Intellectual Capitalism:
Promoting Innovation by Defending Its Value

By Keith Mallinson, WiseHarbor, September 2007

Executive Summary

Owners need the strength to defend their intellectual property (IP) from those at home and abroad who steal it, seek to undermine its value or get hold of it on the cheap.

This report identifies the high cost of IP, including R&D-based innovation. It shows that explicit recognition of value through licensing is increasing innovation, competition and customer choice. Many initiatives fail and some are burdened with significant legal costs in protecting the fruits of IP development from infringement or product liability claims. Major investments are also required in bringing products to market. Profits from successes must make up for the time taken and for all the failures along the way.

The fully vertically integrated company is a rarity these days. Thirty years ago, information communications and technology (ICT) companies such as IBM, Xerox and AT&T were successful with a business model that included R&D, extensive manufacturing including semiconductor fabrication, marketing and distribution. Other industry sectors including pharmaceuticals pursued similar business models. Now, alternative business models prevail with significantly different financial characteristics. Vertically integrated companies and those with subcontracted manufacturing have end-to-end control of the value chain from design to distribution and sale of branded goods. They may never need to explicitly identify the value of their IP—including patents, copyrights or brands. Apple (with the iPod) and Pfizer (with the cholesterol reducing drug Lipitor) have been very successful at selling their highly proprietary complete products. In these instances, the key IP is owned and used exclusively in-house and is deeply embedded in the branded complete products the companies distribute. In contrast, licensing companies' lifeblood is in recognizing value from royalties on copyrights or patents. Companies such as Amgen in biotechnology, and Microsoft and QUALCOMM in ICT have thrived through licensing sales.

Younger and smaller companies and those pursuing alternative business models have often proven superior innovators, significantly disrupting major markets in many cases. These players and other institutions such as universities and government agencies typically do not have the means or inclination to produce complete products or services. Instead, they need fair and efficient markets with strong patent rights and pricing freedom so they can license the IP they create, reap their just rewards and continue to invest.

This fertile environment stimulates market entry for licensors and licensees. It attracts investment, lowers market entry barriers and increases competition against traditional companies with integrated ownership or control.

Innovation is best fostered by enabling entrepreneurs and mavericks to choose how they seek reward for their risk-taking and perseverance through a variety of different business models. Intellectual property owners are prevented from making excessive returns because a free market system encourages introduction of substitute products and only provides patent or copyright protection for limited periods.

Table of Contents

1 Introduction

This report investigates the conditions for successful and sustained innovation, and investment in IP. It profiles business models in R&D-intensive industries and identifies how patented intellectual property is capitalized, implicitly in complete products, through cross-licensing and explicitly through licensing royalties. It analyzes competition and market development in IP-based industries.

This report is sponsored by QUALCOMM, Inc., a pioneer and innovator in digital mobile communications with a disruptive licensing business model that is challenging the oligopoly of mobile handset vendors. All opinions are entirely those of the report's author.

Author Brief

The author led Yankee Group's global wireless and mobile team in Boston for six years until 2006. He managed the ICT research firm's European division for the previous five years. For more, see page 31.

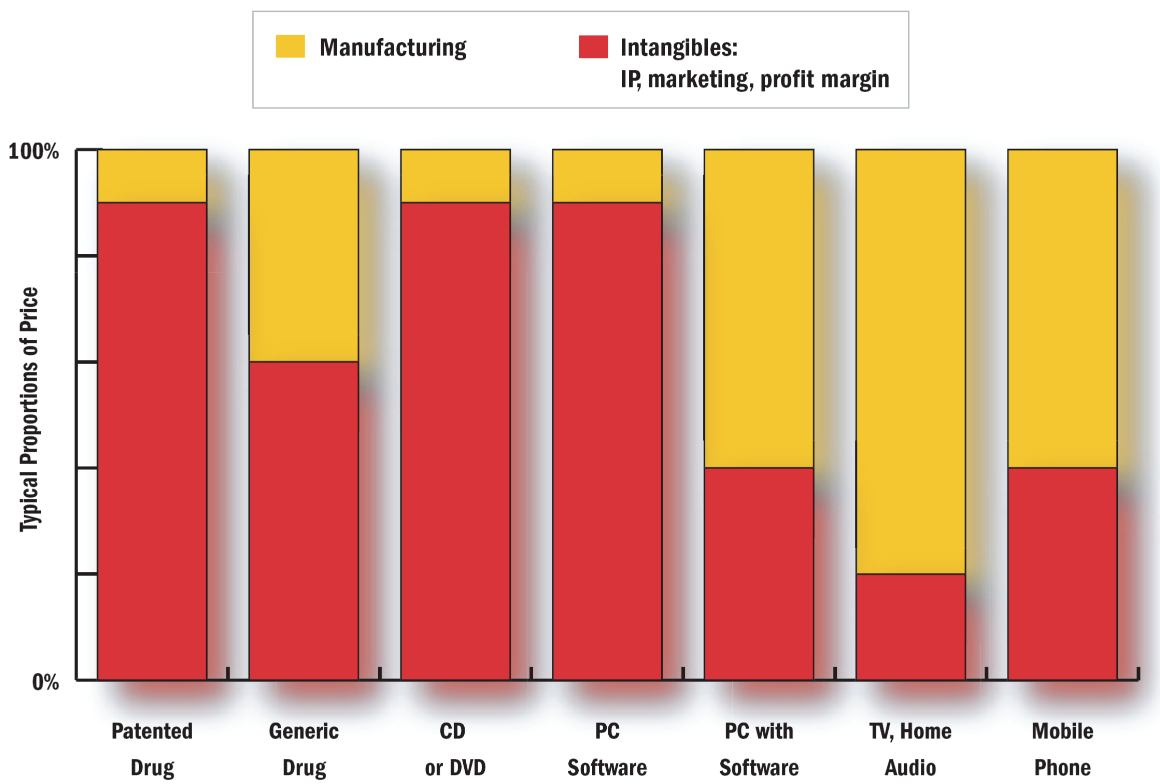
2 Innovation and IP Uncovered

2.1 Disaggregating the Value Chain

Thirty years ago, leading technology innovators IBM, Xerox and AT&T were vertically integrated, including research and development (R&D), manufacturing, marketing and distribution. Under this business model it was not necessary to reveal cost structures or where profits were being made in the value-chain. All that was required was sufficient overall profitability to enable reinvestment in development of new technologies and products. Many companies today that are called *manufacturers* actually abandoned a vertically integrated business model with in-house manufacturing many years ago or never manufactured in the first place. Whereas industrial companies Ford and Siemens have retained vertically integrated structures, ICT and life sciences industries have become stratified. Successful technology innovators focus on specific parts of the value chain while partnering with specialized suppliers.

Exhibit 1

Manufactured Content Varies Substantially by Product Category



Source: WiseHarbor, 2007

Exhibit 1 shows the proportion of product cost or value in manufacturing varies substantially among different product categories. Intangibles including proprietary technology, software, product design and branding can be at least as valuable as the manufacturing. Apple has succeeded with its iPod through internal hardware and software development while subcontracting manufacturing. SAP business software—sold under license by many integrators—runs on a variety of vendors' computer hardware. High-value-added hardware companies such as Apple have lowered capital expenditures and headcounts by eliminating in-house manufacturing while continuing to book the full value of finished product sales on its income statement. Amgen and many other biotechnology companies license their patented technologies to pharmaceutical companies with the much larger resources needed in running clinical trials and bringing drugs to market. IKEA consists of a team of furniture designers and a global retail network that subcontracts to manufacture its products.

As companies become less vertically integrated, there is increasing recognition of where value lies across the product or service value chain. Brand is an intangible asset that results from many factors including investments in design and marketing. The Interbrand division of Omnicom assesses the value of brands in an annual ranking it publishes in BusinessWeek magazine[1]. In 2007 it values top ICT brands as follows: Microsoft $59 billion, IBM $57 billion, Nokia $34 billion and Intel $31 billion. The figures represent 22%, 37%, 28% and 23% of these companies' August 15, 2007 respective stock market capitalizations.

Specialization with stratification of the value chain is not unique to technology and manufacturing industries. Hollywood studios in the IP rich motion picture business, such as Paramount Pictures, face large investments and commercial risks in producing movies. They rely on many different separately owned and valued movie theater chains, TV networks, video stores and emerging online distribution channels to reach their audiences.

Innovation with product and market development is costly and can dwarf associated manufacturing costs. Just as the cost of paper and ink has little bearing on the price of a textbook, the cost of a prescription medicine is much more than the cost of the ingredients. The costs of producing a movie or computer program are also much more than the manufacture of the DVD or CD on which they reside. Similarly, hardware technology products including computers and mobile phones are based on upfront research and development, including embedded software costs. These development costs also create significant intangible value and need to be recouped with sufficient returns to encourage further investment.

2.2 Disruptive Innovators

Innovation is not just about products. It can occur at every level in the creation and delivery of products and services including pricing, marketing and distribution. Innovation can be incremental or disruptive.

Most product and process improvements build upon existing technologies and business models. Countless small innovations are accounted for in part by the thousands of patent applications filed each year. The corresponding competitive environment is with many small performance or quality improvements and cost reductions.

In addition, some of the most costly and risky innovations have been with dramatic changes that create discontinuities in the marketplace. These can also be the most

[1] http://www.businessweek.com/pdfs/2007/0732_globalbrands.pdf

profound and valuable innovations. Schumpeter described this kind of competition as a "perennial gale of creative destruction" that "strikes not at the margins of the profits of the existing firms but at their foundations and their very lives"[2] Disruptive technologies can rapidly push aside market leaders or marginalize their positions. Clayton Christensen's book entitled *The Innovator's Dilemma*[3] illustrates how Intel's 8088 microprocessor, the hydraulic excavator and a succession of computer hard drive technologies revolutionized markets with major changes in market positions for suppliers. For example, the microprocessor created an entirely new market for personal computing while exerting catastrophic competitive pressure on several mainframe and minicomputer vendors.

