

Biotechnology Business Development in Hitachi

Hiroshi Sonoda
Yoshinori Harada, Ph.D
Hitoshi Matsuo
Tetsuo Yokoyama, Ph.D

OVERVIEW: Biotechnology harnesses the power of living organisms to perform useful work for people. It has been used for ages in the agriculture and brewing industries such as for food production. In the 1980s, a host of new technologies appeared beginning with genetic engineering that gave birth to the current age of biotechnology. These innovations are improving the QoL (quality of life) and they are having a big impact on industry. For example, in medicine and medical treatment, researchers are shedding light on drug efficacy and side-effect mechanisms and investigating individual characteristics at the genetic level. Soon we can expect preventative care and therapy geared to each patient. For environmental preservation, biotechnology is making contributions towards the development of safe materials, the efficient use of biomass, and the elimination of contaminants. Hitachi sees a lot of latent potential in biotechnology. To develop and to apply this potential towards life science businesses, Hitachi is converging its deep expertise in measurement, data processing, and molecular biology. Individually, these businesses have already produced excellent results in cutting-edge equipment for research in life science and medical imaging diagnostics.

INTRODUCTION

THE objective of biotechnology is to effectively harness the diverse powers in living organisms to daily life and industry. Since the discovery of the double helix structure of DNA (deoxyribonucleic acid) by

J. Watson and F. Crick in 1953, biotechnology has become the technology of molecular biology with the task of elucidating the roles of genes and proteins produced by living organisms. Entering the 21st century, genome sequencing of various organisms had

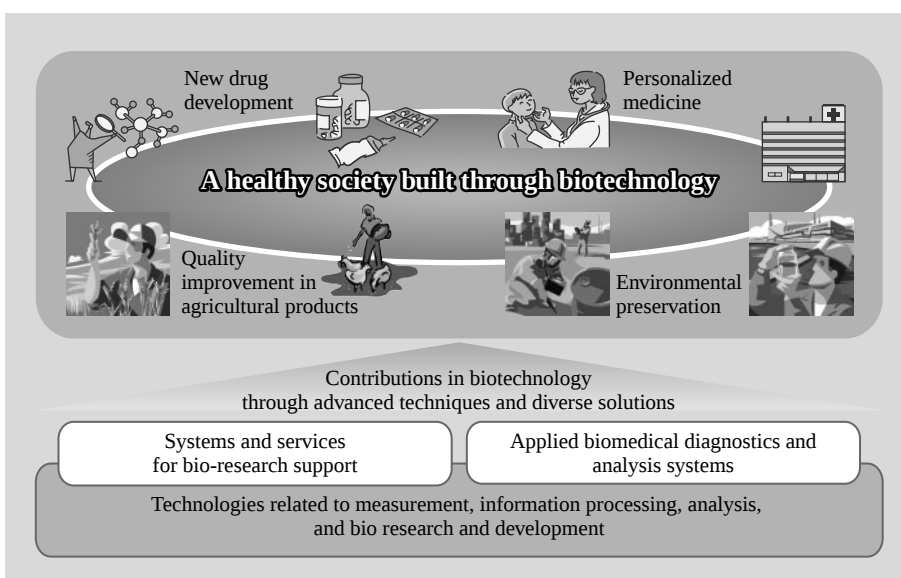


Fig. 1—Contribution to Healthy Society through Biotechnology and Business Development by Hitachi. With the advances in biotechnology, we can look forward to a healthier society. Hitachi is contributing to biotechnology progress, implementation, and solutions based on core techniques in measurement, data processing, and analysis. Hitachi solutions serve academia and various bio-related industries.

already been completed, including the human genome. For biotechnology, this achievement has ushered in a new trend from genome sequencing to attempts to understand the proteome (protein equivalent of the genome) and the metabolome (metabolite equivalent of the genome). This trend has greatly expanded data collection and efforts to elucidate a wider range of biogenic processes. As biotechnology enters a new era, the new knowledge gained will revolutionize medicine, medical treatment, food, and the environment with new applications.

Starting with equipment for biochemical analysis and DNA sequencing, Hitachi develops various products and services that support biotechnology research.

This paper describes biotechnology as it enters a new era, Hitachi's response in R&D (research and development), and the new lineup of application products and services.

