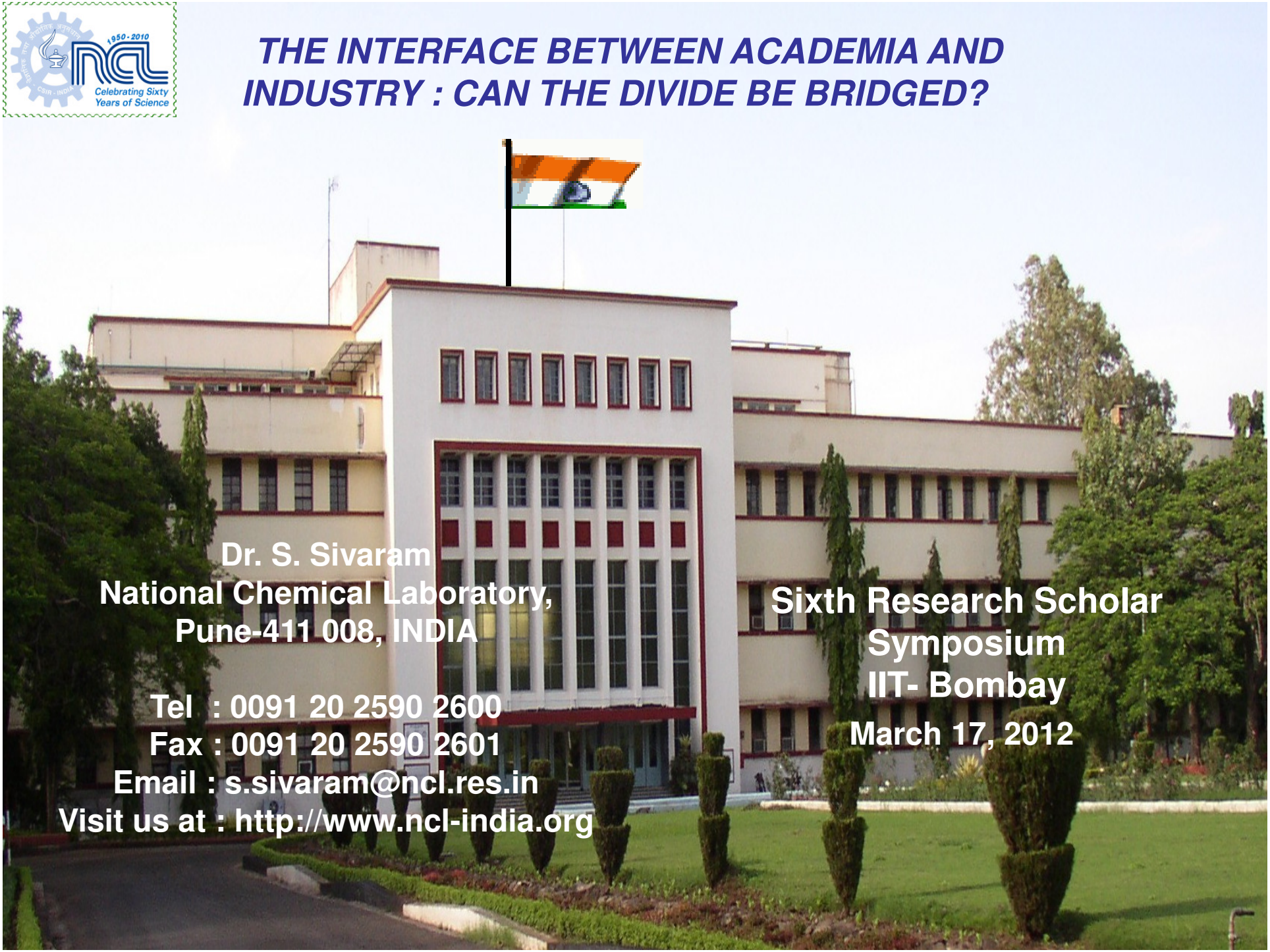
THE INTERFACE BETWEEN ACADEMIA AND INDUSTRY : CAN THE DIVIDE BE BRIDGED?



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Sixth Research Scholar Symposium
IIT- Bombay
March 17, 2012

OUTLINE

- The academia-industry relationship: The Beginning
- The nature of scientific enterprise in academia
- The dawn of the industrial R&D: The Corporate R&D as driver of innovationThe demise of corporate R&D
- Linking science to markets: The new paradigm
- Linking science to markets : A case Study
- The academia – industry relationship: The evolution of new models

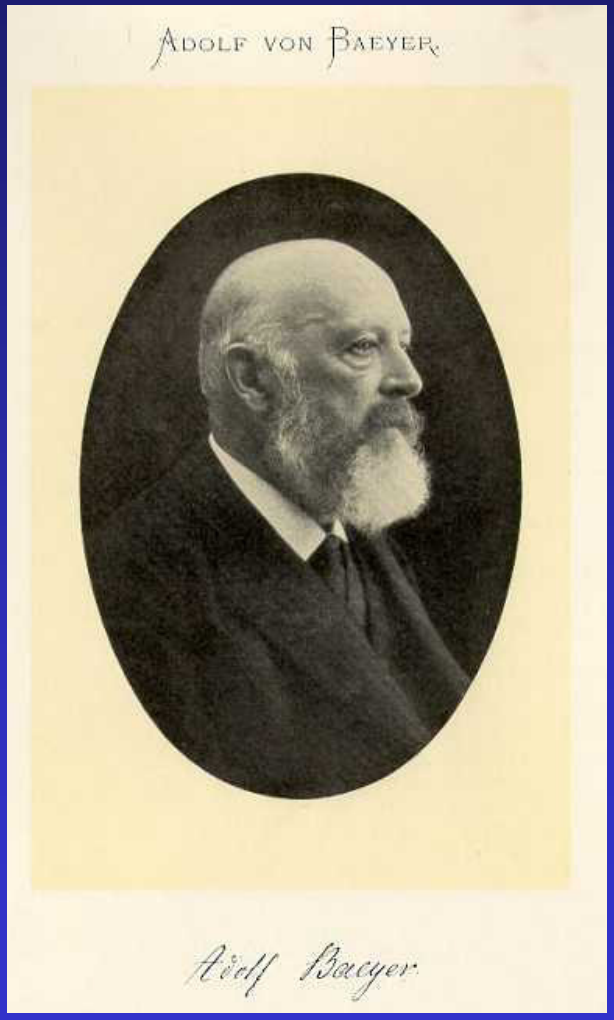
CHEMICAL SCIENCE AND CHEMICAL INDUSTRY

- **Chemical science and industry have been closely intertwined throughout its history**
- **Creation of wealth has always been the underlying motivation for many of the epoch making discoveries**
- **More than any other breed of scientists, chemists have always exhibited a heightened awareness of society's problems and an altruistic desire to solve them**
- **For over a century , academic and industrial chemistry have enjoyed a healthy and symbiotic relationship. Every major landmark in applications of chemistry can be traced back to the fundamental insights gained through painstaking and sustained research in academia**

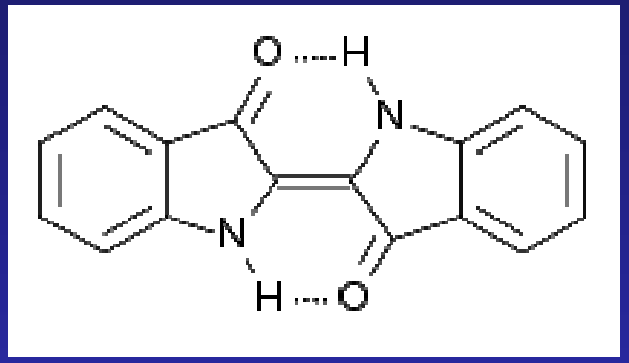
CHEMICAL SCIENCE AND INDUSTRY: THREE PHASES OF EVOLUTION

- **Post Industrial Revolution (1760-1915)**
- **World War I and II (1915-1950)**
- **The Era of inexpensive Petroleum (1950- 2000)**

