Framework for Pharma Value Chain Sourcing to Emerging Markets/Developing Economies

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Class of 2005

Rationale

In the previous few decades, many of the components of the value chain of a number of industries have been outsourced to emerging markets. This typically occurs as various components become increasingly commoditized – a decreasing production function - and the value-add comes less from labor or tangible capital intensive processes and more from intangible capital (basic research, institutions, brand equity) processes. In Developed Countries, due to the sheer capital infrastructure in place, half of all economic growth comes from growth in intangible capital mainly research and development that increase productivity. As a result, most profitability results in investments that take advantage of basic research, human resources, superior social institutions, among other sources of intangible capital that allow for superior productivity. This is reflected in the high input prices of labor and capital (e.g., real estate) that, however, offer massive discounts and pale relatively in costs when chasing ideas.

In developing countries, the major driver for growth is growth in capital; capital is what the economy lacks the most, productivity is not the constraint. As labor intensive processes acquire more capital – capital deepening - the economy moves up the value chain; assuming the condition of efficient dispersion of capital (conditional convergence). Essentially, what is first an arbitrage of cheap basic labor moves up the value chain as the labor acquires more skill, firms acquire better technology, better productivity, and therefore, command more capital. Eventually, the economic "cluster of firms and institutions" move up from highly labor intensive to the realm of basic research.

An excellent example are the electronics and software industries in East Asia and India as firms which yesterday concentrated mainly on labor arbitrage and now have dramatically moved up the value chain and eaten significantly into the market share of their industries in the United States and Europe in the horizontals they operate. A case particularly, in point are LCD Crytstal displays: once a hallmark of production in Japan and American technology, key patents are now held by Japanese firms while Taiwanese firms have now moved their production to mainland China and are now beginning to invest in R&D. The myth of poor quality is also questionable with examples of Mitsubishi (Six Sigma) and Infosys (SEI-CMM Level 5) pioneering leading edge quality practices worldwide. Further, due to decades of planned economics, despite poor literacy rates, many emerging markets have several elite and top-tier institutions that churn out highly skilled human resources: the IITs in India serve as an excellent example.

With genomics, pharmaceutical drug discovery has taken a bold step towards becoming more of an engineer's field where ability to manage a portfolio (read capital) and project managements skills become increasingly important. Today, time to market, market size, and cost per NCE introduced are critical variables in a game of probability. Yesterday's basic research has now slipped "downstream" to acquire increasing characterizes of development. To survive and thrive, present technology clusters in Silicon Valley and

commodotized processes. Alternatively, if they have the economies of scale, they must establish their own research and/or development centers in technology clusters in emerging markets where input prices are substantially lower and similar levels of productivity and quality can be achieved.

The paper tries to evolve a framework to evaluate sourcing opportunities. It does not comment on manufacturing (though it does on commercialization), distribution, and, sales and marketing, nor does it comment on emerging upstream value ads for developed economy technology clusters. It also assumes that all drug discovery research firms have migrated towards genomics-led drug discovery; a process that is still occurring

Suggested Methodology

- Look at present steps for genomics led Drug discovery. Look at each value add in terms of cost components, technical depth requirements, likely innovation trends.
- Look at present worldwide industry in terms of size, technology cluster and geographical location; identify input costs and availibility
- Identify any barriers (preservation innovation cycle, additional overheads) to outsourcing to model cost savings in emerging markets
- Identify matrix filters for sourcing opportunities

The remaining paper sets the agenda and provides background information for a more exhaustive study into emerging market outsourcing.

Present steps for Genomics led Drug Discovery:

Information to be formulated on:

- Definition
- Key inputs (skills sets, capital infrastructure, variable inputs)
- Cost Components
- Key technologies and emerging trends
- Key outputs
- Metrics for measuring success

Steps:

- **Gene Sequencing.** Building of library of sequences to mine for information
- **Target ID.** Looking for protein/mRNA expression (or lack thereof) in diseased state.
- **Target Validation.** Verification of the protein involvement in the diseased state and analysis & comprehension of protein pathways and interactions.
- **Lead Discovery.** Evaluation of leads to 'cure' the problem:
    - Replace missing or defective gene with 'gene therapy'
    - Anti-sense RNA to prevent protein expression
    - Anti-body to remove protein
    - Stimulation of synthesis to replace protein
- **Pre-Clinical.** Animal tests of toxicity and efficacy of therapy.
- **Clinical Phase I.** Small numbers (<100, in 10s) to determine safety and toxicity. Maybe some members of the target group.