Major disruptive innovations also occur with alternative business models. These can create an entirely different basis of competition that can expand markets enormously or create new markets. Some of the most dramatic and beneficial economic and social advances have occurred through innovations in the value-chain of supply and with horizontal specialization. These changes may have a revolutionary effect on the way consumers or business customers buy or use products and services. Alternatively, the impact can be among trading partners within commercial ecosystems. Intel (in microprocessors) and Microsoft (in operating system and mainstream application software) each focus on part of the value chain, whereas traditional computer companies such as IBM, Digital Equipment Corporation, Nixdorf, ICL and others in their heyday of the 1970s were all vertically integrated. Driving the Internet revolution of the late 1990s, Dell transformed and expanded the PC market with its direct sales approach in selling custom-configured, low-cost computers. Amazon.com's key innovation was its alternative way of selling and distributing books. eBay created an auctioning system with unprecedented geographic reach that has fostered the development of an entire new sub-sector of merchants that make a living by buying and selling online. Biotechnology companies have pursued a novel licensing-based R&D business model that contrasts with and complements that of the traditional vertically integrated pharmaceutical companies.

Business model-based innovation can provoke the most hostile reactions and claims of unfair competition from incumbents that are threatened by change and seek to maintain the status quo. Small village shops resist the appearance of large-scale discount retailers such as Wal-Mart and Carrefour in their vicinity. Dell completely bypassed traditional PC distributors. Amazon.com has helped put many small bookstores out of business and other online retailers are also pressuring their bricks and mortar counterparts. The trend to off-shore call centers since the late 1990s has attracted strong union and political resistance. In contrast, off-shore manufacturing is so commonplace and well-established in many industries including consumer electronics that it is no longer controversial.

One of the best known competitive battles is between the Betamax and VHS. This is often described as a duel of standards, yet the consensus is that the winning VHS format was technically inferior. The key competitive issue was the extent to which the VCRs and videos were available in each format. Panasonic's business model included widespread licensing for the VHS technology, whereas Sony sought to keep the

[2] Capitalism, Socialism and Democracy by Joseph A. Schumpeter, 1942

[3] The Innovator's Dilemma by Clayton Christensen, 1997

Betamax technology to itself for a lengthy period. This resulted in a market with many VCR brands and products at competitive prices for VHS and much more limited choice with Betamax.

A recent example of business models clashing is the new communications service providers that lack their own networks; they rely on the broadband networks of others for their bandwidth-intensive services at little or no incremental cost to themselves or their end-user customers. As with the text and graphic-based dot-coms of the 1990s, these new players are the true innovators. Skype's near studio-quality voice over IP service can consume 150 kilobits per second in comparison to 60 kilobits per second for a regular phone connection and around 10 kilobits per second on a cell phone. YouTube allows the uploading and downloading of multi-megabit video files. SlingMedia's Slingbox enables consumers to stream their home cable TV selections over the Internet to their PCs or mobile devices while away from home. The battle cry from these innovators is a demand for network neutrality. The dominant incumbent broadband providers resist what they regard as freeloading by these new service providers with their high-cost network capacity demands.

Changes in business models are sometimes, but not always, successful. Fast-growing companies in many different industries including Genentech in biotechnology—currently with earnings of more than $2 billion increasing at a rate of 65%—typically feel compelled to vertically integrate to maintain growth. Companies that have been successful in one part of the value chain often flounder where different competitive conditions apply or may lose focus on what they do best.

Success in the laboratory requires different skills to those needed to compete in manufacturing or marketing. Sir Clive Sinclair's company, Sinclair Research in the UK, was famous for a variety of innovations, including the world's first pocket calculator in 1972, a pocket TV and a market-leading personal computer with spreadsheet program. Each innovation subsequently failed because the company was ineffective at downstream operations. In contrast, Alan Sugar's Amstrad fared much better in commercializing products for the UK with home audio equipment, personal computers and satellite receivers.

Monopoly phone companies with extremely high margins in core businesses such as international direct-dial telephony until the 1980s or 1990s squandered billions of dollars in vertical and horizontal diversifications. Examples include UK's Prestel and Germany's Bildschirmtext *Videotex* information services in the 1970s and 1980s. France's counterpart the Minitel service is frequently heralded as a success, but like the Concorde supersonic jet, its adoption was at the cost of billions of dollars in subsidies without offsetting increases in revenue.

Google and QUALCOMM are examples of particularly significant and successful business model innovators that have come to the fore this decade.

2.2.1 Google

Google owes its success in part to development and implementation of novel information processing algorithms with fast and cheap computing, whereas the most important and valuable innovation is its unique business model. For several years, Google was developing and operating the most advanced search capabilities, but without having identified a means of significantly monetizing its services. Its breakthrough was in turning the Internet portal business model on its head. Up to that point, Internet portals such as Yahoo, Lycos and Excite strove to attract people to their sites and then if at all possible keep them there where their eyeballs could be exposed to the portal's proprietary content and general display advertising. Search as we know it today with Google was anathema to these companies because it takes eyeballs away from the portal. The portals were new and highly innovative companies. Nonetheless, Google succeeded in disrupting their marketplace with a radically different approach to selling advertising and delivering information.

Google benefited commercially by helping searchers obtain precisely what they were seeking. The combination of an exemplary search experience and relevant sponsored text-based advertising links created a system that was popular with consumers, effective for specialized advertisers and lucrative for Google. Revenues grew from $86 million in 2001 to $10.6 billion in 2006. Core business growth and profitability has enabled the company to broaden its scope of innovation.

Google is even innovative in the bottom-up methods it uses to foster innovation. According to *The Search,* a book by John Battelle[4], instead of unwieldy, top-down projects that harnessed dozens of engineering resources, founders Serge Brin and Larry Page created a more dynamic structure in which small teams tackled hundreds of projects all at once. The company launched Google Labs, where interesting new projects—the best of the Top 100—could have an early public view. In the company's fabled development process, engineers are encouraged to pursue other interests beyond their core workload including *ten percent time* for developing really wild ideas that at first glance are difficult to justify against Google's current business lines.

Google also has innovative staff retention policies. It recognizes that as successful technology companies reach middle age, the employment market tends to reward maverick innovation better elsewhere. Many successful innovators in Silicon Valley have left major employers to form start-ups, only to sell these companies back to their former employers for multi-million dollar personal gains. Google seeks to circumvent some of this cost by encouraging these people to develop their technologies and businesses in-house and rewarding them more flexibly and handsomely for staying put.

2.2.2 QUALCOMM

QUALCOMM is also exceptional because it has successfully innovated at multiple levels:

1. QUALCOMM is a leader in developing and applying information theory to civilian mobile communications. It worked closely with the academic community and drew upon breakthroughs by Claude Shannon and QUALCOMM cofounder Andrew Viterbi.
2. QUALCOMM pioneered the adoption of code division multiple access (CDMA) radio against major skepticism that algorithms could be implemented with available digital signal processing technology or technology that could be developed.
3. QUALCOMM created a radically new and unique business model with licensing of all its technologies including CDMA, supporting software layers including BREW with its associated ecosystem and sales of its chipset on the most widespread and non-discriminatory basis possible.

[4] The Search, How Google and Its Rivals Rewrote the Rules of Business and Transformed Our Culture, 2005

QUALCOMM's founders were visionaries who believed in CDMA. They recognized through *modern communications theory* that it should be possible to increase the spectral efficiency, rate of information flow and security of radio networks to much higher levels than possible with the prevailing analog or TDMA-based air interface protocols. They created a company, figured out how to implement CDMA in silicon signal processing and applied it to the rapidly growing and capacity-constrained market for mobile communications products and services.

QUALCOMM strove to get CDMA technology licensed and adopted for cellular communications in many key nations, including the US, across Europe, Japan and Korea. From the mid 1990s, the cdmaOne standard followed by its successor CDMA2000 were accepted in the US, Japan and Korea. In contrast, these standards were almost entirely excluded from Europe. Half of all US mobile phone users have a CDMA handset today. This proportion is increasing with the obsolescence and decline of TDMA-based systems including GSM. Following the proven performance of CDMA during the 1990s and capitalizing on numerous innovations that made CDMA technically possible, CDMA was eventually embraced by the European authorities and others worldwide including the International Telecommunications Union (ITU) for third-generation mobile services. The W-CDMA standard was developed for this purpose, incorporating a large proportion of QUALCOMM's existing technology developed and patented over the previous decade together with additional contributions from QUALCOMM and others specific to the new standard. For example, power control, *soft hand-off* of a mobile phone's communication from one base station to another and *rake receivers* that improve radio signal performance are fundamental capabilities required by all CDMA mobile network technologies for which QUALCOMM owns many patents[5].

QUALCOMM has invested significantly in R&D for 20 years, resulting in thousands of innovative ideas, new business methods and products that have revolutionized the wireless world. With $1.5 billion spent in 2006, it has an exceptionally high ratio of R&D expenditure to sales revenue (20%)—significantly more than the proportion invested by any other major mobile technology vendor, including Nokia (11%), Ericsson (16%), Motorola (10%) and Texas Instruments (15%).

In the mid 1990s, QUALCOMM was compelled to build vertically integrated operations including a network infrastructure and handset division. It needed to ensure that its new technologies would work end-to-end and be promoted aggressively at every level in the supply chain. The large incumbents were struggling because of their lack of experience with CDMA. By 2000, the CDMA technology markets had matured following the market entry by the large incumbent original equipment vendors, including Lucent, Nortel, Motorola, LG Electronics and Samsung. QUALCOMM exited the handset and infrastructure markets to refocus on its core activities, including technology development, chipset design and mobile phone operating system software.