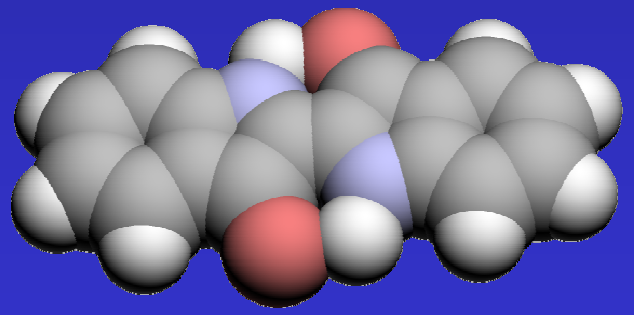
BEGINNING OF INDUSTRIAL CHEMISTRY : THE INDIGO SYNTHESIS



Adolf von Baeyer (1835-1917)



Synthesis of a plant derived natural product, from Isatin and 2-Nitrobenzaldehyde (1878-80)



Nobel Prize , 1905

THE DAWN OF THE CHEMICAL INDUSTRY: THE MANUFACTURE OF INDIGO

BASF commences manufacture of synthetic Indigo (1897)

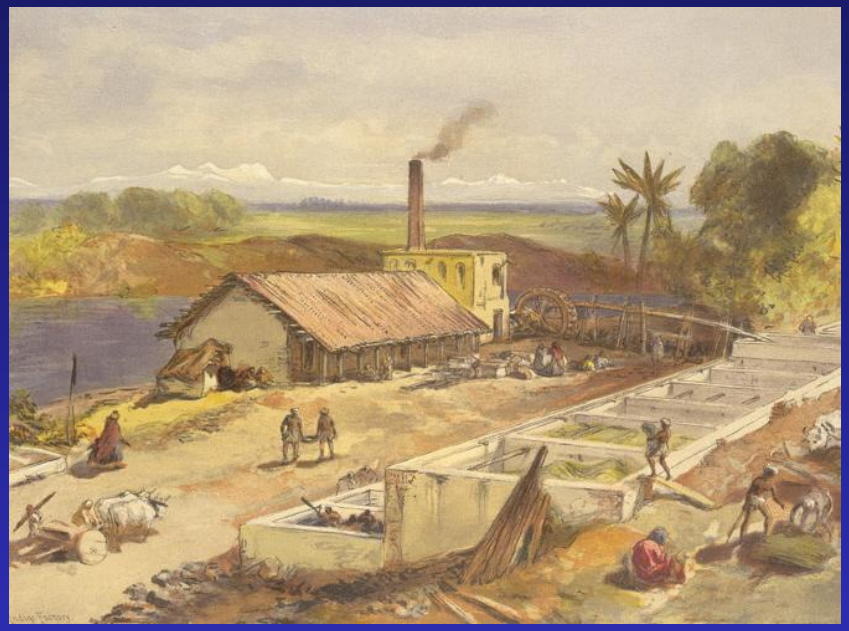
BASF develops a more economic route based on N-2-carboxyphenyl glycine, derived from aniline, which had become just then available from coal tar distillation

Indigofera Tinctoria

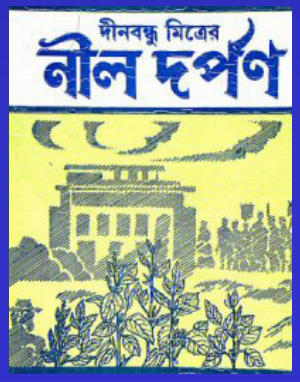
Indigo dye

Blue denim

THE DAWN OF THE CHEMICAL INDUSTRY: THE BENGAL CONNECTION



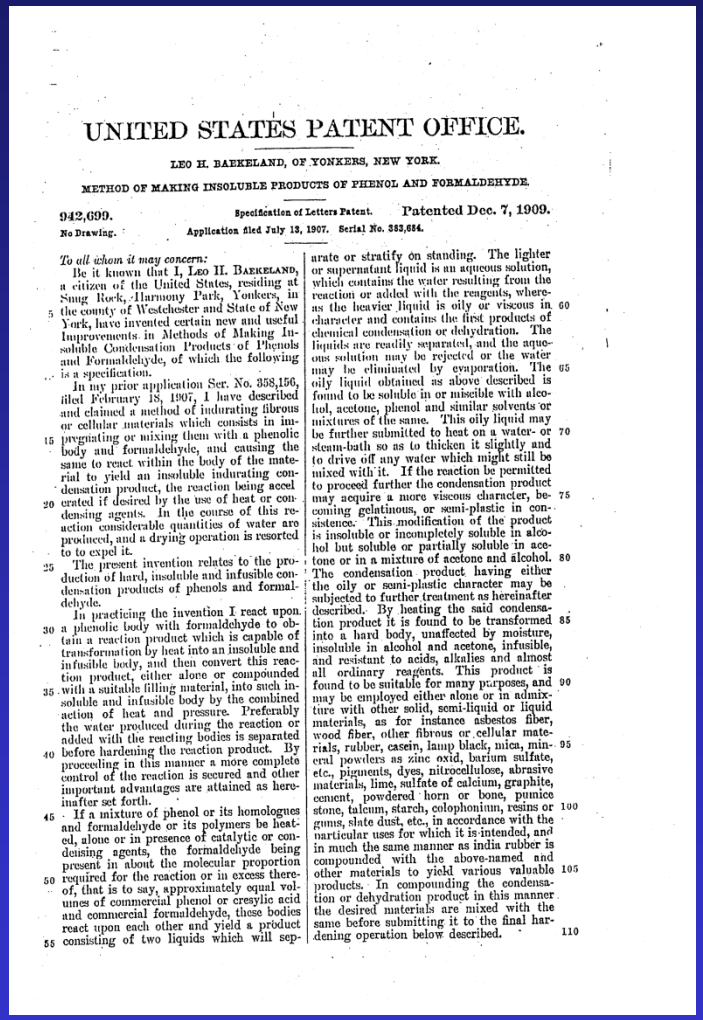
Indigo dye factory in Bengal, circa 1867



Nil Darpan by Dinabandhu Mitra (1860)

- Indigo plantation in Bengal dates back to 1777
- The Indigo Riots (Nil Bidroho) began in Nadia in 1859, an uprising of the farmers against the exploitation by the planters and later spread to Champaran in Bihar in 1868
- There was an anger against the British traders, fresh after the Sepoy Mutiny of 1857
- Regarded as the first non violent passive resistance in Indian history
- India's exports of over 20,000 tons of Indigo to Europe ceases; by 1914 synthetic Indigo completely replaces natural Indigo

THE DAWN OF THE CHEMICAL INDUSTRY: THE MANUFACTURE OF BAKELITE



UNITED STATES PATENT OFFICE.

LEO H. BAEKELAND, OF YONKERS, NEW YORK.

METHOD OF MAKING INSOLUBLE PRODUCTS OF PHENOL AND FORMALDEHYDE.

942,699. Specification of Letters Patent. Patented Dec. 7, 1909.

No Drawing. Application filed July 13, 1907. Serial No. 383,884.

To all whom it may concern:

Be it known that I, LEO H. BAEKELAND, a citizen of the United States, residing at Snug Rock, Harmony Park, Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Methods of Making Insoluble Condensation Products of Phenols and Formaldehyde, of which the following is a specification.

In my prior application Ser. No. 358,156, filed February 18, 1907, I have described and claimed a method of indurating fibrous or cellular materials which consists in impregnating or mixing them with a phenolic body and formaldehyde, and causing the same to react within the body of the material to yield an insoluble indurating condensation product, the reaction being accelerated if desired by the use of heat or condensing agents. In the course of this reaction considerable quantities of water are produced, and a drying operation is resorted to to expel it.

The present invention relates to the production of hard, insoluble and infusible condensation products of phenols and formaldehyde.

