Executive Summary

The term innovation refers to a new way of doing something. It may refer to incremental, radical, and revolutionary changes in thinking, products, processes, or organizations. A distinction is typically made between invention, an idea made manifest, and innovation, ideas applied successfully. In many fields, something new must be substantially different to be innovative, not an insignificant change, e.g., in the arts, economics, business and government policy. In economics the change must increase value, customer value, or producer value. The goal of innovation is positive change, to make someone or something better. Innovation leading to increased productivity is the fundamental source of increasing wealth in an economy.

Companies are focused intently on the opportunities to source, develop, manufacture, sell, and service their products in the emerging world. But long-term success will take far more than simply making minor adjustments to existing products, lowering prices, or replicating existing sales channels. Instead, a new set of competencies and organizational structures will be required to generate a continuing stream of innovative products and services tailored to the needs of consumers and industrial buyers in emerging markets.

Companies are finding attractive opportunities across the income spectrum in emerging world, including the growing segment of affluent consumers. But many companies are finding the greatest success by developing and manufacturing products that can be sold profitably at dramatically lower prices that match the lower purchasing power of middle and lower-income consumers and of smaller firms in these countries. By creating markets for their products among the consumers and businesses in emerging world, many of whom are not currently being effectively served in many categories, companies have the ability to drive sustainable, profitable growth. And they have the potential to develop products and skills that can be used to change the competitive landscape in developed markets as well.

This report outlines the significant role that innovation plays in the telecom, automobile and healthcare industry.

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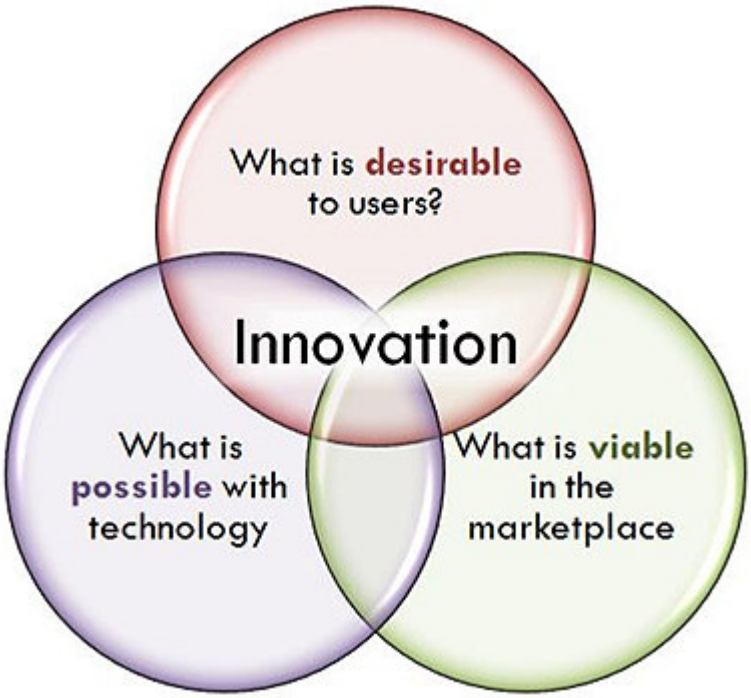
Introduction

What is Innovation

Innovation is an important topic in the study of economics, business, design, technology, sociology, and engineering. Colloquially, the word "innovation" is often synonymous with the output of the process. However, economists tend to focus on the process itself, from the origination of an idea to its transformation into something useful, to its implementation; and on the system within which the process of innovation unfolds. Since innovation is also considered a major driver of the economy, especially when it leads to increasing productivity, the factors that lead to innovation are also considered to be critical to policy makers. In particular, followers of innovation economics stress using public policy to spur innovation and growth.



Those who are directly responsible for application of the innovation are often called pioneers in their field, whether they are individuals or organizations.

Essential Ingredients to the definition of Innovation

Something New

Everyone likes something new. Most of the advertisements that we see use the words "new and improved"? We all want the latest and greatest products and ways of doing things. Novelty, however, is just the beginning.

Better Than What Exists

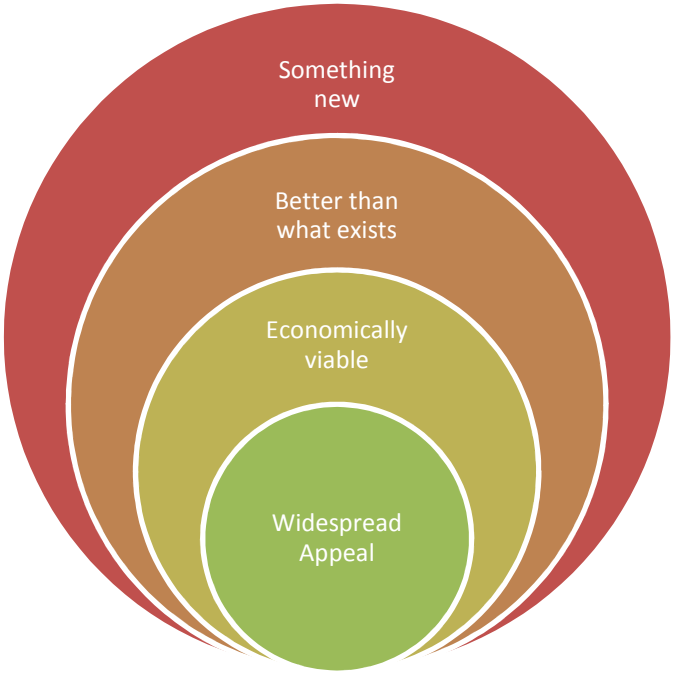
New for the sake of being new is of little value. It must also be improved. A new and improved toothpaste must have a new ingredient that increases its perceived value. A new office procedure must actually do something better than the old way.

Economically Viable

The innovative product or process should be such that it either makes or saves money for the innovator. If it doesn't, then it shouldn't be implemented. For example, if the new and improved toothpaste results in improved sales that in turn results in higher profits, it is a profitable addition. If the new office procedure improves the efficiency of the work place and therefore saves labor costs, it makes the organization more profitable.

Widespread Appeal

All the first 3 elements are very important and even related to this one. However, there needs to be a basic mass appeal to the new innovation. If not, the idea won't sell. For example, if the new and improved toothpaste is garlic flavored, then it might have very limited appeal. Garlic may even be a cheaper flavor to implement that any others but if nobody wants it, then it is not a true innovation.



Types of Innovation

Innovation is the lifeblood of any organization. Innovation can apply to many things. It is usually the term applied to a new product, but it can also be used to describe new processes, methods or inventions. Innovation extends far beyond just making improvements or expansions to products and

services. It involves constantly seeking for ways to improve all aspects of your business. Following are the different types of innovation:

Business Model Innovation

The first of the types of innovation where an organization can innovate is the business model. This is simply the way an organization gets paid for its product or service. For instance, the business model of a sit-down restaurant involves the customer being served first and paying just before they leave. The business model of a fast-food restaurant requires the customer to pay up-front before they get the food.

Partnership Innovation

Another of the types of innovation could be in your partnerships. It is about asking yourself what the true-core strength of your business is. For example, an organization may be better at marketing than at being a supplier. This could revolutionize who the organization works with, enabling it to cut costs and increase productivity with a sharper focus.

Organizational Innovation

Another type of innovation is internal organization innovation. For instance, Wegman's supermarkets are widely regarded as one of the best places to work. They make it clear that they put their employees ahead of their customers, turning the old "the customer is always right" concept upside down. Contrary to popular belief, this has not created a negative impact on the business. They have one of the largest arrays of offerings of any supermarket in the nation, their customer service is second to none, they have amazing prepared foods, and they have extremely competitive prices. This is because the employees are motivated to perform at their maximum potential due to the incentive programs the organization has.

Business Plan Innovation

Business plan innovation refers to a change in the way the organization conducts its day-to-day operations so that it posts a profit and also gives value to its customers. An example of this are stores like Target in USA and Big Bazaar in India. It is obvious that selling cheap, but in volume is in their business plan. They operate on a smaller profit margin, but more than make up for it by selling more products as a result of their highly-competitive prices.

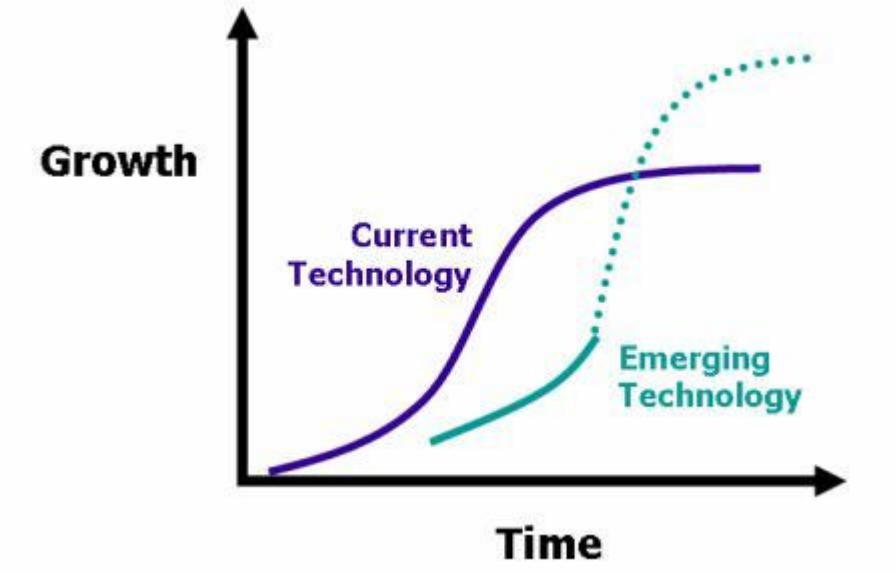
Success: UPS (UPS), for instance, has evolved from requiring customers to drop off parcels at a central collection point to picking up packages from clients at specified times. This demonstrates a significant transformation from a business process focus on the firm to a business process focus on each unique customer experience. In other words, no company can afford to think its business can plod on as usual. The ability to rethink a firm's fundamentals and implement appropriate changes will provide the driver of success within the N=1, R=G world.

Innovation Curve

Once innovation occurs, innovations may be spread from the innovator to other individuals and groups. This process has been proposed that the life cycle of innovations can be described using the 's-curve' or diffusion curve. The s-curve maps growth of revenue or productivity against time. In the early stage of a particular innovation, growth is relatively slow as the new product establishes itself. At some point customers begin to demand and the product growth increases more rapidly. New incremental innovations or changes to the product allow growth to continue. Towards the end of its life cycle growth slows and may even begin to decline. In the later stages, no amount of new investment in that product will yield a normal rate of return.