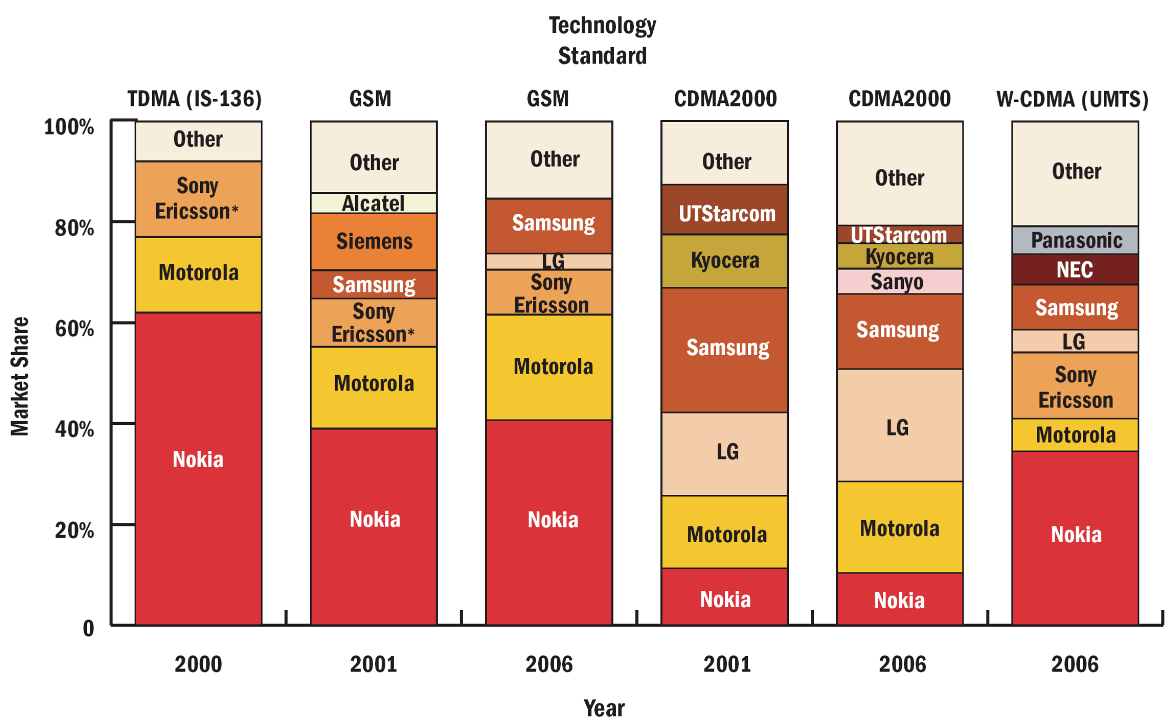
QUALCOMM's radical licensing-based business model has expanded competition in the downstream handset and infrastructure equipment markets by lowering its partners' market entry and operating costs. The CDMA technology sectors in which QUALCOMM participates, including CDMA2000 and W-CDMA, have far less concentrated market shares than the TDMA technology markets—including GSM, where market leaders

[5] Commonalities Between CDMA2000 and W-CDMA Technologies, Qualcomm Incorporated, 2006

including Nokia and Motorola have stronger vertical control in the value chain and command much higher market shares. CDMA technology markets are attracting a large number of downstream vendors that can all concurrently benefit from QUALCOMM's core technology developments on a neutral and non-discriminatory basis. To develop a similar technological base, each licensee would otherwise have to invest a similar amount in core technology development, as well as the specific designs of their individual products. QUALCOMM's customers including LG and Samsung have achieved much larger market shares with CDMA-based technologies, as we show in Exhibit 2, than with TDMA-based technology markets where licensing fees must be paid to their dominant competitors the original equipment manufactures including Nokia, Motorola and Sony Ericsson.

Exhibit 2.

Handset Supply More Concentrated with TDMA and GSM than with CDMA2000 and W-CDMA



* Market share solely applicable to Ericsson prior to formation of Sony Ericsson joint venture in 2001.

Sources: Gartner Group (TDMA), Strategy Analytics (GSM, CDMA, W-CDMA)

3 Leaders and Losers

US companies continue to outstrip their European rivals in R&D investment. Corporate R&D spending in the US rose 8.2% from 2005 to 2006, compared with a 5.8% rise in Europe, according to the UK Department of Trade and Industry's R&D Scoreboard[6]. The

[6] The R&D Scoreboard 2006. www.innovation.gov.uk/rd_scoreboard

gap is even more striking when viewed over the longer term. European companies spent 5.6% more in the past year than the average spent over the previous four years, while the comparable increase for US companies was 15.4%.

When the DTI started this annual survey in 1991, it was based on a widespread belief that British companies were suffering from under-investment in science and technology. Recent findings add fuel to a growing campaign in Europe for action to reverse the region's long-term under-performance in industrial innovation.

The US leads the world in corporate R&D, with $330 billion (equivalent to 3% of GDP) invested in the US versus $136 billion in China and $130 billion in Japan, according to OECD. China’s second position arises as a result of 20% growth last year. US leadership is unsurprising given American companies preeminence in R&D-intensive industries such as ICT, with many market leaders such as Microsoft, Intel, IBM, Cisco and Google. The US also dominates other R&D-intensive sectors including biotechnology. US is ranked by European business school INSEAD as by far the world’s most innovative nation in an academic study, published in 2007, using multiple criteria including: institutions and policies; infrastructure; human capacity; technological sophistication; business markets and capital.

Even though R&D expenditures are increasing, according to a Booz Allen Hamilton study, the ratio of R&D expenditure to sales has reduced in the last few years for the Global Innovation 1000 Companies. The shortfall is just a few percent but this is the equivalent of $27 billion dollars. The R&D to sales ratio fell most significantly in ICT, including software, Internet and telecom where carrier companies no longer have the large R&D staffs and budgets they had 15 years ago and where many equipment vendors are still recovering from the downturn at the beginning of the decade. For example, phone companies such as AT&T, British Telecom and France Telecom once had large internal R&D groups funded by their national monopolies—until the introduction of competition in the mid 1980s in the US and 1990s in Europe forced them to radically reduce costs. Technological innovation has passed from these national telecommunications operators to global equipment suppliers such as Alcatel, Lucent, Ericsson, Motorola, Nokia and QUALCOMM.

R&D is a major cost and is a substantial proportion of sales revenues for many innovative companies. The table in Exhibit 3 ranks the world’s top 12 R&D spenders showing that half of these are headquartered in the US with strongest representation in automotive, healthcare and information technologies including software, Internet computing and electronics.

Comparing companies within industry sectors, in contrast to Booz Allen Hamilton’s findings, DTI concludes that in technology hardware and software there is a very clear correlation between long-term R&D growth and sales growth. DTI concludes that technology companies that responded to the sector's slump in sales between 2001 and 2003 by increasing R&D, such as Nokia, AMD and Juniper Networks, have done much better since then than the companies that cut R&D.

Exhibit 3

Top 12 Global R&D Spenders, 2005

Rank	Company	R&D Spend (millions)	Headquarters Region	Industry	R&D/ Sales
1	Ford	$8,000	North America	Auto	5%
2	Pfizer	$7,442	North America	Health	15%
3	Toyota	$7,178	Japan	Auto	4%
4	DaimlerChrysler	$7,019	Europe	Auto	4%
5	General Motors	$6,700	North America	Auto	3%
6	Siemens	$6,546	Europe	Industrials	7%
7	Johnson & Johnson	$6,312	North America	Health	12%
8	Microsoft	$6,184	North America	Software and Internet	16%
9	IBM	$5,842	North America	Computing and Electronics	6%
10	GlaxoSmithKline	$5,700	Europe	Health	14%
11	Samsung	$5,428	Rest of World	Computing and Electronics	7%
12	Intel	$5,145	North America	Computing and Electronics	13%

Source: Booz Allen Hamilton Global Innovation 1000

R&D expenditure is clearly no guarantee of success. Despite Ford's leadership in R&D spending in 2005, the company posted a record loss of $12.7 billion in 2006, exceeding General Motors' $10.6 billion loss in 2005. The two car makers have deep structural problems, including an uncompetitive cost position with excessive staff-related costs. Toyota is fairing better with more effective R&D, resulting in market share growth and is overtaking General Motors as market leader in 2007.

Strategic focus and sustained financial commitment can be crucial to ensure ongoing commercial success. There are many examples of successful innovators losing their first mover advantages and leadership to competitors that developed a better understanding of overall market requirements and potential. For example, the diversified technology and music publishing company EMI, based in the United Kingdom, is a notable Harvard Business School case study of commercial failure in the CT medical scanner business through unwillingness to sustain R&D, patent infringement defense costs and other market investments[7]. EMI led the global CT scanner market with more than 50% market share in the mid 1970s, but by 1979 its market share had eroded to a low single digit share. EMI did not maintain sufficient investment focus in this high-growth market. Siemens (with scanners in 10 of the top 15 US hospitals today, according to its sales literature), General Electric and others claimed the market. Successful competitors exploited key digital image processing technologies developed for CT scanners and used the profits from this market to fund technical and market development of the emerging MRI scanner business.

Although large R&D expenditures do not guarantee success, in many sectors large and sustained investments are an essential perquisite to establishing and maintaining a sustainable market position. In fact, without significant ongoing R&D, market leadership can soon be lost, as illustrated in the case of EMI.

The large R&D requirements also indicate that successful market players cannot afford to have their innovations expropriated or devalued through piracy or weak intellectual property protection. They need to reap their just rewards so they at least have the opportunity to reinvest to stay in the game.

4 Effective Investment

4.1 IP's Importance and Threats

As we noted at the outset of this report, IP is threatened by those at home and abroad who steal it, seek to undermine its value or get hold of it on the cheap. Music, movies, drug patents, software, information technology, manufactured product designs and business processes are costly to develop and represent a substantial proportion of GDP in developed nations. The International Intellectual Property Alliance report on Copyright Industries in the US Economy estimates copyright industries value added at $1,388 billion, equivalent to 11% of GDP in 2005. The United States Trade Representative estimates that piracy and counterfeiting costs US companies $250 billion in lost revenues each year.

