

# The Commercialization of Technology Concepts into Medical Products

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## Overview

- Pharmaceutical Industry
- Biotechnology
- Startups
- Investment Community
- Incubators
- Medical Products
- Validation of Medical Products
- Gene Therapy Products

## The Pharmaceutical Industry:

### *Selling Medical Products*

- *Pharmaceutical Industry*
- International
- National
- Biotech companies
- Start up companies
- Entrepreneurs
- Concepts/Visions
- Patients/Physicians
- Insurers/Uninsured
- Government:State/Federal
- **Pharmaceutical Industry**
- Health Care Institutions  
Managed/Non-Profit  
National/ International
- \$\$\$ drug pricing

## Origins of the Pharmaceutical Industry

1880's Germany

Government, Business and Academics

Education; Technology Colleges

1930's England

Emigration of German Scientists

Clinical validation of Penicillin\*

\* (The Mold in Dr. Florey's coat by E. Lax)

## Re-War Drug Development

- US Government & the Pharmaceutical Industry:1940's
- Manufacturing of Penicillin
- Fermentation plants in the Pharmaceutical Industry produced kilogram quantities of Penicillin for the war effort.
- Penicillin became a wonder drug made on an industrial scale.

## Post-War Drug Development

1945 to ~1990's

- The College GI Bill sent veterans to college.
- US Government development of the Medical Centers and Universities by the NIH (\$\$\$)
- Cancer (1970), AIDS (1980), Genome (1990)
- European Scientists attracted to the US Medical Centers by the scientific resources and funding available.

## The Pharmaceutical Industry Today

### **Consolidation?**

~ 3-5 big Pharmaceutical Companies

or

### **Niche Markets ?**

Genetic diagnostics markers and  
therapeutics for a specific class of  
patients (i.e. Herceptin, Genentech;  
Breast Cancer)

Biotechnology Industry: Making products

## **Why did Biotechnology start in California?**

- 1970's Biotechnology
- Money (Investment Banking) meets Science (Molecular Biology).
- Why San Francisco? Germany 1880?
- Why not New York? US? Europe? Asia?
- Academics, Business and Government

## **Why Dr. Boyer in ~1975?**

- Was Dr. Boyer the first to be approached?
- Why an academic at UCSF?
- Why was Insulin was the first product?
- What is the attitude in Academics today?
- Ask the Technology Transfer Office.

## Insulin

- What was the source of insulin prior to genetically engineered insulin?
- Why was it not synthesized at Genentech?
- What was the impact of this product on the government, business and academics?
- “The Eight Day of Creation” by H. Judson (Molecular Biology from 1940-1980)

## Biotechnology 2010

Where will these products be created?

Europe, Asia, USA?

Synergy between government, business and academics

Educational institutions (German Technology Colleges)

Information is digital and immediate.

## Startups: Validating Concepts

### Start-up Essentials

- Create & Sustain innovative technology
- IP protection
- Value Proposition (Market need)
- Secure “marquee” customer early
- Better, Faster and Cheaper than Competition
- Management team & Board
- Return on Investment (ROI=10-20x)

## Entrepreneurs: Deal Flow

- Concept/vision
- Funding: Friends, Family and Fools (\$250,000)
- Government funding: SBIR,STTR, NIH grants
- Angels: early stage validation (\$.25-2 million)
- Funding Gap: \$2-5 million
- Venture Capital: \$5million and above

## Investment Community



## Angel Investors

- 2000-2005  
Stronger: Mentoring, Due Diligence, ROI
- ~200 Angel Groups in the US; ~20,000 Angels
- Largest “Angel Group” is in Southern California
- Tech Coast Angels: SB-San Diego (~270);
- Pasadena Angels (~100)
- Angels work closely with Academic Institutions

## Angel Capital Overview

- Invested ~\$15.7 Billion in 2002 in ~36,000 ventures
- Historically: ~\$30 Billion in 500,000 ventures with about ~400,000 Angels
- Invest annually: ~\$300 million/year

## Why Angels exist?

- First round capital is hard to find
- Management talent is a scarce resource
- Venture capital (VC) funds have grown dramatically in 2005
- VC investments are a minimum of ~\$5 m
- VC startup deals are only ~2-5% of their total deals.

## Angel Investor Characteristics

- Invest their own capital
- Limited financial resources
- Variety of Professional Backgrounds (i.e. CEO, COO, CMO, CSO)
- Well connected with networks & resources
- Invests close to home
- Patient capital

## Angel Value Add

- Funding –early and later VC rounds
- Great networking source
- Mentoring
- Board of Directors & Advisory Board
- Experience founding and building a company
- Active investor

## Funding Process

- Initial contact through the website
- Pre-screening
- Screening
- Mentor and/or Champion
- Presentation to the full membership
- Due Diligence
- Funding; individual angels invest

## Investment Criteria

- Does the company address an important problem?
- Does the company offer a good solution?
- Do many people have this problem?
- What is the competition?
- Has the company made good progress?
- Is there are sound financial plan for the future?
- Can the management team execute the plan?
- Will the there be a good ROI for the investor?

