

Biotechnology Industry and its Prospects

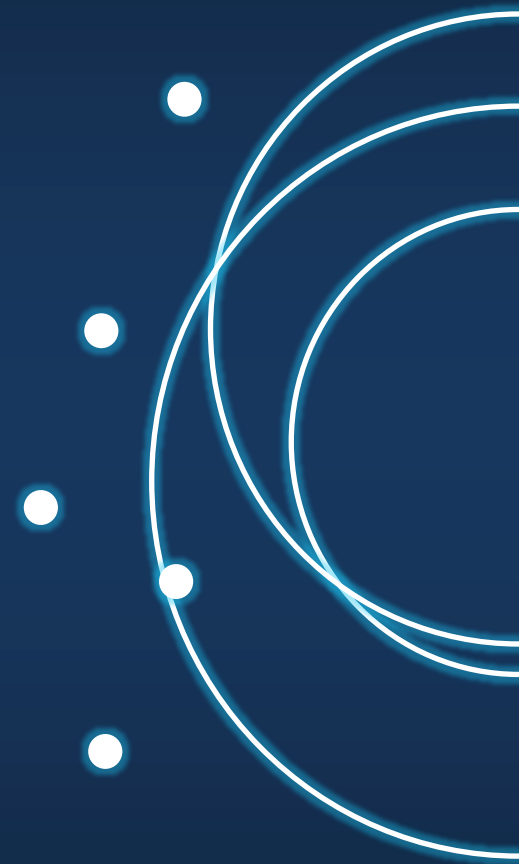


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Two technologies
will dominate the 21st Century
scientifically & industrially

Biotechnology Information Technology

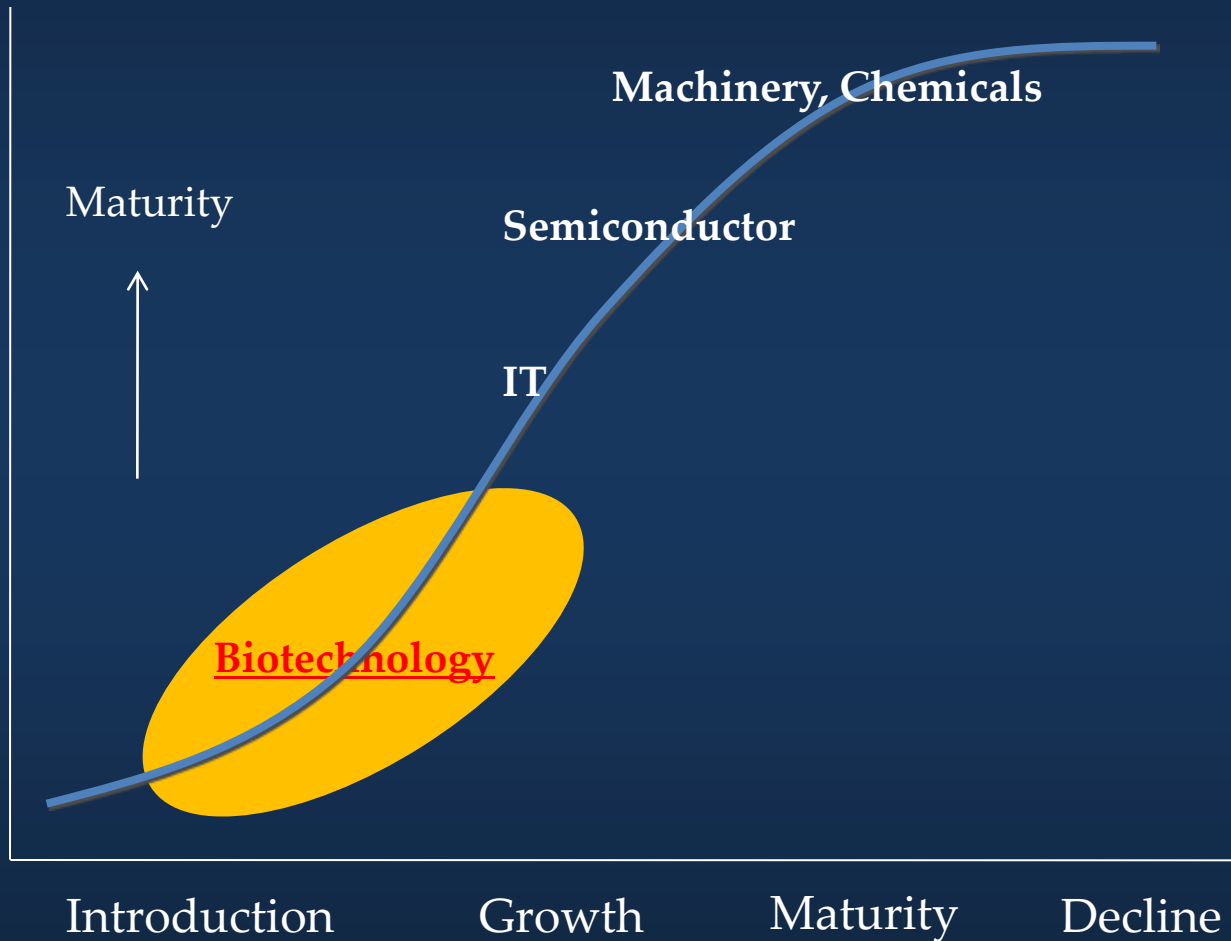
TIME (March 22,1999)

