White Paper

Analytics:
Revealing the Future for Business

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Revealing the Future for Business

Introduction

Analytics stands on the shoulders of information traditions that date back even before the computer era. Although analytics represents the current set of tools that support automated decisions in an expanding number of industry settings, the attitude that gave rise to analytics—the "test and learn culture"—has its beginning in the scientific method.

Seen as an effective decision-support tool primarily for the military and financial services markets just 20 years ago, analytics has now attracted the attention of a growing range of companies that see the field as an important way to gain a competitive edge through the strategic mining and analysis of multitudes of customer, partner and employee data. As an integral part of an organization's business strategy, analytics can also improve their bottom line and—through real-time, interactive decision-making—enhance relationships with their many constituents.

Analytics are employed by companies as diverse as:

- Professional sports teams that continually assess the strategic value of recruits and players
- Hospitality companies that widely implement revenue management systems to optimize occupancy rates and revenues
- Manufacturers that have gained new levels of control and decision-making through the use of visual analytics systems that uniquely present complex data enabling direct interrogation and rapid understanding of both broad trends and granular details
- Consumer brands that need innovative ways to mine customer-feedback to learn about perceptions in the marketplace, and many more.

This paper demonstrates how San Diego has grown to become an important hub for analytics talent and investment. It will showcase several local companies who are examples of how broadly analytics are being used -- beyond traditional definitions -- to drive new levels of automated decisions, meaningful customer experiences, and improved process flow and profitability.

The Evolution of Analytics

Although quarreling over semantics often threatens to upend any overview of this type, "analytics" can be defined as the current evolutionary stage of providing decision support to an organization through the statistical analysis of existing data. In fact, decision support systems have paralleled the evolution of computer technology over the last fifty years, as we see below.

First Wave: Artificial intelligence (pre-1980)

In the 1950s, computers occupied entire rooms and the prevailing vision in the burgeoning field of "artificial intelligence" revolved around making a machine think like a human. Although the state-of-the-art computers of the time were gargantuan, the data sets they could manipulate were, by today's standards, both miniscule and simplistic in their structure. This severely compromised the range of decisions that machines could handle but brilliant minds and clear vision overcame these limitations and managed to move the field forward with many notable successes.

In 1956, Fair Isaac Corporation was founded on the belief that data, if analyzed in a systematic way, can assist with business decisions. Within two years, engineer Bill Fair and mathematician Earl Isaac had developed their first credit scoring system for a financial services client. The Fair Isaac "FICO" Score has since become an industry standard for evaluating credit worthiness in the United States.

In 1961 Jonathan Robbin founded General Analytics Corporation, now Claritas, Inc. Robbin was a scientist who understood before most others that America was becoming a market of diverse populations that reacted and behaved differently to marketing messages. To find, locate and describe these unique sub-markets, Robbin invented a new industry – geodemography, the practice of identifying and mapping the different marketing subsets of the U.S. population. One of its first significant applications was for the federal "War on Poverty" program in the 1960s.

In 1969 J. Robert Beyster, Ph.D. founded Science Applications Incorporated (now SAIC) in La Jolla. SAIC started with a small team of scientists and a couple of consulting contracts including one from Los Alamos and one from Brookhaven National Labs. SAIC has grown to be a leader in scientific, engineering, systems integration and technical services and products. SAIC customers seek domain expertise to solve complex technical challenges in national security, intelligence and homeland defense.

In 1970 Peter Preuss founded Integrated Software Systems Corporation (ISSCO), which was one of the world's leading independent developers of visual information systems software used to create high quality graphics for business, government, and academic applications. Computer Associates acquired ISSCO in 1986.

These early innovators set the stage on which San Diego analytics companies developed during the next wave.

Second Wave: Business Intelligence (80s to mid 90s)

As the size of computers grew radically smaller and as the computing power for these machines grew exponentially larger (following Moore's law that projects a doubling of power and halving of size every two years), we also saw the rise of applications that could handle large, structured data sets and perform sophisticated reporting and analysis. With the focus now shifting to machine learning based on rules, the field of "Business Intelligence" was fueled by the combination of powerful relational database software, coupled with the data analysis, reporting and visualization capabilities of BI applications.

Business Function	Technical Capability	Example
Data Warehouse	Relational Database Management System (RDBMS)	▪ IBM DB2 ▪ Oracle ▪ Teradata ▪ Informix ▪ Sybase
Business Intelligence: data analysis, reporting and visualization	Online Analytic Processing (OLAP)	▪ Brio ▪ Business Objects ▪ Cognos ▪ Hyperion ▪ MicroStrategy

At the same time, the expanded capabilities of computing power, applications, and data structures gave rise to whole classes of enterprise business applications—Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), and more. One classic example of development during this wave was the airline reservation process. Innovation in the reservation systems enabled carriers to optimize both profitability and resource allocation.

