replace it, almost like editing a sentence in a document.

In 2007, scientists at Danisco showed that CRISPR-Cas functions as a bacterial immune system by incorporating viral DNA to build resistance against the virus. Later, University of California, Berkeley researchers Jennifer Doudna and Emmanuelle Charpentier clarified its mechanism. This academic–industry collaboration transformed CRISPR into a powerful gene-editing tool, enabling advances in medicine, agriculture, and biotechnology, with companies now developing therapies for genetic diseases.

1983 - Present *PCR Amplification*

The presence of excellent scientists in industry also extend to the development of ground-breaking technological platforms. Techniques like polymerase chain reaction (PCR) revolutionized molecular biology by enabling rapid DNA amplification that can be used for further analysis including medical diagnosis. While the initial invention emerged from industrial research setting at Cetus Corporation by its biochemist Karyl Mullis, its widespread adoption and refinement occurred through academic research. Universities subsequently expanded PCR's applications in diagnostics, forensics, and evolutionary biology, while companies optimized reagents and instruments for commercial use. This iterative exchange between academia and industry turned PCR into a cornerstone technology, later playing a crucial role in diagnostics such that it became a very popular weekly footage in the famous TV crime series called "CSI".

Therefore, it is without doubt that collaborations between academia and industry drives many impactful innovations. However, they do face challenges like conflicting priorities, data and patent sharing and ethical concerns. Government support and funding is very much needed, especially in facilitating and bridging them together. Such partnership among equal intellectual participants from industry and academia not only fosters a dynamic and impactful innovation ecosystem it also reinforces the value of fundamental research. They enhance education by preparing students for the real world, and the "future world", expanding their opportunities and laying the groundwork for more transformative breakthroughs.

Four practical steps for Malaysia

Based on my observations and experiences, there are at least four actionable steps that can be taken to foster academia-industry collaboration:

Establish "industry immersion" programs in academic environment. Following the example of the US, Japanese and Korean companies that sent senior scientists to Cornell, organizations should create paid, time-bound roles or fellowships that place industry R&D staff directly into university research groups to absorb cutting-edge fundamental knowledge and techniques.

Develop government-supported partnership frameworks for data sharing, patent sharing as well as patent negotiations. The article notes that conflicting priorities, IP rights, and ethical concerns are key challenges. Governments can act as facilitators to establish trust as well as clear rules for patent sharing, data access, and conflict resolution between academic and industry partners.

Integrate real-world, collaborative R&D projects into graduate and postgraduate curricula and research projects. To prepare students for the "future world," industries and universities should co-design courses or thesis projects where students work on applied problems while still grounded in fundamental research, thereby creating a talent pipeline and reinforcing the feedback loop between discovery and commercialization. Resources from both the campus and industry sides can be shared and fully utilized.

Regular brainstorming sessions on industrial futures should be held by all parties, allowing scientists to showcase their creativity and imagine impactful future products in a collaborative manner. These types of events had regularly occurred among the scientists across both sides of the Atlantic organised by their respective scientific organisations like the US National Academy of Sciences, National Science Foundation, the Royal Society of Great Britain and the European Molecular Biology Organisation (EMBO). The various relevant organisations in our region should do likewise.

From collaboration to impact

Technology advances in leaps and bounds when knowledge, people and resources can move between sectors. Malaysia has strong universities, capable scientists and a growing innovation ecosystem. The next step is to make collaboration regular, practical and trusted rather than episodic.

Done well, these partnerships will not weaken fundamental research. They will reinforce its value, improve education, widen opportunities for students and researchers, and create more pathways for discoveries to become solutions that benefit society.

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