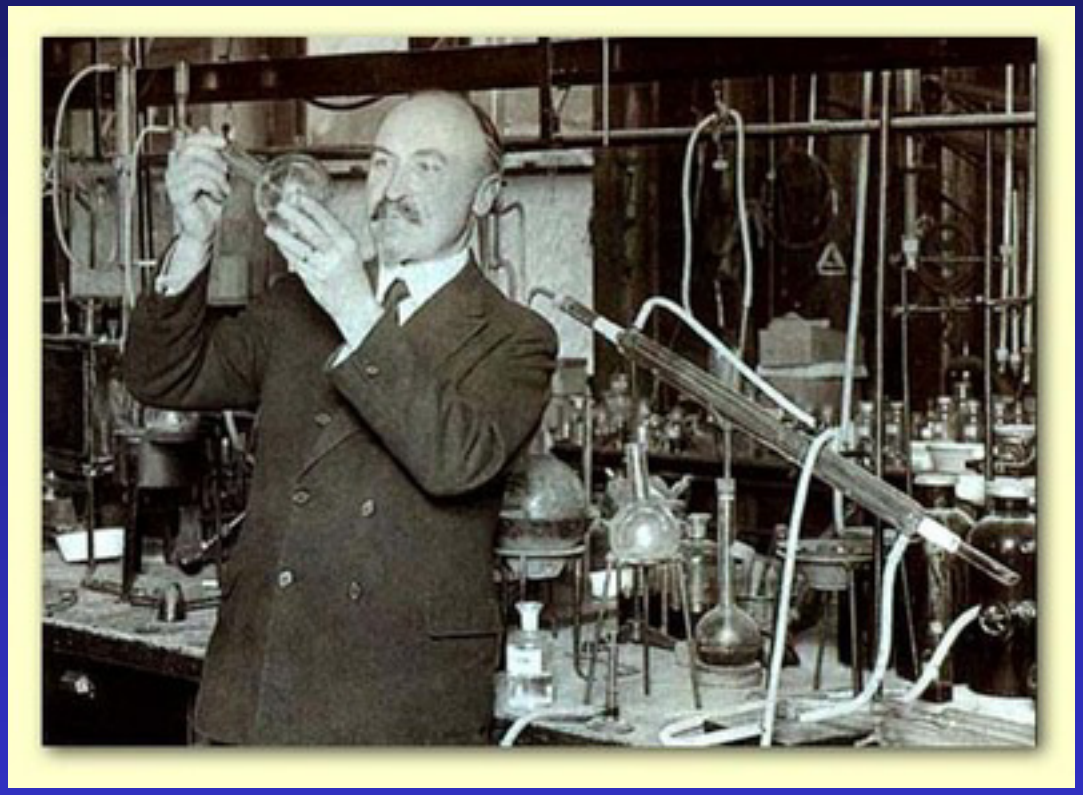
In practicing the invention I react upon a phenolic body with formaldehyde to obtain a reaction product which is capable of transformation by heat into an insoluble and infusible body, and then convert this reaction product, either alone or compounded with a suitable filling material, into such insoluble and infusible body by the combined action of heat and pressure. Preferably the water produced during the reaction or added with the reacting bodies is separated before hardening the reaction product. By proceeding in this manner a more complete control of the reaction is secured and other important advantages are attained as hereinafter set forth.

If a mixture of phenol or its homologues and formaldehyde or its polymers be heated, alone or in presence of catalytic or condensing agents, the formaldehyde being present in about the molecular proportion required for the reaction or in excess thereof, that is to say, approximately equal volumes of commercial phenol or cresylic acid and commercial formaldehyde, those bodies react upon each other and yield a product consisting of two liquids which will separate or stratify on standing. The lighter or supernatant liquid is an aqueous solution, which contains the water resulting from the reaction or added with the reagents, whereas the heavier liquid is oily or viscous in character and contains the first products of chemical condensation or dehydration. The liquids are readily separated, and the aqueous solution may be rejected or the water may be eliminated by evaporation. The oily liquid obtained as above described is found to be soluble in or miscible with alcohol, acetone, phenol and similar solvents or mixtures of the same. This oily liquid may be further submitted to heat on a water- or steam-bath so as to thicken it slightly and to drive off any water which might still be mixed with it. If the reaction be permitted to proceed further the condensation product may acquire a more viscous character, becoming gelatinous, or semi-plastic in consistence. This modification of the product is insoluble or incompletely soluble in alcohol but soluble or partially soluble in acetone or in a mixture of acetone and alcohol. The condensation product having either the oily or semi-plastic character may be subjected to further treatment as hereinafter described. By heating the said condensation product it is found to be transformed into a hard body, unaffected by moisture, insoluble in alcohol and acetone, infusible, and resistant to acids, alkalies and almost all ordinary reagents. This product is found to be suitable for many purposes, and may be employed either alone or in admixture with other solid, semi-liquid or liquid materials, as for instance asbestos fiber, wood fiber, other fibrous or cellular materials, rubber, casein, lamp black, mica, mineral powders as zinc oxid, barium sulfate, etc., pigments, dyes, nitrocellulose, abrasive materials, lime, sulfate of calcium, graphite, cement, powdered horn or bone, pumice stone, talcum, starch, colophonium, resins or gums, slate dust, etc., in accordance with the particular uses for which it is intended, and in much the same manner as india rubber is compounded with the above-named and other materials to yield various valuable products. In compounding the condensation or dehydration product in this manner the desired materials are mixed with the same before submitting it to the final hardening operation below described.

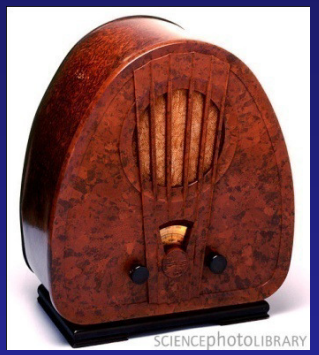
US Patent 942, 699, December 7, 1909

- Baekland set out to discover a substitute for Shellac, then wholly supplied by India to the world
- In the process he made the first man made material, heralding the age of plastics, a discovery considered as revolutionary
- Heat resistant and insulating
- Baekland named his new material Novolak
- He founded a company called Bakelite Corporation in 1910 to manufacture the product

THE DAWN OF THE CHEMICAL INDUSTRY: THE MANUFACTURE OF BAKELITE

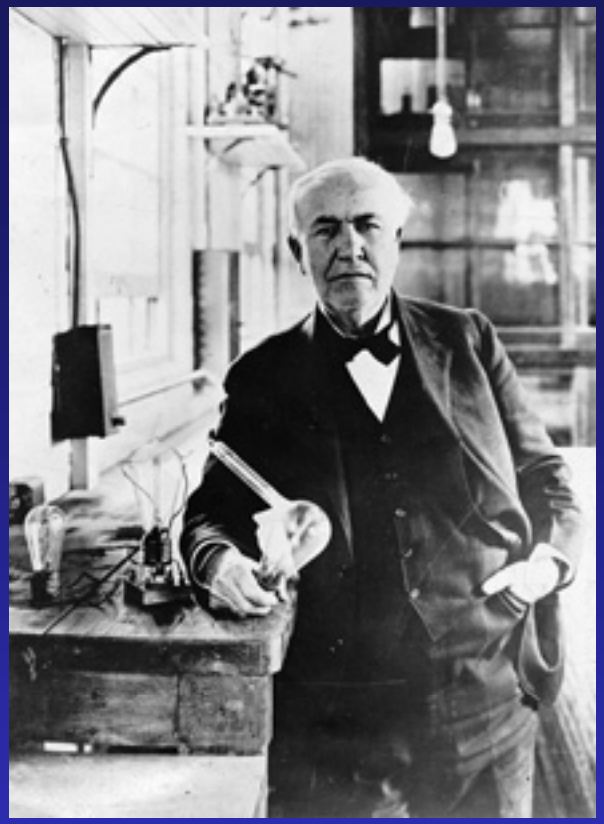


Leo Baekland (1863-1944)



When asked why he chose to work in the field of synthetic resins, he replied " to make money "

EDISON AND MENLO PARK : THE BIRTH OF INVENTION FACTORY



Thomas Alva Edison (1847-1931)

Menlo Park, NJ Laboratory

- Most prolific inventor in the history
- Edison holds the record for the largest number of patents granted to an individual inventor, 1093
- Inventor of phonograph, incandescent bulb, motion picture camera, alkaline battery and many others
- First to organize and manage research , a forerunner to the later day corporate research laboratories of companies
- Assembled a cross functional global team of coworkers, from Germany(glass blowing), Switzerland (watch making),mathematicians, chemists , carpenters and machinists
- In 1900 Menlo Park employed over hundred people who were inventing for a salary and living