The value of patented IP is also being undermined through infringement, proposed reforms to weaken patents and put royalty caps on IP-intense products and services. US patents are threatened by changes that would make patents easier to challenge and reduce damages awards upon infringement. This is a particularly dangerous signal to nations such as China where IP rights violations are endemic. The US and Europe should be encouraging nations to improve their deficient IP protection laws and enforcement. Some nations would like nothing more than to compel the transfer of developed nation technology for less than its true value. Many companies in developed and developing countries alike—typically with much of their intellectual property protected in trade secrets, branded complete products, more robust copyrights or through dominant market positions—also seek to undermine the intellectual property of others through weakened patents. Some vertically integrated companies and those with outsourced manufacturing that take their profits in the sale of downstream products are resisting the development of licensing-based competitors.

[7] EMI and the CT Scanner (A) and (B), Harvard Business School Publishing, 1983

America, Europe and Japan are in industrial decline as manufacturing moves offshore. Call centers, back-office operations and computer programming are also relocating. Resulting trade imbalances have swollen to unprecedented heights, with, for example, a large surplus in China and a corresponding deficit in the US amounting to 6% of GDP.

With competent low-cost labor in emerging nations it is economically efficient for products and services to come from those places, as long as the costs of delivery to consumers are also sufficiently low. In many cases, physical goods including cars and consumer electronics can be more cheaply manufactured and shipped from offshore facilities. With low-cost communications, many services can also be rapidly and cheaply delivered virtually anywhere.

Is this a terminal demise for the world's current economic leaders? On the contrary, this new industrial revolution can benefit developing and developed nations alike, as discussed in many popular texts, including the best seller *The World is Flat* by Thomas Friedman[8]. Developing nations benefit from export-driven industrial and economic development. Developed nations can also flourish by benefiting from lower costs, but there are major impediments. Developed nations must preserve their knowledge-based assets from expropriation abroad and devaluation at home. Innovators and investors can thus continue to capitalize upon the intellectual capital they have created while justifying the costs and risks of continuing to invest in creative works, R&D and other means of innovation.

Most commercial discoveries and IP investments are made in developed nations. Their highly educated workforces create the knowledge that makes possible today's globally-produced products and services including manufactured goods, computer software, pharmaceuticals, books and movies. For example, the US leads the world with an annual investment of $330 billion in R&D, equivalent to 3% of GDP. It is vital that creators are able to retain ownership of the embedded value and have incentives to continue to innovate and invest through their knowledge workers. That is only possible if creators and owners can be sure that that their work is sufficiently valued and defendable through robust property rights.

Developed nations are in danger of eroding IP rights and stifling new business models that can most effectively capitalize on them. Intellectual Communists who insist on capped or royalty-free licensing for open or mandatory standard technologies, centrally planned R&D have a poor track record with tax payer-funded White Elephants such as the Anglo-French Concorde and France's Minitel online data service in the 1980s.

4.2 Investment Imperatives

Innovation through R&D is essential to economic and social progress—increasingly so in today's information society. The proportion of economic output in intellectual property with goods and services is increasing. "Industrialized" nations are decreasingly dependent upon domestic manufacturing. According to the Commerce Department and the Federal Reserve, US manufacturing has steadily reduced from 25% of gross domestic product in 1960 to 12% in 2006. In many cases, manufacturing and routine computer programming is no longer competitive in developed nations because of relatively high labor and social costs. China and other developing nations

[8] The World is Flat: A Brief History of the Twenty-First Century, Release 2.0, Farrar, Straus and Giroux, 2006

have invested heavily in cheap manufacturing capacity with abundant or oversupply worldwide. Similarly, highly educated computer scientists in India typically cost a small proportion of what they cost in Europe, US or Japan. Developed-nation companies alleviate their local competitive disadvantages by subcontracting large production volumes or by licensing their technologies to low-cost off-shore suppliers.

IP is the key to product value. Innovation with R&D and marketing is the lifeblood of technology-based markets including pharmaceuticals, biotechnology, IT and communications. R&D makes entirely new products and services possible, it can make them cheaper, perform better, more convenient, lighter, smaller and less damaging to the environment.

Universities still play a vital role with fundamental research, while the burden of commercially oriented downstream R&D is predominantly and increasingly with commercial businesses. The role of military and government-funded R&D reduced with the end of the cold war. Military and space agency programs have generated spin-off technologies such as jet engines and GPS for civil use. These days, it is increasingly common for the military to benefit from civil technologies such as commercial computers and software rather than be the R&D driver.

Consumer markets for technology products provide the scale to support the high development costs and fastest response to new innovation. The rapid diffusion of new product categories such as digital audio players including the iPod with 23 million devices sold in the fourth quarter of 2006 and a total base of 100 million devices owned by the first quarter 2007.

IP rights make it possible for commercial returns to be made on innovation investments. Writers, composers and artists are all afforded intellectual protection through copyrights for their creative works. In some markets, including perfume, foods and beverages, commercial secrets provide the property protection to compensate for technical and brand development. Similarly, technology-based firms need intellectual property protection. In some cases, such as software, ownership might be provided through copyright law; in other cases, such as hardware design or drug formulation, it is generally patent law that provides the protection.

Commercially successful innovation requires much more than inventing new technologies and products. Substantial investments are required to promote new concepts, win acceptance by regulatory bodies and customers, to defend against prospective patent infringements and product liability suits. Innovations must be pioneered in the face of skeptics and opposing vested interests. Bringing products to market also requires that the market—including intermediaries and end-users—are educated and informed through sales and marketing programs. ICT innovations frequently need inclusion in standards, whereas pharmaceuticals require clinical testing and licensing.

The following analysis draws on a wide variety of examples of innovation and product development in intellectual property-rich sectors including movies, pharmaceutical, biotechnology, and ICT industries. The technologies, products and services differ enormously, but the need to sustain productive investment is universal. Commercial rewards for innovation should rightly accrue to those with strong proprietary positions and intellectual property in fundamental technology, product design, branding, distribution and marketing.

4.3 R&D is Only the First Step

Innovation has to be managed on a broad and systematic basis. In their article entitled *The Road to Disruption,* Scott D. Anthony and Clayton Christensen debunk several innovation myths and deliver some key prescriptions[9]. Innovation is not just about technology. New ways of doing business, making money, understanding what customers want are also valuable forms of innovation. Innovation investments must be carefully directed to avoid frittering away resources. These authors assert that most industry-altering innovations start as whispers that need time and momentum to become big bangs. They believe companies can get innovation right every time by identifying and understanding patterns of success.

R&D is just one part of the innovation process. Successful innovators foster innovation within their companies by dividing the innovation lifecycle into several steps with names such as *opportunity search, ideation,* including basic research and conception, *project selection, product development* and *commercialization* in bringing products to market through licensing or production with or without distribution partners. Each step has its associated management principles and processes.

4.4 War of Attrition

It is a popular misconception that innovation is random or serendipitous. In fact, it takes many ideas to find a few initiatives worth experimenting with, which may then enable a few things to be identified that are worth investing in significantly and might ultimately lead to a winner or two with sufficient business development effort and investment. Pharmaceutical companies recognize this in the management of their drug pipelines, just as a good office equipment sales manager knows that he needs a large sales funnel with many more sales leads and prospects than will result in new customers or orders. Only five of every 10,000 compounds investigated in the laboratory make it to clinical trials. Of those five, only one is approved for patient use.

Business gurus Gary Hamel and Alejandro Sayago lament that many organizations do not have this approach to their strategies[10].

> *"These companies do not think about innovation as a numbers game in which the likelihood of generating a rule-breaking idea is totally dependent on the number of way-out ideas the company created at the start. In fact, most companies would like to believe that they can avoid the experiments and the semi-failed projects by putting some really smart people in a room for a few days and asking them to think really hard."*

British entrepreneur Sir James Dyson made 5,127 prototypes before he perfected his novel dual-cyclone technology bagless vacuum cleaner. He spent three years searching worldwide for someone to manufacture it under license. He got lucky in Japan where consumers fell in love with the pink-and-lavender G-Force, which retailed for a pricey $2,000. He opened a manufacturing plant in the UK in 1993 and later off-shored production to Malaysia. Dyson has the bestselling vacuum cleaner in Britain, America and much of the rest of the world. The company that carries his name has annual

[9] The Road to Disruption, Creating Breakthrough Innovations, Harvard Business School Press, 2006

[10] Toppling the Walls Surrounding Corporate Creativity, Creating Breakthrough Innovations, Harvard Business School Press, 2006

revenues of around $1 billion, 80% of it from exports. It spends about $100 million on R&D with new products including a low-energy consuming hand drier using high-velocity air rather than heated air.

4.5 R&D Productivity and Patents

There is no simple relationship between R&D investment and commercially successful innovation. There are great efforts afoot to improve productivity in innovation, but with many examples of poor commercial performance—including the R&D-intensive biotechnology industry as a whole with near zero cumulative net operating income from 1975 to 2004[11]. Without Amgen, the largest and most profitable firm, the industry sustained steady losses throughout its history. In August 2007, even Amgen is suffering significant difficulties following safety concerns and regulatory restrictions on US sales of its top selling anemia drug Aranasep. The company announced it will cut staff by 14%, reduce capital expenses by $1.9 billion, take $600 million to $700 million in pretax charges and reduce R&D from 24% to 20% of sales.

Some companies are much more productive with their R&D expenditures than others. Booz Allen Hamilton's annual study of the world's 1,000 largest corporate R&D budgets uncovers a small number that have managed to get more out of their R&D investments consistently over a five year period[12]. There is a tenuous relationship between R&D spending and corporate performance measured by sales and earnings growth, gross and operating profitability, market capitalization growth, and total shareholder returns.

