INTELLECTUAL PROPERTY : ITS ROLE IN THE EVERYDAY LIFE OF A SCIENTIST

Dr. S. Sivaram
National Chemical Laboratory,
Pune-411 008, INDIA

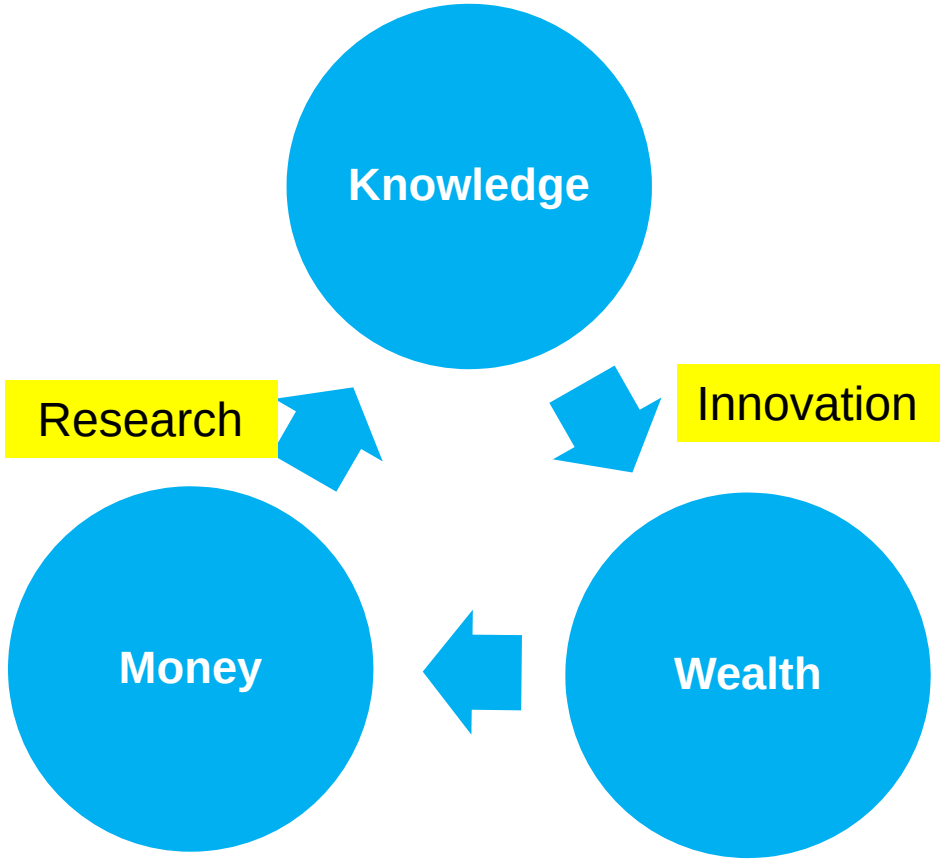
Tel : 0091 20 2590 2614
Fax : 0091 20 2590 2615
Email : s.sivaram@ncl.res.in
Visit us at : http://www.ncl-india.org

Patent Certification Course
Venture Center, Pune

January 31,, 2015

CREATING WEALTH OUT OF KNOWLEDGE

- ***Where*** : Universities, research laboratories, society, industry
- ***Who*** : Faculties, scientists, students, individuals as well as S&T professionals in industry
- ***How*** : Technology transfer and licensing, consulting, spin off ventures, in house conversion to products and services, out-licensing and co-development with partners
- ***Why*** : To create a virtuous cycle of wealth creation from knowledge



INNOVATION

It is the means by which a person creates new wealth producing resources or endows existing resources with enhanced potential for creating wealth

Peter F. Drucker

HBR 1985

Innovation is the successful exploitation of new ideas and is a vital ingredient for competitiveness, productivity and social gain within businesses, organisations and nations

-London Innovation definition*

INTELLECTUAL PROPERTY OR ASSETS

- Patents
- Trademarks / Designs
- Copyrights

<u>Intellectual property of assets management</u>

- Formal techniques for accurately measuring and managing the potential of intellectual property or assets within an organization for creating future value
- In a sense, it is an accounting system, based in intangibles such as knowledge of workers, current R&D efforts, patent portfolio, in-house knowledge, both documented and resident in people

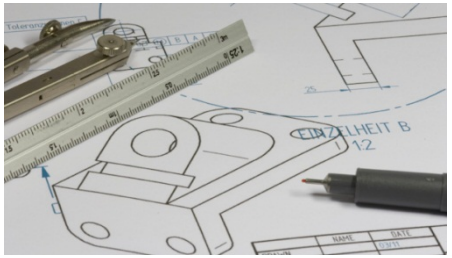
INTELLECTUAL PROPERTY

Industrial property

- **Patents**
- **Designs**
- **Geographical Indications**
- **Trademarks**

Copyright

- **Literary and artistic works**
- **Electronic media**
- **Performances of artists**



INTELLECTUAL PROPERTY MANAGEMENT

- Create intellectual property
  - Define research strategy
- Manage intellectual assets
  - Sell/acquire/protect
  - Add value
  - Generate wealth

INVENTION AND INNOVATION

- An invention is an idea that can solve a practical problem in a new way, while innovation is the action needed to put it into practice
- Both invention and innovation can be patented
- The greater the scientific knowledge of the inventor, the greater is his or her range of potential inventions
- Innovation may take place centuries after the invention because the knowledge was not in the right place, the materials and processes were lacking or because there was not a big reward. Sometimes innovation occurs within a few years (example : electricity and Facebook)
- Predicting the future of invention/innovation is important, bit it is rarely correct

THE NON LINEAR PROCESS : SEAMLESS INTEGRATION OF SCIENCE, TECHNOLOGY 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

FAILURES OF VISION

1876 - 'This "telephone" has too many shortcomings to be seriously considered as a means of communication.' - ***Western Union internal memo***

1895 - 'Heavier-than-air flying machines are impossible.' - ***Lord Kelvin, President, Royal Society***

1899- 'Everything that can be invented has been invented.' - ***Charles Duell, Commissioner of the US Office of Patents***

Contd…..