STRUCTURE OF SCIENTIFIC ENTERPRISE

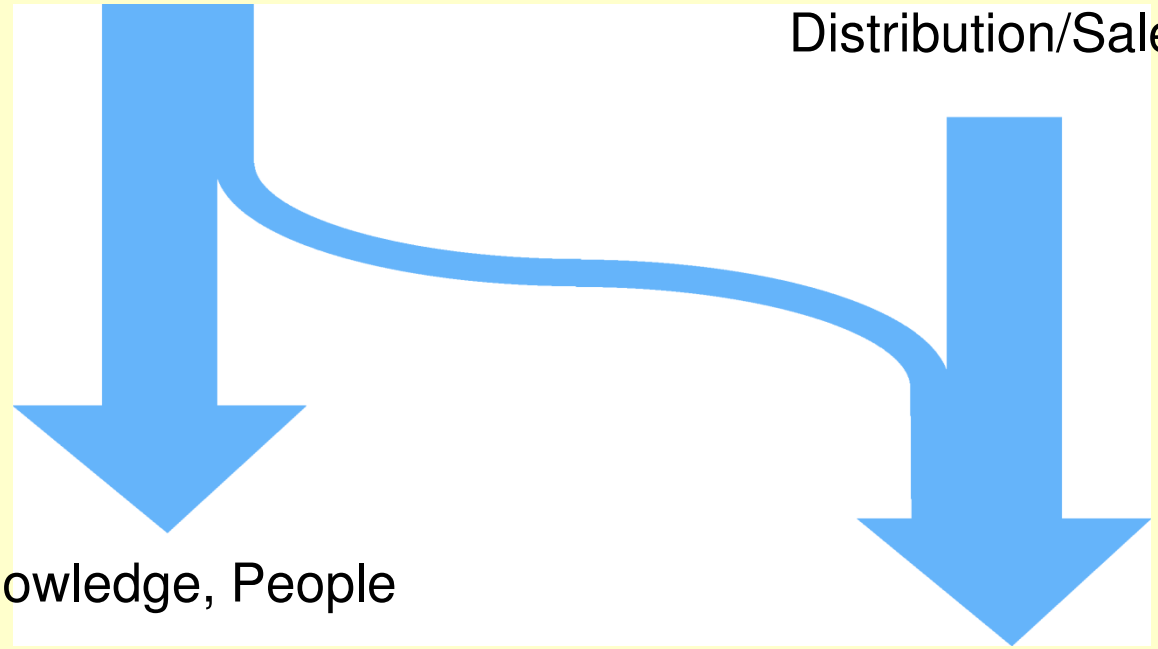
Money

University **Government** Laws, Regulation

Industry

("Liebig" Model:
Professor/Student/Problem/Thesis)

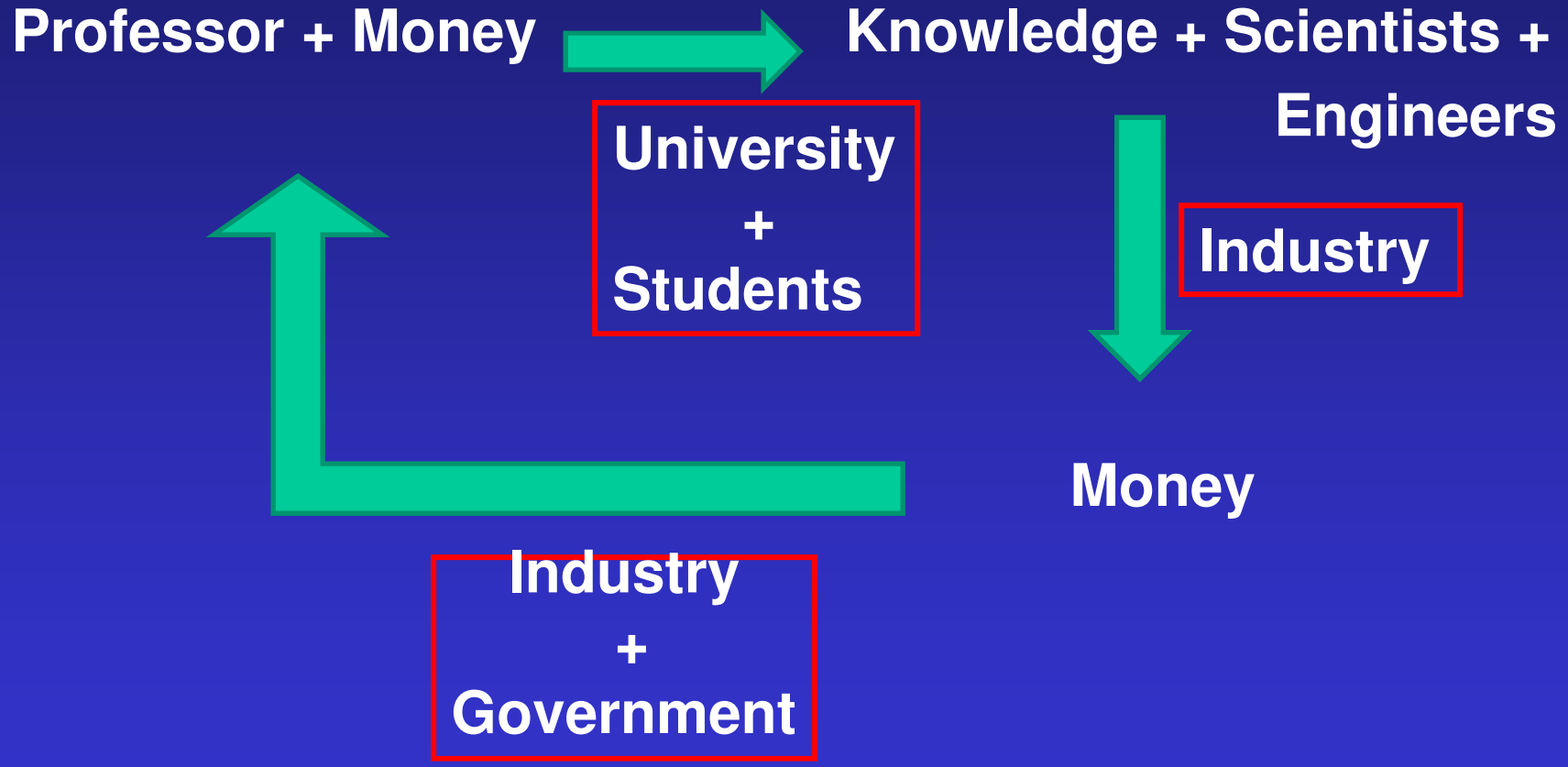
(Development, Manufacturing,
Distribution/Sales)



Knowledge, People

Products/Solutions for Problems

LEIBIG´S MODEL



LEIBIG MODEL OF RESEARCH TRAINING

Professor assigns a problem to a student

The student solves the problem , gets his Ph D; the professor becomes famous

The student goes on to become a professor and repeats the process all over again

THE PRINCIPLES OF A KNOWLEDGE ORGANIZATION (Sveiby 1997)

	INDUSTRY	*ACADEMIA*
People	Cost generators	Revenue generators
Power base	Level in hierarchy	Level of knowledge
Task	Supervise subordinates	Support colleagues
Production	Physical tangible assets	Knowledge and intangible assets
Revenue flow	Tangible (financial)	Intangible (ideas, customers)
Manifestation of production	Hardware	Concepts
Production flow	Machine driven	Idea driven
Effect of size	Economics of scale	Economics of scope
Purpose of learning	Application of tools	Creation of tools

HERDING CATS: BEING ADVICE TO ASPIRING ACADEMIC AND RESEARCH LEADERS

(Geoff Garret and Graeme Davies (2010)

- **In professional life most academics and researchers will – like cats- seek to exercise as much as independence as possible.**
- **Researchers are typically individuals with high ideals and a frequently argumentative style**
- **Often very conservative and resistant to change**
- **Considerable difficulties in seeking cross boundary collaborations.**
- **Many institutional processes are bureaucratic in nature**

LINEAR MODEL OF IMPACT OF SCIENCE

Money → Institutions

→ Research → Papers and PhD's →

Greater prosperity and wealth creation in society

Basic research → Applied research → Development

Basic research performed in academia

Applied research and commercialization in industry

Vannevar Bush, Science : The Endless Frontier, 1945

RE-EXAMINE THE MODELS

- **Is the "Liebig Model" obsolete?**
- **Is the current model of the university ("a collection of semi-isolated experts") still workable?**
- **Can curiosity-driven basic research survive?**
- **Should research be driven by large missions ?**
- **Should translational research be funded by the state or should be left to industry ?**

Goethe once said about science: "To one man it is the highest thing, a goddess; to another it is a productive cow who supplies them with butter. We must honor the goddess and feed the cow.

Science : Is it for

- Pleasure ?
- Profit ?, or
- Pleasure and Profit ?

Does it benefit anybody ?
Who cares for the science?
Is it worth the money spent on it ?
Is it directed at the right objectives ?
Is there too much or too little?
Is it too pure or applied ?
What are the rewards of research ?