The S-curve derives from an assumption that new products are likely to have "product Life". i.e. a start-up phase, a rapid increase in revenue and eventual decline. In fact the great majority of innovations never get off the bottom of the curve, and never produce normal returns.

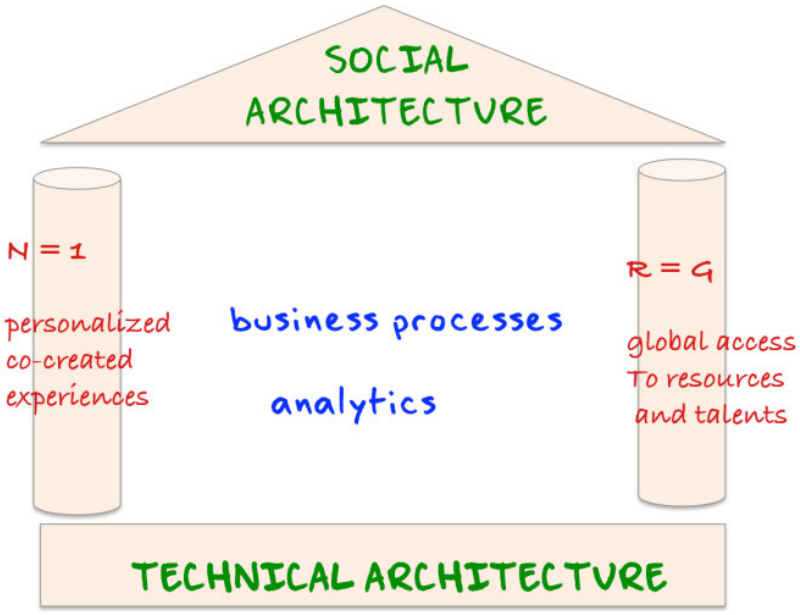
Innovative companies will typically be working on new innovations that will eventually replace older ones. Successive s-curves will come along to replace older ones and continue to drive growth upwards. In the figure above the first curve shows a current technology. The second shows an emerging technology that current yields lower growth but will eventually overtake current technology and lead to even greater levels of growth. The length of life will depend on many factors.



The New Age of Innovation

Despite the press attention lavished on companies such as Apple and Google, modern business is not all about Web 2.0, cutting-edge consumer tech. The latest voices reminding us of this—and that innovation is a topic with a broad scope.

Innovation revolves around two ideas. N=1 states that "value is based on unique, personalized experiences of consumers." That is, even companies serving 100 million consumers need to focus on individuals. R=G, meanwhile, argues that since no company can hope to satisfy the varied expectations of so many consumers, it must diversify how it operates. **"All firms will access resources from a wide variety of other big and small firms—a global ecosystem,"** say Prahalad and Krishnan. In other words, companies' internal focus should be on gaining access to resources, not necessarily owning them. There has been a shift from impersonal to customized, vertical to horizontal, with a wealth of examples from an array of industries.

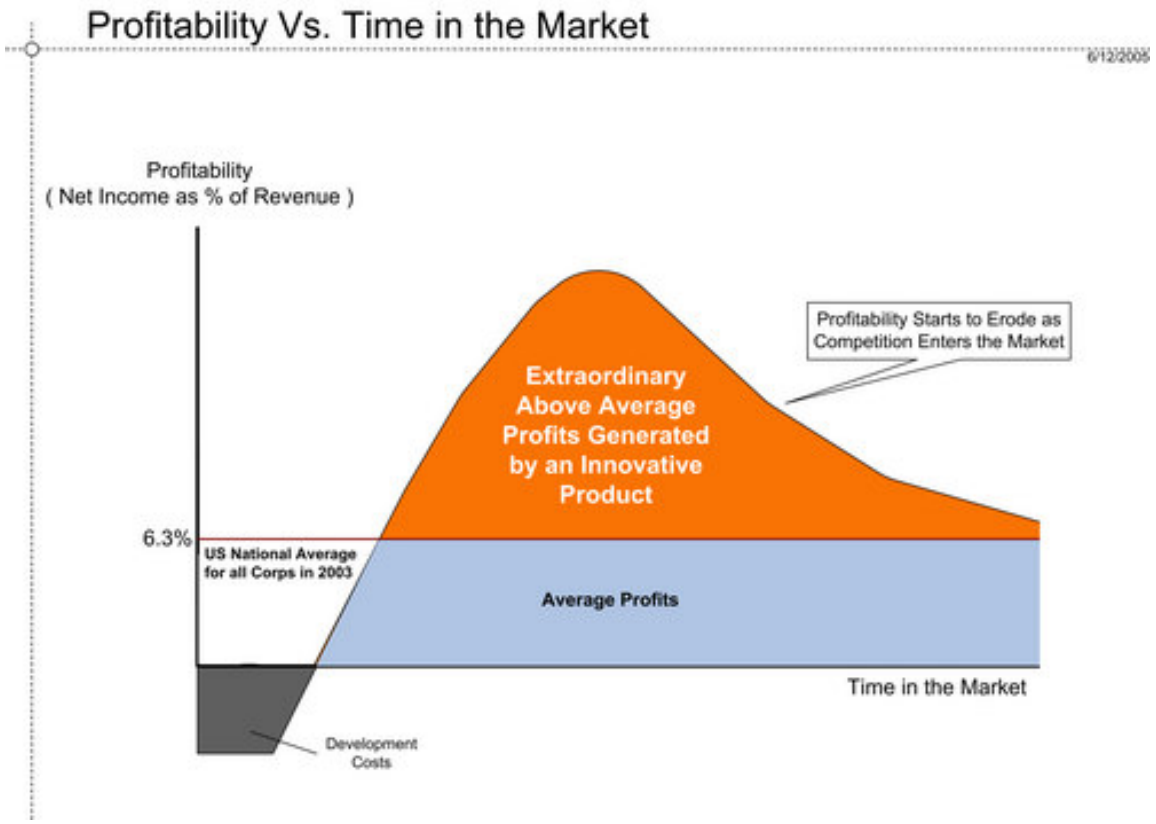


Success: Executives at Madras Cements, a division of India's Ramco Group, decided against deploying sophisticated—and expensive—GPS technology to track the movement of its trucks and goods. Instead, drivers were issued $30 cell phones and instructed to communicate their whereabouts via SMS text messages. The company designed an infrastructure that could process these raw data and give regular, timely insights into driver performance, helping executives identify areas of improvement for both individuals and the company at large. To date, the simple, innovative solution has led to recurring annual savings of more than $4 million.

Goals of innovation

Programs of organizational innovation are typically tightly linked to organizational goals and objectives, to the business plan, and to market competitive positioning. For example, one driver for innovation programs in corporations is to achieve growth objectives. As Davila et al. note,**"Companies cannot grow through cost reduction and reengineering alone . . . Innovation is the key element in providing aggressive top-line growth, and for increasing bottom-line results"**

In general, business organizations spend a significant amount of their turnover on innovation i.e. making changes to their established products, processes and services. The amount of investment can vary from as low as a half a percent of turnover for organizations with a low rate of change to anything over twenty percent of turnover for organizations with a high rate of change. The average investment across all types of organizations is four percent. For an organization with a turnover of say one billion currency units, this represents an investment of forty million units. This budget will typically be spread across various functions including marketing, product design, information systems, manufacturing systems and quality assurance.



Organizational innovations are most frequently driven by:

- Improved quality
- Creation of new markets
- Extension of the product range
- Reduced labour costs
- Improved production processes
- Reduced materials
- Reduced environmental damage
- Replacement of products/services
- Reduced energy consumption
- Conformance to regulations

These goals vary between improvements to products, processes and services and dispel a popular myth that innovation deals mainly with new product development. Most of the goals could apply to any organization be it a manufacturing facility, marketing firm, hospital or local government.

Failure: In one powerful example, from the book “The New Age of Innovation” written by Prahalad and Krishnan, that is undercut by the company in question oddly not being named (an anomaly), the authors discuss the example of a "major auto supplier" in the U.S shifting the sourcing of various parts to China. Unexpectedly, what seemed like a clear-cut business decision had a negative impact on many levels: The logistics of air-freighting parts from China wiped out any cost benefits, while the resulting lack of flexibility and longer lead times meant that the company's internal design process also had to be entirely rethought. The example provides a salient reminder of the importance of stepping back and thinking about the big picture, to consider the existence of less codified processes and systems, and to identify and preempt the potential consequences of any decision.

Case Study on the Telecom Sector

The Indian Telecom Industry

The Indian Telecommunications network with 110.01 million connections is the fifth largest in the world and the second largest among the emerging economies of Asia. In the last 3 years, two out of every three new telephone subscribers were wireless subscribers. Consequently, wireless now accounts for 54.6% of the total telephone subscriber base, as compared to only 40% in 2003. Wireless subscriber growth is expected to bypass 2.5 million new subscribers per month by 2007. The wireless technologies currently in use are Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA).

There are three types of players in telecom services:

- State owned companies (BSNL and MTNL)
- Private Indian owned companies (Reliance Infocomm, Tata Teleservices,)
- Foreign invested companies (Vodafone-Essar and Airtel)

Key Processes for a Telecom Company

Innovation in process – Led by Bharti – Airtel

Established in 1985, Bharti Airtel has been a pioneering force in the telecom sector with many firsts and innovations to its credit, ranging from being the first mobile service in Delhi, first private basic telephone service provider in the country, first Indian company to provide comprehensive telecom services outside India in Seychelles and first private sector service provider to launch National Long Distance Services in India.

Not having the deep pockets to aggressively expand its operation on an all India basis and unlike competitors, having deep pockets, apart from reinvesting all its profits in business, Bharti Airtel, broke away from the general industry trend whereby the telecom operator itself manages its IT network, Bharti Airtel outsourced its entire IT network to IBM in 2004 by way of a unique revenue share model.