Ring farewell to the century of **physics**,
it's time to ring in the century of **biotechnology**

- *Bill Gates, Microsoft*

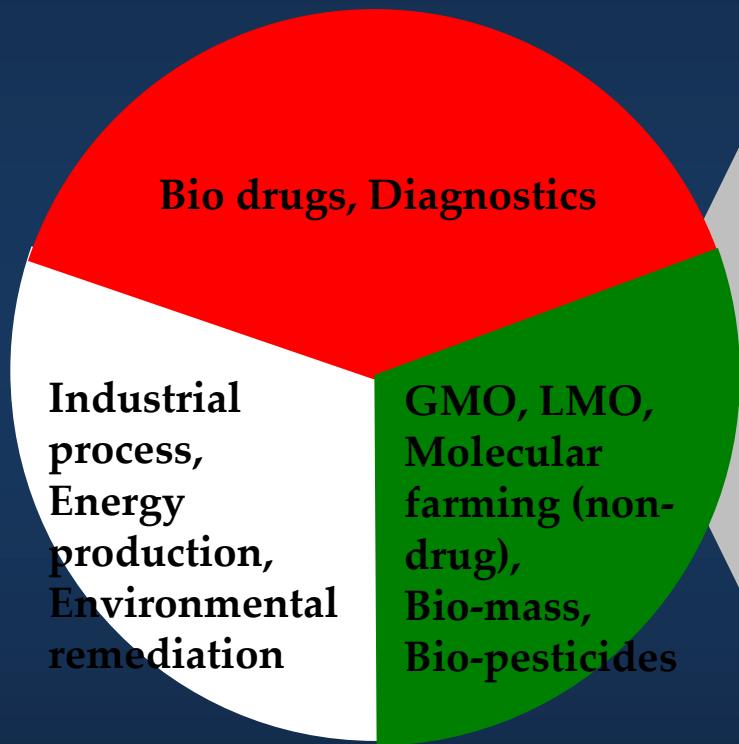
Biotechnology

❖ Biotechnology: Frontier of high tech industry in 21st C



Bio-industry : Classification

❖ Bio-industry includes different areas of industrial sectors



✓ Red Biotech

- Health & medical application
- Biosynthetic- , Protein- , Natural compound-drug, DDS drug / Bio-generic, Bio-similar
- Prevention/Prediction/Personalization-targeted next generation bio drug

✓ Green Biotech

- Agro & food application
- Nano-bio food, functional food

✓ White Biotech

- Industrial application
- Bio-fuels & Bio-energy
- Clean technology & Waste degradation
- Bio-degradable plastic

Bio-industry : Classification

❖ Market sharing(%) of Red, Green and White bio-industry based on nation

(%)	Red	Green	White	Etc.
USA	66.6	4.4	0.1	28.9
Canada	75.5	12.1	3.5	11.9
Europe	71.7	11.8	3.3	13.2
Asia	44.0	28.2	12.9	14.9

Source : Datamonitor(2007)

Major Markets

Bio-industries	Major products	Current Stage	Market size for 2010 (E) (billion USD)	Major participatory companies
Medicine	Cholesterol inhibitors, Erythrocyte growth accelerators	Commercialized	970	Pfizer GSK Amgen Genentech
Biotechnology drugs	Cell therapy, Gene therapy, Transfusion drugs	Applied technologies and commercialization trials are underway	56.2	Dendreon Aastrom ONYX Vical
U-health	Bio-chips, Operational systems	Applied technologies and commercialization trials are underway	30	Affimetrix Medtronics
Living modified organisms	Corps, Animals, Fish	Commercialized	15	Monsanto Sygenta

Major Markets

Bio-industries	Major products	Current Stage	Market size for 2010(E) (billion USD)	Major participatory companies
Biotechnology equipment	Image-based diagnostic equipment, Analyzers	Commercialized	85	HP GE Agilent
Biotechnological applications in environment and energy	Microbial decomposition, Biotechnological fuels	Initial commercialization stage	16	Shell BP
Biotechnological processes	Replacing existing processes	Initial commercialization stage	25	Cargill-Dow BASF Dupont

Source : Samsung Economic Research Institute reports, IMS health, Jain Pharma Biotech Report , etc.

