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The global importance of patents

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Adam Smith, the 18th century English economist in his book, *An Inquiry into the Nature and Causes of the Wealth of Nations*, expounded that the wealth of a nation depends on capital, labour, and mineral resources[1]. Therefore, it is rather recent that the world has begun to view a nation's true wealth as being based on the creativity of its people and the ideas and innovations they generate, rather than on natural resources or access to low-skilled labour. Erich Bloch, former head of the US National Science Foundation[2], said in 1990:

> In the modern market place, knowledge is the critical asset. It is as important a commodity as the access to natural resources or to a low-skilled labor market was in the past. Knowledge has given birth to vast new industries, particularly those based on computers, semiconductors, biotechnology and designed materials.

Since the industrial revolution that began in Britain and spanned from the late 18th to the early 19th century, the world has undergone a tumultuous transformation[3]:

> The Western industrial technology has transformed the world more than any leader, religion, revolution or war. Nowadays, only a handful of people in the most remote corners of the earth survive with their lives unaltered by industrial products. The conquest of the non-Western world by the Western industrial technology still proceeds unabated.

Today, trillions of dollars, millions of jobs, and economic and geo-political power flow from the exploitation of technologies (such as biotechnology, electronics, communications, etc.) which have deep roots in science, rather than from raw materials and smoky factories.

William Bernstein, in his book *The Birth of Plenty*[4], cites four prerequisites for prosperity: (1) property rights (where advances are not confiscated by the government); (2) scientific rationalism (where, for example, religious beliefs do not overturn scientific advances); (3) capital markets (with some honesty) and (4) efficient communication and transportation (so one can sell what one produces at different places). The industrial revolution in England in the 1800s put these four prerequsites together with great effect. Today all developed and developing countries satisfy Bernstein's criteria and hence competition in the global market has intensified.

Patents create property from information

The essence of property right is the right of exclusion – to prevent trespassing. Patents create property from information. A patent is an alienable right of monopoly for a limited period, a tradable commodity of the most flexible sort. Trade in high-technology goods and services which are knowledge-intensive, and where intellectual property protection is most common, is among the fastest growing in international trade.

Since the 15th century, grants of ownership of intellectual property (IP) as a legitimate means of social and economic progress have grown enormously. In fact, Venice in 1594 granted Galileo, a 'privilege' (what we know as a patent) on a machine which he had invented[5] 'for raising water and irrigating land with small expense and great convenience', on the condition that it had never before been thought of or made by others. In his petition for the privilege he said, 'it not being fit that this invention, which is my own, discovered by me with great labor and expense, be made the common property of everyone'; and also, that if he were granted the privilege, 'I shall the more attentively apply myself to new inventions for universal benefit.'

Clearly, even Galileo, the father of modern science, was unwilling to divulge his invention for free exploitation by others. The Venetian Council saw merit in his argument and granted him a 'privilege' for 21 years.

The rising prosperity of England in the 19th century and the phenomenal prosperity of the US in the 20th century are outstanding examples of what limited-period ownership of IP granted and protected by governments can do. It is doubtful that without patent protection, epoch-defining technological innovations built around inventions such as the electric dynamo, the combustion engine and the transistor would have occurred as quickly. It is equally doubtful that chemical, pharmaceutical and electrical engineering industries would have flourished, or that the world would have seen the rise of corporations. It is the rise of corporations that led to the rapid expansion of the middle class.

University–industry and R&D laboratory–industry collaborations

Since the past several decades, the main drivers of advanced economies have been technology and technological innovations,

rather than manufacturing and agriculture. In fact, in the US, its unparalleled system of research universities and their association with the industry have been an important driver of the new economy. This university–industry association is multifaceted. It includes exchanges of knowledge, expertise, work culture and money. The growth of the biotechnology sector in recent decades has further intensified the association.

This intensification was facilitated by the Bayh–Dole Act[6] of 1980 and the Stevenson–Wydler Act[7] of 1980, which along with further amendments and augmentation have shown the world the kind of remarkable progress a society can make when governments act with magnanimity.

In the 1970s, the US Government discovered that many of the inventions that resulted from its funding, although freely available to the public, were languishing for lack of additional investment needed to turn them into marketable products. The Bayh–Dole Act of 1980 was meant to redress this problem; its purpose: 'to use the patent system to promote the utilization of inventions arising from federally funded research or development.'

Descriptions of inventions were to be legislatively protected from public dissemination and from requests under the Freedom of Information Act for a reasonable period to allow filing of patent applications. The two Acts (Bayh–Dole, and Stevenson–Wydler) laid the foundation for unlocking dormant inventions and discoveries, and catalysed further inventions and discoveries on a scale unimaginable in earlier times. Indeed, *The Economist*, in its 14 December 2002 issue wrote:

> Possibly the most inspired piece of legislation to be enacted in America over the past half-century was the Bayh–Dole act of 1980. . . . More than anything, this single policy measure helped to reverse America's precipitous slide into industrial irrelevance.

The Bayh–Dole Act is widely believed to have energized US State Governments into targeting universities as engines for economic growth. Many countries have now made similar provisions in their patent systems. Globally this has led to private enterprises increasing their R&D spending, where it now overshadows government R&D spending.