BIOTECHNOLOGY TRENDS

The human genome project began in the 1980s with the investment of many developed nations and it finished in 2003 with the announcement that all human genome sequences had been decoded. This achievement has impacted society in two ways. First, mapping the human genome makes it possible to analyze individual genetic information passed on from parents. Second, bioscience combined with industrialized technological innovations makes it possible to analyze genes and proteins comprehensively, not only individually but also on an industrial scale. At the same time, the emphasis of biotechnology research is shifting towards more complex targets like transcriptome analysis (comprehensive gene expression under defined conditions), proteome analysis (comprehensive protein expression under defined conditions), and metabolome analysis (comprehensive metabolite expression under defined conditions). For human genome analysis, research to develop medicine and treatment is very active and advancing through the support of a national fund. Research areas include the detailed functional analysis of individual genes and gene clusters and comprehensive analysis to uncover the causal relationship between individual differences among the same disease and genetic variation [SNP (single nucleotide polymorphism)].

Biotechnology applications currently drawing attention include individual-optimized medical treatment using SNP information and genetic testing.

Bio-measurement technology

- For complex structures and extremely minute samples
- For data reliability and reproducibility

Data processing and analysis technology

- For vast data volume and multiple databases
- For complex simulations and 3D structural analysis

R&D outsourcing

- For faster research against intensified competition
- For more accurate and more complex research methods
- More efficient research, lower cost

Fig. 2—Biotechnology R&D Requirements.

To improve the reliability, the efficiency, and the speed of research results, society demands complete R&D support systems that include bio-measurement technology, data processing and R&D outsourcing services.

Biotech R&D is extremely active in Japan and overseas, with participants from the bioscience industry like national and public institutions and pharmaceutical companies as well as hospitals. This brisk activity with its increasing complexity of themes, greater sophistication, increasing research volume, and intensifying competition has created important issues related to R&D reliability, efficiency, and speed. To meet these new challenges, methods must be found to upgrade and enhance the biotechnology R&D support environment, which includes biotechnology instrumentation technology, data processing and analysis technologies, and outsourcing services that support R&D.

HITACHI'S ACTIVITIES

Hitachi has an active health solutions business centered on equipment for research analysis, medical imaging, and culturing. Hitachi is strengthening efforts in a wide range of devices from measurement, diagnostics, and data processing to industrial use. Fig. 3 summarizes current biotech product development in response to demands from society and industry. Public institutions, pharmaceutical companies, and functional food makers all have proper R&D requirements. To meet these requirements, Hitachi is developing and offering a variety of advanced analysis services. The lineup includes highly reliable measurement systems for bioresearch, analysis and testing devices, large-volume data analysis, and information processing