FAILURES OF VISION

1920 - 'The wireless music box (radio) has no imaginable commercial value. Who would pay for a message sent to nobody in particular?' - *David Sarnoff's associates, in response to his urgings for investment in the radio*

1943 - 'I think there's a world market for maybe five computers.' - *Thomas Watson, chairman of IBM*

1949 - 'Computers in the future may weigh no more than 1.5 tons.' - *Popular Mechanics*

1977 - 'There is no reason anyone would want a computer in their home.' - *Ken Olson, president, chairman and founder of Digital Equipment*

1981 - '640K ought to be enough computer memory for anyone.' - *Bill Gates, chairman of Microsoft*

INNOVATION AND PATENTS

- Ideas and innovations are the most precious currency in an economy
- Without constant flow of ideas, a business and economy is condemned to obsolescence
- A patent is an instrument which protects the legitimate interest of the inventor at the same time allowing for free flow of ideas

Innovation is commercial imagination

SCIENTISTS AS AN INVENTOR

- **Patenting defines a scientist as an inventor**
- **As a currency or visiting card, patents add credibility to scientist as an inventor**
- **Patenting provides an inventor opportunities to translate science into useful products or processes**
- **Patenting has created incredible wealth to scientists, institutions as well as to the world**
- **The quantity and quality of patents define the “Innovation quotient” of an individual, organization or even a nation**

INDIA AND INNOVATION

(Source : Cornell U, INSEAD and WIPO)

- India ranks 66th amongst 142 economies on innovation capacity and efficiency. Switzerland #1, UK #3, USA #5, Ireland #9

- India's strengths: Gross capital formation, investment in new business, industrial cluster development, growth rate, IT exports, creative goods export

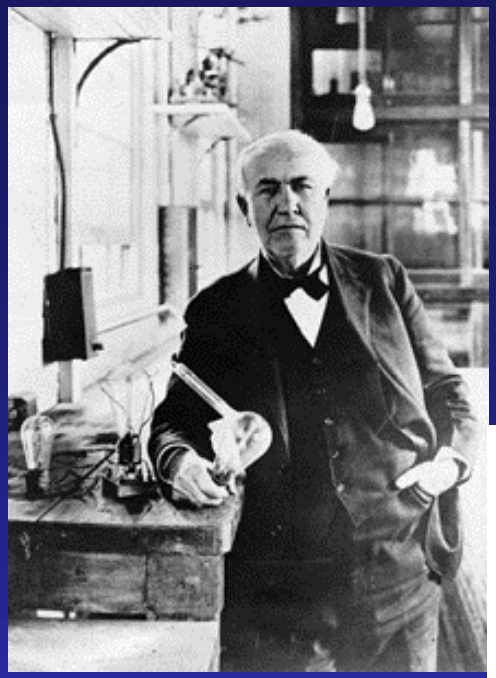
- India's weakness : Political stability, ease of starting a business, human capital, school life expectancy, teacher : pupil ratio, knowledge absorption capacity, poor IP culture, poor branding; poor design and engineering skills

US Patents (2005-10)

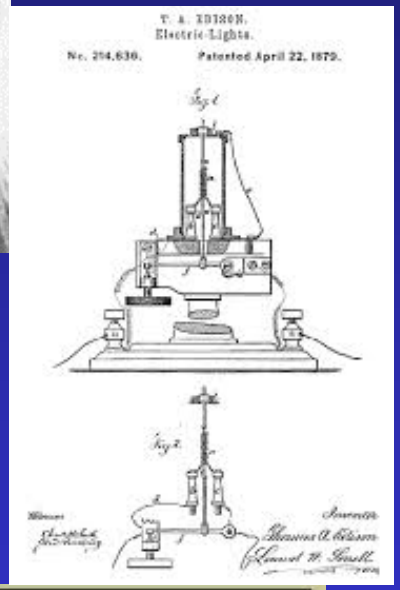
Infosys : 13
Dr Reddy's Lab : 34
IBM, India : 250
GE, India : 193

India has to transition from a *"Factor"* driven to *"Efficiency"* driven and ultimately *"Innovation"* driven economy

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

SOME EXAMPLES OF MAJOR INVENTIONS FROM ACADEMIA

- Google : Stanford University (Larry Page and Sergey Brin)
- Taxol : University of Florida
- Cis Platin : Michigan State University
- Steptomycin : Rutgers (Waksman, Nobel Prize)
- Polio vaccine : University of Pittsburgh (Jonas Salk, Nobel Prize)
- Insulin : University of Toronto
- Recombinant DNA : Stanford and University of California (Cohen and Boyer)
- MRI : State University of New York
- Fluoride in toothpaste : Indiana University
- Gatorade : University of Florida

PATENTS AS A TOOL FOR INNOVATION

- Create wealth out of intellectual property
- Create value to customer
  - Create patent estates
- Provide secure technology transfer
  - Minimize probability of infringement
  - Open global markets
- Competitive assessment

Patents by themselves do not define how it may be used to create wealth; one can choose to use patents for competitive positioning in the market place; or, one can donate the patent in such a manner that it is widely available for the good of the people. Similarly, the owner of the patent can seek personal financial gain or forgo it in the larger public interest

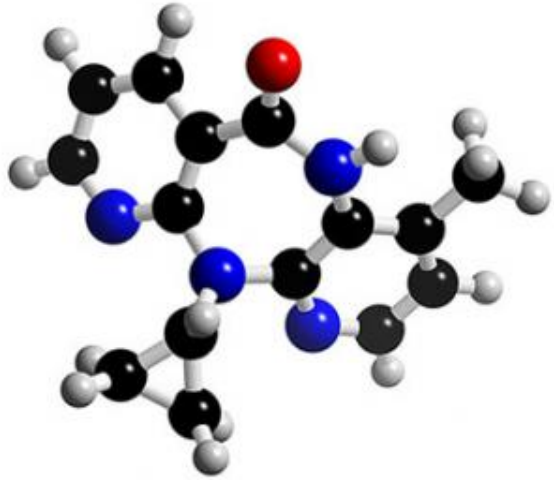
OBJECTIVE OF A PATENT

- **Provide incentive to inventor to disclose his/her findings for the long term benefit of society rather than an attempt to profit from the invention in secret**
- **A patent is a legal covenant between the “state” and the “inventor”**
- **The patent gives the owner only a “right to exclude others from practicing the invention”, not a right to “practice the invention”. Freedom to practice is not implied in grant of a patent**
- **The framing of US Patent Laws in 1870 was a landmark event, providing extraordinary stimuli to science and technology and heralding the “industrial revolution” and the epoch making discoveries of the twentieth century**