As the world attains prosperity, science is taken for granted and is increasingly being questioned

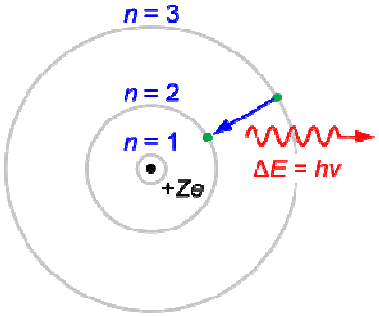
SCIENCE AND APPLICABLE SCIENCE

Metaphor: Buckets of paint vs painting

There is science and the applications of science : Louis Pasteur

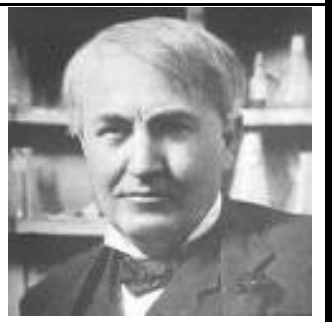
Pasteur's Quadrant

Bohr



Pasteur

Average
Academic
and
Industrial
R & D



Edison

Fundamental Research

Use Inspired Research

R.E.Stokes

RESEARCH ENTERPRISE : COMPLEXITIES

- Individual or solo research
- Collaborative research
- Mission driven research
- Research leading to IP
- Research leading to products and prototypes
- Research aimed at societal needs
- Teaching , mentoring and communication

SCIENCE IN THE 21st CENTURY

- **Blue skies vs Directed Science**
- **Small vs Big Science**
- **Individual vs Team Science**
- **Curiosity driven vs Grand Challenges or Utilitarian Science**
- **Open access vs Intellectual Property**

GLOBAL ISSUES

- **Difficulties in identifying new growth platforms**
- **Difficulties in creating value and high entry barriers for new product introductions**
- **Globalization of economy, reduced barrier to movements of goods services**
- **Increased global segmentation in terms of technology providers , low cost producers of feed-stocks and large domestic markets**

INDUSTRY – ACADEMIA LINKAGE

- **The western world moved from agrarian to industrial and then on to knowledge driven enterprises over two hundred years. The system had the time to accept and manage the change**

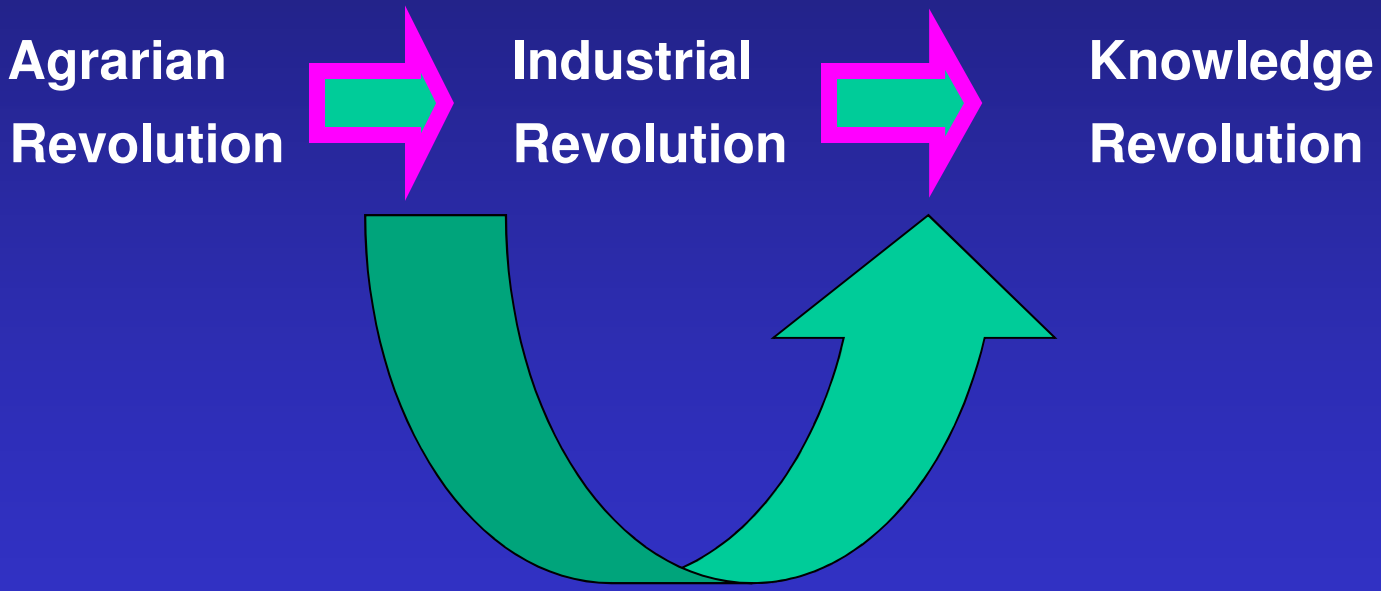
- **The industrial revolution laid the foundation of industrial R&D; Large corporate research facilities became the visible symbols of successful enterprises. They hired large number of highly educated professionals and provided them an ambience to create and innovate**

- **However, beyond the late eighties , the monolithic central or corporate R&D centers began to disintegrate as competition around the world enlarged and technology diffusion became more rapid**