- **Clinical Phase II.** Larger numbers (in 100s) to determine efficacy, dosage and safety.
- **Clinical Phase III.** 1000s of patients and normals to determine efficacy, dosage, safety, side effects, and interactions
- **Commercialization of NCE**
    - Drug Delivery Researh
    - Formulations Research

Actors for Skill Set and Compensation Comparisons: Chemist, Clinical Specialist, Clinical Data Manager, Clinical Data Specialist, Clinical Pharmacist, Clinical Research Associate, Clinical Research Manager, Drug Safety/Medical Information Specialist, Engineer, Field Service Engineer, Instrumentation Engineer, Manufacturing Engineer, Medical Director, Medical Writer, Microbiologist, Patent Agent, Patent Attorney, Pharmacist/Pharmacy Technician, Post doctorate Scientist, Process Associate, Process Engineer, Project Manager, QA Engineer, QA Specialist, QC Analyst, QC Inspector, Regulatory Affairs Specialist, Research Fellow, Research Associate, Scientist, Statistician, Technical Writer, Validation Engineer

Workflow for Drug Discovery Research (and key technologies)

Evolving approach

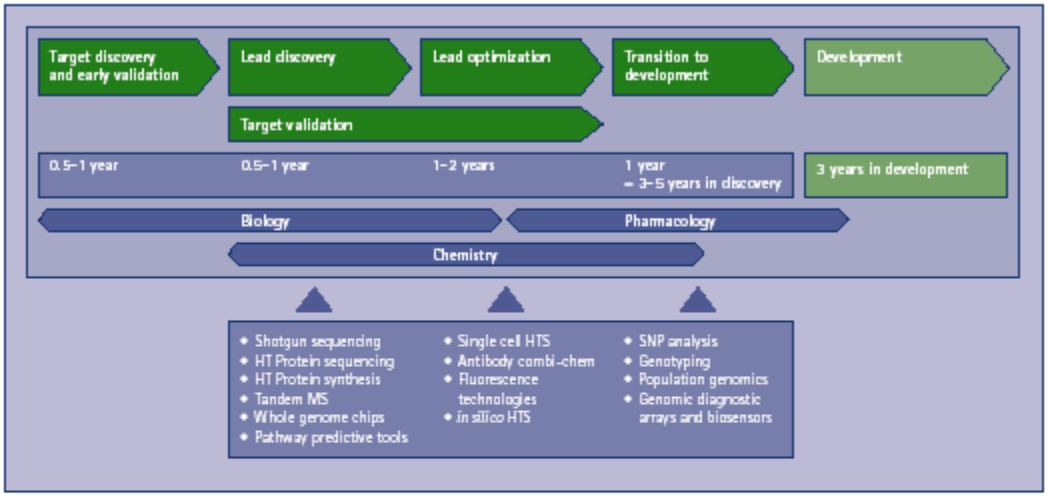
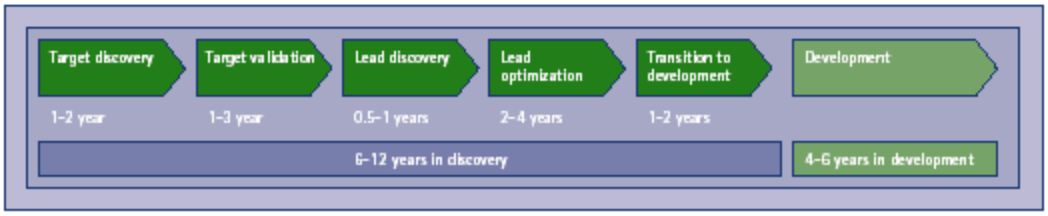


Figure 08a

Traditional approach



(High Performance Drug Discovery: Operating for a New Era. Accenture)

Present US Drug Discovery Industry

Research Based US Domestic Pharma Companies

Year	Percentage
1985	15.1%
1990	16.2%
1995	19.4%
1998	20.1%
1999	17.4%
2000 (est)	17.0%
2001 (est)	18.0%
Avg. US	15.8%