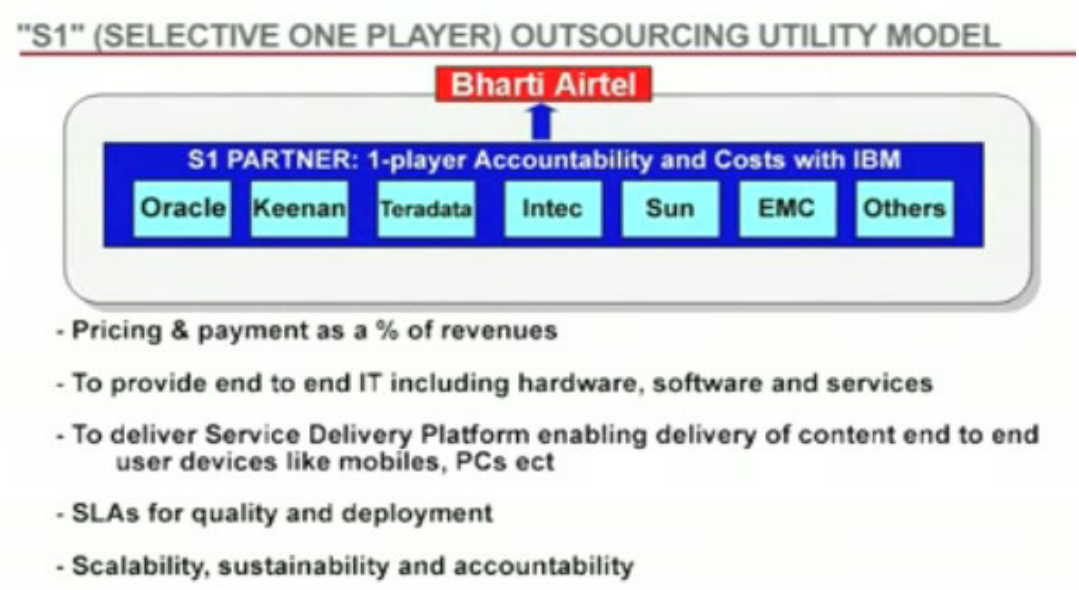
The Outsourcing Deal-What's it's about?

In 2004, after a 15-month long deliberation involving top officials in both Bharti Airtel and IBM, Bharti Airtel entered into a 10 year outsourcing deal whereby IBM will be the custodian of Bharti Airtel's entire IT infrastructure, be it Customer Relation Management (CRM), billing, interconnect or business intelligence. This will also cover IT in HR, financials, Intranet, e-mail, e-learning and other collaboration aspects of the company.

As a part of the deal IBM would:

1. Procure all the necessary hardware required for providing tele-communication service
2. Maintain and upgrade Bharti Airtel's entire IT infrastructure, which will also include areas such as security, data centers, disaster recovery and procurement of PCs, servers, storage, etc. The size of the deal is gigantic.

For the first five years it is expected to be $250-275 million and over a 10-year period it could grow to $750 million.



How would BhartiAirtel benefit?

Bharti Airtel's rationale for the deal with IBM was to enhance shareholder value by ensuring a:

1. Predictable IT spend,
2. Optimized use of technology resources
3. Bharti Airtel to focus on key areas of Sales Marketing and Customer relationships
4. Improved financials

Calling it a unique deal, IBM officials were projecting it as nothing short of a model for other telecom and large enterprises to follow.

How successful did it prove?

The success of this model cannot be over emphasized. Bharti Airtel today is by far the "An Undisputed Leader" in the telecom space. By outsourcing the IT aspect to IBM, Bharti Airtel could focus on its core competencies.

Today Bharti Airtel, has an subscriber base of over 100 million customers. In 2004, Bharti Airtel and IBM had expected that the IT outsourcing deal would yield revenues to the tune of $750mn over the 10-year period. But, projections proved to be widely underestimated as Bharti Airtel experienced record growth over the last couple of years.

The growth is best understood if we consider the figures. Bharti Airtel had about 6 million mobile customers when the deal with IBM was signed in 2004, but the telecom subscriber base has reached over 100 million at present. Bharti Airtel is also adding close to 3 million new customers per month, equivalent to 50% of its subscriber base in 2004.

IBM has bagged and executed several telecom projects globally over the last two decades, but until recently, it was involved only in three end-to-end IT infrastructure transformation projects, all of which were in India. The Maxis-deal, the latest addition to the IT's major's kitty is a clone of its deals here.

Bharti Airtel, which recently launched mobile services in Sri Lanka, has outsourced all its IT requirements in the island nation to IBM. It also handles the IT operations for Jersey Airtel, a subsidiary of Bharti which offers mobile services in Channel Islands in Europe.

Way Forward

Bharti Airtel

Bharti has continued using this model for its other businesslike Broadband, IPTV and DTH.

IBM

Riding on the success of this deal with Bharti, IBM had also signed similar outsourcing deals with Vodafone and Idea Cellular last year, worth $1.2 billion and $900 million, respectively. In February this year, IBM also announced an IT outsourcing deal with Malaysia's leading operator Maxis. Executive familiar with this partnership said that the Maxis deal was too, similar to the ones IBM has with the Indian operators.

"The Maxis deal is estimated to be worth around $300 million and was largely handled by the IBM's Indian team that had handled similar projects here," explained an executive who tracked the development. Additionally, leveraging its partnership with Bharti, the US-based software major is in talks to extend this IT outsourcing model with Africa's largest telecom MTN in a deal that is estimated to be worth about $2 billion, this executive added.

Case Study on the Automobile Sector

The Automobile Industry

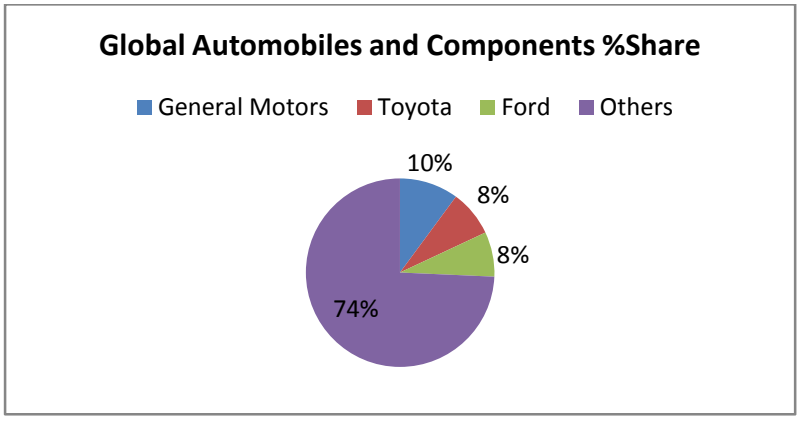
The global automotive industry is a highly diversified sector that comprises of manufacturers, suppliers, dealers, retailers, original equipment manufacturers or OEMs, aftermarket parts manufacturers, automotive engineers, motor mechanics, auto electricians, spray painters or body repairers, fuel producers, environmental and transport safety groups, and trade unions.

The automobile and automotive parts & components manufacturers constitute a major chunk of automotive industry throughout the world. The automotive manufacturing sector consists of automobile and light truck manufacturers, motor vehicle body manufacturers, and motor vehicle parts and supplies manufacturers. This sector is engaged in manufacturing of automotives and light duty motor vehicles, motor vehicle bodies, chassis, cabs, trucks, automobile and utility trailers, buses, military vehicles, and motor vehicle gasoline engines.

United States, Japan, China, Germany and South Korea are the top five automobile manufacturing nations throughout the world. Northeastern United States and Southern Great Lakes Region, Northwestern Europe, Western Russia and the Ukraine, and Japan are the major manufacturing regions of automotive in the world.

Major Industry Players

The worldwide automobile industry is largely dominated by five leading automobile manufacturing corporations namely Toyota, General Motors, Ford Motor Company, Volkswagen AG, and Daimler Chrysler. These corporations have their presence in almost every country and they continue to invest into production facilities in emerging markets namely Latin America, Middle East, Eastern Europe, China, Malaysia and other markets in Southeast Asia with the main aim of reducing their production costs.



Future outlook in the Emerging World

The automotive industry is witnessing tremendous and unprecedented changes these days. This industry is slowly and gradually shifting towards Asian countries, mainly because of saturation of automobile industry in the western world. The principal driving markets for Asian automotive industry are China, India and ASEAN nations. Low cost vehicles namely scooters, motorcycles, mopeds and bicycles have led to the massive growth of some of the fastest developing economies like China and India. The future of automotive industry in the Asian countries such as Thailand, Philippines, Indonesia, and Malaysia is bright and promising because of the ASEAN free trade area under which the export tariffs are very less.

It is believed that by 2015, the global auto component industry would reach US$ 1.9 trillion. With different low cost countries emerging at a fast pace in this industry, it is also expected that around 40% of the money will be sourced from such countries. India is one of such low cost countries. At present, it has only 0.4% of the global auto components trade of US$ 185 billion. By the year 2025, it is expected that India might be among the top five auto component economies.

Key Drivers

- **Offers support to other industries** such as iron, steel, rubber, glass, plastic, petroleum, textiles, oil & gas, paints & coatings, transportation industries.
- **Rising foreign investments** have led to the rapid growth in terms of automobile production in developing countries and exports.
- Continuous investment in **research & development** has resulted in increased productivity and better quality automobiles, automotive accessories and parts.
- Increase in standards of living and purchasing power parity have resulted in the **increase demand of automobiles** especially four-wheelers **in developing nations**, mostly in South Asian region.
- This sector **provides employment** to major chunk of human population in the world i.e. 25 million.

Innovation in the Automobile Industry

If one listens to the makers, hybrid cars are the best invention since sliced bread. While there are many reasons to buy a hybrid car, including a new tax incentive for US owners, it helps to have a good understanding of how they work.

What is a hybrid car?

Basically, it's a normal, fuel efficient car that has two motors - an electric motor and a gasoline powered motor. It also has a special system to capture braking energy to store in an onboard battery.

Why a hybrid?

The reason for two motors is in the strengths and weaknesses of both types. Specifically, electric motors use no energy during idle - they turn off - and use less than gas motors at low speeds. Gas

motors do better at high speeds and can deliver more power for a given motor weight. That means during rush hour stop and go driving, the electric motor works great and, as an added benefit, does not produce any exhaust thus reducing smog levels. At higher speeds - above 40 mph - the gas motor kicks in and gives that peppy feel so many car owners look for when driving on the highway. Another benefit of having the gas motor is it charges the batteries while it's running. Other than that, hybrid car offer many green advantages as well. Even a small increase in fuel economy makes a large difference in emissions over the life of the car. Also, in large cities were pollution is at its worst, they make an even larger difference since they produce very little emissions during low speed city driving and the inevitable traffic jams. A hybrid cuts emissions by 25% to 35% over even the most fuel efficient gas powered models. (Refer to Appendix)

While the US has just started producing hybrids, the Japanese are the recognized leaders. Honda and Toyota are the two largest producers with the Insight and Prius. US car makers are well behind. In fact, during recent introduction of a new hybrid by GM - the Mercury Mariner, they admitted they had to license over 20 separate technologies from the Japanese. US car makers still specialize in SUVs and trucks – Ford has even introduced a hybrid version of its popular Escape SUV.

