

The Market Size of Bioinformatics

"there is a lot of information that is locked up in the presentation of data"

'The omics - from the Latin 'give us your money'¹

Just what is the size of the market for Bioinformatics? This simple question proves to be very difficult to answer for a number of reasons; first Bioinformatics² covers a multitude of technologies and applications, the market addresses a diverse sector and today many of the deals and company details remain private. Our approach therefore is to correlate a number of methods to estimate the market that should bound the size of the market, assuming an economic rationality and adequate return on investment.

Broadly speaking the market comprises a small number of specialist data firms (such as Incyte) who sell data with the tools needed to manage this data, a larger number of specialist companies (such as NetGenics) who develop software tools and data integration facilities and finally over 200 drug-discovery companies who develop tools as part of their proprietary technology³. Identifying the "software only" components from a market with bundled sales and database sales is difficult. Our estimate is that the database sales stands at approximately \$300m (with Incyte the dominant vendor) and the tools market stands at \$200m⁴.

However based on the level of venture funding this has to rise by at least \$250m in the next 3 years. Although even the \$200m income is close to the ceiling set by the calculated value of Bioinformatics tools to the customer base.

Price, Cost & Value

As with all emergent technologies there are already a number of widely (order of magnitude) estimates and the uncertainty as to whether these estimates are of price, cost or value⁵.

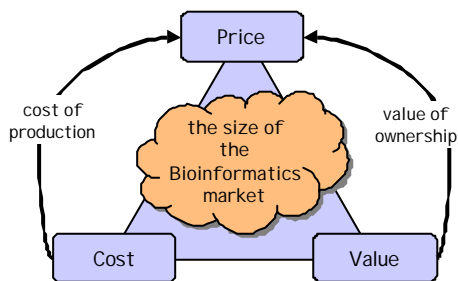


Figure 1 Price, Cost and Value

?? The price ultimately defines the real market value. Today this is heavily distorted by the incentives for early purchases and the excitement of a venture led emerging market.

?? The cost is the economic effort required to produce the goods

?? The value is the economic benefit obtained from the user(s) of the technology.

Clearly price is the ultimate measure of the market, it is after all what the buyer is prepared to pay. However a price lower

than the cost makes the market untenable for suppliers, a price higher than the value is foolhardy for the purchaser.

This model sets bounds for the market size - by looking at the potential and projected *price* (based on the current market activity), *cost* (based on the required economic return from the

¹ Neil Kipling - CEO IDBS

² First coined in 1987 in a journal article by Hwa Lim, now president of D'Trends Inc.

³ Bioinformatics in the Forefront, R&D Directions, July 2001

⁴ Various 'insider' estimates put this figure as low as \$50m for the pure 'software' component of the market.

⁵ I am indebted to Clive Montaux formerly purchasing manager of Glaxo R&D for this distinction - *price is a matter of negotiation, cost is a matter of fact and value a matter of experience*

venture funding) and *value* (by studying the linkage of Bioinformatics and the Pharmaceutical market it serves).

The Potential Market

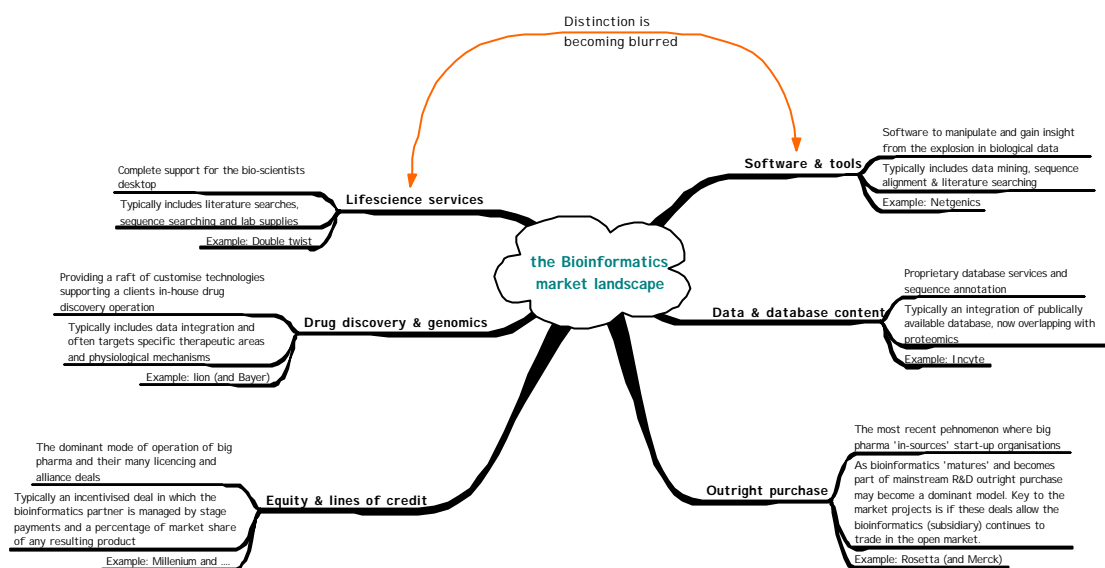


Figure 2 Bioinformatics market landscape

Market Fundamentals

The fundamental impact of biotechnology industry is the realisation that the technology and talent of drug discovery has moved outside the confines, and conformity, of big Pharma. Replacing the totally integrated Pharmaceutical company there is now an ecology of small, venture funded start-ups working in what, a decade ago, would have been an internal function. This market change generates new levels of scientific interest and commercial visibility.