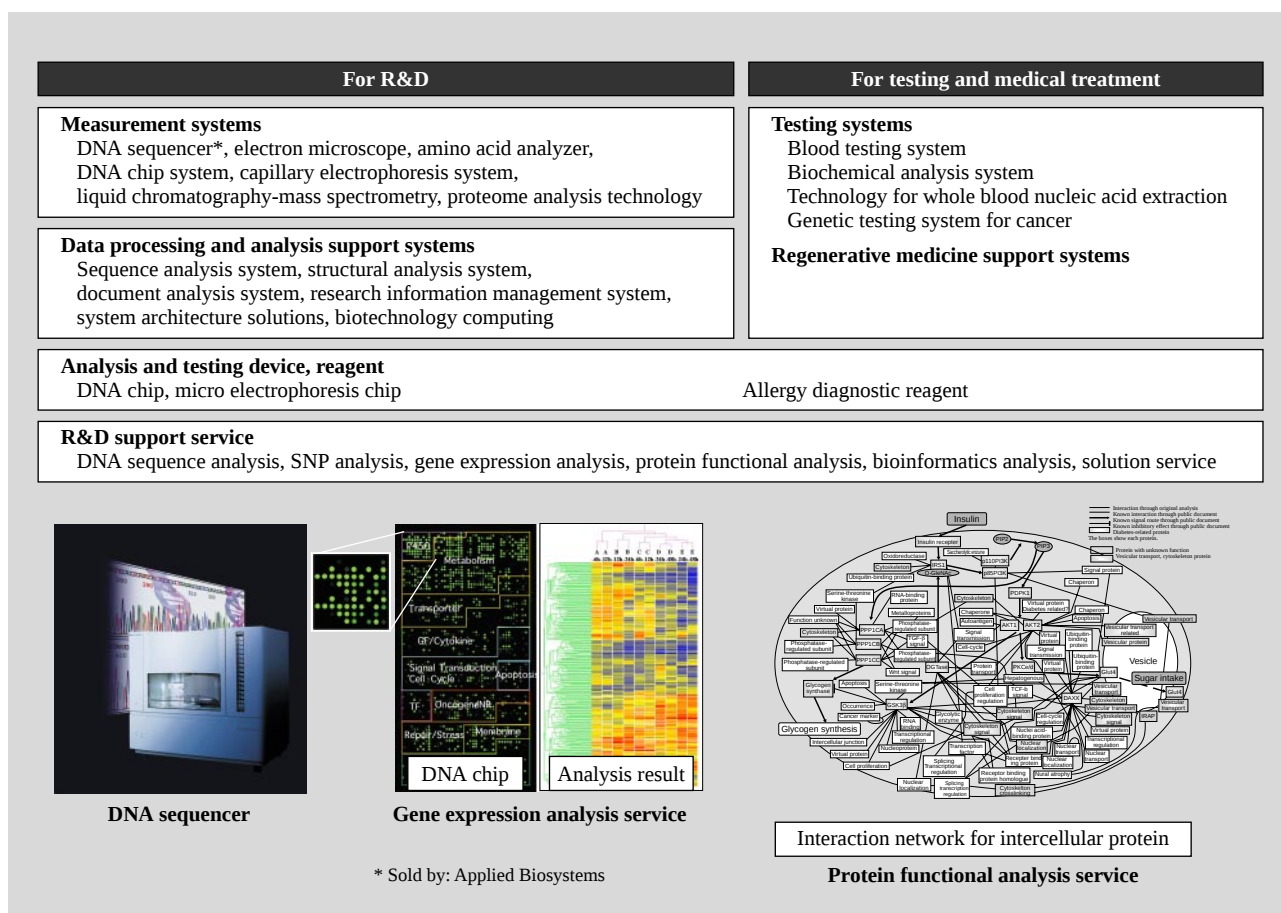


Fig. 3—Hitachi's Biotech Products, Services, and Development Technologies.

Hitachi meets diverse demands in biotechnology from wet systems (measurement, testing, reagent) and dry systems (bio-information processing, analysis support) to R&D support services that combine the two.

suitable for simulation (bioinformatics). For testing and medical treatment and data mining, Hitachi is developing genetic testing systems, high-sensitivity allergy diagnostic reagents, as well as technology and equipment for regenerative medicine. Genetic testing systems will likely become widespread in the future.

A battery of biotechnology products is supported by so called wet and dry technologies. Wet technology includes measurement and testing systems and their supporting production techniques. Dry technology includes data processing support systems. One strength of Hitachi is its ability to provide both advanced wet and dry technologies. With this capability, Hitachi can offer a customer more than just suitable equipment and systems, it can offer solutions that integrate wet and dry methods.

Innovations in biotechnology come at extremely high speed and their applications range over diverse fields. To help sprout future advances, Hitachi's

laboratories will continue to collaborate with business departments and affiliate companies within the Hitachi group.

R&D Products and Services

Measurement system

Hitachi has developed measurement systems for biotechnology R&D products including centrifuges and other sample preparation devices, DNA sequencers, and DNA chip systems. Hitachi also develops products with unique features for genome and transcriptome analyses. In the future, proteome analysis and metabolome analysis will become very active fields. These fields will require high-precision technology to measure minute sample quantity and complex structures.

Hitachi has succeeded in developing the measurement technologies customers demand. Below are two technologies Hitachi will incorporate into products for proteome analysis and metabolome

analysis.

(1) NanoLC (liquid chromatograph) trap TOF (time of flight) mass spectrometer: This product can measure bio-molecules with high sensitivity and can separate minute samples with excellent reproducibility.

(2) Electron-capture dissociation system implemented in a radio-frequency trap for proteomics: This product is suitable for the analysis of complex, modified proteins.

Bioinformatics support systems

The ability to collect genome and proteome data on an industrial scale has caused the volume of data to increase rapidly. Databases at government and private institutions in Japan and overseas are growing enormously. These institutions are also digitizing document data for input into databases. To navigate through these documents for known genome and proteome information, researchers require a massive search engine that can traverse many databases. In biotechnology, images are often very important, so a search engine must also incorporate image data. High-speed computing with high resolution is another requirement. For example, after refining a protein search, a researcher may need even more advanced information obtained through structure and function analysis and simulation that predicts the binding characteristics between a drug and a protein. Up to now, the computing power required for this level of information processing in bioresearch has not been satisfactory. Researches are waiting for powerful hardware and software to catch up with needs.