Synthetic vs. Biotech Drugs

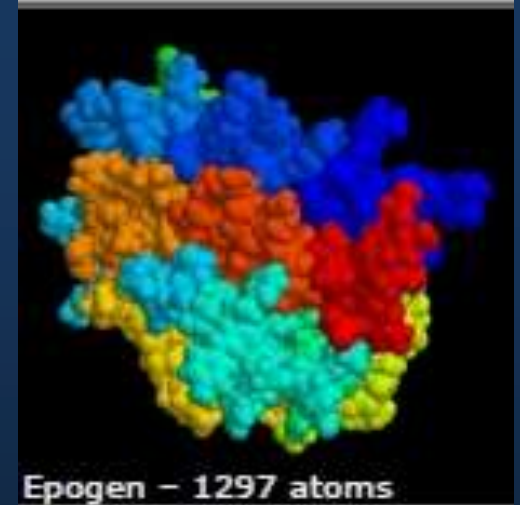
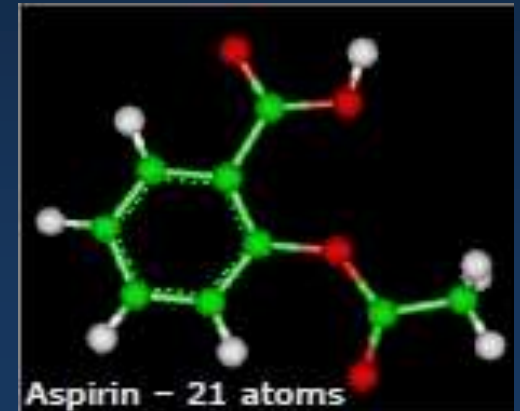
Synthetic vs. Biotech Drugs

✓ Synthetic Drugs

- Chemically synthesized
- Typically small and water soluble
- Can withstand stomach acids and enter bloodstream

✓ Biologic (Biotechnology) Drugs

- Biologically synthesized
- Typically large proteins, not necessarily water soluble
- Cannot withstand stomach acids
- Cannot cross into bloodstream



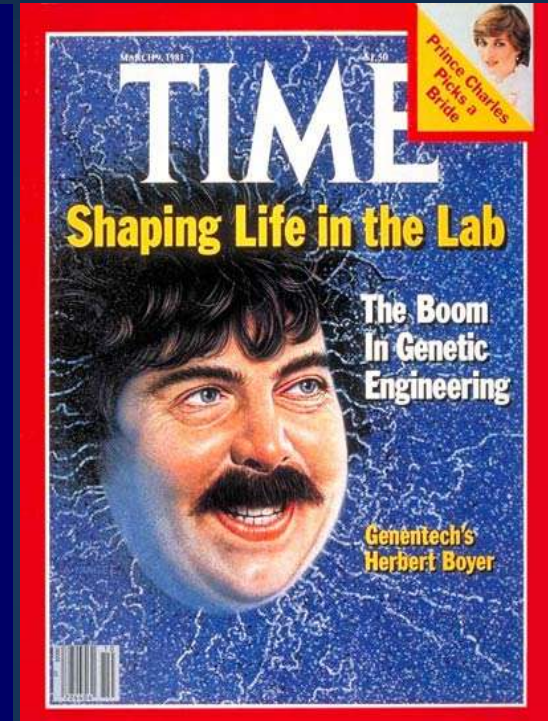
❖ Genentech is a Prototype for Biotech Business Development

1973 : Stanley Cohen & Herbert Boyer demonstrate gene splicing

1976 : Boyer & Robert Swanson found Genentech

1982 : Recombinant human insulin licensed to Eli Lilly

1985 : Genentech becomes the first biotech company to market its own drug-hGH



Efficiently manufacture large quantities of biological drugs to satisfy unmet needs

EPO

❖ Erythropoietin(EPO) – the first blockbuster in Biotech

✓ EPO is a hormone that increases red blood cell proliferation

- Used to treat anemia
- Reduces need for blood transfusions

✓ Developed by “Amgen”

✓ Development timeline

- Initially purified from 2,500 quarts of human urine in 1976
- Patents filed in 1984
- Efficacy demonstrated in 1986
- Approved for HIV patients in 1990 - 14 years after first purification
- Expanded approvals thereafter



Changes of the World Top 10 Medicines

(million USD)

year	2000			2008			2014E		
rank	Product	Company	Sales	Product	Company	Sales	Product	Company	Sales
1	Losec/Prilosec	AstraZenca	6,260	Lipitor	Pfizer / Astellas / Almirall	13,507	Avastin	Roche	9,232
2	Zocor	Merck / Sanofi-Aventis	5,328	Plavix	BMS / Sanofi-Aventis	9,447	Humira	Abbott / Eisai	9,134
3	Lipitor	Pfizer / Astellas	5,207	Advair	GlaxoSmithKline	7,282	Rituxan	Roche	7,815
4	Epogen/ Procrit	J&J / Amgen	4,672	Enbrel	Wyeth / Amgen / Takeda	6,455	Enbrel	Wyeth / Amgen / Takeda	6,583
5	Norvasc	Pfizer	3,361	Diovan	Novartis / Ipsen	5,825	Lantus	Sanofi-Aventis	6,386
6	Pravachol	BMS / Daiichi Sankyo	2,866	Rituxan	Roche	5,481	Herceptin	Roche	5,796
7	Prozac	Eli Lilly	2,585	Remicade	SGP / J&J	5,293	Crestor	AstraZeneca	5,739
8	Zyprexa	Eli Lilly	2,366	Nexium	AstraZeneca	5,200	Spiriva	Boehringer Ingelheim	5,552
9	Seroxat/ Paxil IR	GlaxoSmithKline	2,349	Epogen/ Procrit	J&J / Amgen / Kirin	5,162	Remicade	SGP / J&J	5,220
10	Claritin	Schering-Plough	2,194	Avastin	Roche	4,818	Gleevec/Glivec	Novartis	5,136