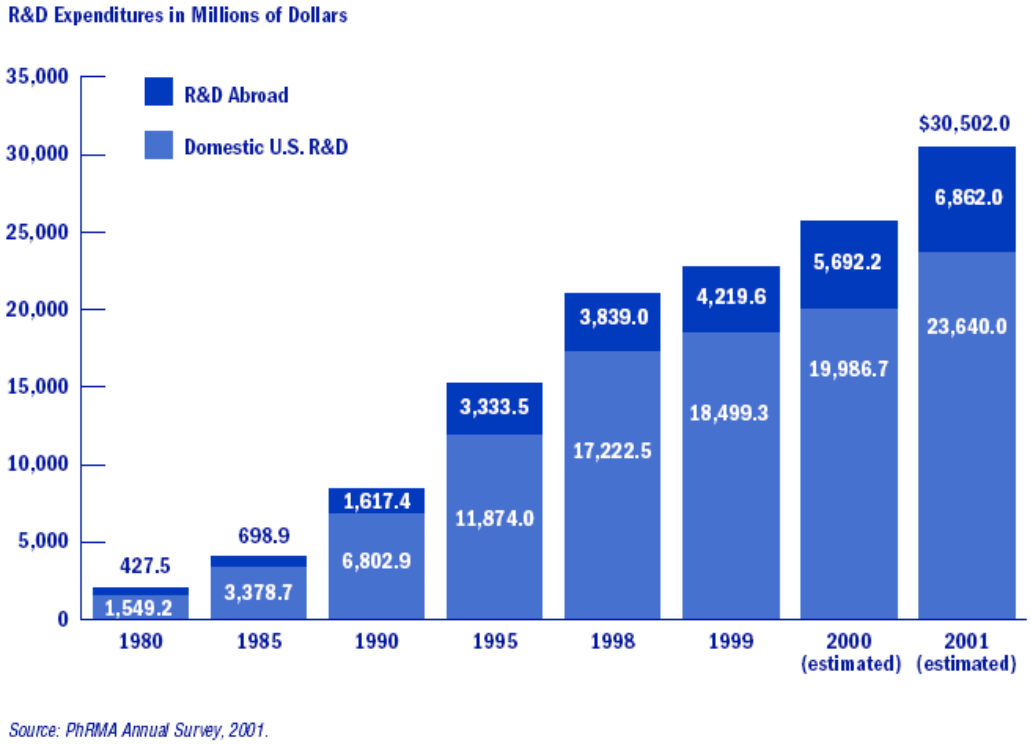
PhRMA, 2001 Annual Survey

Allocation of US R&D by Function

Function	Percentage
Synthesis and Extraction	10.0%
Biological and Pharmalogical Screening	14.2%
Toxicology and Safety Testing	4.5%
Pharma Dosage, Formulation and Safety	7.3%
Clinical Evaluation: Phase I to III	29.1%
Clinical Evaluation: Phase IV	11.7%
Process Development for Manufacturing and Quality Control	8.3%
Regulatory IND and NDA	4.1%
Bioavalibility	1.8%
Other	9.0%