Hitachi packages sequencing and structure analysis software with each device. In addition, Hitachi offers data mining systems that incorporate natural language processing, structure analysis systems, and system operation support services. For customers that demand large-scale data sharing and computing power, Hitachi is also developing bio grid computing technology.

R&D support service

Biotechnology R&D is becoming more complex and more advanced than ever. A single enterprise or government institution may consider it too expensive or inefficient to do all R&D in house. In either case, R&D outsourcing is on the increase. In response to genome, transcriptome, proteome, and metabolome needs, Hitachi offers outsourcing analysis services through experts who use Hitachi products.

Current customer trends show increasing demand for value-added services that provide data

interpretation results and decreasing demand for devices that store raw data or databases that process raw data. To meet this new demand for interpretation results, Hitachi offers R&D services that support business through bioinformatics.

When providing R&D support services, a service provider may obtain knowledge of a customer's genetic information through handling a sample. Hitachi has established an ethics committee, which lays down procedures to ensure the service provides complete anonymity to any human sample. If the customer is a pharmaceutical company, GLP (good laboratory practice) guidelines are applied as required when acquiring data for drug authorization.

Products for Testing and Medical Treatment

Products for medical treatment that apply biotechnology include genetic testing systems. Currently, robots handle part of the manufacturing process. However, human hands do a majority of the work. In the future, hospitals everywhere will use genetic testing as a routine procedure in laboratories. However, genetic testing systems must shrink to the size of a kit and become automated and fast.

In Japan hay fever has become a kind of national ailment. To search for an allergy's cause and to be as non-invasive as possible, doctors require improved measurement sensitivity, multiple-item testing, and speed.

Hitachi is developing several biotechnologies, suitable for testing systems in medical treatment, that have improved automation, speed, and functionality.

(1) Nucleic acid extraction technology through a suction-discharge method: this method provides easy and fast extraction of nucleic acid from blood and easy genetic testing pretreatment.

(2) A genetic testing system for cancer that can predict the risk of reoccurrence: this system automates the manual testing process and speeds up time-consuming electrophoresis.

(3) Diagnostics reagents for allergies used in screening and testing: the reagents achieve fast measurements, high sensitivity, and multiple-item testing.

(4) Material production for clean rooms that can detect and eliminate contamination: this technology is for regenerative medicine and related research facilities.

CONCLUSIONS

This paper has described trends in biotechnology, Hitachi's product lineup in research and medical treatment, and the development of fundamental

technologies.

In the future, biotechnology research will accelerate and applications will branch into many new fields. Hitachi will continue to advance biotechnology and to provide state-of-the-art bio-products and services.

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ABOUT THE AUTHORS



Hiroshi Sonoda

Joined Hitachi, Ltd. in 1985, and now works at the Pharma and Biotech Systems Department, the Total Solutions Division. He is currently engaged in promoting bio-related businesses. Mr. Sonoda is a member of the Chemical Society of Japan (CSJ), and can be reached by e-mail at hiroshi.sonoda.dn@hitachi.com.



Yoshinori Harada

Joined Hitachi, Ltd. in 1982, and now works at the Life Science Group. He is currently engaged in information service planning related to life science industrial technology evaluation, collaboration negotiations, and service marketing. Dr. Harada is a member of the Japanese Biochemical Society (JBS), CSJ, The Biophysical Society of Japan, and Protein Science Society of Japan, and can be reached by e-mail at yharada@ls.hitachi.co.jp.



Hitoshi Matsuo

Joined Hitachi, Ltd. in 1982, and now works at the Life Science Research Laboratory of the Central Research Laboratory. He is currently engaged in R&D management of the life science research with a focus on medical instrument and biology. Mr. Matsuo is a member of The Institute of Electrical and Electronics Engineers, Inc. (IEEE), Healthcare Information and Management Systems Society (HIMSS), the Japan Society of Medical Informatics (JAM), and the Japanese Society for Medical and Biological Engineering (JSMBE), and can be reached by e-mail at matsuo@crl.hitachi.co.jp.



Tetsuo Yokoyama

Joined Hitachi, Ltd. in 1972, and now works at the Development Headquarters, Nano Technology Products Division, Hitachi High-Technologies Corporation and the Life Science Group of Hitachi, Ltd. He is currently engaged in biomedical R&D management. Dr. Yokoyama is a member of IEEE and JSMBE, and can be reached by e-mail at yokoyama-tetsuo@naka.hitachi-hitec.com.