In response big Pharma is looking to either copy this trend to captures its vitality (for example GSK's new re-organisation of discovery around self-contained biotech 'clusters'⁶) or to establish internal venture capital funds to capitalise on the innovation.

The key issue in moving from the Totally Integrated Pharma Co⁷ to the ecology of the Biotech industry is the fragmentation of the infrastructure. Whereas there is some evidence that the essential creativity and innovation comes from small groups and focused organisations this potential is easily lost if these small companies are under-resourced and under-equipped. Automation and miniaturisation has significantly reduced the cost of research - for example a gene sequence which formerly took a laboratory full of chemists to analyst its structure reduced to a few dollars analysed through an automated device.

Data Explosion

Scientifically the challenge facing all bioPharma research is the rapid expansion of the data & information infrastructure to cope with the flood of data emerging from the new sciences, such as genomics, and the new automation in high throughput screening ...

Growth of chemical data	Growth of biological data
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⁶ Yamada stokes the boiler in GSK's engine room article by David Pilling, Financial Times, February 22 2001

⁷ Modern Strategy for Preclinical Pharmaceutical R & D: Towards the Virtual Research Company By David Cavalla, John D. Flack, Richard Jennings John Wiley & Sons; ISBN: 0471971170

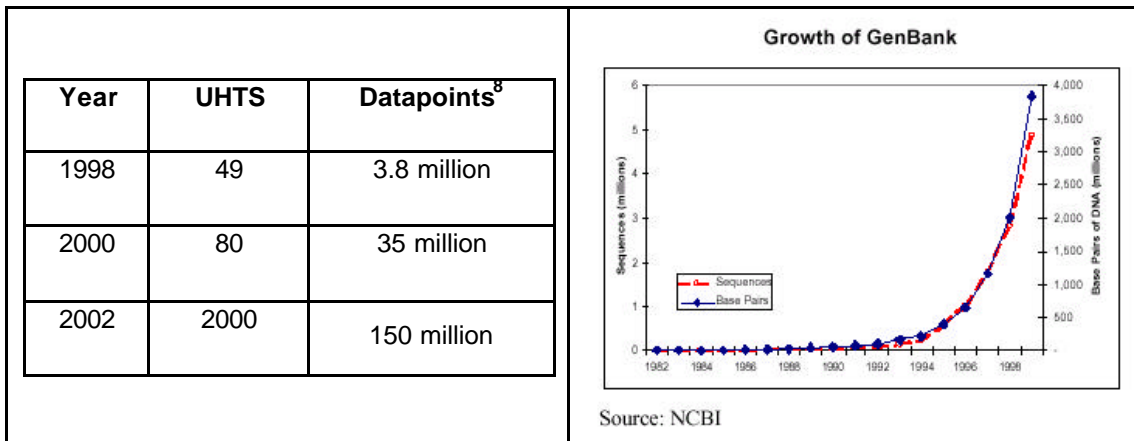
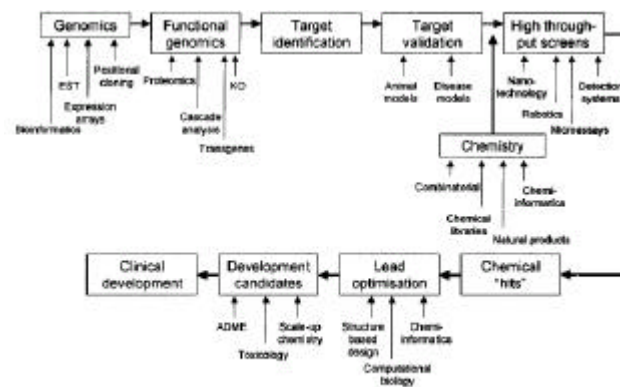


Figure 3 Life Science data explosion

Bioinformatics, and its companion, Chemoinformatics now for a key component of the discovery infrastructure of bioPharma companies ...



Source: Lehman Brothers pharmaceutical research

Figure 4 Bioinformatics & Chemoinformatics

In practical terms the technology is leading to a significant re-design of the early stage processes of large and mid-range Pharma. A recently presented example¹⁰ from Bayer indicates the change in the pipeline and the extent of the commercial partnerships necessary to meet this challenge

⁸ Pfizer Analysts Meeting, December 2000

⁹ Source: The Fruits of Genomics, Lehman Brothers, January 2001

¹⁰ Executive Case Study: A Big Pharma Research Platform, present to eyeforPharma east 2001 Business in the Post Genomics Era, by Prof Dr. Wolf-Dieter Busse of Bayer.