Business intelligence—sometimes referred to today as "easy analytics"—continues to have wide applicability in business, delivering improvements to the bottom line by providing key insights through "data-based decision-making" and leading to more informed business decisions. These decisions give rise to new policies that are then embodied within an organization's policy manual, pricing sheet, marketing campaigns, or as business rules within enterprise applications.

Third Wave: Analytics (mid 90s to the present)

While consumers experienced a power boost in desktop computing, the scientific, mathematics and IT communities saw several quantum leaps take place in the computational power of workstations and in the sophistication of network architectures, including the internet. As computing power and software sophistication grew, this enabled the closer integration of complex algorithms into a business' operational processes to drive

customer decisions. This new class of more sophisticated decision-making tools was called "analytics".

A key driver of analytics is data—structured and unstructured, historical and real-time. We live in a time of great data proliferation. As more powerful analytics applications become available, more of this data yields to analysis and supports decisions. For example, unstructured text represents a huge body of data that has been probed by analytic tools in the just the last ten years to deliver real-time intelligence and decision support to businesses. With the advent of new technologies like radio frequency identification (RFID), that accumulation of new bodies of data—along with the applications to unlock new findings—will only accelerate.

During this wave of the evolution, we have seen the emergence of new trends, notably online applications like social networking, web analytics, sophisticated search strategies, and new models of commerce, driven by a company's ability to operate confidently in the web environment.

This analytics wave has also been characterized by diversity—with new branches of analytics serving entirely new industries in entirely new application areas. Indeed, no business seems beyond the grasp of analytics. For example, analytics are now applied not only to numeric data but to text and video data as well. This opens many new opportunities both for analytics companies and their clients. The analysis of text data to understand customer behavior and attitudes has begun to revolutionize customer service and market research.

SAIC is an example of a company that mines and analyzes both text and audio data. According to the *Business 2.0* article "In the Company of Spies", SAIC helps government intelligence organizations sift through immense volumes of phone, fax, and email data, as well as other types of electronic communications. SAIC applications are used to identify patterns and connections between names, terms, and ideas in written text. The application can process 2 billion documents every four seconds, and produce analyses that would take the human mind months to complete. According to the article, SAIC applications "process language in much the same way the human mind does and contains a degree of artificial intelligence that allows it to make judgments about abstract connections." [1]

Similar content analysis principles can also be applied to video and other unstructured data. San Diego-based DriveCam uses video and wave form analysis created in a vehicle event recorder to identify what's going on in our vehicle's environment and improves risky driving behavior by predicting and preventing crashes and other hazards. These are just a few local examples of companies applying analytics to solve a broad array of business, social, and national problems using non-numeric data.

Technology developments fueling the proliferation of analytics into more business processes include:

- Internet-enabled, real-time querying and decision support, making analytic services readily accessible to employees and customers
- "Electronification" of business processes—via ERP, CRM, SCM and the internet—generating increasingly more detailed data on employee, customer and supplier behavior, providing new raw material for analysis
- Converting long-established algorithms into automated and processor-intensive data-mining tools and integrating these into a business workflow for executive decision support
- Service Oriented Architecture (SOA), facilitating the connectivity of analytic services to existing software applications
- XML, making large amounts of data "cullable" and sharable across applications
- Continued growth in computing power and data storage capabilities

In addition to technology developments we also see increasing business rule complexity driven by competitive and regulatory forces that lend themselves toward more sophisticated analytic applications. Whereas earlier waves of business intelligence aimed to have machine learning mimic human learning, machine learning in the current environment typically outstrips what humans could even perceive. During the early years of analytics, applications typically sought to automate human judgment and processes. For example making a decision to approve a loan or insurance policy more quickly, more cost effectively, and more consistently. Today however, analytic applications can identify patterns or relationships in vast data sets that are so subtle and discriminating that most humans would not be able to draw these complex conclusions, even in much longer periods of time. Through the use of sophisticated tools, the analysis of disparate and seemingly unstructured data sets can result in the subtle discrimination of patterns and connections that can result in conclusions that would be otherwise unobtainable.