## Spreading the Risk

- Entrepreneurs: challenges & opportunities
- Angels and Venture Capital Groups
- Biotechnology Sector
- Pharmaceutical Industry:
  - Is this model unique to California? US?
  - Europe? Asia?
- Government-Business-Academic Institutions

## Incubators

- **Building:** Academics, Government or Industry
- Support services
- Entrepreneurs
- Network of management experts
- Venture capitalists
- Advisory Board Members

## Medical Products

### **Therapeutics:** (selective and non-toxic)

**New Chemical Entities (NCE):** small molecules

**Biologicals:** MCA, Vaccines, Proteins, Gene Therapy, ...

### **Diagnostics** (In Vitro/ In Vivo)

### **Nutritional Supplements**

### **Medical Devices**

## How do you make a Medical Product?

### **The Pharmaceutical Development Pipeline:**

- Pre-Clinical Research: concept validation
- Clinical Development: Regulatory/CMC
- Project Management: Product Launch
- Management: the senior team and the board

## Why do Medical Products succeed?

- It meets an unmet medical need.
- It is pure, safe and efficacious.
- The product adds value to the company.
- It can be a disruptive technology.

## Why do drugs fail?

### **Selective and Non-Toxic (ADMET)**

A: administration of the drug to the patient

D: delivery of the drug to the target tissue  
(PK and PD)

M: metabolism of the drug in the cell

E: efflux of the drug from the cell/tissue

T: toxicology

## Biotechnology Products

- 1985-2000
- 137 medical products in the market
- ~1900 failures
- 2005
- 1400 Biotech Firms;
- 350 drugs in development

## How to Analyze a Medical Product

### **The Pre-Clinical Science:**

- Does the science/technology fill an unmet medical need?
- Define the science/technology of the product and its utility.
- Is the science/technology novel and validated?
- What is the non-human pharmacology/toxicology?
- Has the medical product been manufactured (pilot batch)?
- Intellectual Property: Is it filed/issued/challenged?
- What other products are in competition with this concept?

## How to Analyze a Medical Product

### **The Clinical Development**

- Does the clinical data meet an unmet medical need?
- Are their manufacturing issues for scale up of the product?
- What is the human pharmacology/toxicology (Phase 1)?
- What is the indication and is it efficacious (Phase 2)?
- What is the optimal dose for the specific patient (Phase 3)?
- FDA: Is the medical product pure, safe and efficacious?
- FDA: Fast Track Approval for an unmet medical need?
- What are the competing clinical products in this field?



## How to analyze a Company

### **The Business**

What is the track record for the management team?

What is the financial strategy for the company/product?

What is the sales & marketing strategy for the product?

What are the other competitive products in the field?

What is the market size and expected penetration?

(locally, regionally, nationally and internationally?)

What are the expectations of this product in the market?

(6, 12, 24 and 48 months?)

## Gene Therapy Products

- 1980-2000
- Antisense and Ribozymes
- Oncogenes
- Cytokines
- Viral and Non-Viral Gene Delivery Systems
- No products

## Gene Therapy Products

- 2000's
- siRNA, Ribozymes and Antisense
- Micro arrays; managing the data or question
- Immunology Therapies; T-cells, DC,..?
- In vivo vs. Ex vivo Gene Therapies
- Delivery Systems= Stem Cells?

## Challenges

- Scientific Education (Darwin)
- Academic Culture for Commercialization
- Conflict of Science with Business Culture
- Synergy: academics, business and government

## Opportunities

- Strong business culture; can do it
- Not a risk adverse culture
- Mentoring from the Investment community
- Startup culture that is a model for the world

## Medicine in Asia

- Traditional Chinese Medicine  
*Natural products for treating human diseases.*
- Japanese Fermentation Industry  
*Source of natural antibiotics*
- Western Medicine  
*Molecular Biology/Genomics*

## My Academic Career

- **Academic Medicine**
  - Molecular Biology (Univ. of London; Ph.D.)
  - Cancer Biochemical Pharmacology (Yale Med. School)
  - Clinical Cancer Pharmacology (Mt. Sinai Med. School)
  - Research: Anti-Oncogenes Ribozymes & Gene Therapy
  - Publications, Awards, Editor, President (ISCGT)

## My Business Career

- **Pharmaceutical Industry**
  - Berlex; Schering AG; Berlin, Germany
- **Graduate School**
  - Science/Business course on the Pharmaceutical Industry
- **Venture Capital Community**
  - Mentoring and Funding Entrepreneurs

## My Consulting Career

- Dublin, Ireland: Biotechnology Center (2000-)
- Altadena, CA: Business Technology Center (2004-)
- Wellington, NZ: Biotechnology Center (2005-)
- Shenyang, China: Biotechnology Center (2006-)

## Summary

- The process from “concept to market”
- **Medical product:** Validation, Scale up, Clinical, Sales & Marketing
- What is the role of an early investor?
- What is the role of an incubator?
- **Biotech:** Validation of the Market
- **Pharmaceutical Industry:** Sales & Distribution
- **Role of Business, Academics and Government**

## Case Studies

1. Science/Technology
2. Clinical Development/FDA
3. Management
4. Manager from the Company