Biotech vs. Pharmaceutical Companies

Biotech

(Oct.15, '10)

Company	Revenue ('08)	Products	Market Cap
Amgen	\$14.7B	Enbrel	\$54.36B
Genentech	\$10.5B	Avastin	merged by Roche in 2009
Gilead	\$5.1B	Truvada	\$31.64B
Allergan	\$3.5B	Botox	\$20.75B
Genzyme	\$4.2B	Cerezyme	\$18.40B
Biogen Idec	\$2.8B	Avonex	\$13.95B

Pharma

(Oct.15, '10)

Company	Revenue ('08)	Products	Market Cap
Pfizer	\$44.2B	Lipitor, Celebrex	\$142.68B
GSK	\$43.0B	Seretide, Valtrex	\$117.58B
Sanofi-Aventis	\$38.7B	Lovenox, Plavix	\$89.90B
Novartis	\$36.0B	Diovan, Gleevec	\$135.01B
Astra Zeneca	\$31.6B	Nexium, Seroquel	\$75.23B

Source: *The Pharma Exec 50, May 2009, EURO RSCG LIFE*

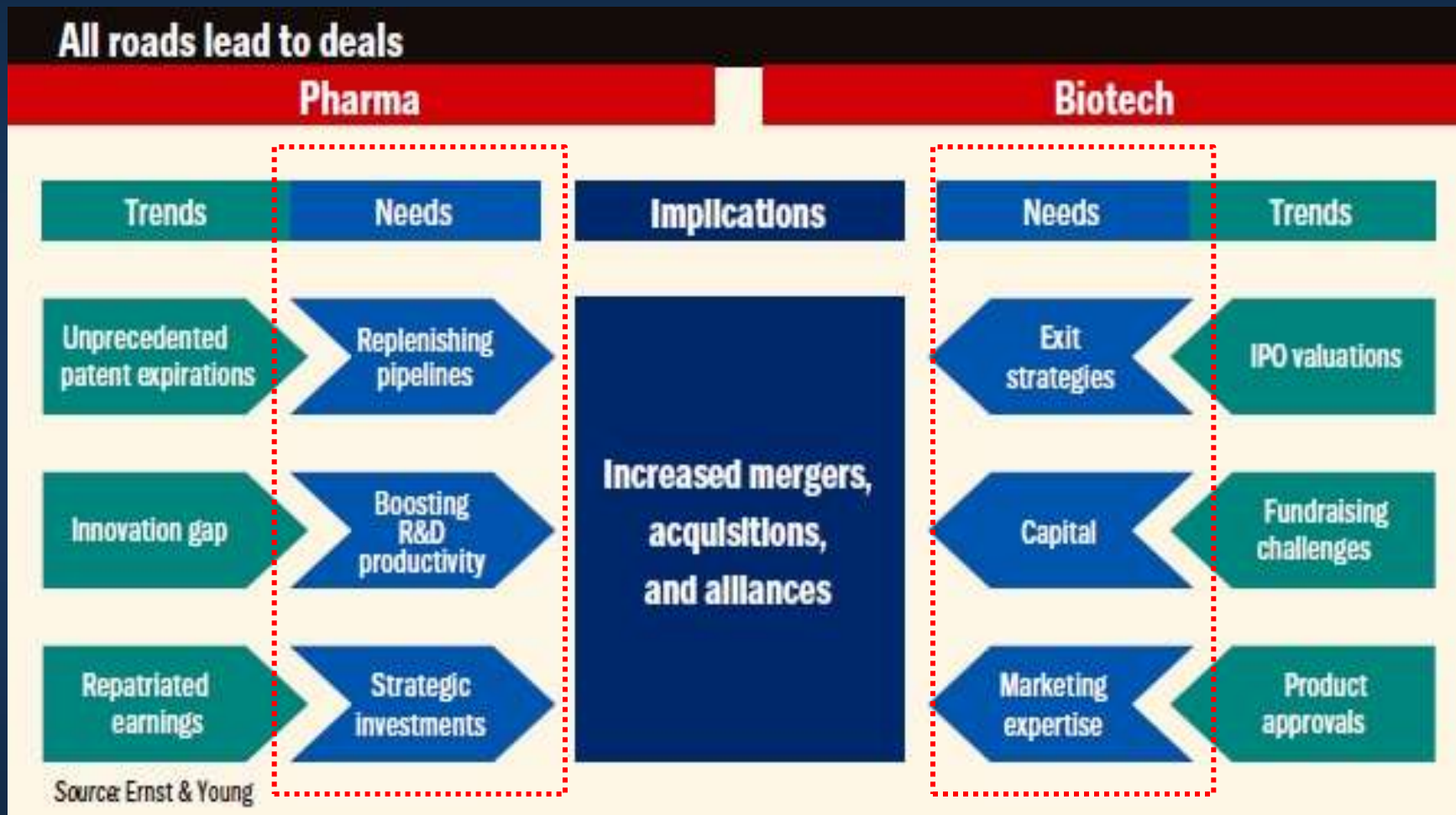
Trend in Bio-pharma Industry

❖ Increase R&D cost related to Regulatory Approval & Pipelines are limited



Trend in Bio-Pharma Industry

Win-Win Partnership between Biotech vs Pharma



M&A cases in Bio-Pharma Industry

	Acquirer	Target company	M&A Vol. (billion USD)	year
Big Pharma	Bayer AG	Schering AG	19.9	2006
	Merck KGaA	Serono S.A.	13.3	
	Abbott	Kos Pharmaceutical	3.7	
	Eli Lilly	Icos	2.5	
	Merck & Co.	Sirna THERapeutics	1.1	
	Schering-Plough	Organon Biosciences	14.4	
	Astra Zeneca	Cambridge Antibody Technology	1.32	2007
		MedImmune	15.6	
	Mitsubishi Chemical	Tanabe Seiyaku	4.3	
	Shire Pharma	New River Pharma	2.6	
Roche	Genentech	44.0	2009	