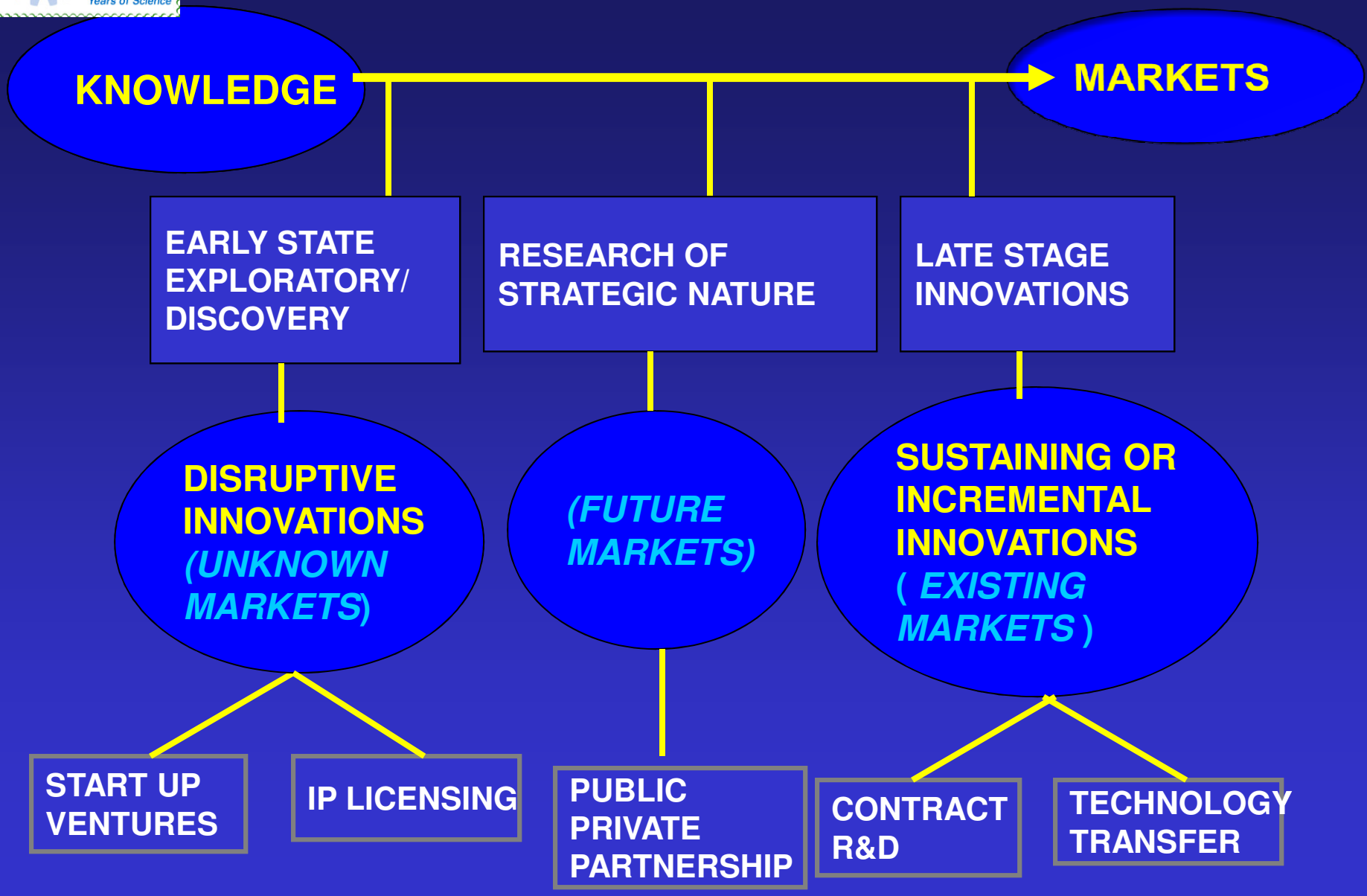
INDUSTRY – ACADEMIA LINKAGE

- **However, in India we missed the beneficial aspects of the manufacturing revolution. India began to industrialize in the early fifties, but before this process reached maturity, India migrated to a service economy**
- **R&D in industrial enterprises never became institutionalized. There was no established innovation processes in majority of the Indian companies, barring a few honorable exceptions.**
- **Service industry does not require process or product innovations, but only innovations in delivery and cost management.**
- **In India, even R&D began to assume a service model, largely due to the cost arbitrage. A large proportion of R&D that is conducted in India by companies are for customers outside India, both by global MNC's and by Indian companies, especially in the pharma sector. The outsourced R&D model never gave Indian organizations an opportunity to take a concept to the market, completing the full innovation chain. Instead they were only deployed to do those things where they had some competence**

HAS INDIA MISSED A FULL BLOWN INDUSTRIAL REVOLUTION?



LINKING KNOWLEDGE TO MARKETS



FROM CONCEPT TO MARKET : A CASE STUDY

- 1997 : Ph D research of L.S.Ramanathan
- 1999 : Four US patents and publications (US Pat.,5,814,675; 5,859,075; 5,962,003; 6,123,988)
- We had a solution, but there was no problem !
- 2000-2005 : Incubation and presented results in many forums including industries, Indian and Global
- 2006: One such chance encounter defines the problem; Getting fragrances into clothes presents a challenge for detergent companies and suppliers
- 2007 : Problem definition; potential application of knowledge; product development begins
- 2007 : Research collaboration set up with P&G; product fine tuning, scale up. Product evaluation with Laundry Science group at New castle and Brussels
- 2010 : Applications patents applied for
- 2010 : Product enters market – Downy Fabric Softeners

MICROCAPSULATED PERFUME

“ Getting fragrance onto clothes presents a challenge for detergent companies and their suppliers”

Cover story: Chemical & Engineering News, January 29,2007

Customer perceptions

Nice fragrance while taking out the fabric from washing machine

Fragrance persists when washed fabric is being used i.e. superior “tenacity “ is desired.

Far better ”tenacity” fragrance should have good “substantivity”

To protect the perfume from different chemicals present in detergent composition i.e. perfume should have good storage stability in the product.

High values of these parameters can be obtained by using microencapsulated perfumes.

Procter's gamble

How much force do you need to twist the cap off a bottle? How do you keep clothes smelling nice even a week after they've been washed? Just some of the questions that allow one of the world's largest consumer goods giants to take its Indian brains global

Seema Singh
seema.s@livemint.com

Stepping inside the innovation centre of the world's largest consumer goods company in suburban Bangalore, anticipation runs high: how does the $78.9 billion Procter & Gamble Co., maker of Tide detergent and Pampers diapers, come up with its next blockbuster product? How big is the innovation funnel that has spewed out products ranging from paper towels to dentifrice to boatloads of over-the-counter brands?

Inside the fifth floor of Neil Rao Towers at Whitefield, a thin veil of disappointment descends when all that comes to view is a bunch of P&G products neatly displayed in the hallway, and later, deliberately arranged in the conference room.

But as Ashish Chatterjee, head of the Bangalore Innovation Centre (BLIC), starts talking about some of the 200 brands that the company sells, and how it immerses itself into the lives of consumers, it dawns that the consumer business is far from being a pedestrian affair.

What should be the optimum force needed for twisting open a bottle cap? What's the right pressure for the plunger on a bottle of skincare cream? Why should the black box that a lotion comes in be replaced with transparent packaging, as with Olay products?

These and many such questions dominate researchers' work as they drive "purpose-inspired innovation" at P&G. "It's certainly not an aircraft engine; we don't always go for the big bang," says Chatterjee. "Our innovation is driven by consumer inspiration."

He sums it up as two moments of truth—one, when the consumer browses in a store and ends up buying a P&G product; second, when the person returns to buy either the same or any other item made by the company.

Defined by these moments of truth, BLIC was set up in July 2008 as one of the 28 innovation centres within P&G. It is a capability hub, smaller than some of P&G's mega centres, and provides modelling and open innovation resources for the global enterprise.

It was in 2000 that the Connect and Develop, or C+D, concept of open innovation was mooted by the then chief executive Alan G. Lafley. It wasn't the best of times for P&G: the stock had just lost half its value amid an aggressive growth plan and Lafley decided to shed bricks and mortar R&D infrastructure for open innovation. He directed that ideas and innovations sourced from outside should go up from 10 per cent to 50 per cent in the next five years.

A decade later, the company has far exceeded that limit. It has also changed tack — from getting the world to its lab to taking its labs to the world. For each of its 100 engineers and scientists working in Bangalore, the centre collaborates with five researchers outside.

Now, at two-year-old BLIC, there are a few tangible results, says Chatterjee, who is also director, Asia C+D and Bangalore Beauty Care.

Using computer modelling, this centre has screened millions of molecules to identify a new molecule in the area of skin improvement. While it's into clinical studies now, Chatterjee emphasises that in such studies, knowing "how it works", rather than "why it works" is more important so that the active can be used in other skin applications as well. The computing expertise of BLIC, which Chatterjee likens to "Intel Inside", powers the P&G innovation engine but isn't visible from outside.

From simulating entire packaging lines to complete plant production units, modelling is used to reduce the start-up cost, eliminate waste in the system and to optimise existing operations. A new multi-category production system, designed at BLIC, has just been rolled out which Chatterjee says will save "several millions of dollars for P&G". In this industry, there's no such thing as a cost that can't be cut.

As economic recovery has been slow in many parts of world and consumers are still hurting, premium brands continue to struggle. Meanwhile, in India, where the $24 billion consumer packaged-goods industry is growing at 12 per cent per year according to Nielsen Co., P&G lags behind its closest rival, Unilever, in market share.

Historically, says Ramesh Srinivas, executive director, consumer business practice, KPMG Advisory Services India, P&G has placed its products globally; it won't be looking at just regional benefits arising out of these innovation centres. He is right.

Though some of the BLIC-designed packaging, such as of Olay Total Effects and Olay Regenerist, have been selling in global stores, one of the earliest examples of open innovation from here has gone into products that have not yet entered the Indian market.

For instance, BLIC and the National Chemical Laboratory, a Council of Scientific and Industrial Research laboratory in Pune, have developed a new micro-encapsulating technology that has gone into its fabric softener Downy. Yet to hit Indian stores, the company says its fragrance lasts for a week after the wash, longer than rival products.

The key lies in the technology that allows the perfume-containing micro capsules to open up when the dehydration process kicks in. The end product, says Chatterjee, is "cheaper and better". The laundry science groups in Newcastle and Brussels were also involved in the development of the product.

P&G, like many other consumer goods companies, is trying hard to boost sales in the US and Europe.

While sales growth in emerging markets is easier to come by, in mature markets the company needs to rely on lowering prices or come up with innovative products, says Jack P. Russo, an analyst with the Edward Jones, a retail brokerage in St Louis, US.

"P&G is relying on both of these measures but it appears the emphasis on innovation has been more pronounced since (Robert) McDonald has taken over as CEO (in June 2009)."

Consumers definitely want innovative products but because they are also seeking value P&G won't be able to charge a premium on these as it would have done in the past, added Russo.

The Cincinnati giant is already treading that path. C+D 2.0, which has been effective since 2008, is all about value creation for the company and its partners", Chatterjee says.

P&G's products touch about four billion lives today. The company intends to add another billion to this in the next five years, spurred by its well-oiled innovation machine. To the two Asian 'mega' centres in China and Japan, a third one is being added in Singapore. "It's no secret Asia is a battleground," says Chatterjee, who is firming up plans to add more products as well as processes to BLIC's modelling capabilities.