Although analytics seems to be an expanding field with few limitations, there are, in fact, real-world problems that do not yield to an analytics approach. Analytics works best in those areas where historical data is large and where analytic decisions are applied in large-scale, repeatable, high-value decision areas, such as:

> Consumer goods marketing - There are many potential offers, many potential customers, and there is an opportunity to perform numerous "tests" to learn which offers are most appealing to a sample of customers before applying them to the entire customer base. In contrast, one-time strategic decisions—such as whether or not to merge with a particular competitor—are poor candidates for analytics, as there is typically little or no historical data upon which to model the outcome.

Identification of fraud – The principles of identifying fraud are based in identifying the characteristics that are similar for well-performing or "good" loans, transactions, activities, etc. and those that are "bad", and discerning the two with a high level of accuracy. There are many types of fraud that are identified well using analytics. For example, mortgage fraud, fraud related to telecommunications roaming charges, and internet "click" fraud all represent good fits for analytics, again because the data sets are considerable and they reflect behavioral models that can be analyzed to reveal fraudulent patterns. Click fraud is a relatively new anti-competitive behavior related to search engine marketing.

Customer feedback—whether collected online or through e-mails—has been mined to provide companies with real-time market "buzz," competitive information, desired feature sets for products, and even instant "brand snapshots." Can iterative analysis of voice and visual feedback be far behind?

Analytics have been widely adopted across industries and firms that best leverage analytics are increasingly leading their industries.[2] Capital One (consumer finance), Harrah's (casinos), and The Boston Red Sox (baseball team) are all recognized leaders in their respective industries and who cite their use of analytics as a principal component of their competitive strategy.[3] In fact, "data analysis" is now seen as a fundamental basis of innovation—as able to create a sustainable competitive advantage as innovations in cost, design, logistics, or product line extension.[4]

Next Wave: What will this look like?

Seeing the progression of decision-support technology as it has progressed from the 50s up to the present, one's curiosity naturally turns to the future, wondering what new developments might unfold in the next decade. This question was posed to several prominent members of the San Diego analytics community. Their thoughts are presented below:

Bruce Hansen, ID Analytics:

We see the field moving toward an increasing use of real-time analytics. Automated real-time decision flow, as an aspect of machine-to-machine processes that build on themselves, will reach higher levels of power and sophistication. An example of this is using analytics to better understand consumer behavior and presenting meaningful, customized product and services offerings at the point of customer interaction on the Web, in a retail store, or on the telephone. Then using the feedback or outcome of that customer interaction to feed and build future targeting and marketing strategies. Operationalizing analytics makes it more powerful by driving the insight into the decision-making process directly. It's important to see that analytics works hand in glove with the software industry. Data and software, together, fuel analytics.

Although there will be more flavors of the technology, much of it will still be based on human neural networks—a landmark technology but just one of dozens of new models for machine learning. The academic community will push the envelope by developing more models for machine learning.

As these new decision frameworks are brought to bear on existing data collections, more companies and service providers will achieve a greater return on their IT investment by leveraging that data which they invested so heavily in amassing and storing. Now those data assets provide for the payoff through sophisticated, automated, and self-learning decision flow.

Todd Gutschow, HNC Co-founder:

As computers get faster and smaller, we will see the evolution of capable autonomous systems moving into areas previously reserved for human beings. There are many examples of systems already in development today in San Diego and elsewhere, including: home cleaning and yard care systems; fruit harvesting and tree and vine pruning systems improving labor intensive activities in the agricultural sector; and firefighting and other activities that are inherently hazardous to people. Analytics and software together can also assist in caring for our aging population by providing our senior citizens with interactive "companions" that present engaging activities and also monitor for health and safety issues.

Steven Gal, ProQuo.com:

One of the most exciting trends in analytics will be in exposing more of the analytics and targeting controls directly to consumers on the Web, enabling individuals to drive decisions rather than having them made by distant corporations. Quality and recency of data is critical in both building effective analytic systems and in ensuring their performance. As we involved individuals directly in the collection and correction of their data and the tuning of their analytics we will see performance that has not been possible with the old model of centralized analytics on third party data.

Russ Mann, Covario:

Analytics is the key to guiding strategic and operational decisions, bridging the gap between the customer's voice and solid business metrics and performance. Covariance is a measure of how much two variables change together. Identifying the most critical, high-impact metrics and communicating performance for those metrics in a way that drives action is the key to maintaining competitive advantage. The true value of analytics isn't found in "what you can analyze", but rather the "why".

Today's economy requires that all organizations evaluate the impact of their spend more closely than before and, as a result, they are demanding analytics platforms that can better correlate the type, frequency, channel and quality of customer interaction to the company's financial performance. Interactive marketing analytics enables these organizations to make strategic decisions in real time to impact marketing ROI, customer experiences and profitability.