The number of patents owned is also a simplistic and poor indicator of effectiveness with R&D and innovation. Public officials and others fixate about patent counts as a proxy for national innovation—but all patents are not equal. Among its key conclusions, Booz Allen Hamilton indicates that boosting R&D expenditure will increase the number of patents a company controls. But there is no statistical relationship between the number or quality of patents and overall financial performance. Booz Allen Hamilton compared its analysis of company R&D performance with data from ipIQ, a technology analysis firm known for its comprehensive patent database. Quality ratings are based on the number of patent citations in scientific and technical literature.

Xerox performed poorly in commercializing its inventions with most of the benefits accruing to others, as described in *Fumbling the Future: How Xerox Invented, Then Ignored, The First Personal Computer*[13]. On the strength of a near monopoly position in the high-end copier business during the 1960s and 1970s with profits rising from $3 million in 1959 to $348 million in 1974, it diversified its R&D budget with more than half going into developments other than copying. Despite substantial R&D investments and some terrific inventions including the local area network, the computer mouse and a graphical user interface with windows and icons, the company failed to capitalize on these innovations. Meanwhile, its market position in photocopiers has significantly eroded. It was not effective in responding to an emerging market for desktop copiers.

[11] Science Business: The Promise, The Reality, and the Future of Biotech, by Gary P. Pisano, 2006

[12] Smart Spenders: The Global Innovation 1000. http://www.strategy-business.com/resiliencereport/resilience/rr00039?pg=0

[13] Fumbling the Future: How Xerox Invented, Then Ignored, The First Personal Computer, by Douglas K. Smith and Robert C. Alexander

Since 1982, the company redefined itself as “the document company” and focused on the core copier business with slight diversification into digital distribution and printing. The laser printer is one of its few R&D initiatives that made a significant contribution to it revenues. Financial performance has been poor or lackluster for most of the last decade or so following a five year earnings restatement of $2 billion in 2002 for revenue recognition irregularities. Revenues have been flat since then at around $15.8 billion as income has recovered.

4.6 Government and Institutional Factors

A fertile external environment is also required. Microsoft, Intel, Apple, Google, Cisco and hundreds of others in the US Seattle and Silicon Valley areas have flourished with, among other factors, proximity to first-class universities, a free market for skilled labor, plentiful sources of venture capital and strong intellectual property protection. Customers and other stake-holders around the world benefited enormously from the increased personal productivity, information access, employment and the contribution to economic growth that these companies have created.

Government grants and tax breaks are a popular political gesture to stimulate R&D, but are not an effective way to invest in innovation. Romano Prodi, Italian prime minister and former president of the European Commission, warned in an interview with the Financial Times on November 6, 2006, that Italy must raise its economic growth rate as a first goal, or it will be “lost.” Prodi stated that he intends to pursue a variety of economic reforms including using tax incentives to boost research and development in 2007.

Relying on blanket supply-side measures such as these will repeat previous failures that directed funding for political reasons above commercial logic. Subsidies and tax relief will encourage R&D, but this focuses on the costs rather than the fruits of investment. Subsidies will likely encourage the wrong initiatives.

Governments and bureaucrats are notoriously bad at picking commercial winners. Poor British performance in the commercial aircraft industry since World War II was aggravated by the availability of large government hand-outs that impaired the commercial judgment of development decision-makers. The Anglo-French Concorde supersonic aircraft was a phenomenal technical advance and a commercial disaster with billions of dollars in losses at the expense of British and French taxpayers. The UK Government’s National Enterprise Board sought to propel the nation to the forefront on the global semiconductor industry with initial funding of $100 million for INMOS in 1978. The company temporarily captured a significant share of the commoditizing SRAM market but failed in its core mission with the parallel processing *transputer.* Eurotunnel was another Anglo-French government-inspired project, in this case with private financing, but also with disastrous results for a succession of investors. ICT *dirigisme* in France with elimination of phone books and their replacement by Minitel terminals in the 1980s was hailed a success, but this assessment ignored the large cost of having to give the terminals away.

The pharmaceutical sector presents a major dilemma to governments that would like to limit or reduce healthcare costs without discouraging investment in new drugs. Healthcare costs are spiraling upwards. According to the Center for Automotive Research and car manufacturers Ford and General Motors, healthcare costs for retired employees have tripled to more than $600 and $875 per vehicle for each manufacturer, respectively, between 1999 and 2005. It is tempting for governments to regulate prices or weaken patent protection to reduce the drug expenditures. This is shortsighted because the reduced financial returns make pharmaceutical and biotechnology companies less inclined to invest in the innovation needed to create new drugs that can get people cured and back to work or out of the hospital.

4.7 Property Rights and Pricing Freedom

Strong intellectual property rights and pricing freedom are required to generate the relatively high gross profit margins (i.e., revenues minus direct or marginal costs) necessary to offset high innovation costs and risks. The movie, music recording and publishing businesses are protected by copyright law with exclusivity for 50 years and no pricing controls. Drug patents last 20 years, but approximately half this period is spent in development and clinical trials in advance of any sales. The remainder of the patent period is crucial because generic drugs—priced at marginal cost and benefiting from the former patent holder's development and government approval work—rapidly enter the market for the most popular *blockbuster* drugs upon patent expiration. This brings prices down to a small fraction of what the drug was selling for under patent. Drug prices are not regulated in the US but are controlled in other regions, including Canada and Europe.

Similarly, pioneering semiconductor, software and communications technology developments typically rely on patent law for periods of exclusivity. There is generally pricing freedom, but this principle is being challenged by those who would like to cap royalties where standards are required to ensure interoperability among different products and service providers. This jeopardizes the ability of technology pioneers that do not have vertically integrated businesses to find ways of achieving an adequate commercial return. For example, licensing-based businesses such as QUALCOMM's QTL division derive revenues from royalties, whereas QUALCOMM's QCT division and Texas Instruments sell chipsets. Handset vendors including Nokia and Sony Ericsson have the latitude to take their returns from the margin they charge on finished product sales that dwarf the revenues attributable to royalties or chipsets.

4.8 Risk and Reward

Large compensating revenues are needed to offset the costs, risks and long timescales of bringing innovative products to market. Successful products and services must recoup their own research, development and marketing costs plus those of the commercial failures. QUALCOMM pioneered CDMA technology for more than 10 years before the US was willing to accept it as a cellular standard and for a further eight years before European authorities licensed it. Positive returns may never come at all. Wikipedia lists 91 movies with production costs of $100 million or more, before adjusting for inflation, and many of these have bombed at the box office with big losses to the film studios.

Pharmaceutical companies are among the largest R&D spenders. For example, revenues amounting to in excess of $1 billion per year blockbuster drug are required if investments are to continue in drug development. Pharmaceutical companies develop new drugs at an average of cost of $802 million apiece in 2000, up from $318 million in 1987[14] and it takes an average of 10 to 15 years to bring a new medicine to the market.

For drugs that make it to the pharmacist's shelf, twice as much is typically spent on marketing to educate physicians and provide product samples as is spent on R&D[15]. This maximizes volume demand in a business where fixed costs are very high versus the low incremental or average costs in production and distribution.

Additional costs include product liability and patent infringement defense. In the 1990s, Wyeth was mired in litigation with the diet drug known as Fen-Phen. Since then the company has reserved or paid out more than $21 billion to cover legal fees, judgments and settlements for claims of heart damage. Merck is currently spending $1 million per day to defend itself against 27,200 lawsuits and 275 proposed class actions stemming from its 2004 decision to withdraw the painkiller Vioxx from the market after trials linked it to increased risk of heart attacks and strokes. Industry expert opinions on Merck's ultimate liability range from a few billion dollars to $25 billion and bankruptcy. Pfizer's market capitalization dropped by $25 billion at a stroke—representing one-eighth of the firm's market capitalization—upon the 2006 withdrawal of its cardiovascular drug Torcetrapib during late-stage clinical trails.

Most innovations fail commercially if not technically. Successful innovations must cover the cost of failures as well as their own costs. In the case of pharmaceuticals and biotechnology in particular, programs are often abandoned after many years of work and up to hundreds of millions of dollars invested, due to inefficacy or adverse patient side effects. Movie productions very rarely fail for technical reasons, but every screenplay and cast represent significant risks. The box office and other receipts must cover these production costs as well as the cost of lemons, such as Heaven's Gate[16] or any Madonna movie, if a satisfactory investment return is to be provided to shareholders.

Consumer electronics, IT and communications technologies are much less likely to fail technically after similar investments in time or money, but many factors determine the commercial outlook. Alternative technologies and suppliers may diminish commercial potential substantially or entirely if these perform significantly better or are preferentially adopted by standardization bodies, distributors or customers for other reasons. The aforementioned Sony Betamax famously lost the VCR standards war to Panasonic's widely licensed VHS. Lotus pioneered its 1-2-3 spreadsheet and Netscape the web browser, but even these highly innovative and effective products that forged significant new markets were commercially eclipsed by Microsoft's close substitutes Excel and Explorer, respectively.

Despite QUALCOMM's pioneering efforts, CDMA technology was excluded from the European market for eight years by exclusive licensing of TDMA-based technology for mobile phones with the GSM standard. Perseverance in the US, Japan and in other nations brought acceptance and licensing of CDMA (IS-95) to supplement TDMA technologies including GSM and PDC from around 1993. This was four years after the Telecommunication Industry Association selected TDMA (IS-54) as the basis of the

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[14] The Price of Innovation: New Estimates of Drug Development Costs by J.A. DiMasi, R.W. Hansen, and H.G. Gabowski, published in the *Journal of Health Economics 22 (2003).*

[15] Overdose: How Excessive Government Stifles Pharmaceutical Innovation, Richard Epstein, 2006

[16] Final Cut: Dreams and Disaster in the Making of Heaven's Gate, by Steven Bach, 1985

next-generation digital cellular standard in the US. This standard was subsequently enhanced under IS-136.

