Application Story

Motorola Life Sciences selects Insightful's analytic technology to manufacture reliable high-quality biochips for genomics and expression data mining

High-performance analytic software technology combined with Motorola's Six Sigma semiconductor manufacturing legacy optimizes manufacturing processes, geometrically increases product sensitivity, repeatability, and miniaturization and provides an ever-increasing level of customer satisfaction. Product yield and quality has increased substantially since the application of Insightful's advanced analytical software mixed with a unique application of techniques gleaned from Motorola's experience in semiconductor engineering.

Motorola Life Sciences, a business unit of Motorola, Inc. (NYSE: MOT) develops products that deliver better healthcare through the understanding and practical application of genomics. It develops products that enable scientists and healthcare professionals to quickly and accurately analyze DNA, RNA and proteins from living cells. Motorola is applying its core competency in manufacturing high-quality semiconductors, signal processing, microfluidics and embedded systems to making the industry's best biochips for life science research, drug development and clinical diagnostics.

Biochip production is big business. Industry experts estimate that sales will reach between $5 and $10 billion by 2010. Within the next seven years, industry analysts predict that doctors will be able to retrieve our genetic makeup from an identification card and use handheld technology to compare our data against terabytes of genetic data contained on disposable biochips. Better information has the potential to redefine treatment, eradicate disease and add years to human life.

A biochip is a small silicon wafer that contains thousands of probes sensitive enough to measuring individual gene activity. The human genome is estimated to contain 30,000 to 40,000 unique genes. Motorola's human biochip currently contains 10,000 probes and is expected to release a chip containing 20,000 probes by early next year. Buyers are demanding better information faster, from adding more probes per chip to requesting specialized products for clinical research. Creating new reliable designs to meet market demand is increasing manufacturing challenges.

Healthcare professionals are using biochips to identify, understand and treat genetic diseases. For example, researchers can mine terabytes of gene expression data provided on a biochip against a normal human cell. Motorola's SNP chip helps researchers and clinicians detect subtle changes in the genetic code that causes heritable genetic defects. Early detection helps doctors diagnose, delay or even completely prevent the onset of symptoms in their patients.

The Challenge

Scientists, programmers and statisticians in the Department of Statistical Informatics at Motorola Life Sciences, Northbrook, IL, led by Dr. Xianqun Wang provide analytic expertise for biochip manufacturing from product design to real-world delivery. At Motorola, industrial engineers and planners, materials management teams and researchers rely on this team to

provide accurate analytic information to make important decisions about improving or designing new products to optimizing product quality.

“Our healthcare customers rely on our products to provide them with reliable, reproducible information to make important decisions with confidence. Our biochip tools are used in the early stages of drug discovery by researchers who identify genetic targets in order to develop effective treatments. Robust, analytic technology, like Insightful’s is definitely mission-critical for producing high-quality biochips that provide the most reproducible biological information currently available,“ said Dr. Phillip Stafford, Sr. Scientist, for Motorola Life Sciences.

Stafford reviewed competitive products and selected Insightful’s flexible, powerful analytic technology. Unlike competitive packages Insightful offered the most complete solution including:

- robust, reliable and scalable analytic tools capable of mining enormous biological datasets with minimal hardware overhead to optimize design and manufacturing processes
- flexibility to model and prototype new chip designs quickly and efficiently
- a complete environment for analyzing, prototyping, visualizing and integrating analytics into Motorola’s production and research infrastructure for information sharing and rapid statistical analyses
- extensibility using a programming language to integrate advanced statistical solutions tightly and seamlessly with production Oracle databases and file servers
- advanced visualization techniques for enterprise-level web-based reporting
- shallow learning curve with the option to access advanced statistical tools when ready

The Solution

The MLS statistics team performs a variety of statistical methods in order to merge biological engineering with the rigorous engineering legacy of semiconductor design and manufacture. Biological processes have by nature been notoriously difficult to measure in a repeatable fashion, yet Motorola utilizes precise, comprehensive analytic methods to measure variability, sensitivity and reproducibility of biochip designs and manufactured products. Insightful’s technology provides decision-makers with the best information available to make smart business decisions in order to quickly optimize design and production processes and stay well ahead of the competition.

The research laboratory at Motorola Life Sciences provides the Statistics team with high-quality expression and genomic data so they can examine the minute variation between individual biochips. In a competitive industry, slight differences in sensitivity and reproducibility can mean the difference between a sale and a missed opportunity. “Motorola’s Six Sigma methodology combined with Insightful’s analytic expertise allows us to optimize production quality and design industry-leading biochips for our customers. This key advantage puts us way ahead of traditional microarray companies,“ said Stafford.

Stafford relies on Insightful’s analytic solution to deliver accurate results. “Our customers need high-quality, precise information to make important decisions. Poor information during the early stages of drug discovery could cost our customers millions. It’s our job to produce biochips that provide our clients with information that they can use with confidence. Insightful provides us with the analytic expertise we need to deliver on quality,” said Stafford.

Insightful has been delivering flexible, extensible analytic technology to leading healthcare companies for more than ten years. “Insightful’s analytic technology, direct database

connectivity and Java extensibility, helps us prototype new product designs extremely quickly. Selecting the optimal design that meets our stringent product quality and manufacturing standards is critical. Selecting the wrong design can cost pharmaceutical companies millions in poor yields and lost revenue.

"With Insightful's technology, we can prototype new designs within minutes. It has helped us improve our productivity and use our resources much more wisely. In a rapidly changing industry, finding the right design and building new products to meet customer demand gives us with a significant competitive advantage. Previously, we would spend days writing code and analyzing models to build similar prototypes and could not even guarantee if the design would be successful or not," said Stafford.

Motorola deploys Insightful's analytic technology to improve and build new products. Researchers at MLS use Insightful's analytic technology for creating and running predictive logistic regression models, multivariate analyses and clustering functions for genomic analyses and linkage mapping. Insightful's data mining techniques for gene expression combined with unparalleled visualization tools allow decision-makers to communicate accurate information across the enterprise to thoroughly optimize novel chip designs and improve production processes.

Unlike "black box" technologies, Insightful's analytic technology offers a complete programming environment that allows Stafford to program analytics for decision-makers up, down and across his organization.

Insightful's analytic technology allows Stafford to:

- create new algorithms or analytic methods quickly and easily
- optimize production processes in real-time through ODBC/JDBC database connectivity
- visualize large datasets with a minimum of hardware requirements

"In the past, we had to manage quality control as well as scientific applications using less-than-robust software. With the addition of managing multiple software packages we were spread fairly thin. Now we are able to maintain consistency and increase our productivity with one package," said Stafford.

Insightful's technology offers Java and XML features that allow Stafford to utilize database access and external Java functionality directly with the S+ language. Custom Graphlets (an S+ specific feature) allow users to drill-down to data points in order to review background information from word processing documents to supplemental charts, alternate data and much more. "One of my favorite features of Insightful's technology is the thoughtful integration of Java functionality, which is definitely the leading platform for biotechnology software. Java Graphlets and web-page integration give our managers an informative snapshot of production and design issues that are critical to daily business decisions. Integrating analytics into our internal web infrastructure has been pretty straightforward using these built-in Java features," said Stafford.

Applications

- Design of Experiments
- Statistical Process Control
- Power Analysis
- Clustering
- ANOVA, Robust and Logistic regression, Multivariate analyses and Nonparametric methods
- Graphing, Graphlets, JSP
- Java functionality in UNIX

Products

- S-PLUS