■ BLIC head Ashish Chatterjee poses with P&G's products at its Bangalore centre.

yeswecan

■ Bangalore Innovation Centre Started: 2008

■ Made in India: New 'holistic' designs of Head & Shoulder shampoo and conditioner bottles; a new molecule/active for skin improvement; transparent packaging of Olay products; microencapsulating technology that has gone into its fabric softener Downy

■ Laboratories at P&G's innovation centre in Bangalore support computer modelling. HEMANT MISHRA / MINT PHOTOS

■ Every Friday, this series chronicles technological innovation and India's rise as a global R&D hub. Read previous stories at www.hindustantimes.com/innovation

Hindustan Times 17th Sept. 2010

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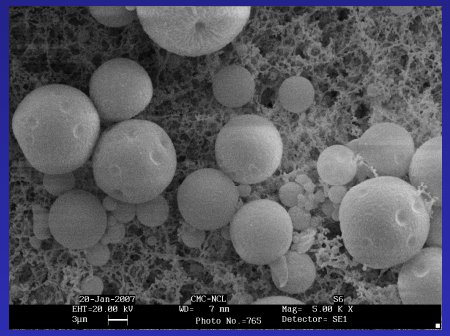
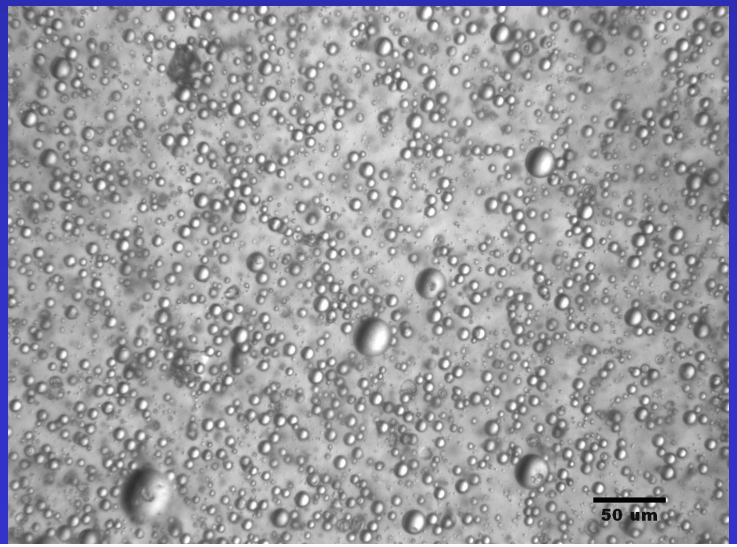
Patent applications filed US 2010/0119679 and WO 2010/053940

Polymer microcapsules for fabric care





FROM CONCEPT TO MARKET : LESSONS LEARNT

- **The power of partnership**
- **Staying with an idea long enough**
- **Communication to multiple interest groups**
- **The power of cross functional teams to deliver the product to the market**

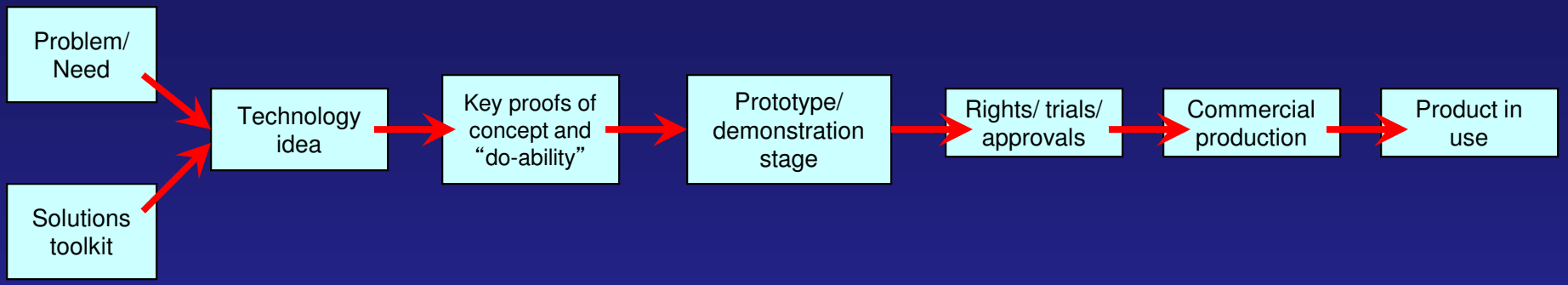
Investment in idea generation and curiosity driven research always pay off

SOME USEFUL LESSONS

- **Learn to walk the last mile**
- **Putting the team together and energizing the team**
- **Patience , perseverance and failure tolerant**
- **Who gets the glory and who gets the blame**
- **The role of a champion; the leader as a champion**
- **Going beyond the written contract**
- **Passion to succeed; Are you ready to stake your reputation?**

Science is an individual effort; technology is a collective endeavor

TECHNOLOGY INNOVATION: A SIMPLISTIC MODEL



Invention

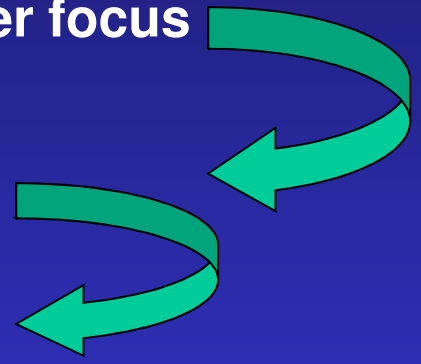
80% of work, time, investment

All the inventions that are remembered have successfully navigated this process!

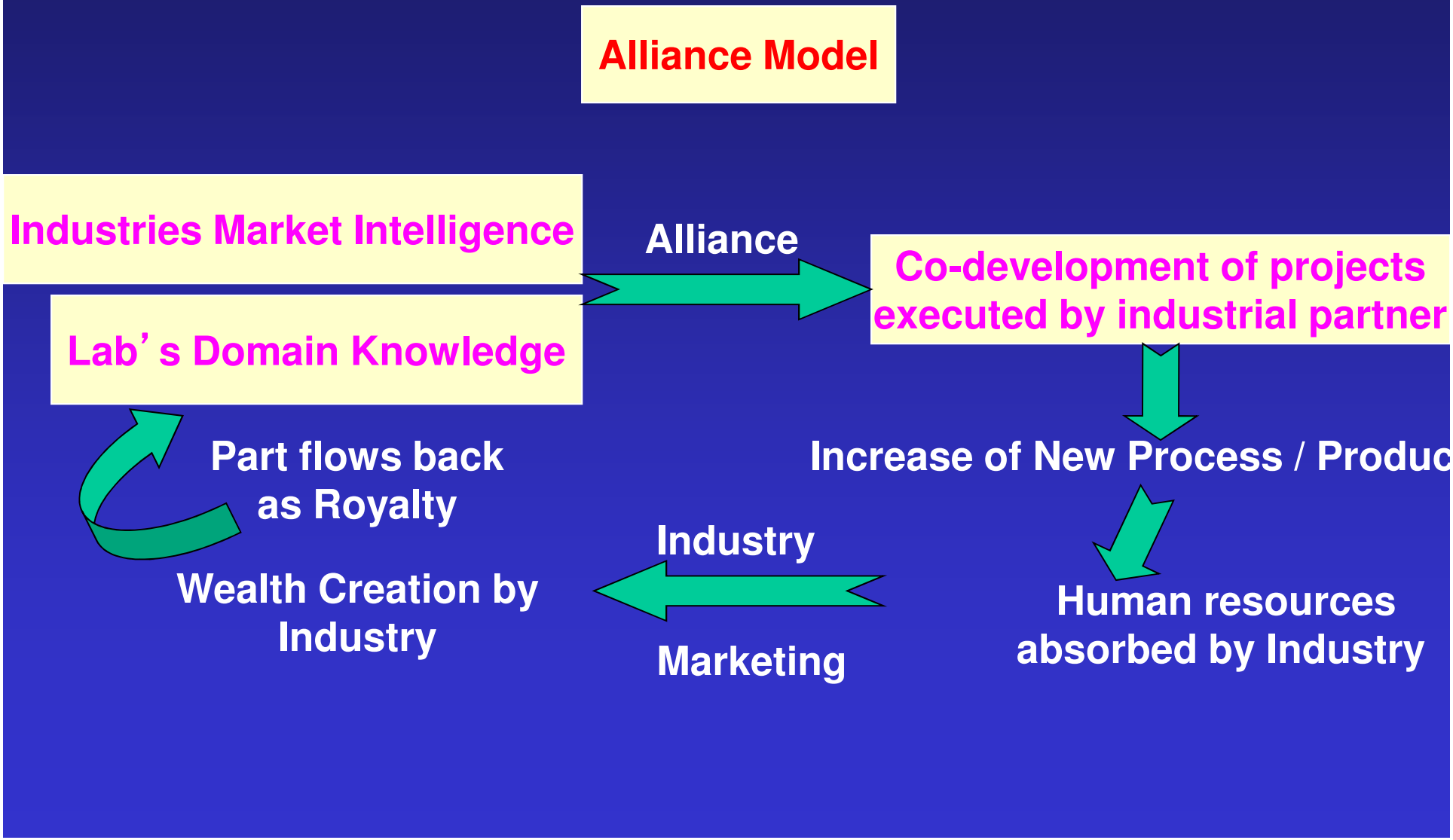
Innovation is 80 % perspiration, 20 % inspiration !