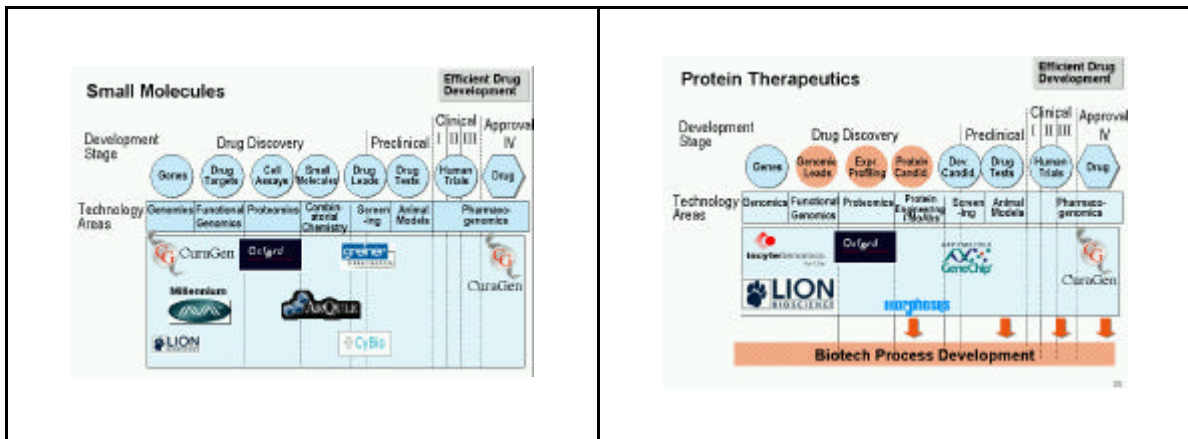
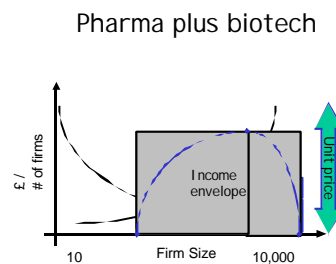
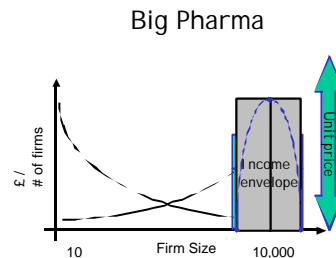
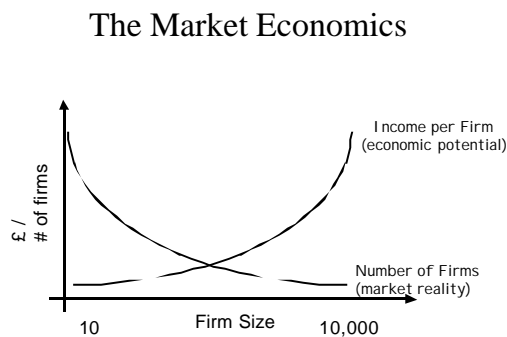


Figure 5 Bioinformatics integrated into discovery

Business Models - Assessing the Market

The key problem remains that the market for Bioinformatics, at least as originally conceived, isn't large enough to support a company built around one or two high-cost software programs targeted to a relatively small user group¹¹.

As we assess the market or potential market of Bioinformatics we must consider the strategies effective to reach different, or all, parts of the potential market. Strategies focused at the high margin big Pharma market (limited in opportunities) or strategies designed to embrace all biological scientist (but of reduced or variable margin). The income envelope for a supplier in these markets is illustrated below:-



¹¹ Start Up, Windhover January 2000

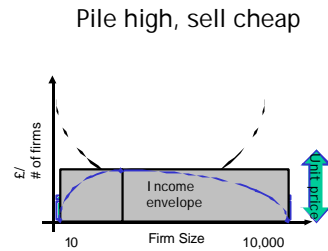


Figure 6 Bioinformatics market models

To develop the potential market there is the clearer choice for the Bioinformatics vendors of strategies focused at large Pharma (with a high cost, high cost of production and restricted market) through to the embracing all life scientists (with a lower cost but expanded market).

However this market choice is not just about the cost of the product and the direct sale market, but also about the value proposition. As big Pharma looks to the biotech and start-up markets for innovation so Bioinformatics, if it is to be part of this innovation and hence value proposition, has to re-position itself, moving to embrace smaller organisations¹².

Market Prices

Market Value based on Current Sales

Hyperbole

Computer code, according to Bill Joy, chief scientist at Sun Microsystems, is now having more impact on the biological sciences than traditional exploration techniques, like examining tissue samples. "It is symbolic that the code of the human genome has been broken in the year 2000. It has made biology into an information science. The 21st century is going to be the real information age, and I don't mean the Internet.

"The upside is enormous. Over the course of the next century, it can create USD 1,000 trillion in new wealth," he told the Forum, according to Reuters. Paul Saffo, director of the Institute for the Future, said: "The biggest surprise is perhaps that we are at the intersection of the two [biotechnology and computing]."

It's no coincidence that Ellison and Venter share a passion for both biology and information sciences. These once-separate domains are flowing together in a union that could change the whole geography of high technology--and lead to a \$43 billion market by 2004. On one side, the tsunami of information generated by the Human Genome Project is forcing drug companies to retool themselves as information brokers. Their survival will depend on finding new ways to spin gene data into blockbuster drugs¹³.

¹² Further market analysis is available in my paper Bioinformatics, published in Drug and Market Bulletin, March 2001

¹³ Business Week; April 3, 2001 Section: BusinessWeek 50 BIOINFORMATICS Copyright 2001 The McGraw-Hill Companies, Inc.