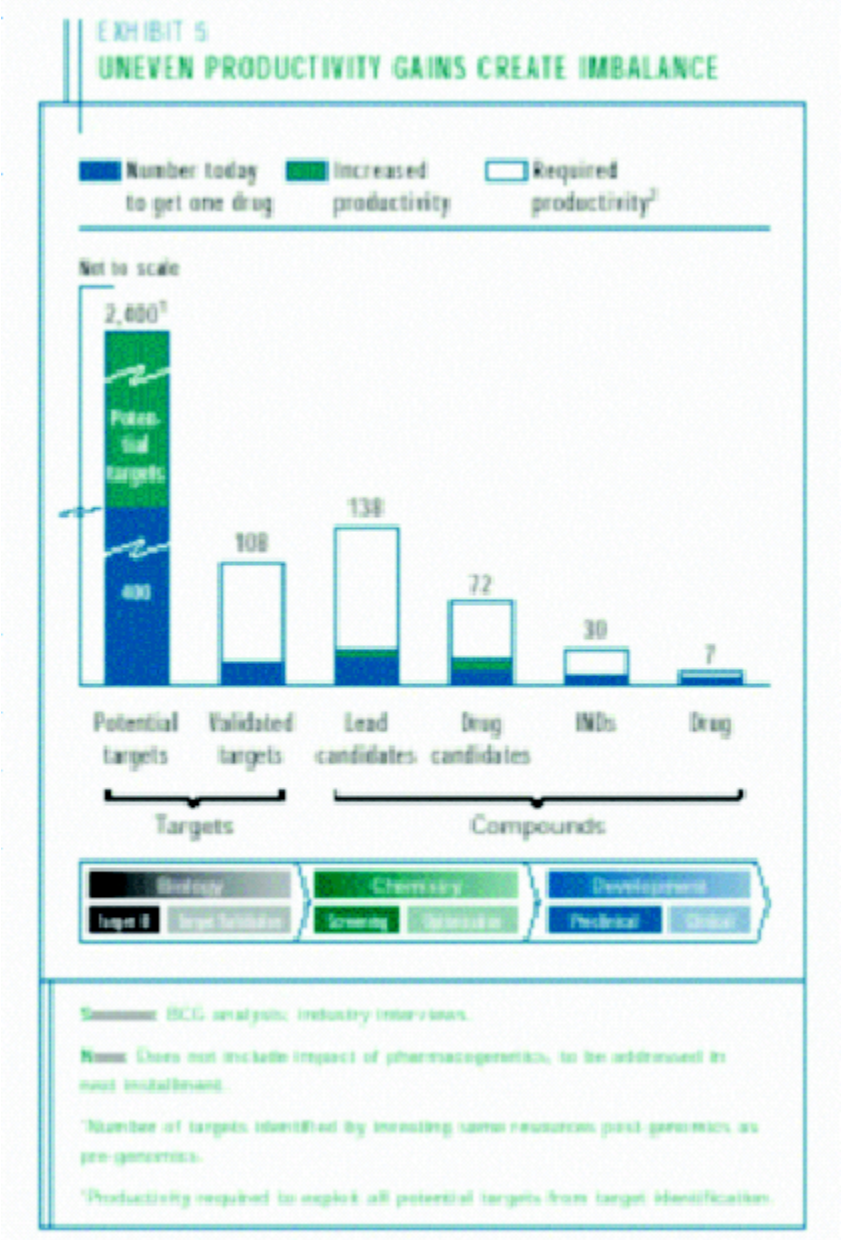
The Pharma Industry always known for its immense research needs has seen astonishing growth in research spending.

R&D U.S. and Abroad Expenditures, Ethical Pharmaceuticals, Research-Based Pharmaceutical Companies, 1980–2001



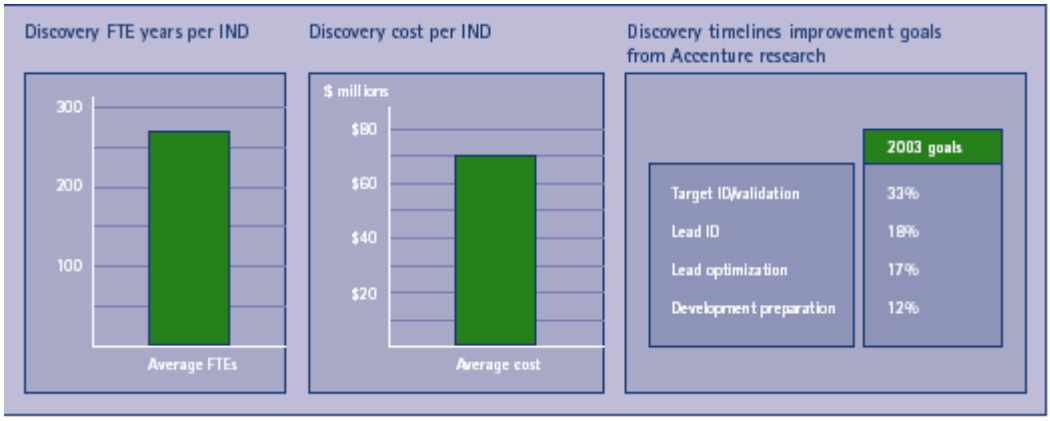
Source: PhRMA Annual Survey, 2001.

However, growth in overall research spending does not reflect the problems with lack of productivity in key process across the value chain that act as bottlenecks.