WHAT IS A PATENT

- A right granted to inventors to prevent unauthorized use of an invention, within a particular territory, for a limited time
- Does not guarantee the inventor the freedom to exploit his invention restricted by : Earlier patents : External factors
- A patent allows an invention to be developed / exploited by the inventor while others are kept out (exclusive) patents are public disclosure the state grants limited monopoly rights to inventors in exchange for full disclosure
- A patent is a scientific / legal document
- A patent is a negative monopoly

WHAT IS A PATENT?



- Patent
  - is an exclusive and monopoly right
    - to use the patented invention
  - for a limited area and time (20 Years)
  - by stopping others
    - from making, using, importing or selling.

- Patents are territorial rights,
  - so an Indian patent will only give the owner rights
  - within India and
  - rights to stop others from importing products into India

- No concept of International Patents

- When a patent is granted,
  - the applicant becomes the owner of the patent.
  - Like any other form of property, a patent can be bought, sold, licensed or mortgaged.

THREE TYPES OF PATENTS

- Utility Patents – Granted for a process; machine or manufacture; composition of matter; or an improvement thereof. Utility patents have sequential numbers.
- Design Patents – Protects the new, ornamental design (i.e. “outward appearance”) for an article of manufacture. Design patent numbers are preceded by the letter “D.”
- Plant Patents – granted on any distinct and new variety of an asexually reproduced plant. Plant patent numbers are preceded by “PP.”

GEOGRAPHIC REACH

Patent rights are limited geographically

- A U.S. patent is limited to the U.S. and its territories; Similarly, for other countries
- A U.S. patent cannot be enforced outside the U.S.

PATENT PROTECTION TERMS

- Utility patent – twenty years from non-provisional patent filing date
- Design patent – fourteen years from the issue date
- Plant patent – twenty years from filing date

Once these terms expire, the invention is now in 'public domain' *and anyone may use it!*

EARLY PATENT SYSTEMS

- **First patent (20 year) granted to Galileo by the Doge of Venice on a "Lift irrigation mechanism for raising water to fields"**
- **Enshrined in the U.S. Constitution, Article 1, Section 8 (July 4, 1776) and converted to an Act of US Congress in 1790**
- **The first US Patent, July 31, 1790 to Samuel Hopkins on an "Improved method for making potash from wood ashes for use in soad making", signed by George Washington, Edmund Randolph and Thomas Jefferson**

WHY WERE PATENTS CREATED?

- Patents are an instrument to protect intellectual property
- Origin of patents shares an interesting history with the origins of chemistry. One of the reasons chemistry as a science was slow to progress was because of the excessive secrecy associated with the practice of this science. In contrast early physics and mathematics were more openly discussed and made rapid progress
- The early Alchemists were driven by a desire to convert base metals to gold! Quite naturally, everyone kept their “knowledge” secret
- Isaac Newton was the most prolific Alchemist; His prodigious efforts (never successful) made him experiment with chemical substances and conversions. However, almost all his laboratory records were never made public or published

Contd…

WHY WERE PATENTS CREATED?

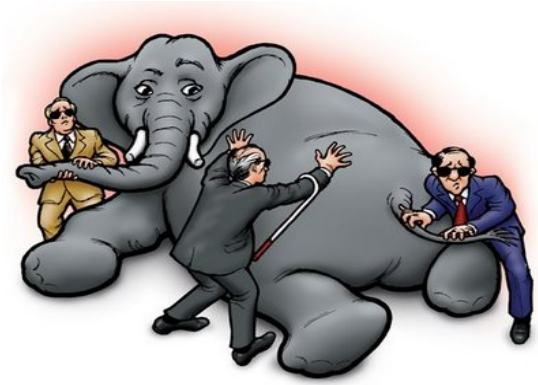
- However, Isaac Newton kept meticulous notes in his own handwriting. Much of this were made public several years after his death, exposing the ingenuity of Newton
- Efforts of Alchemists were always held confidential. So while physics and mathematics progressed, chemistry was perceived as a mysterious, secretive science till Michael Faraday dispelled this notion

Lesson : Undue secrecy and confidentiality hinders the progress of science. Public disclosure serves the cause of progress of science

HISTORY OF INDIAN PATENT REGULATIONS
(SOURCE : PATENT OFFICE, GOVERNMENT OF INDIA)

Year	History of Indian Patent Regulations
1856	The Act VI of 1856 protecting inventions. Framework used the British Patent Law of 1852
1859	Modified Act XV
1872	The Patents and Designs Protection Act
1883	The Protection of Inventions Act
1888	The Inventions and Design Act
1911	The Indian Patents and Design Act
1972	The Patents Act (Act 39 of 1970)
1972	The Patent Rules of 1972
1999	The Patents (Amendment) Act of 1999
2002	The Patents (Amendment) Act of 2002

WHAT CANNOT BE PATENTED IN INDIA?