Defining The Market¹⁴

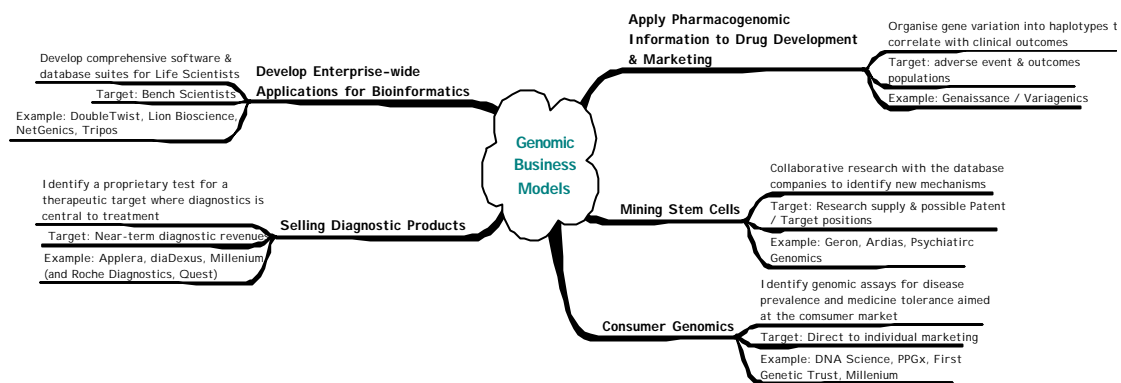


Figure 7 Genomic business models

The modelling and simulation market is about \$100 million. In that area, we have about a 70% market share, one other public company has a 20% share and all other smaller companies and academic groups make up about 10%. The Chemoinformatics and Bioinformatics markets are really very new and are growing rapidly. They're estimated to be in the \$100 million range and there are projections that they will grow to several billion dollars over the next 10 years¹⁵.

The worldwide Bioinformatics market is mostly localized in the United States and Europe. The market value of products and services is valued at over US\$ 2 billion. Predominantly, there are two application areas - Agriculture and Pharmaceuticals. While Agricultural Bioinformatics depends on the whole genome sequencing of plants, the Pharmaceutical sector relies on the success of the Human Genome Sequencing efforts along with the sequencing of the mouse and other model organisms for comparative genomic efforts and for clinical trials in model organisms.

Given the nascent nature of this industry and the large number of private players in the field, the current market for external products and services is hard to determine. Surveys of the 50 or so Bioinformatics tool and database companies by market research groups like Frontline and Frost & Sullivan, for example, put the current market for Bioinformatics databases, products and services at roughly \$300 million¹⁶, with about half of the annual sales by data suppliers and half of the sales by tool/IT providers of various kinds.

These groups and other industry observers believe that this market could grow to \$1.5-2.0 billion over the next five years. These estimates exclude some significant internal spending on IT infrastructure by Pharmaceutical and biotechnology companies that is Bioinformatics related, and could be as large as \$ 2.0 billion + annually. As discussed above, also excluded are most of the project-based R&D collaborations between 'Pharma/ag-bio' companies and genomics companies that include Bioinformatics "content," and which total well over \$1.0 billion on a cumulative basis over the past 3-5 years

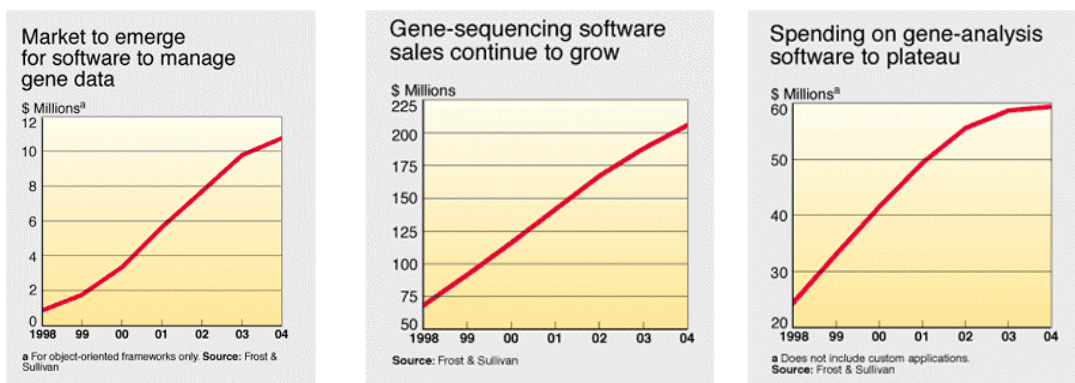
The landmark study on the size of the Bioinformatics was by Frost & Sullivan who, in 1997, completed a broad ranging study with Front Line consulting. This study has been variously re-reported and had led to the \$2Bn estimate, although many subsequent authors have failed to re-calibrate the time axis – the \$290M market is today (2001) with \$2bn in five years time. The analysis was deep and produced a segmented market view as demonstrated below:-

¹⁴ Derived from Maturing Business Models Using Genomics Data Michael Lytton, Start-Up January 2001, Windhover

¹⁵ JOSEPH A. MOLLICA is Chairman, President and Chief Executive Officer of Pharmacoepia, Inc. quoted in The Wall Street Transcript

¹⁶ Such industry surveys have their dangers. For example reference 3 suggest there are 290+ companies with Bioinformatics products, compared with the 50 chosen by F&S. Also the survey frequently look at publicly quoted or venture funded organisations, much Bioinformatics development is privately funded as is the case for MatrixScience (private communication, John Cottrell)