The Stevenson–Wydler Act, as amended by the Federal Technology Transfer Act of 1986, was meant to facilitate collaboration between government R&D laboratories and private companies. It allowed a private company and a government R&D laboratory to collaborate under a Cooperative Research and Development Agreement (CRADA). The purpose of such agreements is to allow the collaborating partners to optimize their resources, share technical expertise in a protected environment, share the resulting IP (such as patents and licenses), and speed the commercialization of the technology. Both partners can provide personnel, services, facilities, equipment or other resources, but only the private partner can provide direct funds to the joint project. Generally, both parties will have the right to use any patented technology resulting from the joint project. If the private partners want exclusive rights to the technology, then they have the first right to an exclusive license. Unfortunately, accurate information about CRADAs is difficult to get, even though several of them are known to have been quite successful (for example, the AIDS drug, AZT, was developed by Burroughs–Wellcome in a CRADA with the NIH), because of the statutory provisions that protect the confidentiality of the agreements. CRADA proposals and reports are exempted from the Freedom of Information Act. The contracting parties are bound by the Agreement not to reveal any proprietary information brought to the CRADA, or any research results that emanate from it without mutual consent. None of the agencies responsible for managing the CRADA programme collects information about the extent of its CRADA activity on a regular basis, much less comprehensively[8]. CRADA-like arrangements exist in other countries too, but the US example is the most active one. However, it is the university–industry collaboration that has become the key element in the industrial policies of most governments of the industrialized nations.

In recent years, governments of developed and certain developing countries have been striving to ensure that 3% of their GDP will be spent on R&D by 2010, shared roughly in the ratio of 1 : 2 between the government and private enterprise. Now that technology and related know-how have become important components of international trade, industry does expect financial returns, often in the form of intellectual property rights, from much of the research it funds, including that in academia.

Rise of intellectual property

In importance, patents have begun to replace what in the 19th century were prized mineral rights and trading concessions. In 1947, IP comprised less than 10% of all US exports. In 1986, it was more than 37% (ref. 9). Today, it is well over 50%. Accordingly, business strategies have shifted emphasis from transactions to relationships; from technology features and function to knowledge and expertise; and from quality products that can be procured at an affordable price to solutions that can be customized to the client's needs.

Smart companies now help their clients achieve success by introducing new ways of thinking, working, managing and structuring themselves, equipping them with new tools and capabilities, if need be. Not surprisingly, the patent portfolios of such companies have become corporate profit centres. The future is about capitalizing on economies of expertise, not just on economies of scale.

Mega-research agreements

The IP competition is now so intense that forward-looking governments have set specific goals to ensure that their respective national economies are deeply rooted in science-based technologies, such as biotechnology, nanotechnology, and information technology by 2010. The central, frequent and extensive role to be played by university–industry research collaboration in furthering these goals is taken as given. Therefore, the need to restructure the university system, remove barriers to university–industry collaborations, develop new funding frameworks to strengthen science and technology education (especially of the gifted), source creative talent by relaxing immigration laws, and strengthen technology transfer mechanisms, have become the core concerns of governments. In addition, the need to strengthen IP laws and harmonize them across the world, educate people on the importance of nurturing IP, develop financial agencies and technology appraisal agencies so that in concert they can support commercialization of high-value patents owned by small and

medium enterprises by taking patents rather than material as securities, etc., is being felt and explored by all governments.

The future is expected to see 'mega-research-agreements' between individual companies and universities in cutting-edge technology areas; the building of state-of-the-art research centres initiated by governments, but jointly funded by public and private funds, and industry consortia to support university research. The recent restructuring of Japan's national universities as independent corporate entities[10] has made possible new opportunities for flexibility and innovation in Japan. The trend is likely to be picked up by other countries.

Balancing concerns

To fuel the economies of the 21st century, there is a need for an IP system that fuels private enterprise and sustains the public domain; it must reward and protect inventors and their inventions and yet encourage openness so that innovation is not stifled. Indeed, if academics and academic freedom are squeezed out of a patent-laden field, industry would lose its most important lifeline. On the other hand, the scorched earth strategy of placing data, methods and source codes in the public domain or under copyleft licenses also has undesirable consequences. The new generation of academicians now being brought up in an atmosphere of complex university–industry collaboration is learning to strike a balance between for-profit and not-for-profit research. Universities can no longer survive as completely not-for-profit organizations.

In fact, it is now unlikely that universities would commit the blunder once made in the UK. The failure to patent the hybridoma technique for making monoclonal antibodies, one of the momentous biotechnology breakthroughs of the 20th century, still haunts the British Medical Council. The inventors of the technique, Caesar Milstein and Georges Koehler, went on to win the 1984 Nobel Prize in Physiology or Medicine for it. Their invention, made in 1975, has given rise to an enduring multibillion dollar market[11].

Without patent protection, commercial researchers would naturally become secretive to protect their investments, making duplicated research more likely. Balancing these concerns is crucial, for example, in maintaining the health of the life sciences industry ecosystem.

Collaborative R&D is an important means of stimulating innovation, reducing cost by eliminating duplication of R&D, achieving economies of scale, enabling synergies, and economizing on R&D resources (including human researchers). On the flip side is the fear that collaborators will appropriate their partners' technology or become eventual competitors.

In today's world, the real barrier into businesses is no longer capital, cheap labour (both are mobile), first-mover advantage (it is transient), or brand (it is ephemeral), but a patent portfolio. Unfortunately, while India desires to become a major player in the knowledge economy, its understanding of IP protection can only be considered as naïve[12].

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