- Mere Idea/Discovery
- Contrary to Natural laws
- Contrary to Public Morality or Order
- Mere Admixture/Arrangement/Rearrangement
- New use/property of a known material
- Method of Agriculture/Horticulture
- Plants and Animals except Micro-organisms
- Mathematical or Business Method
- Computer Program *per se*

$$k = \lambda / 2\pi$$

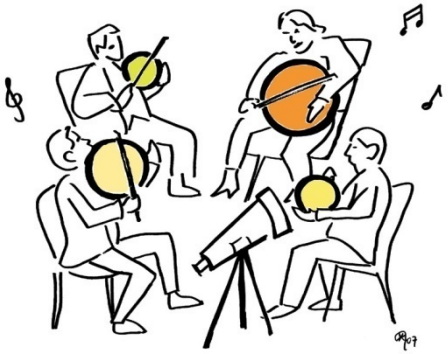
$$\alpha_{hh} = \frac{\varepsilon - 1}{\left(\cos\theta + \sqrt{\varepsilon - \sin^2\theta}\right)^2}$$

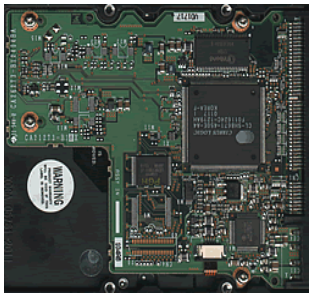
$$\alpha_{vv} = \frac{(\varepsilon - 1)\left(\varepsilon + \varepsilon\sin^2\theta - \sin^2\theta\right)}{\left(\varepsilon\cos\theta + \sqrt{\varepsilon - \sin^2\theta}\right)^2}$$

Contd..

WHAT CANNOT BE PATENTED IN INDIA?

- Process of treating human beings or animals
- Atomic energy
- Traditional Knowledge
- Topography of Integrated Circuits
- Presentation of Information
- Mere Scheme/Rule/Method of performing mental act or playing game
- Literary, dramatic, musical or artistic work





INDIAN PATENT LAWS AND ITS IMPACT ON GROWTH OF PHARMA INDUSTRY

Indian Patent Act 1911	**Modeled after US and UK Patent Laws; Indian Patent Office established**
Indian Patent Act 1970	**Abolished "product" patents in health and food sector. Process patents valid for seven years. Legal right and freedom to manufacture and market within India any drug available internationally ; Domestic pharma industry flourishes through "reverse engineering"**
Indian Patent Act 2005	**India harmonizes its laws with that of the world; WTO- TRIPS compliant; Domestic drug industry ramps up discovery research and "non-infringing" routes to generics**

REQUIREMENTS OF PATENTABILITY

Substantive requirements

- Subject matter : 101
- Utility : 101
- Novelty : 102
- Obviousness : 103

Procedural requirements

- Enablement
- Definiteness : 112
- Best mode

Ideas /Concept <u>cannot</u> be patented

BODY OF PATENT

“Subject”

“Prior art”

Statement of the “problem”

“Objects” of the invention (benefit)

“Definition” of the invention

Elaboration of the invention

Description of “utility”

Working examples

“Claims” or legal description of exclusive rights

Background of the invention

Summary of the invention

Description of specific embodiments

Examples

Claims

SUBJECT MATTER

- Manufacture
- Machine
- Composition of matter
- Process

e.g.

Genetically modified bacteria human engineered mice

- <u>Utility</u>
  Minimum demonstration
- <u>Novelty</u>
  Not anticipated in “prior art” “prior art”- anything previously published, patented, known, used, sold, publications by inventors more than one year before filing patent application

SUBJECT MATTER

- <u>Obviousness</u>
  Knowledge at the time of invention must not be obvious to one of ordinary skill in that area determined by
  - Scope / Content of prior art
  - As level of ordinary skill in technology increases, so does the obviousness of advances
- <u>Enablement</u>

HOW TO WRITE THE PATENT APPLICATION

1. <u>Think : What is the inventive step</u>
   How your method is different from the way other people do it . Characterize the invention at the most abstract level
2. Has anybody else done it before?
3. <u>Writing the text : Structure</u>
   - Introduction
     Area of application
     Problem the invention addresses
   - Prior art
     How do other do it
     what is wrong or inadequate with what they do
     Cost, complexity, difficulty of manufacture

HOW TO WRITE THE PATENT APPLICATION

- Description of invention
  - The inventive step
  - What is right or better about what we propose
  - Examples of implementation
- Writing the text : Wording
  - Scientific accuracy
  - Precision in language
  - Legal veracity
  - Others cannot get around it
    Ability to use the invention without “undue experimentation” (specification)

HOW TO WRITE THE PATENT APPLICATION

- Definiteness inquiry
  Understanding limits of invention based on claim language

<u>Best mode</u>

Best way known to him/her to carry out the claimed invention

Disclosure must allow a person of “ordinary skill in the art” to practice the invention

Concealment of best mode results in rejection

PRIOR ART SEARCH

- With more than 8 million granted patents placed into more than 450 classes and 450,000 subclasses of inventions, how do we locate those inventions *most similar* to our ideas in the Patent databases?!
- Start your search from a known piece of information – a patent number, inventor name, company or university. Look at their inventions that are similar to yours, and the classifications for those inventions.
- Search the patent databases using likely keywords or combinations, and examine the resulting 'hits' for similarity; then look at the classifications on the most similar patents.
- Use the Patent Classification tools – http://www.uspto.gov/patents/resources/classification/index.jsp

FROM THE MOST SPECIFIC TO THE MOST GENERAL

- Start your search from a known piece of information – a patent number, inventor name, company or university. Look at their inventions that are similar to yours, and the classifications for those inventions.

- Search the patent databases using likely keywords or combinations, and examine the resulting 'hits' for similarity; then look at the classifications on the most similar patents.

- Use the Patent Classification tools – http://www.uspto.gov/patents/resources/classification/index.jsp

IMPORTANCE OF GOOD LABORATORY RECORD KEEPING

- Record the date of conception of an idea
- Record the date when the conception was first “reduced to practice”
- Show “due diligence” in reducing the invention to practice
- Sign and witness all entries in notebook. The laboratory notebook is a legal record. A system for lab record keeping should be evolved

WHO CAN QUALIFY AS INVENTORS

- Provider of the idea / concept
- Members of team who made significant conceptual contributions
- Every team member should have his own notebook or document to record his contribution, dated, signed and witnessed
- If you design an experiment for someone else to perform enter your instructions into your notebook

FACTORS TO CONSIDER IN DECIDING TO FILE

- Nature of invention
- Fit with business interest
- Economic value of the invention
- Other patents that might limit the freedom to practice (dominating patents)
- Patent confers the right to exclude others from practicing the invention, not a right to use it
- Is it for offensive or defensive purpose?
- Are there other patents in the field held by same inventors?