HNC Software

One company figures so prominently in the development of the San Diego analytics community that by taking a closer look at its history and its cross-fertilization with other companies we gain an understanding of the San Diego analytics community as a whole. This overview of HNC Software serves as an example of how one company can create many new analytic innovations both through their own work as well as the influence they have on the community overall.

HNC, or Hecht-Nielsen Neuro-Computing Company, was founded in 1986 by Robert Hecht-Nielsen. His pioneering work in neural networks technology at the University of California, San Diego (UCSD) was central to HNC's first products and services. Neural networks are non-linear mathematical techniques used to understand complex relationships between data elements and uncover subtle patterns in large data sets. His work continues to inspire new analytics applications today. Hecht-Nielsen and co-founder Todd Gutschow, having worked together at **TRW**, were joined by Robert North, who rounded out the executive team as CEO of HNC.

Since desktop PCs at the time were not powerful enough to handle the processor-intensive neural network modeling, HNC developed their own multi-processor hardware configurations which they sold as products to financial services companies interested in developing predictive analytics models as a way to reduce risk and fraud primarily in the financial services industry at first. After selling off their handwriting and alphanumeric character recognition business in 1990 to **Mitek Systems**, HNC focused their business on credit card fraud detection and government contracting services.

In 1992, as a result of the company's focus on the financial services and government spaces, ancillary products were discontinued. However, the analytic talent associated with some of these businesses went on to create new companies such as **N-Space Technologies**, now **Certona**. Through continued focus on the financial services market, HNC deployed its powerful Falcon® credit card fraud detection product to First USA, First Data Resources, Wells Fargo, and Advanta. A breakthrough product, Falcon used neural network technology and pooled regional credit card transaction data across the country to construct predictive models with enhanced accuracy on a national level. HNC grew with its Falcon product and went public in 1995, posting revenues of $44M that year.

Over the next seven years, HNC invested in several analytics companies to diversify their reach beyond financial services and fraud detection. Examples include:

- Forming **Aptex** to focus on automated text analysis.
- Acquiring **Risk Data** and **Retek**, to expand into the insurance and retail sectors.
- Acquiring **CompReview**, to enter medical billing market.
- Acquiring **CASA**, a provider of services and software solutions in financial, retail, and agriculture sectors. CASA further strengthened HNC's financial services

offerings with expanded predictive modeling in consumer banking, specifically personal bankruptcy and credit card delinquency analytics.

As HNC developed a solid foundation across different markets, it continued investing in its Falcon product—the recognized gold standard for improving fraud detection. Falcon by this time was deployed throughout the U.S., Europe, South Africa, Japan, and Latin America. An internet division, **eHNC**, was spun off as a separate company and eFalcon leveraged HNC's intellectual property to bring fraud detection capabilities to the growing community of internet-based merchants.

In 2000, Bob North retired as CEO and was replaced by John Mutch. Under John's leadership, HNC acquired several additional businesses in 2000, including:

Onyx—ASP provider of credit and fraud checks

Systems/Link—fraud detection related to telecommunications using real-time call data

CardAlert—fraud detection services for ATM network clients

Blaze Advisor—a business rules management system (BRMS) for managing and deploying business logic.

Also in 2000, HNC spun off the **Retek,** which brought in more than $2B for parent HNC and shareholders. In 2002, Fair Isaac Corporation acquired HNC. Much of the HNC product portfolio—especially Falcon—has been integrated with the Fair Isaac product lines and the HNC San Diego offices remain a Fair Isaac divisional headquarters. Many HNC alumni have moved on to found or run vibrant, young analytics companies, including: **BasePoint Analytics**, **Covario**, **ID Analytics**, **Proquo**, **Global Analytics**, and **Edgeware Analytics**, to name a few.

During the years 1986 to 2002, HNC was a center for the growth of analytics capabilities in San Diego. Through the ebb and flow generated by its own acquisition, growth, and spin-off cycles, HNC magnetized the San Diego analytics community, infusing it with the entrepreneurial energy that fueled its expansion, attracted new talent, and help bring analytics to its current prominence on the national stage.

San Diego Analytics Community Infrastructural Pillars

We recognize that there are many important factors that have contributed to the development of the San Diego analytics community. These infrastructural pillars are equally important in our next stage of achievement.

Academic Resources: Jacobs School of Engineering

Recognizing that engineering is at the core of our technology-driven society, Jacobs School of Engineering, established in 1986 at University of California, San Diego prides itself on educating students who will become innovators in their field, creative thinkers able to participate on multi-disciplinary teams, and strong communicators who can adapt to the rapidly changing job market.