Biotech	Gilead	Myogen	2.3	2006
	Amgen	Abgenix	2.2	
	Millipore Co.	Serological Co.	1.4	
	Biogen Idec	Conforma	0.25	2007
	Bechman Coulter	Biosite	1.7	

Healthcare Changes to Wellness (vs. sickness)

❖ Healthcare moves from one size fits all to the three/four P's :

- ▶ Personalization
- ▶ Prediction
- ▶ Prevention / disease preemption
- ▶ Patient Responsibility

❖ Y2020 Vision : key issues

- ▶ lab-on-a-chip/smart card → information-based medicine
→ U-healthcare
- ▶ systems biology → new bio medicine(drug)
- ▶ diagnostics/drug/delivery → combination therapies
- ▶ artificial(bio) organs/regenerative medicine
- ▶ global cooperation for licensing and regulation

Source : Burrill & Company, Biotech 2008

Prospects for Y2020 Bio-industry Markets

❖ **Global pharmaceutical market can be expected to be increased to 1.3 trillion USD in Y2020 (Y2007: 0.7 trillion USD)**

(million USD, %)

	Y2005	Y2010	Y2015	Y2020	CAGR (2005~2020)
Bio (New) Drug	1,206.9	3,071.6	7,218.7	11,199.9	15.9
Bio-organ	6.3	19.3	59.1	132.4	22.5
Bio-chip	10.8	47.7	185.2	362.2	26.4
Global Market	72,060.4	164,214.2	371,438.3	517,946.1	14.1

Source : Bio-industry-Vision & Strategy in 2020, KIET, 2007

Biomarker

❖ characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention (NIH/FDA)

- bio-molecules

 - : protein, micro RNA, gene, metabolite, etc.