Table 1 Bioinformatics market segments



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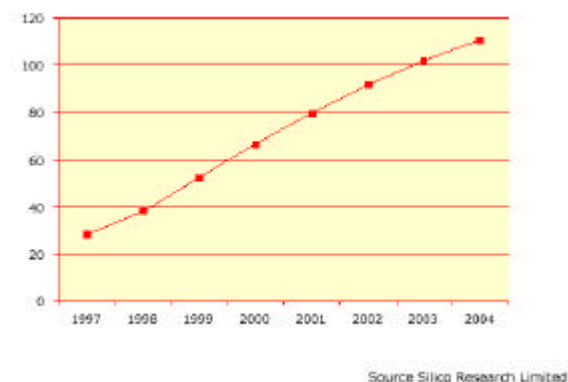
The F&S report identified the major categories of Bioinformatics vendors:-

Table 2 Bioinformatics market shares

Source: Front Line Strategic Management Consulting ¹⁸	1998E	2005E
Data Suppliers	49%	38%
Analytical Software Providers	39%	43%
Enterprise System Providers	12%	19%
Market Total:	\$290 Million	\$1.2 Billion

More recently Silico Research have produced a new analysis based upon extensive interviews with BioPharma companies. Their estimates¹⁹, for F&S's "Analytical Software Providers" segment was significantly lower but still growing significantly.

Table 3 Worldwide Bioinformatics revenues (\$m)



¹⁷ Bioinformatics for the Masses Chemical & Engineering News, February 7, 2000 Volume 78, pp.19-32 ISSN 0009-2347

¹⁸ Quoted in Chemical Market Reporter May 24, 1999 Bioinformatics Emerges as Key Technology for Developing New Drugs. Author/s: Jim Papanikolaw

¹⁹ Bioinformatics Platforms, Silico Research, November 2000

Natt Goodman who estimates the current market at \$200m has also referenced the current market of '\$200M' in the recent amusing article²⁰. These estimates are amplified by the recent report by Oscar Gross²¹ in speculating that an increasing proportion of the informatics spend of BioPharma research will be outsourced²².

As discussed above, also excluded are most of the project-based R&D collaborations between Pharma/Agbio companies and genomics companies that include Bioinformatics "content," and which total well over \$1.0 billion on a cumulative basis over the past 3-5 years²³.

Current market size (by sales) = \$200m

Of course any estimates of the current market has to consider the current trading climate which for Bioinformatics is rather bleak as is evident from the following press releases. It can be expected that the market can, and must, recover from the current 'blip'.

2001 – A chill wind

Company Performance

Weakened market conditions²⁴

Incyte Genomics reported an income of \$51.1m in Q1 2001 despite "weakened market conditions and price erosion in the custom sequencing market". Their database & partnership revenues rose 24% to \$37m and custom genomics revenues grew 31% to \$14.1m. Total costs & expense rose by 29% to \$72.5m yielding a \$21.4m operating loss.

NetGenics Slashes Workforce by 30%

NetGenics laid off 29 people, or nearly 30% of its 100-person work force, as a result of the company's inability to launch its initial public offering due to poor market conditions, NetGenics CEO Manuel Glynias said Friday.

"We haven't been able to get the IPO done and it doesn't look possible for the next quarter or two," said Glynias. "We always hired because it was easy to raise money. Now it seems very sensible to me to focus the business."

According to NetGenics' S-1 statement, filed with the US Securities and Exchange Commission in March, the company, which has raised a total of \$49 million in private financing, had accumulated net losses of \$25.9 million at the end of December 1999, the last year for which data was available.

Lost Horizon²⁵

Even in the relatively tame field of conventional genomics exemplified by companies such as Celera, Fleming says the risk is harder to manage than that of investing in biotech companies developing therapeutics.

"You need to have a diversified investment base, and I'm not sure genomics today affords

²⁰ *Who wants to be a Bioinformatics Millionaire*, Genome Technology, May 2001

²¹ Trends In Commercial Bioinformatics, in *Biotechnology Review*, 13th March 2001, Oscar Gross

²² Ref 3 provides data that \$5.6b of the \$14b (40%) spend on discovery is outsourced.

²³ Ref 21

²⁴ SCRIP No 2641/42 May 9th/11th 2001 p 20

²⁵ *Biotech Venture Fund AGTC Looks Ahead* By Bradley J. Fikes March 5, 2001

that. The time frame between investment and revenues is so uncertain in that business ... I can invest in early-stage preclinical or late-stage, and I have a general idea of when I'm going to get to (profit) realization. But Celera, what's holding that stock up? You got what, \$20 million of revenue²⁶ supporting \$2 billion of capital value? You just hope that everything holds together."

DoubleTwist moves away from planned IPO²⁷

DoubleTwist Inc., which provides gene research services to drug developers, withdrew for now its plan for an initial public stock sale in a market with little investor demand for new stocks.

The money-losing start-up based in Oakland, first filed for the stock sale with the Securities and Exchange Commission last September. As of November it planned a stock sale led by Lehman Brothers Inc. to raise \$65 million to \$75 million.

Bottom Up – Market Value based on Potential Sales

Another way of understanding the value of Bioinformatics is to study the employment patterns of active researchers multiplied by a 'per seat' cost. Provision for Bioinformatics qualifies as 'tools for the trade'. This ignores the 'critical mass' argument of the Lehman study²⁸ and potentially extends out to scientists in Biotech and Pharma (large and small)²⁹.

To this must be added the per seat or subscription costs. Recent reports³⁰ indicates a range from 'a few thousand dollars' to journal level rates (\$500) from DoubleTwist to 50c per search (or \$500 per year) from eBioinformatics.