First Company to launch Hybrid Cars in 1997-Toyota

How does an organization implement one million new creative ideas each year? And become a perennial top ten profitable companies of the world. And achieve market leadership while relentlessly pursuing perfection and delivering some of the best new innovations the world has ever seen. Welcome to Toyota's Innovation Factory. The world knows Toyota as the car maker that produces such great brands as Camry, Lexus, Prius, Scion, Rav4 and more. For example, Toyota introduced the Hybrid car back in 1997 when other car makers had not even put together a design for a hybrid car, much less a concept car.

Foundation of Elegance and Innovation

Toyota was founded by Sakichi Toyoda as a handloom company. In 1898, **Toyoda created Japan's first steam-powered loom**. Toyota Motors began as Toyota Automatic Loom Works, a company whose looms were of the **"highest quality, lowest cost, and easiest to use".** Hence the term "**Elegant Solution**" which according to May is about "**finding the 'AHA' solution to a problem with the greatest parsimony of effort and expense."** And May argues that at Toyota, you get elegance from creativity, simplicity, intelligence, subtlety, economy, and quality. Further, May lays the groundwork for the term Innovation, which according to David Neeleman, founder and CEO of JetBlue means: "**Innovation is trying to figure out a way to do something better than it's ever been done before."** Indeed. This has become one of the guiding principles at Toyota.

Guiding Principles for Driving Innovation

Three guiding principles drive Innovation and create elegant solutions at Toyota, which were originated and finessed by Toyoda. The three principles create both the policy and framework at Toyota for driving innovation and creating elegant solutions. May asserts that these three principles are non-negotiable and must be adhered to by everyone at Toyota.

1. The Art of Ingenuity-"Is there a better Way?"

Ingenuity creates images of cleverness, resourcefulness, initiative, originality, inventiveness, creativity, skill and even cunning – resulting in innovation. The key is to continually ask the question: "Is there a better way?" This is possible if the individual fully leverages their domain knowledge and expertise, continuously pursues every possible way to innovate and perfect, challenges opposition tactfully, does not accept the status quo, and uses organizational efficiencies to drive new ideas and methods. Toyota has made ingenious vehicles such as Camry, RAV4, 4-Runner, RX which have become perpetual favorites in the market place.

2. The (relentless) Pursuit of Perfection

Innovation happens at Toyota through systematic pursuit of perfection at every level, every department, in everything Toyota does. Perfection equates to excellence, precision, flawlessness at Toyota. And it is this chase for perfection that creates better processes, products and services for tomorrow, today. It takes many small steps to create sustainable innovation. For example, the Lexus cars made by Toyota epitomize perfection in the form of car design, function, performance, service and total satisfaction.

3. The Rhythm of Fit-Fit the innovator, the times and the larger system

How can a great innovation shape and then change the attitudes and behaviors of people, the way they think, they work, they live? A change that fits in the current time and environment. For example, the Toyota Prius car. A hybrid car that provides plenty of room in the inside, shows solid performance on the highway, provides all the safety features, and gives great gas mileage and range. Toyota envisioned the changing environment of higher gas costs and pollution that wanted a car which is economical to drive, is environmentally friendly (green innovation), and does not sacrifice the inherent need for roominess, safety and performance.

Blocking Innovation

Here are the three Innovation blockers that Toyota has avoided over the years:

1. Swinging For Fences: The key is to build a sustainable batting average -- lasting innovation, and not just go out swinging every time at bat.

2. Getting Too Clever: Every product manager at one time or the other is guilty of adding all those extra "bells and whistles" that the customer does not care about. This happens when you bow in to competitive pressures, or needs of specific customers that are not indicative of the mass market.
3. Solving Problems Frivolously: Also called the "**brainstorm**" trap, which is creating something that is out of line with the company's core values, not serving customer's true needs, and worse yet, something that is created hastily without rigor and analysis.

Ten Practices for Making Innovation

1. **Let Learning Lead:** "Learning and innovation go hand in hand, but learning comes first." Education and Learning can drive substantial innovation.
2. **Learn to See**: "Elegant solutions often come from customers -- get out more and live in their world." The key is to unearth the latent needs of the customers, and perceive the emerging needs.
3. **Design for Today:** "Focus on clear and present needs, or your great ideas remain just that." Innovation that drives business in today's market is likely to get funded and succeed.
4. **Think in Pictures:** "Make your intentions visual -- you'll surprise yourself with the image."

5. **Capture the Intangible:** "The most compelling solutions are often perceptual and emotional." This is where the product manager needs intuition and the ability to read their customers' minds.

6. **Leverage the Limits:** "Restraining forces rule -- resource constraints can spur ingenuity." It is critical to know what you can deliver, how you can deliver and by when.

7. **Master the Tension:** "Breakthrough thinking demands something to break through." In Failures and Stumbles driving innovation, we talked about the five takeaways stimulating innovation. Accept that mistakes will be made.

8. **Run the Numbers:** "Think for yourself -- temper instinct with insight, focus on facts, and do the math." A sound technical analysis is critical before you begin a new product innovation. This should take into account such factors as risks, probabilities of success, and lessons learned from past projects.

9. **Make Kaizen Mandatory:** "Pursuing perfection requires great discipline -- create a standard, follow it, and find a better way." A process is a must have. Think Six Sigma. Think Rigor at Intuit.

10. **Keep It Lean:** "Complexity kills -- scale it back, make it simple, and let it flow." Innovation happens when you can simplify the intended application and make it so easy-to-use that it becomes a no-brainer.

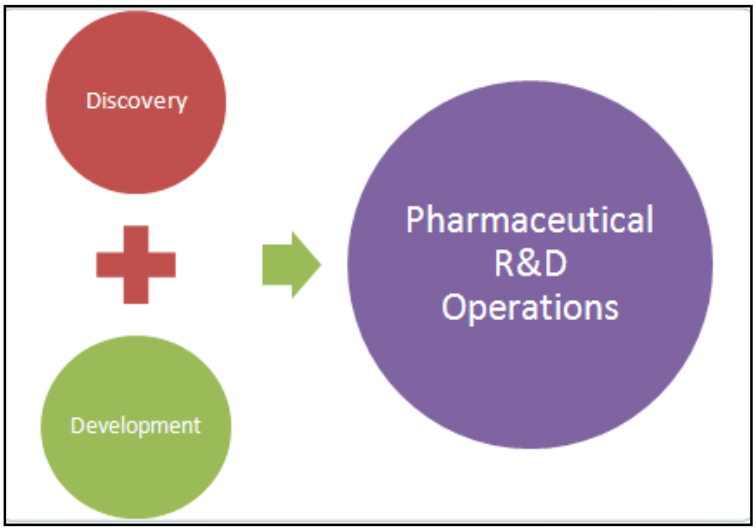
Conclusion

"Toyota is becoming a double threat: the world's finest manufacturer and a truly great innovator . . . that formula, a combination of production prowess and technical innovation, is an unbeatable recipe for success."

Case Study on the Healthcare Industry

Pharmaceutical research and development operations are usually divided into two basic units:

- **Discovery** which is directed towards both, innovative chemical and biological entities, and
- **Development** activities which include chemical, biological and pharmaceutical development, drug security and metabolism, clinical research and development, and medical dealings.



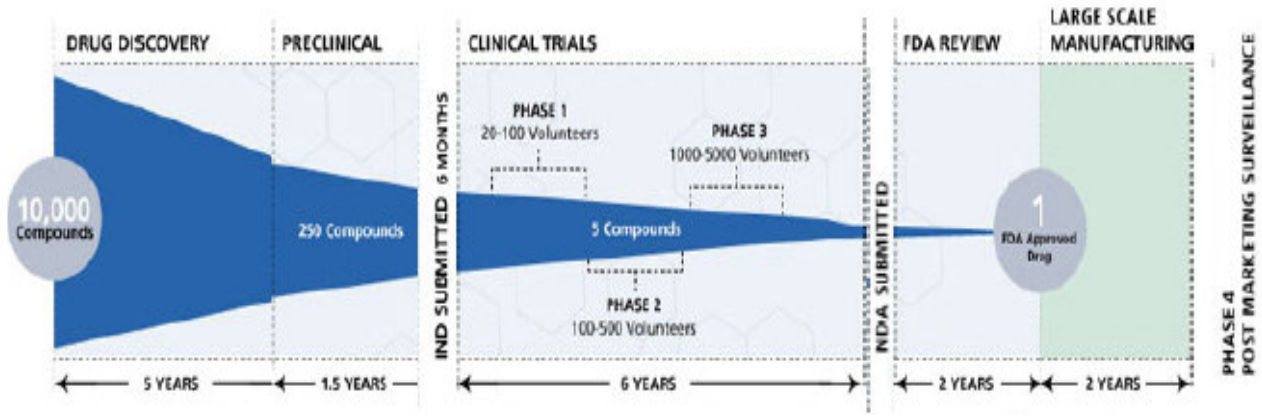
Pharmaceutical product development involves employing suitable technical information on a wide range of matters related to formulating products for immediate or customized release. Most recent technology in the area of pharmaceutical product development is to create poorly soluble products. Pharmaceutical product development also comprises of the ability to design and package drugs that assure the highest level of customer satisfaction.

By ensuring accuracy, quality and experience, companies facilitate the process of pharmaceutical product development, and also guarantee that projects are implemented efficiently and professionally. Pharmaceutical product development range of services include drug substance manufacturer selection, clinical support valuation, development pre-formulation and formulation development, and development protocols.