In some cases no payback will ever be achieved, as was the case with Motorola's Iridium global satellite system in the 1990s. Iridium spent an estimated $5 billion to $7 billion building the satellite network, but despite the engineering feat (66 low-orbit satellites providing a wireless connection around the globe), the project was a dismal commercial failure and Iridium went in to bankruptcy. Iridium and various distressed fiber projects, including those initiated by WorldCom, Global Crossing and Tyco might ultimately provide second or subsequent owners with good commercial returns because distressed assets were sold at massive discounts—amounting to just pennies on the dollar in some cases.

4.9 Exclusive Property Rights Are not Monopoly Rights

Patenting of intellectual property has worked well for consumers who have benefited from innovations and for investors who have been willing to sustain their investments. The exclusive rights that owners enjoy for a limited period of time are essential to ensuring the required investments are made. Detractors argue that the system is flawed and can provide excessive rewards or exploitative positions to patent holders. On the contrary, pharmaceutical companies that are among the largest patented R&D spenders are in financial decline. Pfizer, the world's biggest pharmaceutical company, is cutting 10,000 jobs (equivalent to 10% of the company's workforce). The company has sparse pipeline of drugs to replace earnings of its flagship cholesterol-fighting drug Lipitor—currently generating $12 billion in revenues—that goes off patent in 2010.

There is scant evidence that the patent holders have sought to hold or succeeded in holding markets hostage. There are a variety of reasons for this, including the basic fact that ownership of patented technologies does not create a market monopoly because markets are generally rich with substitutes. Lipitor is a market leading blockbuster drug, but it is already facing strong competition—long before the onslaught of generic drugs. Half a dozen alternative *statin* drugs on the market depend upon the same basic mechanism as Lipitor, but differ in molecular structure.

Similarly, even in standardized markets such as telecommunications and open source computing there are plentiful substitutes. GSM, W-CDMA and CDMDA2000 cellular standards all provide mobile voice and data services, while Wi-Fi provides alternatives to these technologies for data services. The new WiMAX technology is also targeting the same market, with the promise of additional speed and network capacity. Competition among these technologies and against other forms of communication such as landline, cable and satellite communication prevents monopolistic pricing behavior or market exclusion for would-be competitors. Similarly, users have a choice of computer operating systems from Microsoft, Apple or the various flavors of Linux.

However, antitrust problems might occur where governments mandate standards, as the European Commission has with GSM and as it is contemplating with DVB-H in mobile video. Demanding exclusive use of one technology and eliminating competition among rival technologies opens up the possibility of market abuse by holders of the essential IP required to implement the standard that might seek to charge high royalties, or by colluding purchasers driving the price down to an artificial and unfair low level. Rather than seeking to fix a problem of the authority's own making by capping or fixing royalties on the patents required to implement the standard, it is far better to avoid the problem in the first place by giving innovation and competition a free hand and not limiting customer choice of standards that may be employed in the marketplace.

5 Business Models

5.1 From Integration to Stratification

New business models have emerged to displace vertical integration, enabling more specialized market entrants and use of low cost operations. Manufacturing has moved offshore and under independent ownership in many cases. Call centers, back-office operations and computer programming are also relocating and being outsourced. IBM adjusted to the demise of traditional mainframe data processing and other disruptions with divestment of manufacturing operations and product groups, including printers (spun off into Lexmark) and PCs (sold to Lenovo). It has focused on software and services in recent years. The biotechnology sector grew up from its origins 30 years ago on the basis of an unprecedented licensing-based structure in the life sciences industry. Even the Korean *chaebol,* such as Samsung manufacturing semiconductors and finished goods, is dependent upon component supplier QUALCOMM for the core processing chips and IP in its mobile phones. Ford in car manufacturing and Siemens in industrial products (including power generation, medical equipment and train manufacturing) remain significantly vertically integrated in some of their corporate divisions.

5.2 Patented Pharmaceuticals, Generics and Biotechnology

Three distinct business models have emerged in the pharmaceutical and biotechnology industries. The metrics in Exhibit 4 illustrate the distinctly different financial characteristics among these three business models.

Traditional mainstream pharmaceutical companies such as Pfizer and GlaxoSmithKline are self-contained with large and vertically integrated operations including substantial R&D, manufacturing and marketing. These companies sell mostly patented drugs.

Generic drug companies, including Barr Pharmaceuticals and Teva Pharmaceuticals, are at the commodity end of the market and are downstream-focused on manufacturing with relatively small-scale R&D and marketing operations. Generic companies have the lowest gross profit margins despite also having the lowest R&D and marketing spending.

In contrast, biotechnology companies are upstream-focused on R&D and typically do not have all the downstream resources including financial capital required to bring patented drugs to pharmacists' shelves. Instead, many of these companies license their technologies to mainstream pharmaceutical companies that share the costs and risks in clinical trials, patent protection and product liability suits. Their downstream partners in some cases also do the manufacturing, marketing, sales and distribution. For example, Amgen is a global biotechnology company that discovers, develops, manufactures and markets human therapeutics based on advances in cellular and molecular biology. It operates in one business segment: human therapeutics. Amgen's principal products include Enbrel, which is marketed under a co-promotion agreement with mainstream pharmaceutical company Wyeth. Biotechnology companies are the most R&D-intensive companies. They tend to have relatively small, licensing-based (rather than product-based) revenues. Their gross margins need to be relatively high to support the high ratio of R&D expenditure to sales revenue.

These demarcations are not precise and company profiles change continuously. As patented pharmaceutical companies such as Wyeth become licensees to biotechnology companies, they become less vertically integrated. Genentech is a rare example of a commercially successful biotechnology company. It has become less dependent on upstream licensing and contract R&D. It is now more downstream-oriented with product sales accounting for most of its revenues. Merck is likely to sell its generic drug arm so it can increase its focus on patented drugs with the purchase of biotechnology company Serono. Some generic drug companies increase R&D expenditures with the objective of developing their own patented drugs.

Exhibit 4.

Business Model Financial Metrics in Pharmaceuticals and Biotechnology

	Generic		Patented			Biotechnology	
2006	Barr Pharma' (6 months)	Teva Pharma'	Pfizer	GlaxoSmithKline	Wyeth	Amgen	Genentech
Sales (million)	$916	$8,408	$48,317	$44,492	$20,351	$14,268	$9,284
Gross Profit Margin	59%	47%	84%	78%	73%	85%	70%
R&D/Sales	13%	7%	16%	14%	15%	24%	19%
R&D (millions)	$107	$495	$7,599	$6,623	$3,109	$3,366	$1,773

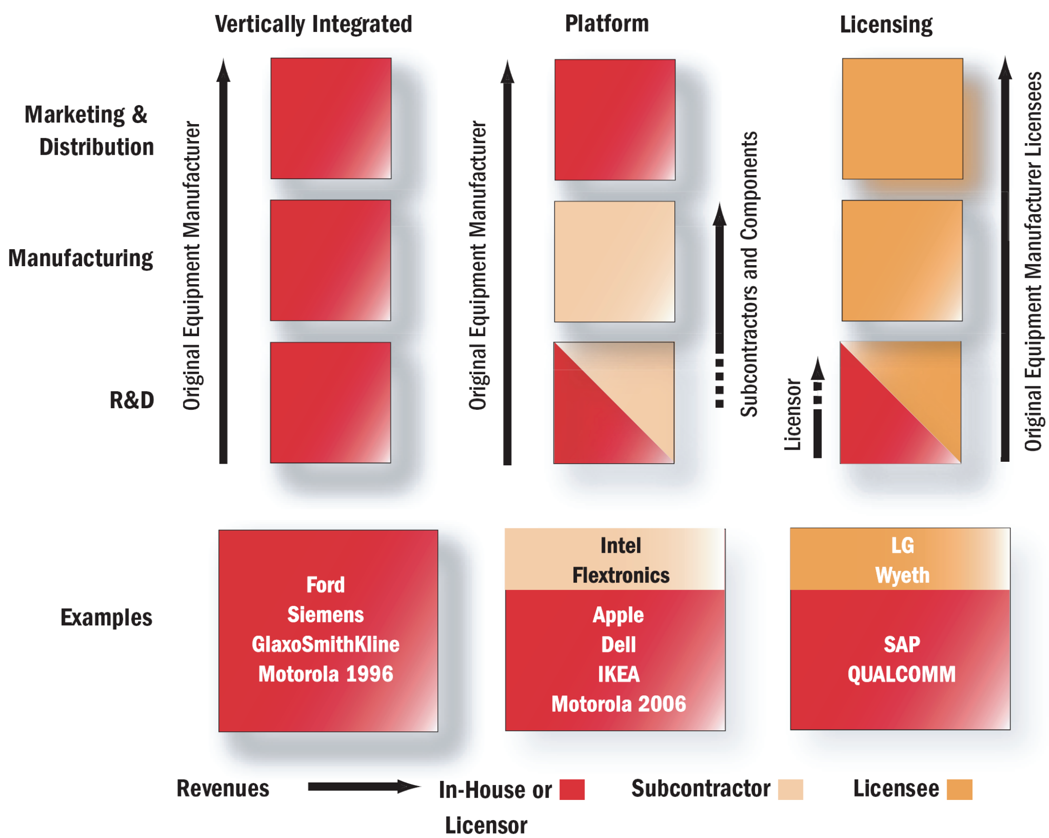
Source: Reuters, Company Reports

5.3 ICT Products

Business models for ICT and other products businesses can also be categorized into three basic types, including the vertically integrated form we described. Many companies align significantly, though in no case perfectly, toward one of the profiles in Exhibit 5. Vertically integrated and *platform companies* recognize revenues across a complete product's entire value chain, as do original equipment manufacturing licensees. Licensors, subcontractors and component suppliers make revenues that correspond to just part of the value chain. These are a relatively small proportion of a product's price.