- pattern of bio-molecules

 - : protein expression, gene expression, metabolites profile

❖ Applications

- Clinical biomarker : new tool for new drug discovery

- Early diagnosis, screening and risk for disease

- Personalized medicine

Biomarker

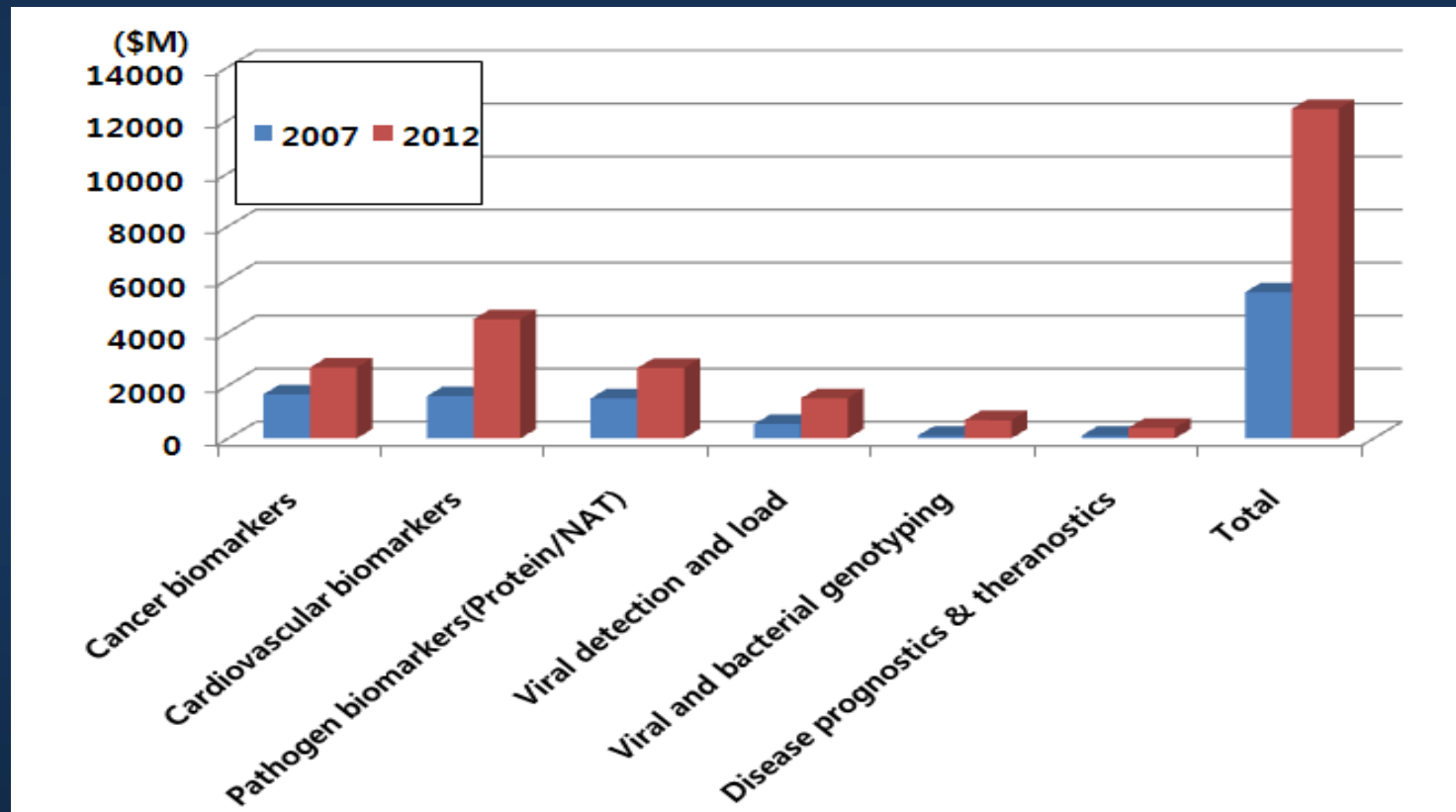
❖ The importance of early diagnosis and disease risk-forecasting is increasingly higher in ;

- Lung cancer, pancreatic cancer ; higher fatality rate cancer
- Degenerative disease ; Alzheimer disease
- Mental disease

Disease	Company	Diagnostic application
Cancer	Myriad Genetics	Breast cancer risk / BRACA1 gene, BRACA2 gene
	Gen-Probe	Prostate cancer screening / PCA3 gene
	Quiagen	Cervical cancer screening / high-risk HPV
	deCODE genetics	Prostate & breast cancer risk / SNP
Alzheimer	Athena Diagnostics	Alzheimer risk / APOE gene, PS gene, APP gene
Cardiovascular	deCODE Genetics	Myocardial infarction in young age / SNP
Etc.	Celera	Cirrhosis & Rheumatoid arthritis risk / SNP
	CombiMatrix	Autism risk / genomic analysis

Biomarker

- ❖ Biomarker market can be expected to be increased from \$5.5B in Y2007 to \$12.4B in Y2012 (CAGR 17.6%)