Steps in Product Development

Pharmaceutical product development covers a wide spectrum from preclinical test to clinical development, on to product launch issues and other activities related to pharmaceutical product development. There are various unique pharmaceutical product development programs, for large pharmaceuticals, small pharmaceuticals, biotechnology companies or medical device companies. With a large-scale infrastructure, committed project teams, cross-functional therapeutic units and new

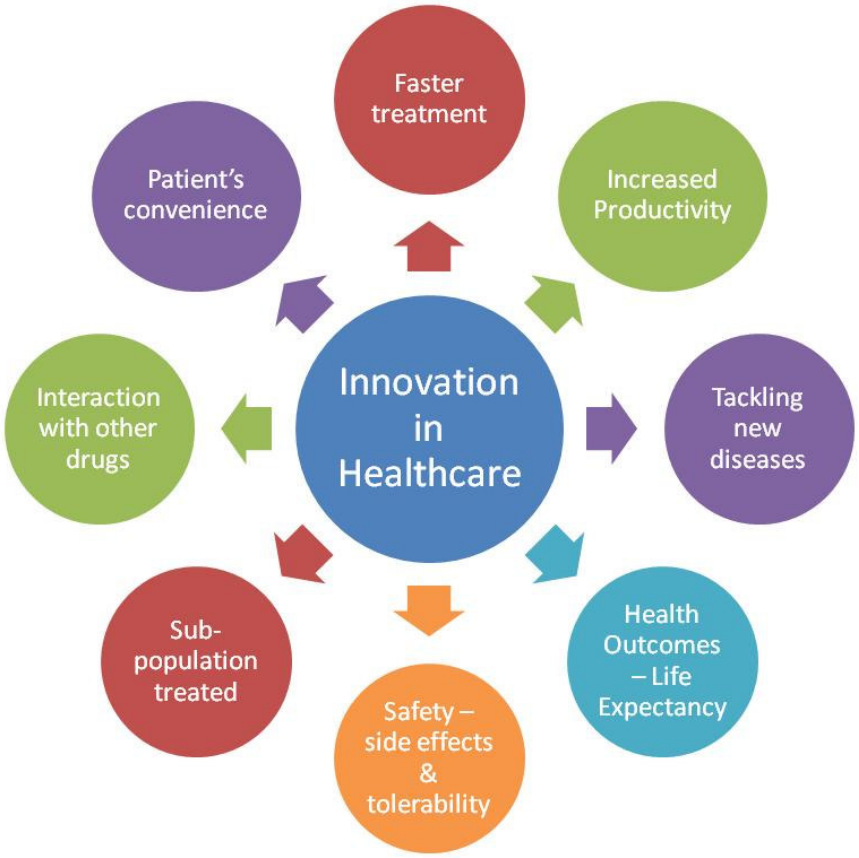
technologies, there are a large number of companies, operating online as well as offline, that have a worldwide dedication to quality and delivering strategic solutions for compound, pharmaceutical product and market development. These companies are research institutions offering discovery, development and post-approval pharmaceutical product services and multiple partnering programs as well. The customers and partners of these companies comprise of pharmaceutical, biotechnology, medical equipment, and educational and government organizations. The staff consists of several pharmaceutical scientists whose main task is to assist customers in the development of new products and line extensions.



By making use of the right strategies, innovative technologies and therapeutic expertise for pharmaceutical product development, companies can maximize returns on their research and development investments and speed up the delivery of safe and effectual therapeutics to patients.

Characteristics of innovation in pharmaceuticals industry

The final consumer is the ultimate arbiter of a product's value and hence of its degree of innovation compared with pre-existing products. But this is often forgotten in the pharmaceutical market. There is often a third party payer acting on behalf of the patient, and prescribers not patients ultimately decide which medicines are used. Rather than be dominated by a desire to contain costs, payers acting on behalf of patients need to take a balanced approach to ensure they pay an appropriate reward for socially valuable innovations while avoiding any problems of over-consumption that may result when patients receive medicines free or below cost at the point of use.



The figure above illustrates the major dimensions of innovation in medicines that are possible. Broadly speaking these are: advances in health gains; advances in patients' convenience; and other societal gains. These other societal gains can include releasing other health care resources when new medicines enable a change in the way health care is provided to patients, and productivity gains to the economy. The social benefit of a new medicine should be judged by its ability to deliver value by improving achievement of one or more of these characteristics.

The OHE Consulting report highlights the need for a better understanding among policy makers of the process of innovation in the pharmaceutical industry. This understanding is needed to ensure that the right economic incentives exist to generate socially valuable R&D.

Examples of Innovation in Pharmaceutical Industry

Below are the cases where prescription drugs, biologics and vaccines have revolutionized public health worldwide:

- Tuberculosis was no longer a threat after the Bacille Calmette-Guerin vaccine was discovered in the 1920's. By 1944, new antibiotics were being used to treat it.
- Polio was eliminated in 1952 when Jonas Salk discovered his vaccine.
- Thanks to new medicines introduced in the 1990s, people living with schizophrenia can now manage their condition more effectively than ever, and with fewer side effects. These medicines - dubbed

"atypical antipsychotics" also help people whose schizophrenia had not previously responded to treatment, making it possible for them to leave institutionalized care, return to work, and lead normal lives.

- In 1995, InviraseTM became the first protease inhibitor approved by the FDA for the treatment of AIDS. Since then, these drugs have become a key ingredient in "drug cocktails" that have reduced AIDS deaths in the U.S. by 70 percent.
- In 2001, the first targeted cancer treatment was approved. Since then more have been approved and they are proving to be a powerful new tool, with far fewer side effects than older therapies.

Collaborating internationally to save lives, Novartis' anti-malarial drug Coartem was co-developed with the two Chinese partners that supply its active ingredients: Kunming Pharmaceutical Corporation and Zhejiang Medicine Company. One of its core ingredients is derived from China's sweet wormwood plant, which has been used for centuries in traditional Chinese medicine. With a 95 percent cure rate, the drug is proving critical in the battle against malaria, which claims more than one million lives each year – the majority of which are African children.

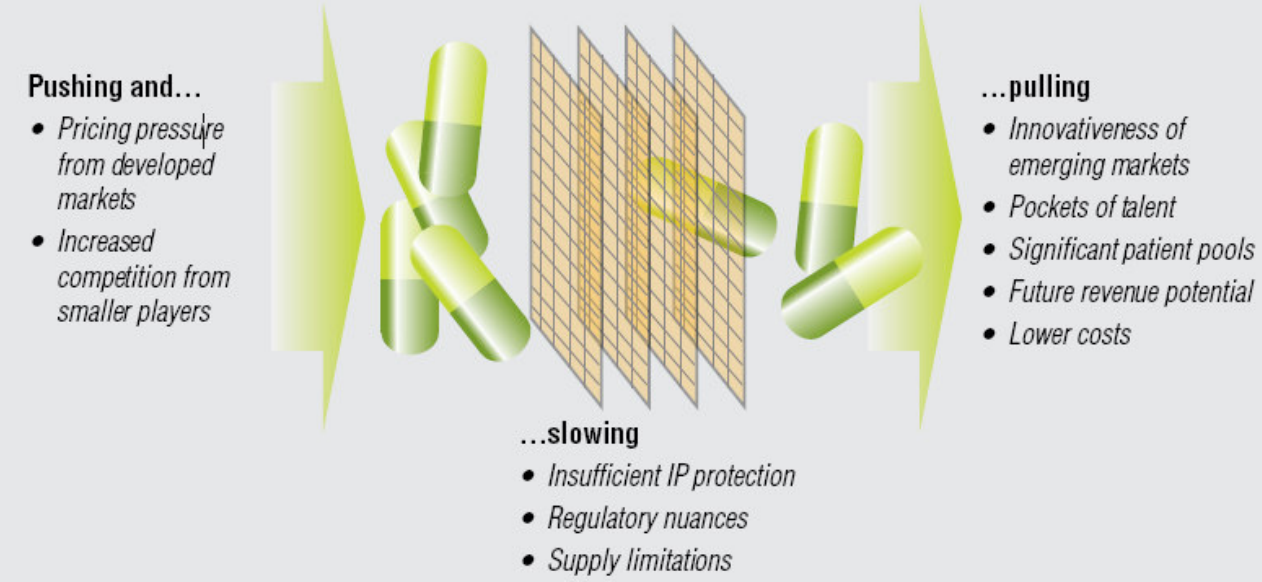
Pharma's new worldview - What is pushing (and pulling) R&D offshore?

While pharma companies struggle to compensate for expiring patents, they face unprecedented pricing pressure and intensifying competition. Worldwide, the size of the elderly demographic group is growing, and government health organizations and insurance companies are desperate to reduce drug spend.

On the competitive front, an increase in available funding has opened the door for smaller players. Public funding, private philanthropic donations and venture capital are on the rise and often are either specifically earmarked for small businesses or directed toward their prime research areas. For example, the Taiwanese government invested **US$1.6 billion** in biotechnology venture capital firms between 2002 and 2006.4 Along with its funding; the US government provides an additional perk, allowing small businesses to retain intellectual property (IP) rights.

Affordable technology is breaking down market-entry barriers as well. As they become better funded and equipped, smaller biotech companies and contract research organizations (CROs) are emerging as competitors, not just research partners. Between 2000 and 2004, the global biotechnology market grew by **11.5%** to reach a value of **US$114.1 billion**.

FIGURE 1.
Pharma is being shoved and tugged in the same direction.



Source: IBM Institute for Business Value analysis.

Patent Regime in India and its impact on innovation in Healthcare sector

The pharmaceutical sector in India has made tremendous progress, as evidenced by Dr G V Prasad, CEO, Dr Reddy's Laboratories, in a statement at the March 2007 Economist Conference, **"Seventy-five percent of the world's top 50 companies are conducting clinical development trials in India. The next area to develop in the country will be pre-clinical and early-phase discovery. It is forecasted that the value of outsourced contract research carried out in India will be close to $2 billion by 2010."**

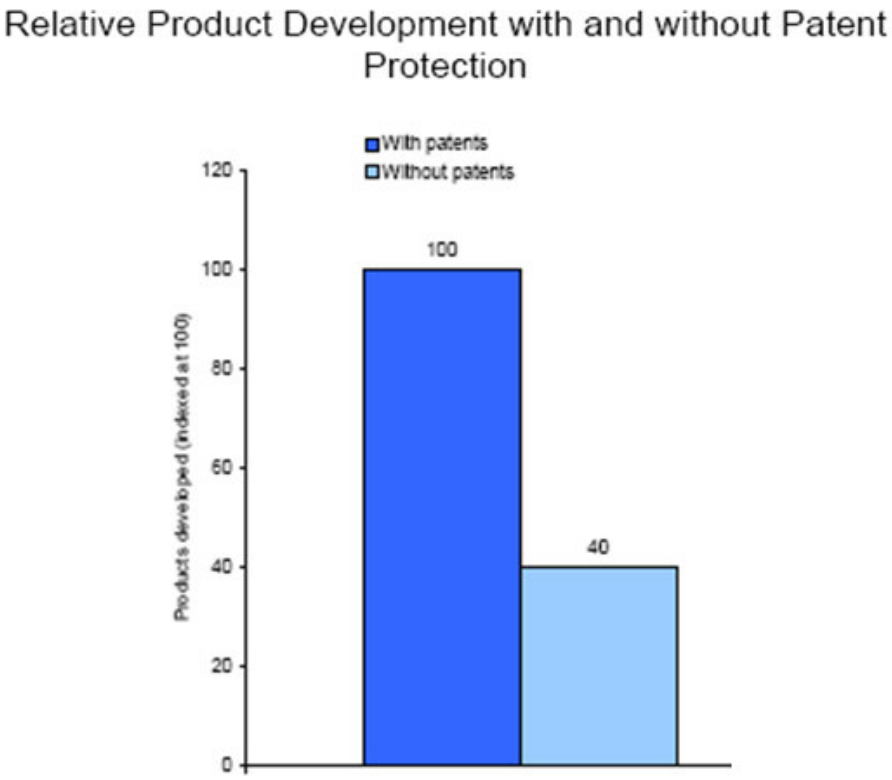
Patents are the legal protection for inventions, including new medicines discovered by research-based pharmaceutical companies. This protection allows a company time to recoup their significant investment in research and development. It is widely acknowledged that patents are a fundamental incentive to innovative activities in pharmaceuticals and biotechnology.