Exhibit 5

Business Model Value Chain in ICT and Other Product Businesses



Source: WiseHarbor, 2007

Today's world-leading ICT companies concentrate on high-value-adding functions in which knowledge and technology take priority over in-house manufacturing capabilities. According to international research boutique GaveKal, the platform company business model is evolving in advanced nations such as the US, Sweden and the UK[17]. The platform company develops and retains ownership of its technology, iconic products and branding at home in developed nations while subcontracting low-return operations including manufacturing and software development to low-cost providers at home and abroad.

This maximizes platform companies' proprietary value while minimizing capital costs, operating expenses and business risk in volatile market conditions. Companies such as Apple, Motorola, Hewlett-Packard and Dell command high margins from retail customers for branded products, while relying on third-party Asian suppliers for capital-intensive and labor-intensive operations. Platform companies can exploit significant manufacturing overcapacity in emerging market nations such as China. Likewise, software companies are increasingly using low wage programmers in India to write

[17] Our Brave New World, by GaveKal Research, 2005

routine code. Many platform companies are reluctant to reveal the extent of this off-shoring for political, public relations and competitive reasons.

Platform companies obtain significant commercial leverage from their proprietary positions. These companies appear vertically integrated from a financial and control perspective while subcontracting operations that account for most of their costs.

Press reports, political and economic commentators have voiced great concern about the large US trade deficit with imports significantly exceeding exports in recent years. This is not as big a problem as it appears because international trade statistics measure revenues rather than incomes (i.e., earnings). Incomes are much more important than revenues to the survival and well being of US corporations because only incomes can justify investment or fuel long-term growth. According to GaveKal, the sale of a $700 Dell computer might generate a negative trade balance of $450, representing the purchase price from Asian manufacturers. Yet the same transaction typically might generate a slender profit of around $30 for the Asian vendors. Dell's significant gross profit margin (18% of sales on its annual income statement) results from its product sales prices less the direct cost of Intel's microprocessor, subcontract manufacture and bundled software from Microsoft.

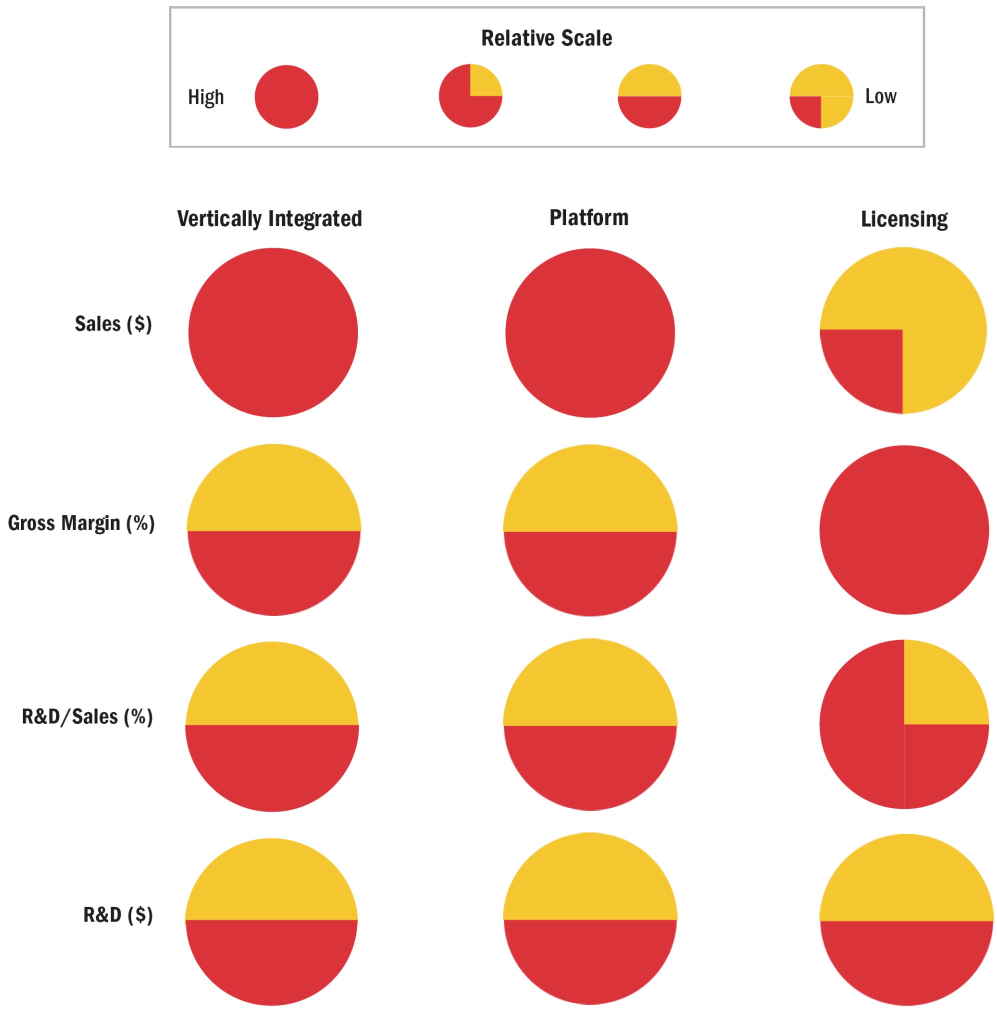
An alternative business model is based on licensing or selling core technology products to companies that are more oriented toward downstream operations including production and distribution of their own branded products. This approach is pursued by most biotechnology companies, software vendors and by QUALCOMM for its advanced communications technologies. Licensing companies must determine prices for the sale of their intellectual property to downstream licensees. In contrast, vertically integrated and platform companies can choose how much intellectual property to license, at what price and at their sole discretion. Alternatively, they can elect to sell none—at any price.

There are important similarities and difference between platform companies and licensing-based companies. As with a licensing business, high-value-adding functions and intellectual property are retained and are a major source of profits. Highly capital-intensive functions such as semiconductor fabrication and labor-intensive manufacturing or coding are left to others whose profits are most sensitive to the ebbs and flows in market demand. Platform companies tend to have significantly larger revenues than licensing businesses because of the downstream trade included on their income statements. Total bottom line profits—with success for both platform and licensing businesses—will most likely be much closer in size. Platform businesses can present the illusion that profits are derived across their entire cost and revenue base, whereas—just like a licensing business—they may be principally derived from their proprietary positions with intellectual property.

These three business models have significantly different financial characteristics with size of sales revenues and gross margins versus R&D expenditures. Exhibit 6 shows that licensing companies tend to have relatively high gross margins in comparison to vertically integrated or platform companies. Licensing revenues tend to be modest in comparison to direct or manufactured costs in vertically-integrated or platform companies. Fixed costs such as R&D tend to predominate in licensing business where R&D to sales ratios will also tend to be relatively high.

Exhibit 6.

Licensing Business Model has Distinct Financial Characteristics



Source: WiseHarbor, 2007

As with the pharmaceutical and biotechnology companies, most ICT product companies align with one of these business models, but few companies are pure exponents and profiles change continuously. Exhibit 7 presents key financial metrics including characteristic gross profit margins and R&D expenditures for major ICT platform companies Dell, Apple and Motorola. It compares these with vertically integrated and licensing-based companies.

The platform model is in some cases adopted from the outset and in other cases as companies grow or add product lines. Many vertically integrated companies became platform companies because they could not stay cost competitive for manufacturing in their home market and to exploit cheap overcapacity from foreign suppliers, as was the case with Dyson. Motorola's semiconductor division went "asset light" around the turn of the century by subcontracting capital-intensive fabrication. A few years later, it spun off its entire semiconductor division to form a separate company—Freescale. Motorola still purchases from Freescale while introducing alternative chipset suppliers. Apple's iPod was manufactured under subcontract since launch.

QUALCOMM was vertically integrated with a network infrastructure and handset division until the turn of the century. It divested these two operations early this decade to focus on its core technology development, chipset design and its BREW mobile phone operating system software. This has enabled it to be most effective with a business model in which it sells chipsets and licenses its technology on the most widespread and neutral basis possible to a large number of handset manufacturers and with no internal competitive conflicts.

Exhibit 7.

Financial Metrics by Business Model in Engineering and ICT

	Vertically Integrated		Platform			Licensing	
2006	**Ford**	**Siemens**	**Dell**	**Apple**	**Motorola**	**SAP**	**QUALCOMM**
Sales (million)	$160,123	$113,038	$55,908	$19,315	$42,879	$12,116	$7,526
Gross Profit Margin	2% (13% in 2005)	27%	18%	29%	30%	66%	71%
R&D/Sales	4%	6%	1%	4%	10%	14%	20%
R&D (millions)	$7,200	$6,503	$463	$712	$4,106	$1,720	$1,538

Source: Reuters, Company Reports

Platform companies subcontract to a variety of manufacturers that are mostly based in low-cost Asian countries, including China, where investment capital is abundant. Flextronics has manufacturing and supply-chain operations in dozens of countries worldwide. Taiwan-based Foxconn Technology Group manufactures Motorola mobile phones and other products for Apple, Microsoft, Dell and Hewlett-Packard. In January 2001, fast-growing handset vendor Sony Ericsson announced it was contracting with Flextronics International and Foxconn to manufacture 10 million handsets in India within two years.

Apple has been able to maximize its commercial leverage as a platform company by sourcing the iPhone's novel touch screen from four suppliers including Epson, Sharp, Toshiba and Matsushita. Apple puts its display business up for bid each time it makes an order for displays, which are the second most expensive component in a mobile phone. In August 2007, Nokia announced the addition of Infineon Technologies as a second chipset supplier in addition to Texas Instruments for its ultra-cost competitive and low priced sub-$40 handsets for developing markets such as India. These baseband and application processing chipsets are the most expensive mobile phone components. Nokia also announced introduction of second source modem chipset suppliers for 3G (W-CDMA) and EDGE technologies.