<u>Decision to file</u>

Business decision

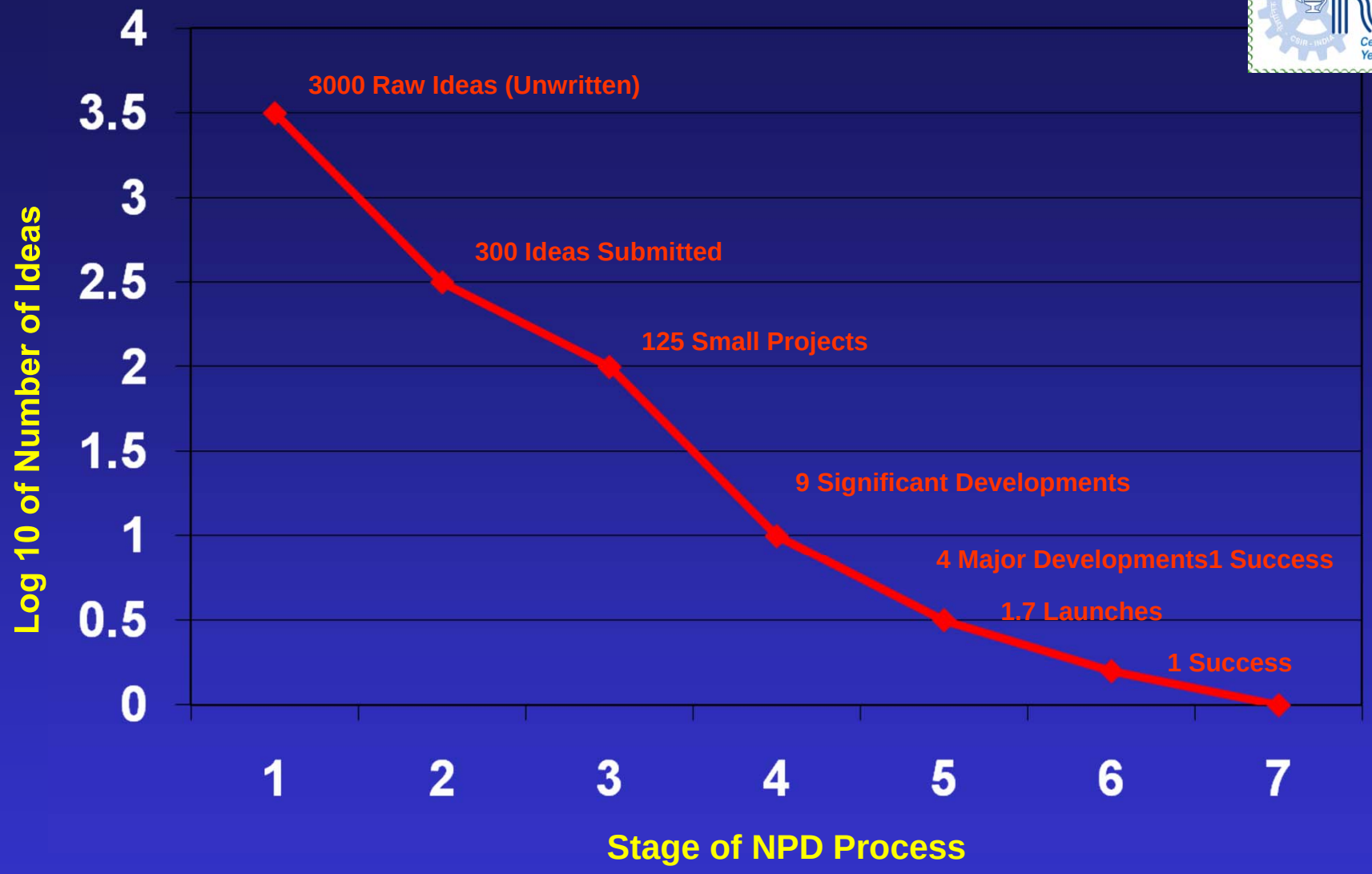
Economic incentive

PATENTS AS A SOURCE OF INFORMATION FOR COMPETITIVE ASSESSMENTS/INTELLIGENCE

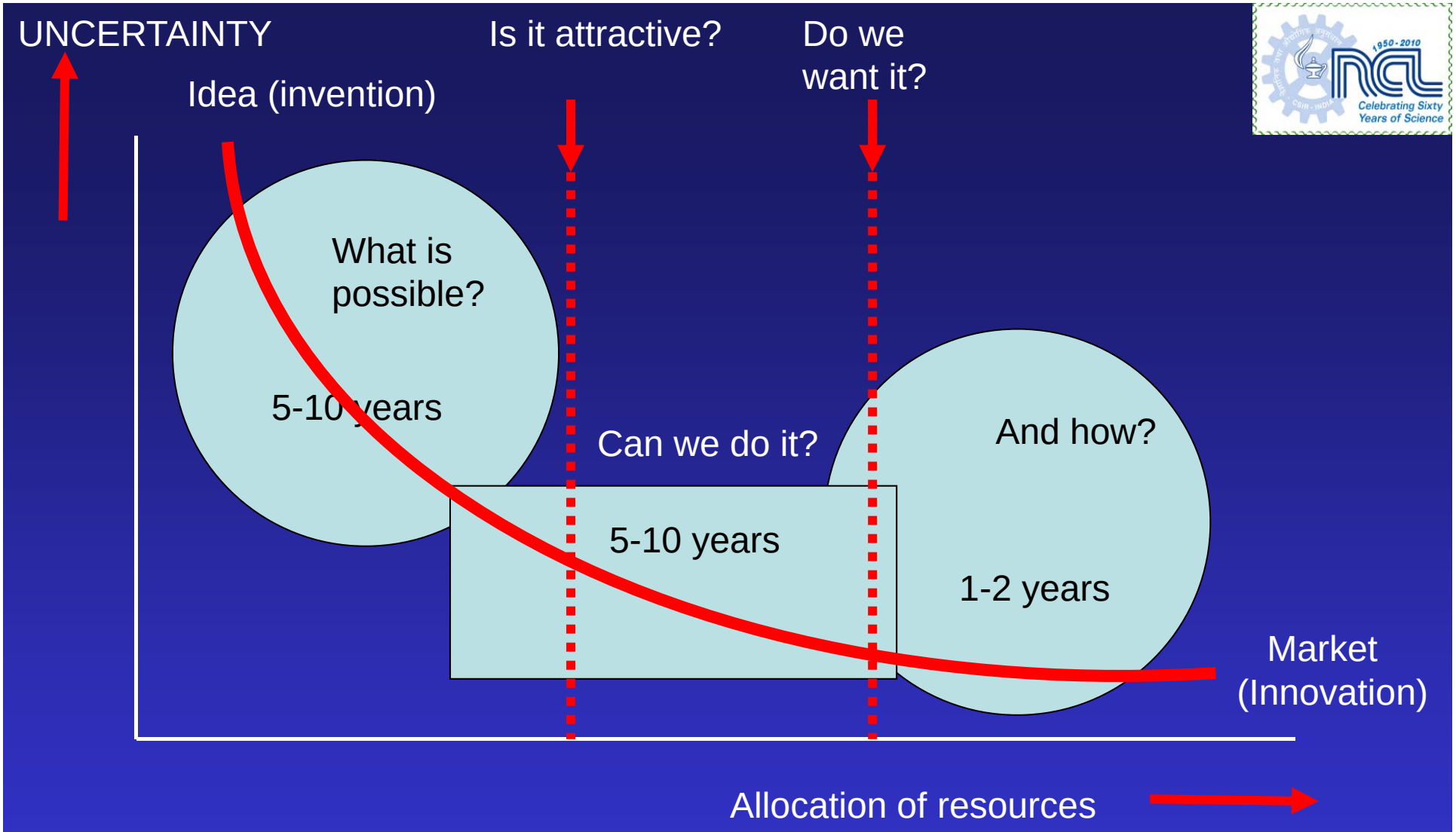
- Patents are a valuable source of information to track technology trends
- 70 to 80% of technical inventions only appear in writing as a patent.
- Science as evidenced in patents is often never published; even when published it is after a long gap
- Systematic "patent watch" can lead to valuable insights into competitive strengths of companies
  - Intensity of R&D in a given area
  - "Peaks" and "troughs" corresponding to waxing and waning of technology interests
  - Identification of 'hot' areas of research
  - Identification of "Invention and Innovation gaps"
  - Identification of new science leading to technology

PATENT ACTIVITY TRACKING …….

- Enables identification of institutions that are loci of inventive activity
- Provides a measure of productivity of an organization's S&T human resource
- Share of foreign patenting by domestic inventors highlights a nation's attractiveness as a market for new technologies



This "universal success curve" illustrates the number of "substantially new" product ideas surviving between each stage of the new product development (NPD) process