The major concern that the social and economic costs of introducing pharmaceutical patents are likely to outweigh the benefits in the case of most developing countries suggests a cautious approach to intellectual property protection in the area of pharmaceuticals.

The WTO's **Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)** introduced intellectual property rules into the multilateral trading system for the first time. The new WTO regime effectively outlawed the generic production of new medicines.

It was **made mandatory by the WTO for its developing nations to fully abide by their IP laws and enforcement practices with the agreement on TRIPS by no later than 1st January 2005**. It lays down minimum standards for protection and enforcement of intellectual property rights in member countries which are required to promote effective and adequate protection of intellectual property rights with a view to reducing distortions and impediments to international trade. For the least-developed countries (LDCs) the transition period will remain in force for pharmaceutical patents and data protection at least until 2016.

Making the patent legislation in compliance with the TRIPS would put India in the row of nations having strong patent legislation.



Salient features of the Patents (Amendment) Act 2005 as relevant to pharmaceutical Industry:

- Extension of product patent protection to products in sectors of drugs, foods and chemical.
- Term for protection of product patent shall be for 20 years.

- Introduction of a provision for enabling grant of compulsory license for export of medicines to countries which have insufficient or no manufacturing capacity
- Mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy of that substance or the mere discovery of any new property or new use for a known substance or of the mere use of a known process, machine or apparatus unless such known process results in a new product or employs at least one new reactant, shall not be patentable.

These amendments have been made with the intention to make India drug and pharma industries competitive at par with multinational companies. The generic drugs would have a limitation and the MNCs would enjoy monopolistic rights, however there is a silver lining in this concept that it would attract contract R&D and therefore MNCs would prefer to open their R&D centers in India.

Innovation in the Healthcare sector – Apollo Hospitals

Apollo Hospitals started as a 150 bed hospital in Chennai in 1983 set up by Dr. Prathap C. Reddy. Today, Apollo Hospitals is a healthcare corporation that operates 38 hospitals in South Asia. It is the largest healthcare provider in Asia and the third largest in the world.

The Apollo Hospitals group includes over 7500 beds across 43 hospitals in India and overseas, neighbourhood diagnostic clinics, an extensive chain of Apollo Pharmacies, medical BPO and health insurance services and clinical research divisions that are working on the cutting edge of medical science.

What makes Apollo Hospitals the pioneer in the health care sector?

- Achieved a 99.6% success rate in cardiac bypass surgeries, over 91% of these were beating heart surgeries
- Conducted over 100,000 cardiac surgeries - one of only 10 hospitals in the world to achieve these volumes
- First Indian hospital group to introduce new techniques in Coronary Angioplasty, Stereotactic Radiotherapy and Radiosurgery
- Performed over 7,50,000 major surgeries and over 10,00,000 minor surgical procedures with exceptional clinical outcomes

- Pioneered orthopaedic procedures like hip and knee replacements, the Illizarov procedure and the Birmingham hip re-surfacing technique
- First hospital group to bring the 320 Slice CT- Angio scan system and the 64 Slice CT-Angio scan system to India
- First hospital group in South-East Asia to introduce the 16 Slice PET-CT Scan
- First to perform liver, multi-organ and cord blood transplants in India
- Equipped with the largest and most sophisticated sleep laboratory in the world

Latest innovation from the Apollo Hospital group

The latest innovation from Apollo Hospitals ushers in a new era in healthcare, and is known as **CyberKnife®** Robotic Radio Surgery System. It is the **world's first and only robotic radiosurgery system** designed to treat tumors anywhere in the body with sub-millimeter accuracy. The CyberKnife® brings an unparalleled approach to treating inoperable tumors. Patients who previously had no options or only high-risk options for treatment now have a safer alternative.

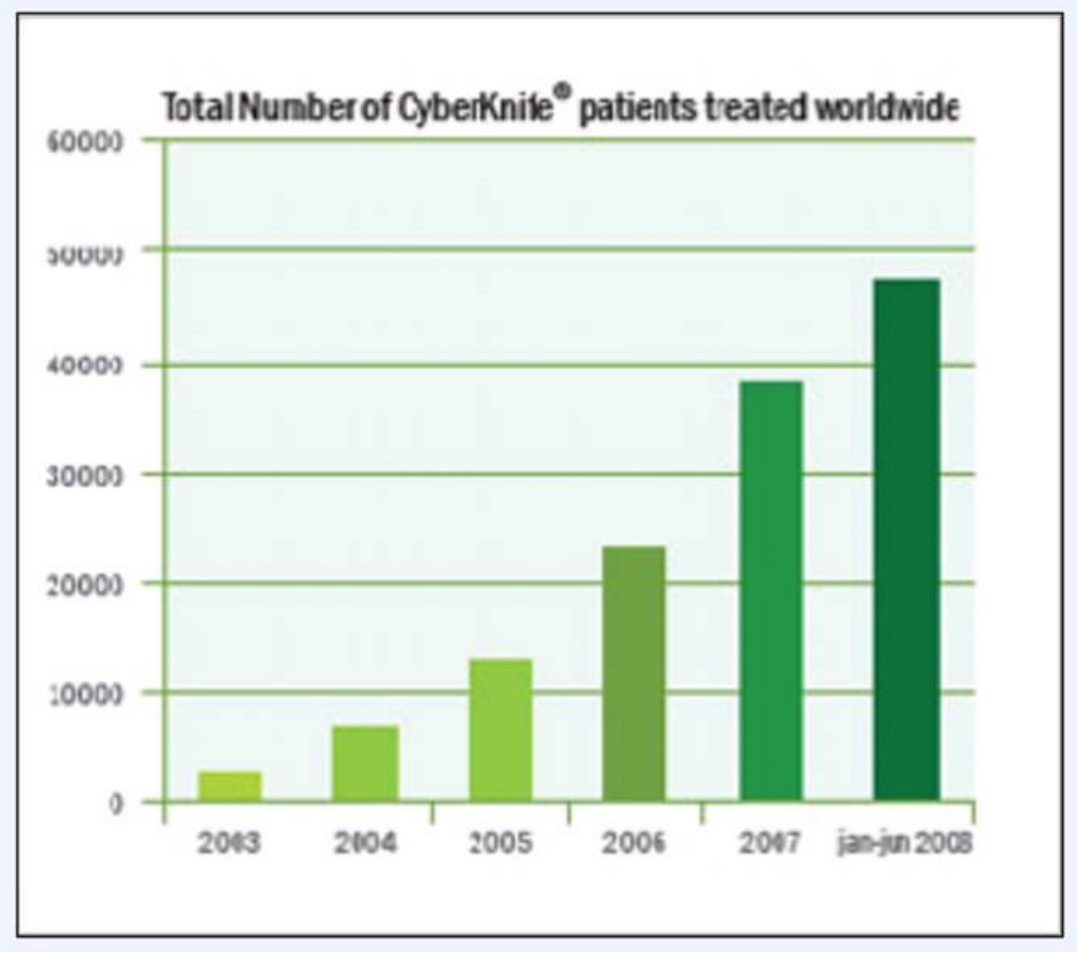
What makes Cyberknife different from other methods of treatment?

In the past, certain tumors - especially in the Central Nervous System (CNS), that is the brain and spinal cord - were considered largely inoperable, and at best, the chances of treatment in these cases

were very slim. In such cases surgery too was risky, and irradiation not possible due to the close vicinity of highly radio-vulnerable structures.

CyberKnife® uses pencil beams of radiation which can be directed at any part of the body, from any direction with the help of a robotic arm. The system tracks the tumour's position, detects any movement of the tumour or patient, and automatically corrects radiation delivery.It then targets the tumour with multiple beams of high-energy radiation, destroying abnormal tissue without damaging surrounding areas.

As there is no open surgery, the risk complications normally associated with an operation are eliminated, as is the need for a long recovery time. The patient is back on his feet within 30-60 minutes after treatment. Most patients leave the hospital the same day. This makes treatment suitable even for those who are not well enough to cope with surgery. Most patients leave the hospital the same day.



Conclusion

Innovation is taking a new dimension. When President Barack Obama said in his weekly radio address on August 3, 2009 that innovation would be a key to the future of the nation, he probably was not thinking specifically of artificial brains or replacement eyeballs. But other researchers already have such goals in mind and are well on their way to building Humans 2.0, the real-life Steve Austin of the "Six Million Dollar Man." Recent breakthroughs in bionics and lab-grown body parts — along with news last month that a Swiss research team aims to recreate the intricacies of the human brain within a decade — show science is rapidly creating many of the parts needed to build a fully functional human almost from scratch. While the ultimate goal remains years if not decades away, and some aspects may be ethically questionable, the work is already helping people live more bearable and productive lives.

There are lots of new ideas coming up at this very moment. But only those implemented is termed as innovation.

The transformation of large firms is neither hard nor easy, but it does take a lot of effort. That effort must start with a deep conviction about the nature of the changes required. Change must start with a point of view about the emerging competitive environment. Guiding the organization toward that future in small but directionally consistent steps is the substance of “how”. We believe that strategy is about your knowing “What” and “why”, and “how”.