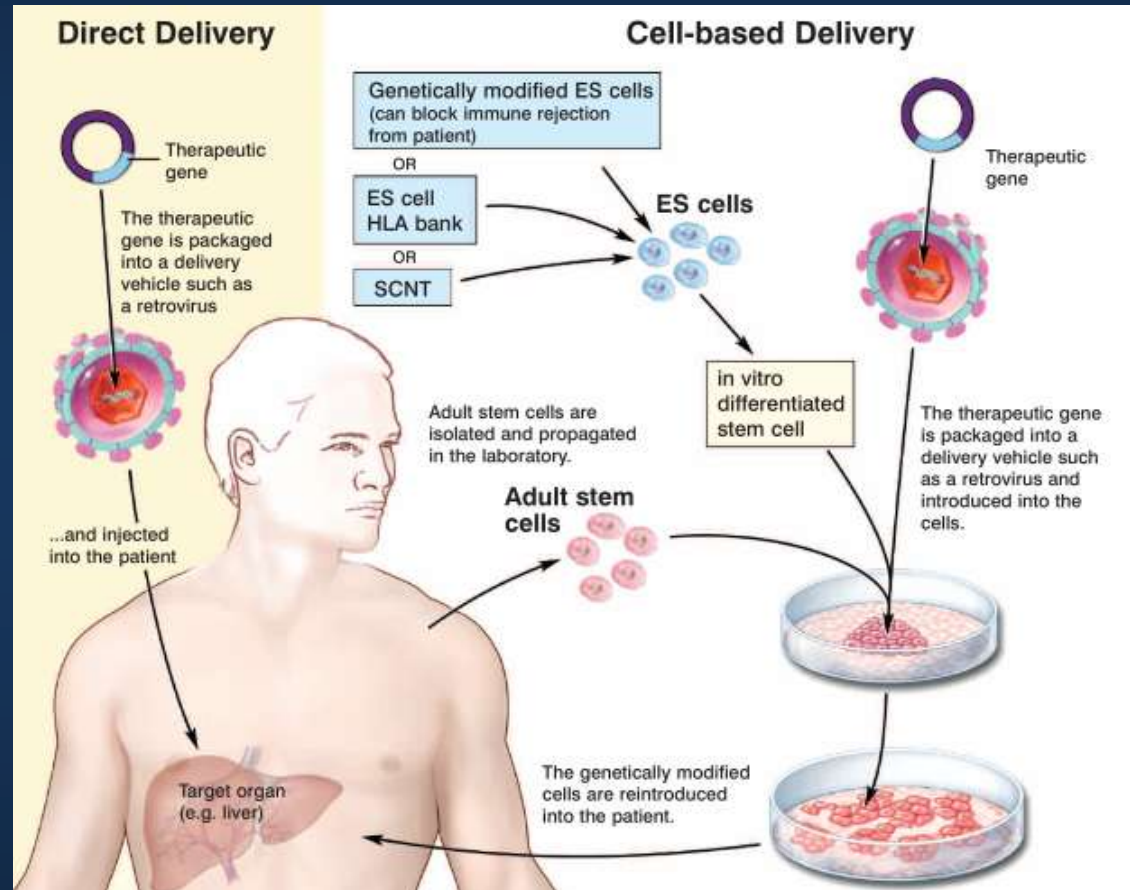
Source : Business Insights, 2008

Cell Therapy

❖ Low-risk but more effective therapy

- ▷ for a new drug
 - long time & high cost
 - high-risk & high-return

- ▶ based on cells of which functions are well-known
 - safer & more effective



Cell Therapy

❖ Higher growth(CAGR 16%) for stem cell market can be expected

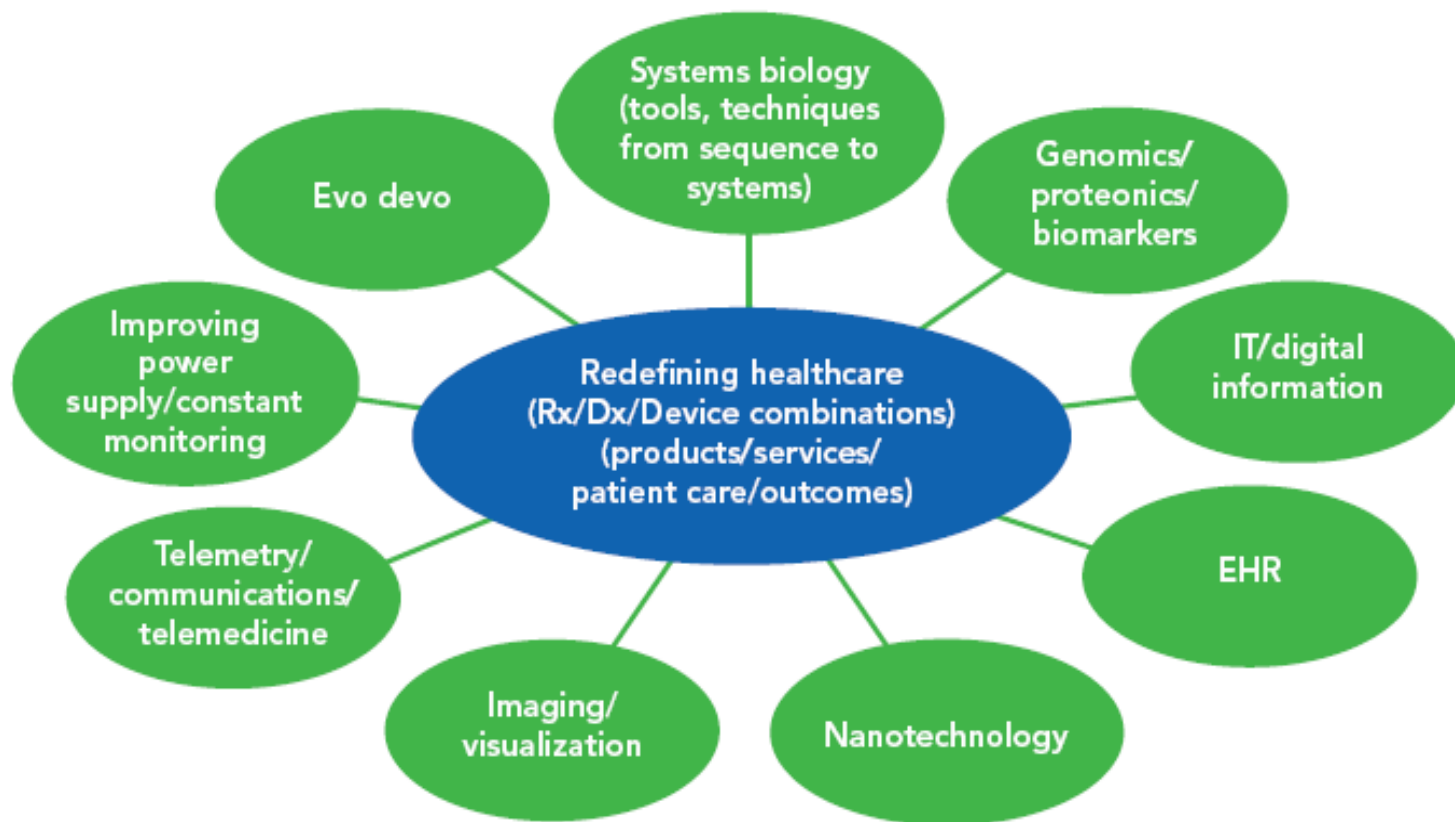
(billion USD)