Allocation of resources. The blue box model relates uncertainty of product feasibility and commitment to (financial) resources allocated over time. It is characterized by three distinctive phases that address differently-oriented questions

Hitting a Bulls Eye in a game of Dart is determined by laws of probability. The more number of throws, greater the chances of hitting the Bulls Eye

Similarly, the larger the number of invention or ideas, greater is the probability that one of them will turn out to be a true innovation; thus, a single practical solution or a product in the market may have several background patents

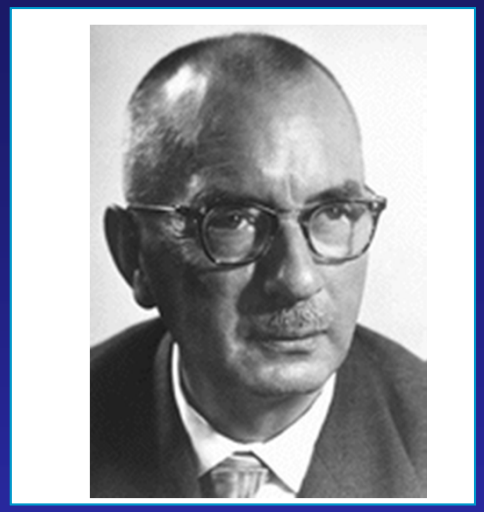
Key : Constant flow of new ideas

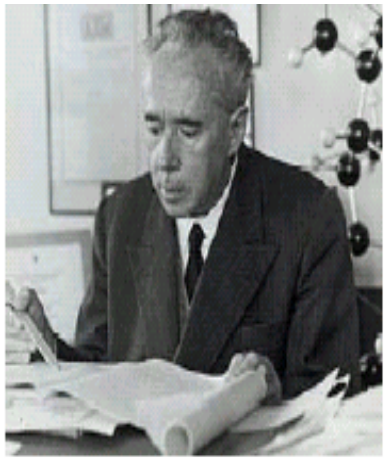
WHY SHOULD SCIENTISTS IN PUBLICLY FUNDED INSTITUTIONS BE INTERESTED IN TRANSLATING SCIENCE INTO PRODUCTS AND SERVICES

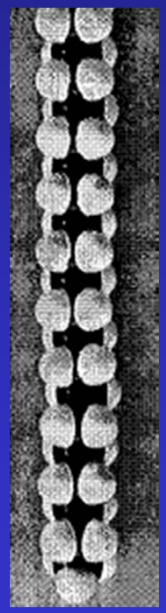
- **Institutional compulsions and demands**
- **Challenge of bringing good science to the market**
- **Creating wealth for the society and to themselves**
- **Altruism or doing good for the society which nurtured them; desire to act as agents of change in society**
- **Self actualization and growth motivation (highest in the hierarchy of human needs according to Abraham Maslow)**