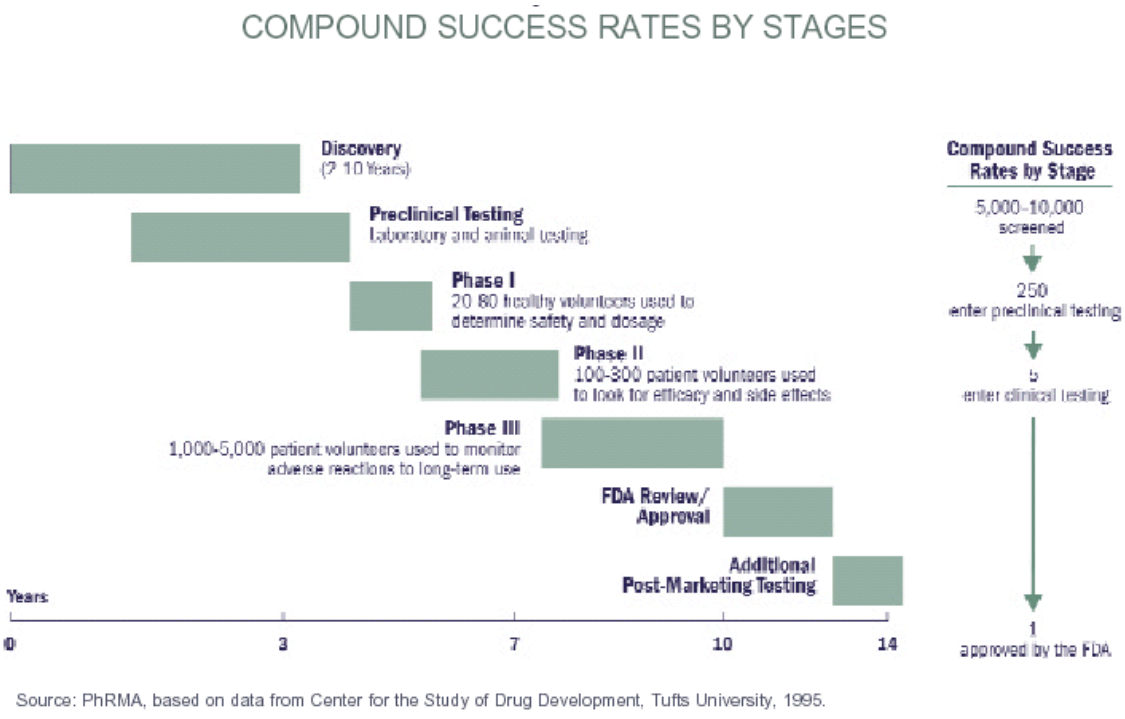
Productivity enhancements in these bottleneck processes would be tremendously welcome; international sourcing could massively increase the whole scale of the effort due to cost savings and thus push through more targets and compounds at the same dollar rate.

Overview of Costs Per Introduced NCE

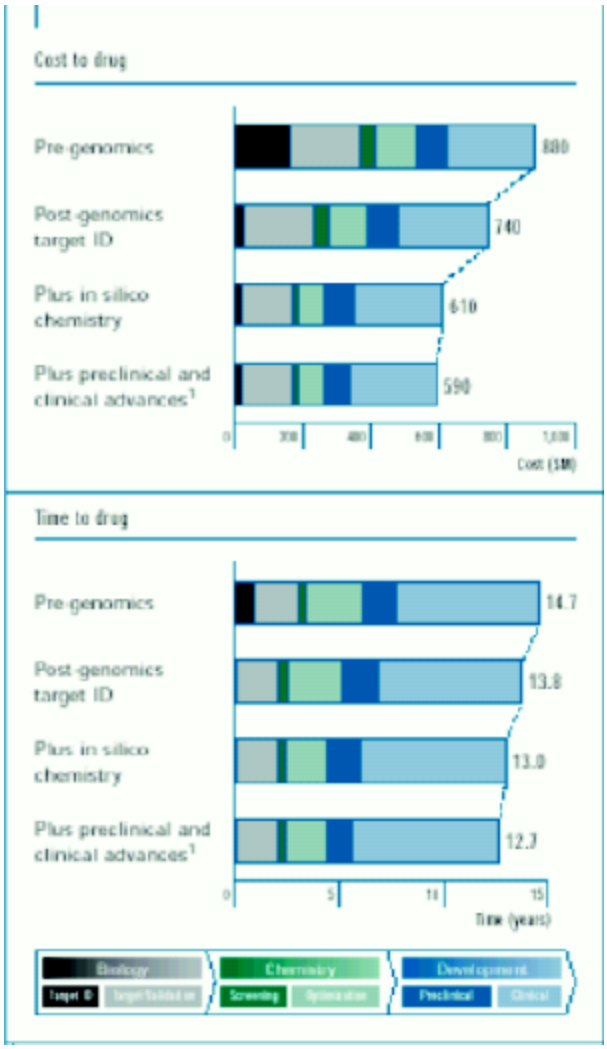


(High Performance Drug Discovery: Operating for a New Era. Accenture)

The key to reduction of costs product introduction lies in productivity at the discovery and pre-clinical stage.