Subcontract manufacturers also have distinct financial profiles. For example, Flextronics is capital intensive and operating cost focused. It has a gross profit margin of just 5% on annual sales of $15.3 billion. The platform companies invest in brand, design and intellectual property and are rewarded with much higher gross margins for commercial risks and historic investments. The subcontract manufacturers invest capital in production assets and face fierce competition from numerous players with very similar capabilities. The subcontractors have little scope for differentiation other than through cost-reducing economies of scale, enabling them to compete on the basis of lower prices. Subcontracted manufacturers and silicon foundries enable platform companies Dell, Nokia, Apple, Hewlett Packard and others to achieve exceptional returns on invested capital by avoiding the need to make capital-intensive investments. Subcontract manufacturers do not achieve anywhere near the high levels of financial performance achieved by successful platform companies.

5.4 Services Incorporating Technologies and Products

An increasing proportion of the global economy is in services rather than products, while in many cases these services substantially depend upon the technical innovations embedded in associated technologies and products. IP costs tend to be very small in comparison to the size of the service revenues they support. Prices of most hardware products such as consumer electronics are flat or declining. Service markets in many cases substantially exceed the revenues from underlying product markets.

A desktop computer is much more costly to own and operate than just the hardware and its software load. A Financial Times supplement leader on the topic of *Digital Business,* published November 8, 2006, estimates the annual cost of ownership for an enterprise computer at $10,000, of which only 10% is hardware "and a few percent more account for the operating software." Technical support costs and subscription to communications and security protection services against spam, viruses and adware can account for much of this additional expenditure.

Network services costs also dwarf hardware and technology costs. In 2006, the global mobile communications services market had revenues of $668 billion, whereas handset revenues were just $137 billion or 17% of the total, according to Yankee Group's market tracking and forecasting publications[18]. Bottom-up analysis yields a lower proportion of expenditure on handsets in developed markets where mobile usage is higher.

IP royalties on wireless communications technologies compensate for massive investments improving radio spectrum efficiency – twenty-fold since analog—battery performance and handset functionality. Handsets—typically bundled with services at subsidized prices—cost $100 at average wholesale prices and are usually replaced every 18 months in developed nations. The handset corresponds to around 12% of the total cost of wireless ownership with service charges averaging $750 over this period. Total royalties on wireless IP—charged only on wholesale handset costs, not service

[18] www.yankeegroup.com

revenues—average up to 10% depending on technology, with GSM also in most W-CDMA phones. This represents only 1.2% of hardware and service costs combined, with 2.0% for W-CDMA as royalties on more costly handsets are partially offset by higher service charges. These small up-front costs are typically absorbed by carriers and do not appear in retail prices. Handsets are usually subsidized by at least $40 and bundled with service contracts. In contrast, value-added tax rates levied on mobile handsets and services range from 15% to 25% in Europe. According to CTIA-The Wireless Association, in the US 14% of an average US wireless bill comprises government taxes, fees and surcharges.

Many ICT vendors pursue a professional services business model serving corporate customers. IT consulting firms Accenture and KPMG together with computer companies IBM and Hewlett-Packard are placing increasing emphasis on systems design and integration services in place of hardware and software products. Under this business model, standardized hardware and software products are building blocks for their *IT solutions*. Profit margins are principally derived from the services element. Services business model organizations seek to commoditize equipment with high levels of standardization and pass the associated product costs through to customers as cheaply as possible. In the pursuit of highly standardized *open systems* that facilitate interoperability among different technologies, products and services, some vendors with services business models are seeking to reduce hardware and software product prices toward marginal costs. This is shortsighted and counterproductive. Standards-based technologies are the fruits of extensive innovation including R&D and pioneering market development. Services business models are highly dependent upon and leverage profits through the hardware and software products they use. These vendors (and their end-user customers) need ongoing product innovation rather than just short-term price reductions. Limiting returns on innovation will jeopardize ongoing product technology investments.

6 Prescriptions for Fruitful and Sustained Innovation

There is an increasing need to defend IP globally against theft and devaluation by explicitly recognizing its value and protecting property rights. In many cases IP either is not traded at all or is only bartered in cross-licensing with no monetary price. Companies we have discussed (including Apple, with its iPod, and Pfizer, with its cholesterol reducing drug Lipitor) have been very successful selling their highly proprietary complete products. In these instances, the key IP is owned and used exclusively in-house and is deeply embedded in the branded complete products they distribute. In other cases, such as in biotechnology and information technology, companies including Amgen, Microsoft and QUALCOMM have thrived through licensing sales, but these companies face threats including weakened patents and regulated prices.

The companies that take the investment risks to create IP must be compensated with significant rewards for success. Innovation is expensive, with high, upfront fixed costs in development and no guarantee of a commercial return. In addition, successful innovations must also recoup the cost of commercial failures. To sustain innovation, large gross profits are essential to recover all costs.

There is no simple formula for successful innovation. Success demands a focused and determined approach by innovators with large investments over long time periods—and even that is not sufficient. A fertile external environment is also required, including easy access to university academics and investment capital, intellectual property rights, pricing freedom and the freedom to force change in the rules of competition.

Innovation can occur in many ways and with a variety of different business models. Many young and small companies have been the most successful innovators. They need the intellectual property protection of a strong patent system to attract external funding, including venture capital. These players, universities and government institutions typically do not have the means or inclination to produce complete products or services. Instead, they need fair and efficient markets so they can license the IP they create, reap their just rewards and continue to invest. The most profound and valuable innovations have occurred through radical changes in technology and in business models. These disruptive innovations can provoke the most hostile reactions from threatened market incumbents that seek to maintain the status quo in technology used and in the ways of doing business.

Internet-based companies Amazon.com, eBay and Google have combined technological innovation with highly-disruptive new business models to revolutionize the sale of goods and advertising. QUALCOMM supplies 60 mobile device vendors with a unique licensing-based business model in communications hardware that is commonplace in software and biotechnology. QUALCOMM's downstream partners benefit from its industry leading ratio of R&D to sales and excellent innovation track record with technology, silicon and software.

There is no upper bound on the non-manufactured value in a product or service. In fact, software sales can be at near-zero marginal cost in manufacturing or delivery. Product value is increasingly derived through intangibles, including new information processing algorithms and communications protocols, software programming and silicon design. The manufacturing cost in the silicon foundry or assembly plant continues to fall. Intellectual property charges can quite reasonably exceed the cost of the physical product or medium upon which it is employed and should not be capped at arbitrary levels. Market-based mechanisms have proven time and time again to be the most effective way of determining prices and motivating market participants into economically efficient and productive action.

Outsiders are not accustomed to seeing where the high returns are made that are needed to plow back into R&D and other innovation costs. To avoid the scrutiny and sanctions of antitrust authorities and regulators such as price caps, innovators diversify into downstream *or upstream* operations. They do this to hide the high-performance upstream *or downstream* activities by spreading profits and diluting apparent profitability across a larger revenue base, including low-margin operations such as manufacturing or distribution. This is inefficient. There may be good reasons to diversify across the value chain: Some companies may be well suited to it but it should not be the only way to harvest adequate returns on innovation.

Authorities should not insist that the temporary profits of intellectual property and innovation may only be fully recovered over the entire value chain of finished goods brought to market by capping IP revenues or profits. Instead, they should recognize where value is created in today's information society, let innovators reap their rewards where they innovate and motivate them to keep up the good work. Regulatory constraints should not be allowed to distort economic efficiency and constrain firms from pursuing the business models that suit them, their customers and consumers best.

Open systems environments that facilitate interoperability among different technologies, products and services can be beneficial, but it is shortsighted, counter-productive and anti-competitive to force contributors to standards-based technologies to marginal cost-based pricing. Fundamental technologies contributed to standards are typically the fruits of extensive innovative work in R&D. Services business models are crucially dependent on the hardware and software products they employ. These vendors and other market participants—including end users—need ongoing product innovation rather than just short-term price minimization.

Mandating standards, as Europe has with GSM and as it threatens in DVB-H mobile video, reduces or may eliminate competition in essential IP, as will regulating its price. Ownership of a standard's essential IP does not automatically create a monopoly because markets would otherwise usually be rich with alternative technologies. For example, broadband wireless standards HSDPA, EV-DO Rev A and WiMAX have similar capabilities. Demanding exclusive use of one technology opens up the possibility of market abuse by essential IP holders that might seek to charge high royalties, or by colluding purchasers driving the price for an open standard down to an artificial and unfair low level. Alternatively, the existence of one or more substitutes helps prevent suppliers or purchasers from unfairly exploiting their commercial positions while increasing competition and encouraging innovation.

7 About the Author

Keith Mallinson, founder of WiseHarbor, has more than 20 years experience in ICT, as research analyst, consultant and as a testifying expert witness. At WiseHarbor, Mallinson provides expert services in wireless, mobile and telecommunications. In addition, he continues to support Yankee Group, his former employer, in the position of Senior Research Fellow.

From 2000 to 2006, he led Yankee Group's global Wireless/Mobile research and consulting team as Executive Vice President, based in Boston. Until then, he had overall responsibility for the firm's European division, as Managing Director from 1995 until 2000. He was the European Research Director prior to 1995.

Complementing his industry focus, Mallinson has a broad skill set including technologies, market analysis, regulation and finance. He has published numerous reports and speaks publicly on a wide variety of topics, most recently including fixed-mobile convergence and substitution, broadband wireless, emerging markets, intellectual property patents and licensing, mobile search and advertising.

Mallinson started his career in military communications design, project management and commercial systems engineering. For several years he was Director at a seed capital investment firm specializing in ICT and biotechnology.

Mallinson has an undergraduate electronic engineering degree from London University's Imperial College and an MBA from the London Business School, including an academic exchange with Northwestern University's Kellogg Graduate School of Management in Illinois.