Market = Number of customers * revenue per customer

Estimating the potential market for Bioinformatics requires an estimate of the number of potential customer multiplied by the potential revenue per customer. The level of employment of the bioPharmaceutical sector is available from a number of sources. More difficult is the task of factoring down the total employees to those who, as active scientists, would be potential client for Bioinformatics tools.

Table 4 Biotechnology - by size and employment

	# Of Organisations	Revenue (2000)	R&D (2000)	Employees
European Biotech	1570	\$8,769m	\$4,977m	61,104
<i>Of which the public companies contribute</i>	<i>105 (6.7%)</i>	<i>\$4,393m (50%)</i>	<i>\$2,663m (54%)</i>	<i>23630 (39%)</i>

²⁶ Current (2001) income is \$89 a big increase from 2000 but still too small to deliver a reasonable P/E ratio [<http://www.applera.com/press/prccorp072601cra.html>]

²⁷ March 08, 2001 BLOOMBERG NEWS

²⁸ Ref 9

²⁹ Some estimates can be gloomy indeed. Private communication from a leading tools provider indicates only 21% of the top 25 'big pharmas' are potential client, the remainder build their own tools with in house teams. Combining this observation with the Lehman view on critical mass could reduce the potential market to just 5 companies!

³⁰ Ref 17

US Biotech	1273	\$23,750m	\$11,400m	162000
Of which the public companies contribute	300	\$20,022m (84%)	\$7,349m (64%)	114000 (70%)

BioWisdom estimates 150,000 potential users working on 5,000 projects at 2,000 biotechnology companies worldwide. Primary users are anticipated to include members of drug discovery and development teams. [To calibrate these estimates it should be noted that Informax claims a user population of 20000 spread across a total of 1650 companies³¹].

However it cannot be assumed that all employees of the Pharma or biotech organisations are potential users of Bioinformatics, however defined. The Pharmaceutical Manufacturers of America provide the following analysis for 'large Pharma'.

Table 5 Employment Patterns in Large Pharma

**DOMESTIC U.S. SCIENTIFIC AND PROFESSIONAL R&D PERSONNEL,
BY R&D FUNCTION, RESEARCH-BASED PHARMACEUTICAL COMPANIES, 1996-1998**

Function	1996 Personnel	1996 Share	1997 Personnel	1997 Share	1998 Personnel	1998 Share
Synthesis and Extraction	4,698	12.6%	3,491	10.8%	3,501	10.4%
Biological Screening and Pharmacological Testing	6,961	18.6%	4,976	15.4%	4,807	14.3%
Toxicology and Safety Testing	2,715	7.3%	2,051	6.4%	2,456	7.3%
Pharmaceutical Dosage Formulation and Stability Testing	5,041	13.5%	4,680	14.5%	4,784	14.2%
Clinical Evaluation: Phases I, II, and III	7,517	20.1%	8,418	26.1%	9,001	26.7%
Clinical Evaluation: Phase IV	1,100	2.9%	650	2.0%	676	2.0%
Process Development for Manufacturing and Quality Control	3,595	9.6%	2,655	8.3%	2,679	7.9%
Regulatory: IND and NDA	1,926	5.2%	2,500	7.7%	2,486	7.3%
Bioavailability	969	2.6%	815	2.5%	901	2.6%
Other	2,841	7.6%	2,028	6.3%	2,316	6.8%
TOTAL	34,784	100.0%	37,363	100.0%	33,607	100.0%

Note: Percentages may not add to totals due to rounding.
Source: Pharmaceutical Research and Manufacturers of America 2000.

Using data from the Pharmaceutical Research and Manufacturers of America identifies a maximum of 25% as active biological scientists (assuming all those in biological screening & pharmacological testing, (14%), those in bioavailability (2.6%) and 30% of those involved in synthesis (10%), toxicology (7%) and formulation (14%)).

Thus our estimates are that in Pharma approximately 25% of all scientists are concerned with biological research and of these, perhaps 60% of these are potential users of Bioinformatics tools. For Biotech companies assume 60% of employees are scientists of whom 60% are concerned with Biological research – or 36% of Biotech employees.

Using these ratios 15% of active scientists in Pharma [5,000] and 36% of employees in Biotech [70,000] are considered as potential Bioinformatics users.

The market size is therefore \$75m per \$1000 of 'subscription' revenue. For example if the Double Twist target subscription of \$10000 were to be applied this values the market at \$750M.

³¹ INFORMAX corporate presentation

At an average subscription rate of \$2000 per user this values the market at \$300m

Customer Value

Market Value calculated on the impact on R&D

The recent Lehman / McKinsey report *The Fruits of Genomics*³² suggests that the vast array of new targets made possible by the genomics revolution³³ will, initially, demand a high and costly attrition through the clinical process. This increased development expenditure will, unabated, limit the companies capable of bringing product to market and strangle the early stage investment. This rather dismal prospectus paints a gloomy mid-term forecast for biotechs (with limited development resources) and narrowly focused (small) Pharma companies.

Using the Lehman figures - the entry cost to Genomics is \$100M annual spend which, using industry averages, means an total R&D budget of \$500M or sales of \$2.5B. This limits the genomics to 39 companies or 23 qualified by an R&D budget exceeding \$500M³⁴.