At the end of the day, every scientist has this yearning for having been useful

METAL CATALYZED OLEFIN POLYMERIZATION







BUNDESREPUBLIK DEUTSCHLAND

AUSGEGEBEN AM 14. APRIL 1960

DEUTSCHES PATENTAMT

PATENTSCHRIFT

Nr. 973 626

KLASSE 39c GRUPPE 25c

INTERNAT. KLASSE C08f

2,5700 IV/39c

Dr. Dr. e. h. Karl Ziegler, Mülheim/Ruhr,
Dr. Heinz Breil, Oberhausen (Rhld.), Dr. Erhard Holzkamp, Düsseldorf,
und Dr. Heinz Martin, Mülheim/Ruhr
sind als Erfinder genannt worden

Dr. Dr. e. h. Karl Ziegler, Mülheim/Ruhr

Verfahren zur Herstellung von hochmolekularen Polyäthylenen

Patentiert im Gebiet der Bundesrepublik Deutschland vom 18. November 1953 an
Patentanmeldung bekanntgemacht am 4. Oktober 1956
Patenterteilung bekanntgemacht am 24. März 1960

DE 973626
Nov 18, 1953

CRYSTALLINE HIGH POLYMERS OF α-OLEFINS

Sir:

No crystalline polymers of olefinic hydrocarbons containing asymmetric carbon atoms in the principal chain of the macromolecules have been reported. Such a lack of crystallinity has been explained[1] by considering such polymers as copolymers of two types of random distributed monomeric units, differing only in the configuration of their dissymmetric group.

G.Natta
JACS 77, 1708, 1955
(March 20, 1955)

ZIEGLER-NATTA CATALYSTS AND POLYMERIZATION: THE BIRTH OF A SCIENCE

Process for preparing high molecular weight polyethylene,

Ger Pat 973, 626, 1960 dated November 18, 1953

to K. Ziegler, H. Breil, E. Holzkamp and H. Martin

- ***Exemplary claim***

  A method for preparing high molecular weight polyethylene

  using aluminum alkyls as catalysts, characterized by bringing together ethylene at pressures >10 atm and temperatures above 50°C with mixtures of aluminum trialkyls and compound of the metals of Group IVa to VIa of the periodic table with the atomic numbers 22 to 74

- **Land mark experiment carried out on October 26, 1953, in the Max Planck Institute fur Kohlen forschung in Mulheim an der Ruhr**
- **A patent was issued to Natta et al (US Pat 3, 112, 200 on June 8, 1954) for the preparation of isotactic polypropylene**

"I set out to follow a broad course of study in which my only guide was , initially, just the desire to do something which gave me pleasure. The course threw up many interesting conclusions , many of them of highly practical value, and one of them led ultimately to a method of making polyethylene "

Karl Ziegler

Nobel Address

DISCOVERY SCIENCE BEGETS NEW TO THE WORLD TECHNOLOGIES

- Bruce Merrifield
- H. C. Brown
- Carl Djerrasi
- Herbert Boyer and Stanley Cohen
- Michael Graetzel
- George Whitesides
- Robert Grubbs
- Chad Mirkin
- Richard Friend
- Robert Langer
- J.P. Kennedy

Excellence in science and creating new technologies are not mutually exclusive

INTEGRATING PATENT LITERATURE WITH SCIENCE EDUCATION

- **Patents are a valuable source of useful information**
- **Reading, understanding and extracting the information from a patent is a non trivial art which can be learnt only by practice**
- **Seek to find what is not said in a patent, rather than what is said**
- **One needs comfort with words like, “comprising”, “comprising of” and “consisting essentially of”**
- **Reading and writing patents is a useful adjunct to the training of a scientists**

Lesson : Integrate patent literature into the literature of science; Encourage patent citations in thesis; Encourage students to write patents

TRACKING PATENTS : KEY INFORMATION SOURCES

- Patents.ibm.com
- European-patent-office.org/espacenet
- Patent.gov.UK
- Micropatent.com
- Uspto.gov
- Ipindia.nic.in
- Wipo.int
- Delphion.com
- Ep.dips.org (Japanese/international)
- Derwent.com (14 million patents)
- Nerac.com
- Pl-x.com (patent e-commerce/TRUU metrics)
- Immall.fplc.edu/psa
- Cas.org
- Paterra.com (English translation of Jap. Patents)
- Surfip.com