Appendix

Top 25 Innovations till date*

1. The Internet
2. Cell phone
3. Personal computers
4. Fiber optics
5. E-mail
6. Commercialized GPS
7. Portable computers
8. Memory storage discs
9. Consumer level digital camera
10. Radio frequency ID tags
11. MEMS
12. DNA fingerprinting
13. Air bags
14. ATM
15. Advanced batteries
16. Hybrid car
17. OLEDs
18. Display panels
19. HDTV
20. Space shuttle
21. Nanotechnology
22. Flash memory
23. Voice mail
24. Modern hearing aids
25. Short Range, High Frequency Radio

*As per CNN as on June 19, 2005

List of Emerging Technologies

Energy Technologies

Emerging Technology	Status	Potentially Marginalized Technologies	Potential Applications
Nuclear fusion power	Theory and experiments	Fossil fuels, renewable energy, nuclear fission power	Electric power generation
Biofuels	Diffusion	Fossil fuels	Energy storage, particularly for transportation
Hydrogen economy	Diffusion (of hydrogen fuel cells); Theory and experiments for less expensive production of hydrogen	Other technologies for storing energy (conventional batteries, fossil fuels)	Storage of energy
Nanowire battery	Working prototypes	Other technologies for storing energy (hydrogen, conventional batteries and in some cases fossil fuels)	Laptops, mobile phones and long-range electric cars. Storing power for electric grid
Ultracapacitor	Diffusion and continued development	conventional batteries	Regenerative braking; generally faster-charging, longer lasting, more flexible, and/or greener energy storage
WiTricity	Working prototypes	Batteries	Wireless energy transfer

Transportation

Emerging Technology	Status	Potentially Marginalized Technologies	Potential Applications
Electric cars	Small scale production, infrastructure investment	Internal combustion engine	Greener transportation
Personal rapid transit	Working prototypes (and models)	Conventional rail/bus public transport; would reduce need for everyone to own their own car	Greener transportation
Personal Aircraft	Commercial production	Commercial Airlines	
Crower six stroke engine	Working prototypes (and models)	Conventional Four-stroke engine and Two-stroke engine	Greener transportation
Precooled jet engines	Laboratory verified precooler	subsonic jets	Very fast, long distance air travel, space travel
Scramjet	Working prototypes	Hypersonic Jet engines, Rocket engines	Very fast air travel
Non-rocket spacelaunch: launch Loop, Mass driver, space gun, space elevator	Theory and some experiments	Rocket	Space colonization, mass space travel, disposal of radioactive waste
Reliable Global Navigation Satellite System	System currently being produced (GLONASS, Galileo, Compass, IRNSS)	Various custom built systems	Mission critical navigation, Personal Air Vehicle

Robotics and Applied Sciences

Emerging Technology	Status	Potentially Marginalized Technologies	Potential Applications
Swarm Robotics	Theory and experiments	distributed computing, Complexity in behavior by simplicity in architecture,	Autonomous construction, Space construction
Molecular nanotechnology, Nanorobotics	Theory and experiments	Small products and parts production & retail	Desktop devices that can make anything given the materials, cheap planetary terraforming
Powered exoskeleton	Prototyping and Diffusion, research & development, Commercialization [3]	Electric wheelchairs, forklifts.	Heavy lifting, paralysis, muscle related diseases, warfare, construction

InformationTechnology

Emerging Technology	Status	Potentially Marginalized Technologies	Potential Applications
Artificial intelligence	Theory and experiments; limited application in specialized domains	Replacement of Human decision, analysis, etc.	Creation of intelligent devices
Machine translation	Prototyping and research	Human translation of natural languages, in areas where misunderstanding is non-critical and language is formalized	Easier cross-cultural communication
Machine vision	Prototyping and research	biological vision, the visual perception of humans	Biometrics, Controlling processes (e.g. a Driverless car, or an Automated Guided Vehicle), Detecting events (e.g. for visual surveillance), Interaction (e.g. for Human-computer interaction), Robot Vision
Machine augmented cognition/exocortices	Diffusion of primitive amplifications; working prototypes of more; theory and experiments on more substantial amplification	Libraries, schools, training, pocket calculators	
Semantic Web or Answers Machine		Search engines	Making the web machine-readable by linking data on the web based on its meaning
General-purpose computing on graphics processing units	Diffusion of non standardized methods	CPU for a few specialized applications	Order of magnitude faster processing of parallelizable algorithms.
Solid-state drive	Diffusion; development of larger capacity	Hard disk drive	Less delicate, low mass (lighter laptop computers & portable electronics), faster, quieter, lower power consuming storage
3D optical data storage or Holographic data storage	Prototyping and research	All other optical data storage solutions, magnetic tape data storage, and other mass storage devices.	Storage and archiving of data that was previously erased for economic reasons
Spintronics	Working prototypes	Mechanical magnetic hard disk drives	Data storage
Optical computing	Theory and experiments - some components of integrated circuits have been developed	Many integrated circuits and other electronics devices	Smaller, faster, lower power consuming computing
Quantum computing	Theory and experiments	Electronic computing, optical computing	Much faster computing, for certain kinds of problems, chemical modeling, new materials with programmed properties, theory of high-temperature superconductivity and superfluidity
Quantum cryptography	Commercialization		Secure communications
Wireless communication	Diffusion	Wired communication	Ubiquitous network connectivity
Screenless display	Theory and experiments	displays	Augmented reality, virtual reality
3D displays	Theory and experiments, Commercialization	CRT, LCD, and other display technologies	Television, Computer interfaces, cinemas
Organic light-emitting diode	first commercial OLED TV in 2008, Sony XEL-1	LCD and plasma displays	Displays; lighting
Interferometric modulator display	Commercialization and development	CRT, LCD, plasma, e-paper and other display technologies	Non-emissive displays with fast response times and potentially the most realistic colors of all display technologies
Laser displays	first commercial Laser TV in 2008, Mitsubishi LaserVue TV	LCD and plasma displays	Displays with very wide colour gamut prowess
Phased array optics	Theory	Conventional displays (e.g., Television)	Mass production of 3 Dimensional imagery
Holography	Diffusion	Display Technologies	
Memristor	Working prototype	Some current integrated circuits, many other electronics devices	Smaller, faster, lower power consuming storage, analogue electronics, Artificial intelligence
3D printing	In commercial production	Manual creation of prototypes and also some mass production methods that lack the ability for customization	Rapid prototyping and production of not only plastic objects but multi-material items, with the potential to significantly customize products for individual consumers
Thermal copper pillar bump	Working prototypes in discrete devices	Conventional thermal solutions, heat sinks, bulk thermoelectrics	Electric circuit cooling; micro-fluidic actuators; small-device thermoelectric power generation
Immersive virtual reality	Theory, limited commercialization	consensus reality	an artificial environment where the user feels just as immersed as they usually feel in consensus reality

Biotechnology

Emerging Technology	Status	Potentially Marginalized Technologies	Potential Applications
Genetic engineering	Commercialization; ongoing research & development	Animal husbandry, Plant breeding	Creation and modification of species, bio-machines, elimination of genetic disorders.
Synthetic biology, Synthetic genomics	Research & development	Chemical industry, Petroleum industry, Process industries	Creation of infinitely scalable production processes based on programmable species of bacteria and other life forms
Nootropics	Available Now		Drugs that improve memory or cognition in healthy or aged populations.
Anti-aging drugs: resveratrol, SRT1720	Animal testing	Existing treatments for age-related diseases	Life extension
Vitrification or Cryoprotectant	Theory and some experiments	Ischemic Damages	Organ transplant, Cryonics
Hibernation or Suspended Animation	Animal trials, ongoing research and development	Surgical anesthesia	Organ transplant, space travel, prolonged surgery, emergency care
Personalized medicine	Theory	Orphan drugs	Cancer management and Preventive treatment; genetic disorders

Fuel consumption and Emission Reduction

Primary Savings of a hybrid design
Relying on both the engine and the electric motors for peak power needs resulting in a smaller engine sized more for average usage rather than peak power usage.
Having significant battery storage capacity to store and reuse recaptured energy, especially in stop-and-go traffic.
Recapturing significant amounts of energy normally wasted during braking etc. (regenerative braking) This is a mechanism that reduces vehicle speed by converting some of its kinetic energy into another useful form of energy, dependent upon the power rating of the motor/generator;
Secondary Savings of a hybrid design
fuel saving measures at the time of shutting down the engine during traffic stops or while coasting or other idle periods
Improving aerodynamics- Improving the shape and aerodynamics of a car is a good way to help better the fuel economy and also improve handling at the same time
Using low rolling resistance tires ; Hybrid cars may use special tires that are more inflated than regular tires and stiffer or by choice of car case structure and rubber compound have lower rolling resistance while retaining acceptable grip, and so improving fuel economy whatever the power source

Statistics related to innovations in Healthcare Industry

Antihypertensive Medicines Have Prevented Deaths and Hospitalizations

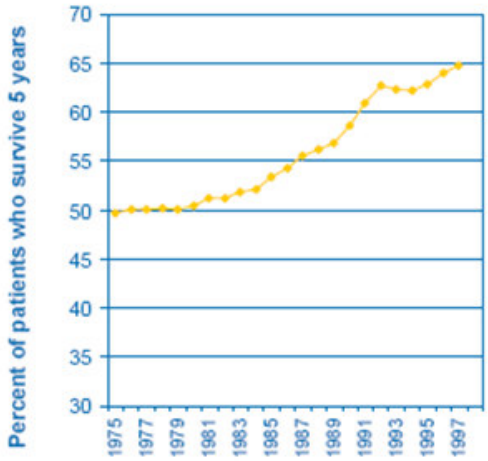
Study Quantified Impact of High Blood Pressure Drugs

WITHOUT antihypertensives we would have seen:

Life Expectancy—MEN	0.5 years lower
Life Expectancy—WOMEN	0.4 years lower
Blood Pressure	10%–13% higher
Deaths	86,000 additional
Hospitalizations	833,000 additional

Data source: G. Long et al., *The Impact of Antihypertensive Drugs on the Number and Risk of Death, Stroke, and Myocardial Infarction in the United States*, National Bureau of Economic Research Working Paper No. 12095 (Cambridge, MA: NBER, March 2006).

Cancer Survival Increasing



Recent study found that new drugs account for **50-60%** of the increase in six-year cancer survival rates since 1975.*

"F.R. Lichtenberg, "The Expanding Pharmaceutical Arsenal in the War on Cancer," National Bureau of Economic Research Working Paper No. 10328 (Cambridge, MA: NBER, February 2004).

