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# Bioinformatics and Computer Technology-Trends in R&D and Industry

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## **ABSTRACT**

*Sharing of knowledge, resource and dissemination of information is the need of the day. No industry can stand in isolation and survive long. It needs to interact, compete and survive using latest technology with a sustainable area based on market demand. This paper takes a macro-view of Bioinformatics area and its sustainable conditions with a special reference to Indian scenario. This paper also illustrate that the demand of human resources in bioinformatics is expanding very fast. To fulfill this ever expanding demand, Government of India's effort has also been depicted briefly with a word of caution that one should not and must not compromise with the quality of teaching standard to produce bio-human resources.*

**Keywords:** *Bioinformatics, R&D, Industry, growth pattern, Human Genome Project, Indian initiative, course, professional*

### **Introduction:**

It is being increasingly felt that the 21<sup>st</sup> century will be driven by knowledge intensive industries such as Information Technology and Life Sciences. The growing importance of knowledge driven industries and business is paving the way for the emergence of new knowledge oriented fields. The field will get momentum for development which has a direct link to mankind particularly with respect to health, hygiene and food. Therefore, the most emerging field which is going to sustain for a long, will be the amalgamation of Biotechnology and Information technology i.e. to be very precisely the field of **Bioinformatics**. It is a field basically the convergence of Information Technology and Biotechnology.

In this short paper, an effort has been made to depict the growing demand of this field.

Broadly, this discipline represents application of IT in Life Sciences. There are several definitions of Bioinformatics as this area has evolved as a result of

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convergence of a number of disciplines of science mainly Biology, Biochemistry, Molecular Biology, Bio-statistics and Computer Science. As such, Bioinformatics is an emerging industry which harnesses the power of IT in areas such as Data Management to pursue research spanning across distinct faculties of Biological Research. The primary focus of Bioinformatics is to alleviate the complexities arising out of the enormous data derived from Biological Research.

#### **Factors contributed for Bioinformatics growth:**

The following developments have not only contributed significantly towards enhancing the application of Bioinformatics but also to sustain its growth for a longer period are:

- \* Clear understanding of how biological molecules are constructed and how they perform their functions.
- \* Availability of High end computing facilities and relevant software with scalable technologies. There have been a plethora of biological problems addressed by computational techniques.
- \* Availability of graphical display technology that enabled scientists to experiment with algorithms on the real life data sets in their own labs.
- \* Availability of Advancement of Internet Technology and the ability to share data through computer networks globally
- \* Publicly available Biological databases and the development of efficient algorithms for searching the databases.
- \* Availability of strong resource personnel in almost all sub-areas of biotechnology with *adequate expertise in the field of Information Technology*

Another very significant event in the history of development of Bioinformatics was "**The Human Genome Project (HGP)**" with ideological origins in mid 1980s. HGP is an international collaborative research programme whose goal is the complete mapping and understanding of all the 3 billion bases in the Human Genome. The vast data generated from this project created a need for software that enables companies to optimally utilize the data.

#### **Upsurge in Bio-R&D Activities**

IT acts as a catalyst and greatly shortens the time and efforts expanded towards research through latest development in hardware and software. Further, it also reduces the costs involved in drug discovery process. It has been estimated that the clinical trial segment of the drug development process can account for as much as 50% of total cost of the entire drug development process. There are many aspects of clinical trial data management that can benefit from automation. Studies show that simple automating data capture can reduce the cost of clinical trials by 10 - 12%.

Most of the countries across the globe are setting up sophisticated R&D Infrastructure to conduct cutting edge research on Genetics, Molecular Biology, Biochemistry etc. Also they have allocated large budgets for biotech R&D that has further augmented the importance of Information Technology in today's era.

#### **Thrust upon Bio-R&D**

More and more Pharma & Biotech Companies are channelizing resources towards improving productivity of their R&D activities. Pharma companies are under tremendous pressure to deliver innovative products at minimum cost. Therefore, these companies are reviewing their existing business models and exploring how IT tools could help further optimizing the situation.

#### **Application of IT to promote Bio-R &D**

Application of IT in Life Science is ever increasing. Basic research in the Life science by Government, Academia and Industry is becoming increasingly interdisciplinary, information integration driven and data intensive. Moreover latest computing and automated technologies, navigational and analysis software such as *DNA sequencing, high throughput screening, data mining, database management, simulations and visualization* have tremendously influenced Life Science Industry.

Across the globe, Pharma & Biotech companies are putting their best resources to develop application on specialized areas of bioinformatics like Genomics, Proteomics, Glycomics, Chemoinformatics,

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Pharmacogenomics, Clinical Informatics, Bio-Engineering, Bio-simulation, Molecular Modeling.

### **Global Bioinformatics Industry**

The market for bioinformatics platforms is growing at a significant pace with the increasing demand from U.S.A., Europe, Australia and India. The trend is supported by the increasing demand for sequencing platforms with increasing life science research using techniques such as gene expression analysis, sequence analysis, and protein expression analysis.

The global bioinformatics market is expected to reach \$8.3 billion by 2014 at a high CAGR of 24.8% from 2009-2014. While knowledge management formed the largest submarket in 2009 at \$1.3 billion, the bioinformatics platforms market is expected to have greatest market share in 2014 at an estimated \$3.9 billion, due to its rising demand.

At the country level, bioinformatics in South Korea will grow at a projected CAGR of over 16% to US\$ 270 Million by 2013. UK will also witness high growth rates in bioinformatics markets at a CAGR of approximately 16%. Japan has demonstrated its capabilities as a global player in bioinformatics databases. Besides, the analysis software and services market for bioinformatics has registered a CAGR of more than 21% between 2007 and 2010.