ACDEMIA INDUSTRY INTERACTIONS : TOWARDS EVOLUTION OF NEW MODELS

- **The transactional model : Little or no stakeholder focus**
- **The relationship model : stakeholder satisfaction**
- **The partnership model : stakeholder success**



INUSTRY ACADEMIA PARTNERSHIP MODELS



Spin outs : Creating Businesses from University Intellectual Property : Graham Richards (2009))

- **Exploitation of intellectual property : Licensed to companies who will pay royalty or alternatively new companies , spin outs can be created**
- **Institutions are not keen to exploit the potential of wealth creation, but are seized by the fear of liability, amounting to paranoia. Research institutions are as a rule risk averse**
- **The need for a strong internal organization (Technology Transfer Office, Research Services Office) to vet all agreements and protect the scientists, who are eager to accept funding, from signing away rights.**
- **It is absolutely essential for the University to own all IP if an external organization is to be entrusted with the responsibility of exploiting the University IP**
- **Encouraging researchers to seek protection prior to publication**
- **The three F's : Family , Friends, and Fools : the first supporters of a venture**

Spin outs : Creating Businesses from University Intellectual Property : Graham Richards (2009)

- **Experience has shown that most of the really successful spin outs have been based on research that was not seen originally to be a likely source of profitable intellectual property. The so called " blue skies" research is a far better source than that which obviously exploitable for profit at the outset.**

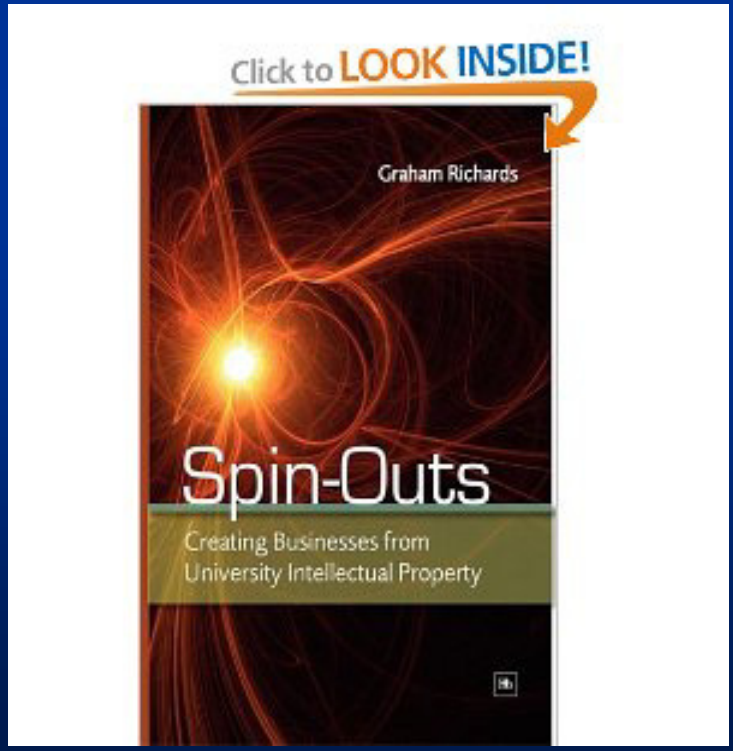
- **The key is to recognize the potential, The best person to do this is the individual who is doing the research with a little advice and support form someone who understands the commercial process**

THE OXFORD CHEMISTRY DEPARTMENT

- ❑ The biggest Chemistry Department in the western World
- ❑ Each year 180 graduates with a four year degree including one full year of research
- ❑ 90 PhDs per year (cf Berkeley 64)
- ❑ 150 Post-doctoral researchers
- ❑ 80 Faculty
- ❑ Rated 5* and now 5**
- ❑ 12 active FRS
- ❑ Produced 4 Nobel Laureates
- ❑ Annual research income ~ £15 million

The Oxford Chemistry Department has contributed some £80 million to the central University as a result of spin-outs.

£40 million cash
£20 million holding in quoted companies
£20 million fair value in unquoted companies



EMERGING TECHNOLOGIES : THE ERA OF START UPS

- **Bio-fuels**
- **Biomass derived chemicals and materials**
- **Biotechnology, diagnostics and biomedical products**
- **Electric vehicles and batteries**
- **Solar energy**
- **Fuel cells**
- **Flexible and molecular electronics**
- **Nanotechnology**

THE NON LINEAR PROCESS : SEAMLESS INTEGRATION OF RESEARCH AND INNOVATION

- **Research : ideas, concepts, principles, techniques, theories (*Discover)***
- **Translation : proof of concept, connecting solutions with needs, validation *(Develop*)**
- **Defining the customer and his needs (met or unmet) and cost –performance targets, prototype or pilot plant development, customer acceptance, business plan, investment and economics *(Demonstrate)***
- **Marketable Product *(Deploy)***

Success in the laboratory does not always translate into success in the market place

"Innovation is no longer the ability to develop or discover a new product or service and then just hoping that someone buys it. The new model asks where we should go, what should we bring with us , who should we partner with and what does the customer need"

R. Kumpf

VP, Future Business Group

Material Science Group, Bayer

SCIENTISTS : SOLO OR CONCERTED?

AH Cottrell The Listener 1960 Sept 13 411

- **The scientist, however, remote he may seem is bound closely to the scientific life around him. He cannot work in a vacuum. He, both, takes and gives in the scientific currency of his time.**
- **Keeping in touch is the thing and that means meeting as many people working in the field**
- **This is because science is at heart a progressive evolutionary subject and a collective endevour**

WHERE ARTS IS AHEAD...

Organizing scientific research on the scale of big operatic and theatrical production is still something new in science

FUTURE OF INNOVATION

- **Innovation = Invention + Implementation**
- **The process of innovation is not necessarily efficient**
- **Innovation will move from large enterprises to small companies**
- **Disruptive innovation will most likely emerge from publicly funded institutions / Universities**
- **Larger companies will need to build entrepreneurial, agile R&D teams through an open innovation or venture models**
- **Partnership and collaboration in R&D will become necessary criteria for success based on shared responsibilities, risks and benefits**

MIND SET CHANGE : FROM RELAY RACE TO TANGO

THE OTHER DEMOGRAPHIC DIVIDEND
(THE ECONOMIST 2010)

- **Emerging markets are teeming with young entrepreneurs**
- **Median age in India will be 28 in 2020 compared to 37 in China, 38 in USA, 45 in Western Europe and 49 in Japan**
- **Direct correlation between age and entrepreneurial pre-disposition; young people are more innately inclined to overthrow the existing order than older people**
- **Drivers ICT, opportunity to leapfrog technologies. Not hampered by legacy systems and mindsets**
- **Entrepreneurial energies are moving eastwards. The next Facebook is increasingly likely to be founded in India rather than in middle aged America or Europe**

Good science is a necessary, but, not a sufficient condition for good technology outcomes. Converting scientific concepts into technology requires deep understanding of customer needs, commitment to walk the last mile, perseverance to overcome small , often scientifically non exciting barriers and positive intervention by mentors. Otherwise, good science will only result in publications and the benefits of technology will not flow to those who made the discoveries

Knowing is not enough; we must apply. Willing is not enough; we must do : ***Goethe***


1950 - 2010
CSIR - INDIA
Celebrating Sixty
Years of Science
THANK YOU