Technology	2005	2010E	2015E
Stem cell	2.0	5.2	10.9
Cord blood	0.5	1.0	2.3
Tissue engineering	6.9	13.5	23.2
Blood transfusion products	12.8	22.4	35.0
Cell-based genetic therapy	1.5	3.0	5.9
Encapsulate cell therapy	0.4	1.9	3.1
Cell-based cancer vaccine	0.9	1.6	2.9
Xenogeneic transplantation	0.6	1.9	3.2
Others (cell line, culture media, cell carrier)	2.0	5.7	9.8
Total	27.6	56.2	96.3

Source : Jain PharmaBiotech Report

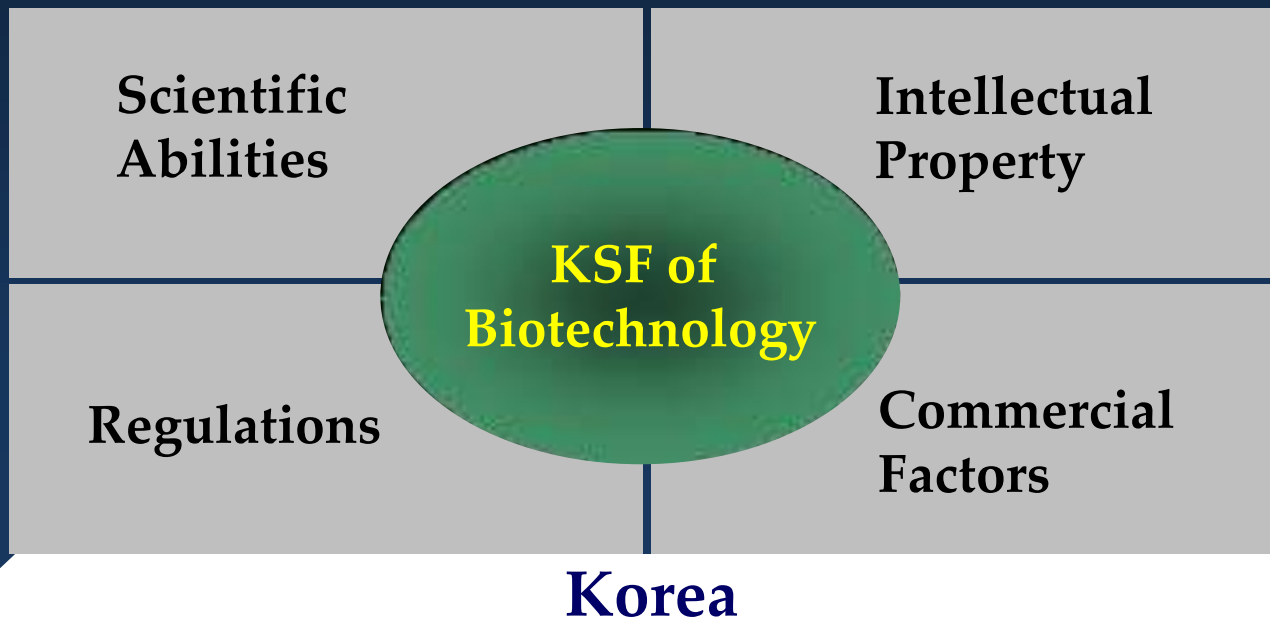
Prospects for Biotech

Confluence of Technology, Tools, and Knowledge !



Source: Burrill & Company

Key Success Factors



- **Well Educated Human Resources**
- Active Promotion for Bio Venture Business
- **Active & Positive Government Policy**
- Top of the World in IT Business

Thank You !

Jay Kim

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