### **Bioinformatics Industry in India**

This is in the phase of evaluation. However, considering the wide ranging recognition of India's capabilities in the Technology driven sector across the globe, it is expected to emerge as a major player in the Bioinformatics area also. The Bioinformatics market in India was about \$15 Million in the year 2002-2003. It has grown to \$18 Million in the year 2003-2004 then to \$35 Million in the year 2006-2007 at a CAGR of 25%. Interesting, owing to low local demand, \$32 Million or about 90% of bioinformatics revenues of 2006-2007 in India are derived from outsourcing activities. Outsourcing to India, compared to other developed countries, offers about 30-40% cost savings in overall drug discovery research and close to 60% cost savings when outsourcing core bioinformatics services. This primarily due to lower wage costs for skilled professional and lower

Infrastructure costs.<sup>4,5,6</sup> The Bioinformatics market in India grows significantly for the last 2-3 years and is about \$75 Million in the year 2009-2010 at a CAGR of 28.92%. This demand growth and need for better utilisation of biotech resources have opened up huge opportunities for the Indian vendors like HCL Technologies, TCS and Infosys, that offer integrated bio technology solutions.

The Indian biotechnology market has a growth rate of 36.5% per annum that is amongst the highest in the world. Although it presently commands a market share of just 2% of global revenues, it has great potential to become a significant player in global biotech market shortly. The major opportunities for the Indian companies in the global Bioinformatics sectors are mainly Data Management and Integration, Software analysis and development, Statistical analysis and Drug discovery & development.

### **Government of India Initiative and Support**

In the tenth plan, GOI has identified Bioinformatics as an area of prime importance and high priority. The aim is to integrate and optimize available resources, plan expansion and encourage private participation. The Department of Biotechnology (DBT) under the Ministry of Science & Technology, established in 1986 laid the foundation of Biotechnology in India. DBT has set up a Biotechnology Information System Network (BTISnet) to create an infrastructure to promote Bioinformatics application. The main objective is to ensure that India could emerge as a key international player in the field of Bioinformatics enabling a great access to wealth of information created during post genome era and accelerate country's attainment of lead position in medical, agricultural, animal and environmental Biotechnology. The major thrust of the programme include advanced research in the frontier of Bioinformatics and computational Biology, development of high quality human resource in Bioinformatics, establish industry-academia interface and creation of world class platform for technology development.

While DBT is playing its role as the nodal Govt. Deptt., there are other agencies both in Government as well as in the private sector who are making commendable efforts to promote this discipline. For example, the Deptt. of Information Technology, GOI is setting up

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BIO-IT parks where various important facilities are created keeping in mind operational and common requirement of the wide spectrum of users. A number of CSIR labs like CCMB, IICB etc. together with other research organisation and academic institutions are also engaged in active research on Bioinformatics. Organisations like CII, FICCI has also join hands for the success of this sector. Besides, in the private sector, a number of organizations are making significant contributions to promote Bioinformatics in the country.

There are other companies also which are performing well. While the market is still big enough for Indian software companies to tap, the important thing is for these companies to realize that Bioinformatics is a highly specialized field where domain knowledge is more important than pricing. However, the overall scenario is encouraging and India should do well in this area in the years to come.

#### **Lack of trained bioinformatics professionals:**

There are enormous opportunities to take up bioinformatics as career development. It faces a serious impediment with the lack of efficient manpower. The availability of well trained human resource in bioinformatics is really inadequate. There is an urgent need to train the next generation in a formal, academic manner in the area bioinformatics. Government of India has realized and started many bioinformatics courses both at under graduate and post graduate level under its various national programme. In spite of this, there is still shortage bioinformatics professional in India. Many private institutes have started exploiting this demand for their commercial interests and offering courses on bioinformatics. A time has come, we need to standardized these courses with respect to subjects, it offer. Mechanism must also be evolved to assess the availability of quality professionals to teach bioinformatics in those institutes. Otherwise, the days are not far off when we will get enough professional with bioinformatics trained courses without actually having any trained person to work on Genomics, Proteomics, Bio-simulation, Molecular Modeling, Protein structure prediction, etc and as a consequence, we will also loose the market reputation of India to produce quality bioinformatics scientists across the globe.

#### **Conclusion:**

Bioinformatics is a new and growing discipline emerging through applications of Computer technology in Life Science. The field has got momentum of development due to direct links to the welfare of mankind particularly with respect to health, hygiene and food. Now this most emerging field which is going to sustain for a long, will be the amalgamation of Biotechnology and Information technology i.e. to be very precisely the field of *Bioinformatics*.

Due to availability of High end computing facilities and relevant software with scalable technologies, there have been a plethora of biological problems addressed by computational techniques. Availability of graphical display technology that enabled scientists to experiment with algorithms on the real life data sets in their own labs. Advancement of Internet Technology and the ability to share data through computer networks globally have provided opportunities the professionals to facilitate their own research in the respective fields. IT acts as a catalyst and greatly shortens the time and efforts expanded towards research through latest development in hardware and software.

The global bioinformatics market is expected to reach \$8.3 billion by 2014 at a high CAGR of 24.8% from 2009-2014 with the increasing demand from U.S.A., Europe, Australia and India. The Indian biotechnology market has a growth rate of 36.5% per annum that is amongst the highest in the world. While DBT is playing its role as the nodal Govt. Deptt., there are other agencies both in Government as well as in the private sector who are making commendable efforts to promote this discipline. For example, the Deptt. of Information Technology, GOI is setting up BIO-IT parks where various important facilities are created keeping in mind operational and common requirement of the wide spectrum of users. A number of CSIR labs like CCMB, IICB etc. together with other research organisation and academic institutions are also engaged in active research on Bioinformatics. Among challenges, trained human resources is the main constraint and govt. of India is trying to solve the problem by integrating training with university courses.

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