The Lehman report goes further by estimating informatics costs at 30% of genomic research costs (which multiplying through these figures represent 7% of R&D or 1.5% of company revenue). Given that the total informatics costs inevitably include 'IT for Knowledge workers' - email, office & productivity tools - a good optimistic estimate would be 5% of R&D or 1% of revenue. Of this it would be prudent to eliminate the internal effort (generally 30% reference of R&D is outsourced but we can probably increase this to 50% for Bioinformatics), there are arguably reductions from the total informatics costs which are not bioinformatics from specialist IT areas such as data collection.

So the estimates based on value are:

1-3% of R&D spend - which for the top 24 companies (in R&D) with a combined expenditure³⁵ of \$38.6 bn is between \$300m to \$1bn³⁶.

Of course all of these estimates must inevitably overestimate the Bioinformatics market because they assume the source of new products (and hence focus for research) is exclusively NCEs unveiled by genomics. It ignores the product extension work (around the existing NCEs for example Nexium), the fast followers (the current equivalent of the analogue bashing but with a know target and/or mechanism), the traditional targets (such as 7TM) and the drug delivery work. Of course the protagonists of genomics forecast a faster take-up of genetic technologies but as yet these predictions are to reach commercial reality.

Table 6 Market Forecast for Genomic based Therapies

Year	Market Value ³⁷	% Of Total Market ³⁸
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³² The Fruits of Genomics, referenced in Chemical Reporter March 12, 2001 p31

³³ Quo vadis, biotech? Jurgen Drews in Drug Discovery Today Vol. 5, No. 12, December 2000

³⁴ Pharmaceutical Business Dec 2000 list of top 50 companies with a revenue in excess of \$2.5B

³⁵ Compared with top 25 Biotechs R&D of \$3.5Bn in R&D.

³⁶ Incidentally the next 24 companies only contribute an additional \$7bn of R&D expenditure - so even if the 'critical mass' argument by Lehman is wrong the market size is not much more than this.

³⁷ Source Datamonitor, assuming constant 1999 values

³⁸ As a 'rule of thumb' the contribution of Genomic techniques in discovery pre-dates the impact on the market but a decade. Typically to achieve a 16% market share in 2020 we should assume 16% of discovery targets are derived from Genomic techniques in 2010

2005	\$500M	0.2%
2010	\$10B	3%
2015	\$25B	8%
2020	\$50B	16%

More appropriately the impact of genomics should be considered against their impact on the research activity across different therapeutic areas where it can make an impact, the figure vary by medical intervention but display the same general characteristics³⁹

Table 7 Genomic Impact by Therapeutic Area

Therapy Area	Share of Genomics 2000 (%)	Share of Genomics 2005 (%)
Central Nervous System	20	40
Cardiovascular Diseases	25	30
Autoimmune Diseases	15	30
Infectious Diseases	20	55
Metabolic Diseases	25	40
Cancer	25	50

Factoring the potential market by the contribution of genomics to new product discovery provides a market value for Bioinformatics between \$150m and \$500m

Other Markets

The forecasts ignore the contribution of Bioinformatics to healthcare in general, diagnostics and of course the wider life and plant sciences⁴⁰. At the macro economic level these markets are both smaller and less profitable than mainstream Pharma, for example the agro-chem market, at \$35bn is more than an order of magnitude smaller than the Pharma market. Data provided in the Saviotti article⁴¹ suggests Pharma is only 21% of the Bioinformatics market with genomics an additional 12%⁴².

Intriguingly this valuation of Bioinformatics ignores the value in diagnostics and analytical techniques. Companies such as Nanogen have focused away from drug development and are positioned to exploit a new market for diagnostics, however this market has significant potential⁴³.

A Dangerous Circularity

There is a dangerous circularity in equating the venture investment in early stage and platform biotechnologies companies with their ability to generate revenue. Despite Wall Street's preference for high tech⁴⁴ the reality of Pharmaceuticals is they only generate

³⁹ Parexel Pharmaceutical R&D yearbook, 2001

⁴⁰ The Changing Market of Bioinformatics PP Saviotti, M deLooze, S Mechelland & D Catherine Nature Biotechnology Vol 18 December 2000 p1247

⁴¹ Ref 40

⁴² Although later in the same article this figure is quoted as over 40%.

⁴³ Figures for Affymetrix suggest a market capitalisation of \$2.3bn or a 10-fold increase in the \$250m investment by GlaxoWellcome in 1995 (assuming the Affymetrix element at 50% of the \$500m purchase of Affymax).

⁴⁴ The Motley Fool Analyst Opinion, May 2001

revenue from medicines - and therefore have to pass the clinical cost and efficacy hurdle. Whilst genomics fail to lower or cheapen the clinical hurdle (and the Lehman report argues that the hurdles become more costly, at least in the short term) the markets remain elusively remote. Companies such as Calera and Quintiles (CRO) are both directed towards 'small molecules' to increase their rent making potential. Interesting too to study the direction of HGS one of the pioneers in this areas focused on healing and patent expiring drugs⁴⁵ traditional fast to market revenue earners.

Costs of Manufacture

Employment Costs in Bioinformatics

In *The Changing Marketplace of Bioinformatics*⁴⁶ estimates the Bioinformatics to comprise 135 firms of which 84 are based in the US and 44 (32%) based in Europe. (To be compared with the wider Biotech market that is 40% based in Europe).

Using their figures it is possible to estimate the number of Bioinformaticians and hence the cost base of the Bioinformatics Industry (at an employment cost of \$50K each). Of the 135 firms..