Source: PhRMA, based on data from Center for the Study of Drug Development, Tufts University, 1995.



Pre-clinical developments cost amount nearly $70 million per IND. However, from that point on due to inability to cross clinical trials cost per NCE introduced balloon to nearly $590 million. This indicates that though massive costs savings are possible in the clinical testing arena and development, the greatest return may lie in investing in more rigorous lead discovery, validation & optimization; find the cure for the disease not the symptom. International sourcing in tandem with new innovative approaches could yield tremendous dividends in terms of both process productivity and sheer scale.

Possible Worldwide Emerging Market Technology Centers for Exploration (based on discussions with various individuals)

China – Hong Kong, Shanghai
South Asia – Bangalore, Delhi, Hyderabad, Mumbai.
South East Asia – Singapore, South Korea (note: Singapore, South Korea are considered NICs; newly industrialized countries and are not strictly developing economies clusters)
Eastern Europe – Hungary, Czech Republic, Slovakia, Poland(?)
South America – Argentina(?), Brazil(?)

Matrix for Evaluating Sourcing Strategy & Technology Cluster Entry

Costs include: explicit costs of differential in inputs, outsourcing management overheads, any opportunity costs in innovation due to lack of externalizing of process.

Technical Complexity of Process includes the process itself and the act of trying to manage a global research or development effort in that process.

		Technical Complexity of Process		
		High	**Medium**	**Low**
	Low	Ignore for Now	Long Term	Opportunistic Entry
Cost Savings	**Medium**	Medium Term to Long Term Phase in Entry; focus on creating beachhead.	Medium Term	Short-term to Medium Term; actively scout
	High	Medium to Long Term	Short-term to Medium Term; actively scout	Immediate

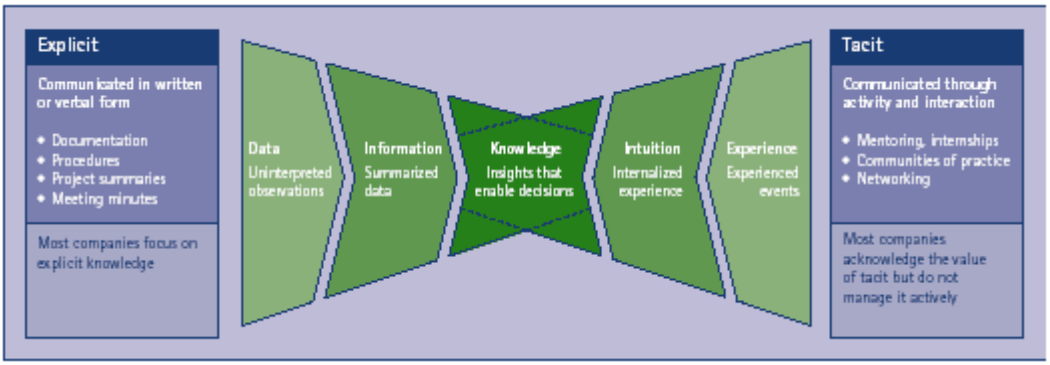
Strategic Importance considers the effect of cost savings due to access of technical talent pools & operations. It also considers the emergence of the technology cluster as major destination for basic research.

Firm's Ability to Exploit Cluster considers the ability of the firm to set-up and run operations efficiently and productively in the country. This includes assessment of geopolitical risk, economic risk, the regulatory environment, acceptability of research elsewhere.

		Firm's Ability to Exploit Cluster	
		Low	**High**
	High	Phase in Entry; Create beachhead first (outsource, Joint Venture)	Rapid Entry
Strategic Importance of Cluster	**Low**	Ignore For Now	Opportunistic Entry; consider outsourcing

Market Growth Rate considers the growth rate of the particular sub-component of the value chain globally.

Importance of & Impact on Innovation Culture considers the critical role the process plays in fostering original thinking and benefits that can arise from co-operation among various technical groups or business units.



Though most firms follow acknowledge the important of tacit knowledge communication, very few actually follow it through. This can adversely effect the productivity of the whole drug discovery and development cycle.

		Importance of Innovation Culture	
		Low	**High**
Market Growth Rate	**High**	Cross-Border Acquisitions; JVs	Greenfield Operations
	Mature or Declining	Outsource	Greenfield Operations or Cross-Border Acquisitions

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