Underscoring the importance of this academic institution to the San Diego analytics community, Robert Hecht-Nielsen conducted his seminal work on neural networks—also known as neurocomputing—while at UCSD's Jacobs School of Engineering. His work launched a major branch of analytics not just here in San Diego but around the country.

UCSD's Jacobs School of Engineering is a recognized leader in the study of science and engineering. The school's mission includes:

- Educating tomorrow's technology leaders
- Conducting leading edge research and driving innovation
- Transferring discoveries to ensure societal benefit and economic prosperity.

UCSD's Jacobs School of Engineering attracts many of the best faculty members in their fields, including members of the National Academy of Engineering and the National Academy of Science. The faculty members working in the analytics field have many key strengths and areas of focus including machine learning, data mining, text mining, and artificial intelligence. The strength of faculty helps attract top engineering students and corporate research sponsors.

According to U.S. News, with $141.0 million in federal, state and industry research support in FY06, the Jacobs School ranks 3rd in the nation for research expenditures per faculty member, reflecting UCSD's leadership as a research university. The Jacobs School's von Liebig Center is a unique program to foster commercialization of Jacobs School discoveries and was recently recognized by the Kauffman Foundation for its highly effective technology transfer model. The Center's team of technology advisors guides faculty through the commercialization process and introduces them to experts, alliances and venture funding opportunities. Funded projects in computer science and engineering include:

- A Software Tool for Identifying the Genetic Basis for Human Disease
- Location-based, Advertising-supported Services via Mobile Phones
- Overcoming Information Overload by Measuring Message Quality Automatically
- Interactive Game–based Music Annotation for Musical Retrieval and Recommendation

In addition, the Jacobs School conducts funded research with many industry leaders in analytics including **Google**, **Intel**, **Yahoo!**, and others. Finally, many of the Jacobs School alumni go on to found and manage leading analytics companies including **HNC Software** and **Urchin Software**. Urchin Software was acquired by Google in April, 2005.

Below is a sample list of other companies that have contributed to making San Diego the analytics hub it is today.

Government and Defense Contractors

Company	Product and/or Service Focus
SPAWAR	Communications, intelligence, surveillance and warfare systems
General Dynamics	Information technology communications, computing, intelligence
SAIC	Technological solutions for national security, intelligence and homeland defense

Public Companies

Company	Product and/or Service Focus
Fair Isaac Corporation	Enterprise decision management
Teradata	Analytics solutions in data warehousing, customer management, finance and performance management, etc.
Mitek	Software to improve business solutions and business performance
Visual Sciences	Provider of real-time analytics applications

Private/Smaller companies

Company	Product and/or Service Focus
Proquo	Consumer Privacy
Covario	Search marketing automation solutions for global organizations
ID Analytics	Identity fraud and risk reduction
Veoh Networks	Video content analysis
Certona	Powerful though generic analytics modules for small to medium-size companies
Salford Systems	New generation data mining and consulting services

Service and Capital Providers

San Diego is fortunate to have many national and international professional service providers and financial services institutions. Many of these organizations support the efforts of SDSIC.

The Future is Analytics

As demonstrated throughout this paper, the applicability of analytics continues to expand, reaching into more business and industry sectors and unlocking findings in databases that only recently could be probed with sophisticated software applications. The tools of analytics—hardware solutions, algorithms, and real-time decision support software—continue to evolve and grow more powerful.

Companies in San Diego have become a driving force in that evolution. Over the last 20 years, this region has become home to the nation's pre-eminent analytics community. With the right mix of large, established companies alongside a constellation of smaller, niche-focused companies that are pushing back the boundaries of analytics applications, San Diego also boasts an unmatched academic resource with UCSD's Jacobs School of Engineering and an experienced professional services network to support the community's growth.

The future of business is analytics. And the future of analytics is taking shape in San Diego where an optimum mix of academic resources, large and small analytics corporations, and an analytics-savvy support community of legal, financial, and marketing firms have come together to support growth, to help launch new companies, and to attract companies and individuals drawn to this area's ideal blend of community factors.

[1] "In the Company of Spies", Paul Kaihla, *Business 2.*0, May 1, 2003
[2] "Math will Rock Your World", *BusinessWeek* magazine, January 23, 2006

[3] "Competing on Analytics", Thomas H. Davenport, *Harvard Business Review*, January 2006
[4] "Innovate, Yes – But Where?", Rick Karlgaard, Forbes,com, March 13, 2006

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