Table 8 Employment in bioinformatics

Proportion	Size (employees)	Average Size	Number of Employees
3%	>500	500	2000
25%	>100 <500	250	8400
60%	>10 <50	20	1600
12%	<10	5	80
Total			12080

On this basis of employment the 'break-even' income for the Bioinformatics industry is approximately \$600m. A figure that exceeds the current income of approximately \$200m even when expanded by the anticipated venture funded growth of \$258m (see Gearing Venture Funding to Market Size).

Venture Capital Costs

The prospects for Bioinformatics are inseparable from the prospects and market structure of Biotech, so much of the equity investment in Biotech during 2000, totalling \$31Bn⁴⁷, will flow into Bioinformatics (of this investment some 16% is based in Europe).

Central to the investment and business model of Bioinformatics lies the investment model and business structure of Biotechnology because as VC funding enters the Biotech market so the trickle down to Bioinformatics will be significant. In Biotech revenues between 1997 and 1999 technology platforms comprised 54% of the income and, of this, Bioinformatics contributed 10% (or 5.4% of the total). Pro-rata this would suggest a Venture investment of \$1.5Bn into Bioinformatics during 2000.

⁴⁵ Genome Expert Looks to the Future United Press International KURT SAMSON, UPI Medical Writer April 25, 2001

⁴⁶ 40

⁴⁷ Integration, Ernst & Young Eighth Annual European Life Science Review, April 2001

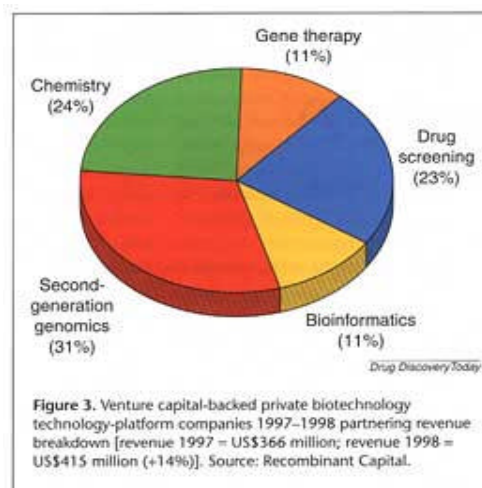
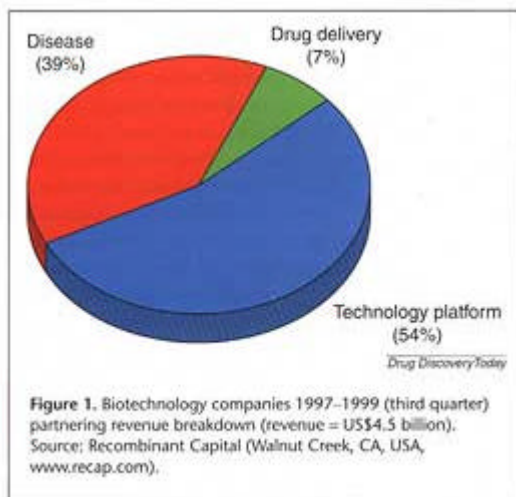


Figure 8 Investment ratios in Biotech

Gearing Venture Funding to Market Size

The economic 'physics' of venture funding demands that the capital funding entering Bioinformatics companies is matched by a growing market and income stream. The mathematics of investment and income are simple – the venture funds in aggregate need to produce a return based on the value of the company, and the value of the company *should*⁴⁸ be related to income.

Using these figures and assuming a three year term of VC funding, with an risk enhanced 20% premium for an adequate return ...

\$1 invested in an equity fund in 2000 should return \$1.72 in 2003

and

Assuming a P/E ratio of 10 the \$1.72 requires \$0.17 of income

On the basis of these calculations and assumptions the economically required market for Bioinformatics has to be an ***additional \$258M in three years.***

The Pharma VC Scene

For example in the last 6 months (at March 2001) both Merck and Eli Lilly launched \$100M in corporate venture funds. The target of these funds has been at the peripheral of drug development and contrasts with the established funds of Johnson & Johnson and SmithKline Beecham who have been active drug hunters. It is to be expected that these investments will be biased towards their core business and proportionately favour Bioinformatics. Understanding the Pharma patterns of investment would also calibrate the perceived significance of Bioinformatics to drug discovery.

However even in aggregate the Pharma funding is dwarfed by the independent venture capital. Except, of course, when compared with the acquisition costs of established companies, such as Merck's recent purchase of Rosetta Inpharmatica⁴⁹.

⁴⁸ Although as footnote 27 testify these relationships may not seem logical.

⁴⁹ Purchased in May 2001 for \$620m. Although it will be some time before the value of the purchase becomes clear, remember with caution the PBM purchases of the mid-1990's.

Closing remarks....

The real advance will be made once Genomics makes a substantial change to the cost of development especially clinical trials. If the cost of this represents a 4:1 ratio with discovery the leverage (and hence value) is much greater. Some work by McKinsey⁵⁰ speculated on how genomics could reduce the size of the clinical trials patient recruitments but the 'killer app' that of reducing the attrition rate in clinical is yet to be proved. Linking Bioinformatics to the clinic remains the goal and will be the subject of a later report.

⁵⁰ Manish Bhandari, Rajesh Garg, Robert Glassman, Philip C. Ma, and Rodney W. Zimmel, "A genetic revolution in health care," *The McKinsey Quarterly*, 1999 Number 4, pp. 58–67.
http://mckinseyquarterly.com/article_page.asp?articlename=gere99

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