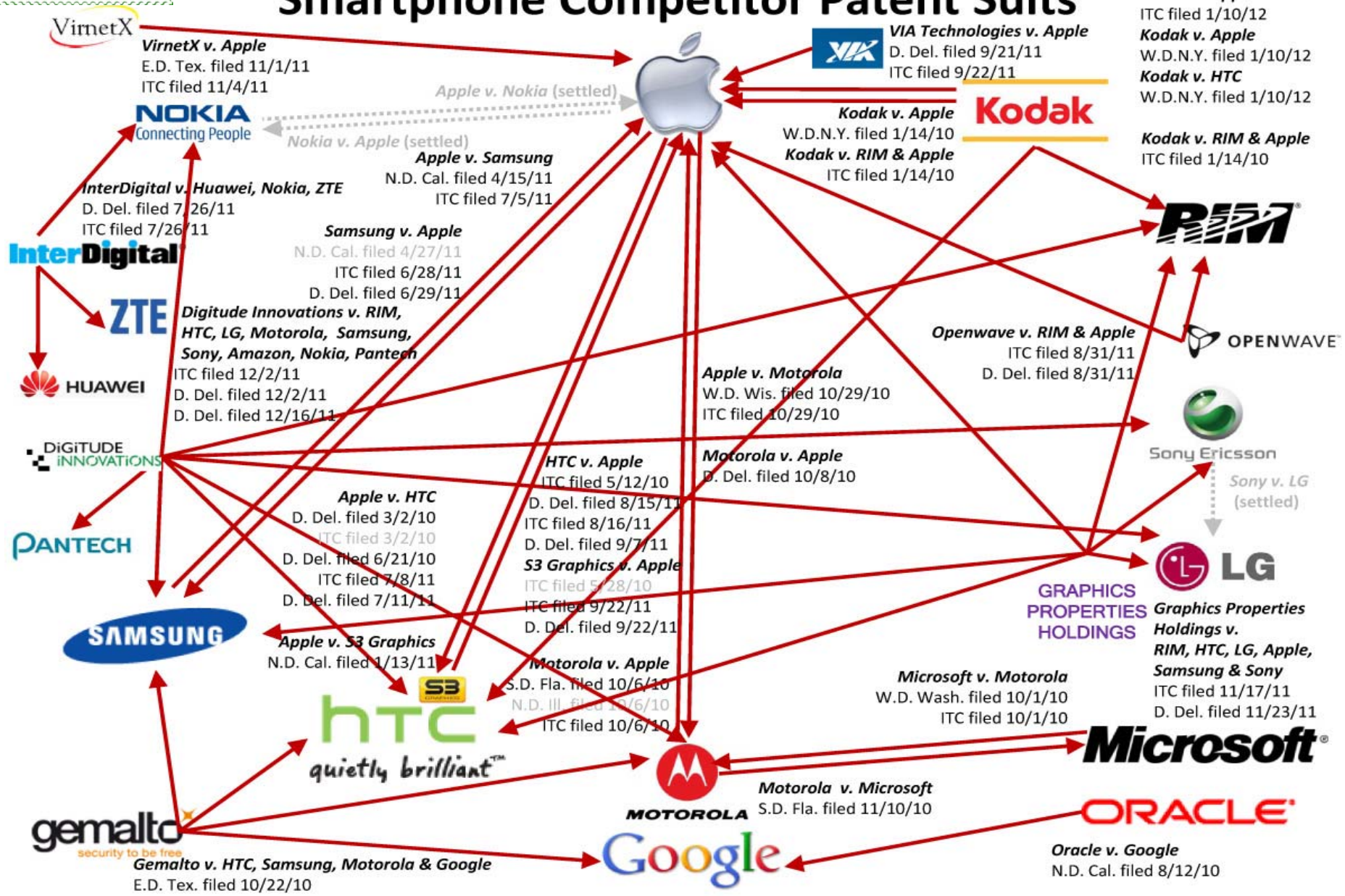
INTELLECTUAL PROPERTY MANAGEMENT:SOME KEY CHALLENGES

- Ability to identify key technologies of future value
- Plan innovation around key technologies
- Build portfolio of patents; consider even acquisition of patents
- Identify potential global customers of research, even during early stages of research
- Track competitive activity in the area and identify threats to your research early; identify dominating patents and those falling under the “doctrine of equivalence”
- Patent early when you have seen the first glimpse of innovation; not wait till research is complete

IN SUMMARY, ORGANIZATIONS MUST BECOME A FULL PARTICIPANT IN THE WORLD TRADE OF IDEAS; FUTURE WARS WILL NOT BE FOUGHT OVER TERRITORIES BUT OVER OWNERSHIP AND EXPLOITATION OF IDEAS

A WAR NOW IN PROGRESS !

Smartphone Competitor Patent Suits



HOW CAN YOU BECOME AN INVENTOR ?

- Learn about legendary inventions and inventors
- Make patent part of your everyday life
- Treat what is known with irreverence
- Cultivate an open and curious mind
- Cultivate broad interest in subjects, sometimes even far removed from your own area of specializations
- Consider strange and unusual combinations
- Play around with ideas and things
- Doggedly follow questions, doubts and hunches
- Make questions and problems bigger
- Ask for help from those who do know nothing
- Believe in your own creative vision

HOW DO I KNOW WHAT IS USEFUL OR IMPORTANT ?

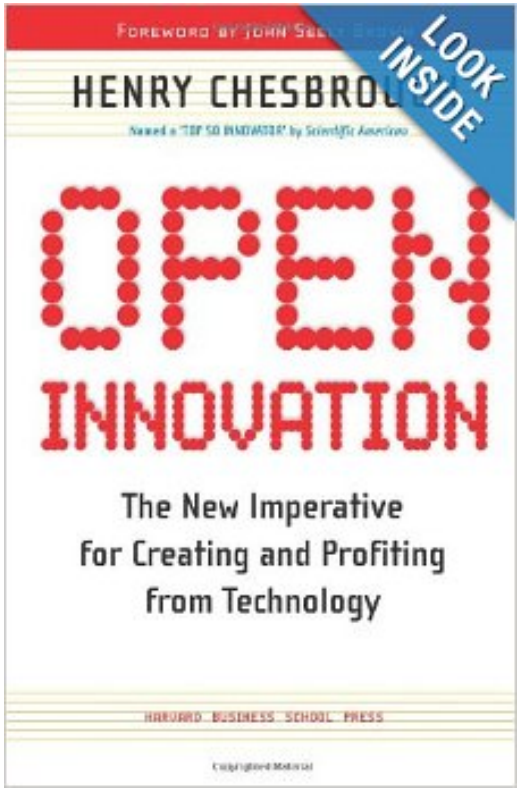
- Industrial consultancy
- Academic lectures in industry/ speakers from industry in academia
- Participation in industry focused conferences/trade shows
- Building professional networks with professionals from industry
- Assisting industry in small and seemingly trivial tasks without considering them as distractions
- Reading trade and commercial literature
- Generally, keeping eyes and ears open

OPEN INNOVATION

- Interface Portals
  - Innocentive
  - Yet2.com
  - Nine Sigma

- Open Challenges
  - X Prize
  - Mahindra RISE Prize

- Company Portals
  - P&G, Unilever, Astra Zeneca, BASF (Creator Space)



Henry Chesbrough,
Harvard Business School Press,
2003

SCIENCE, TECHNOLOGY AND MARKETS

Science

- Possibilities
- Options
- Solutions

Can I do it ?

Technology

- Opportunities
- Feasibility
- Desirability

Is it worth doing it ?

Markets

- Uniqueness
- Customer choice
- Will the customer pay ?

Does anyone need what I am doing ?

Mere exploration without exploitation of knowledge is sterile. In an environment where research is predominantly publicly funded, this situation leads to loss of credibility amongst stakeholders

Professor J. P. Kennedy
University of Akron
Obtained his 100th US patent at the age of eighty !

THANK YOU