National Cancer Institute, National Institutes of Health, Department of Health and Human Services, "Cancer Trends Progress Report – 2005 Update," (Bethesda, MD: NCI, December 2005), http://progressreport.cancer.gov/ (Accessed 26 January 2006).

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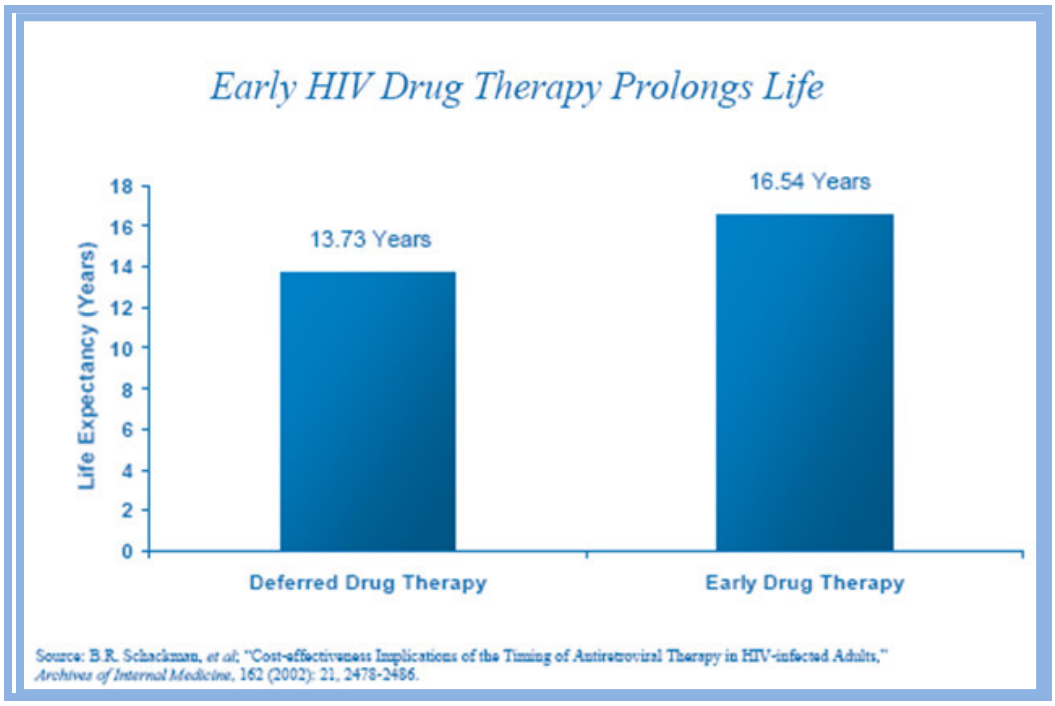
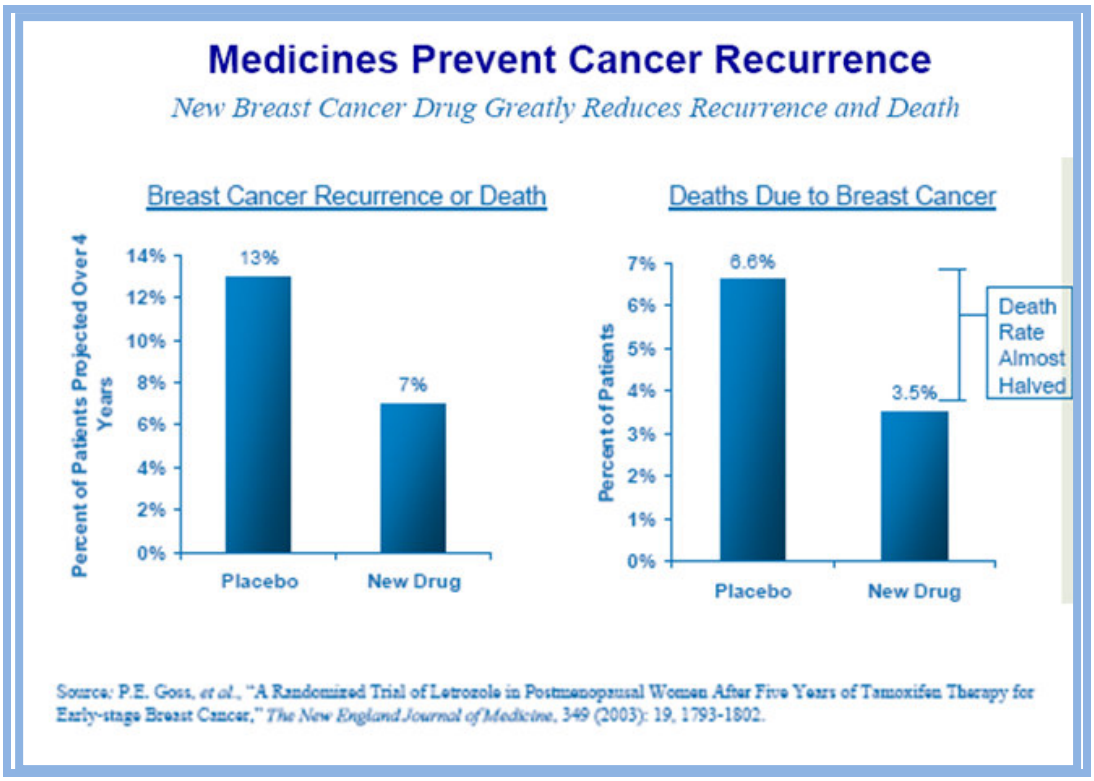
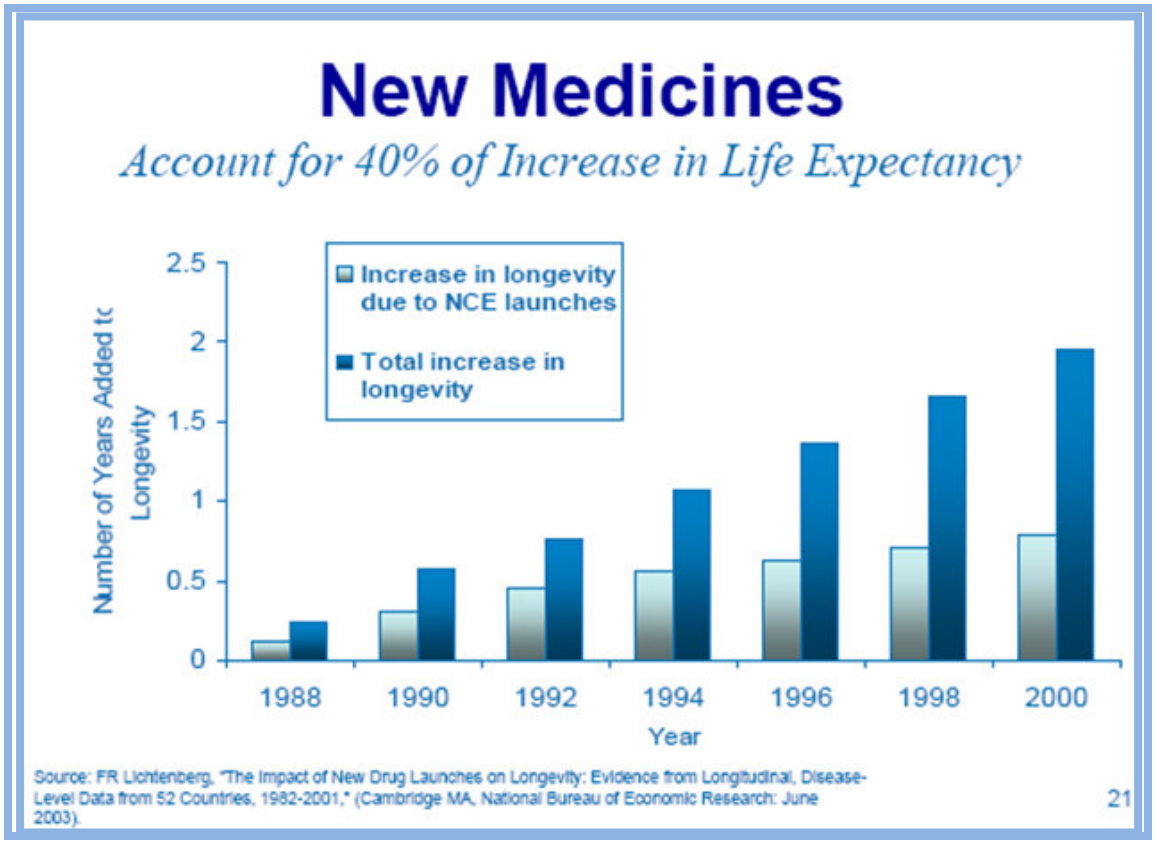

Early HIV Drug Therapy Prolongs Life
Life Expectancy (Years)
18
16
14
12
10
8
6
4
2
0
13.73 Years
16.54 Years
Deferred Drug Therapy
Early Drug Therapy
Source: B.R. Schackman, et al; "Cost-effectiveness Implications of the Timing of Antiretroviral Therapy in HIV-infected Adults," Archives of Internal Medicine, 162 (2002): 21, 2478-2486.


Medicines Prevent Cancer Recurrence
New Breast Cancer Drug Greatly Reduces Recurrence and Death
Breast Cancer Recurrence or Death
Percent of Patients Projected Over 4 Years
14%
12%
10%
8%
6%
4%
2%
0%
13%
7%
Placebo
New Drug
Deaths Due to Breast Cancer
Percent of Patients
7%
6%
5%
4%
3%
2%
1%
0%
6.6%
3.5%
Death Rate Almost Halved
Placebo
New Drug
Source: P.E. Goss, et al., "A Randomized Trial of Letrozole in Postmenopausal Women After Five Years of Tamoxifen Therapy for Early-stage Breast Cancer," The New England Journal of Medicine, 349 (2003): 19, 1793-1802.


New Medicines
Account for 40% of Increase in Life Expectancy
Increase in longevity due to NCE launches
Total increase in longevity
Number of Years Added to Longevity
2.5
2
1.5
1
0.5
0
1988
1990
1992
1994
1996
1998
2000
Year
Source: FR Lichtenberg, "The Impact of New Drug Launches on Longevity: Evidence from Longitudinal, Disease-Level Data from 52 Countries, 1982-2001," (Cambridge MA, National Bureau of Economic Research: June 2003).
21