

# FINANCIAL ENGINEERING NEWS

Universal Coverage of Financial Innovation

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by Nina Mehta, FEN contributing editor

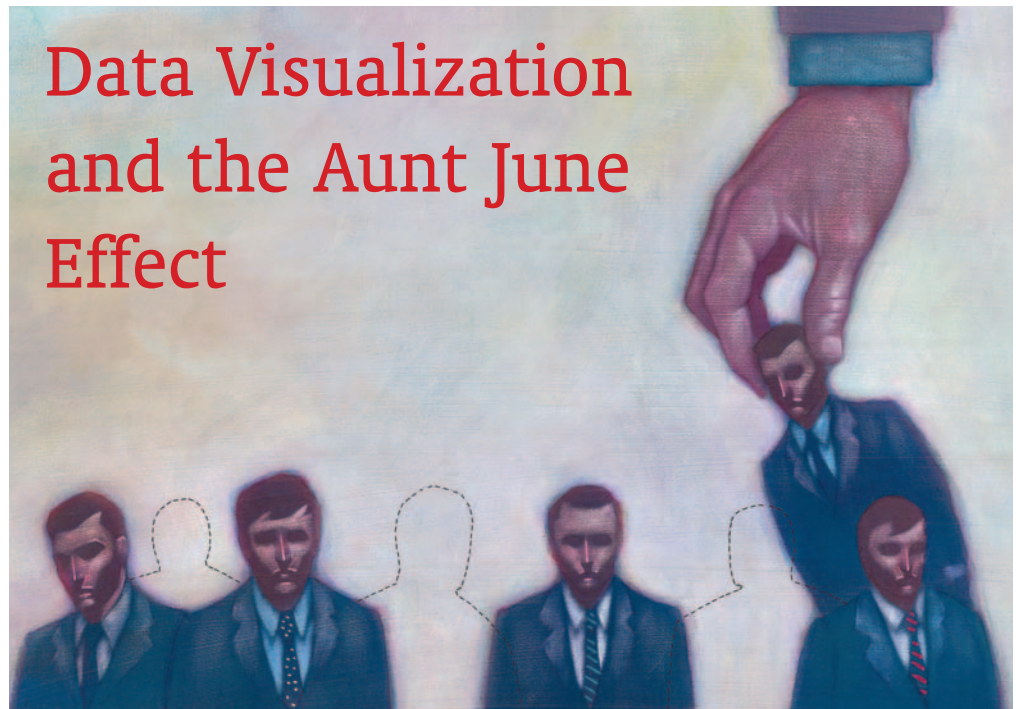
Let's say your Aunt June, or someone resembling her, is 150 yards away, heading towards you. No. Let's say a dozen people who look like her are lined up in a row heading your way. Can you pick her out?

Most likely you can. How you identify her will depend on a complex assessment of many elements: her height and weight distribution, her posture, the slope of her shoulders, the length and width of her torso, how closely to her body she swings her arms, and so on.

In moments you would have run a skeletal and corporeal comparison of the various oncoming shapes to images of Aunt June stashed in your memory and determined whether they match. All this would be done quickly, with no obvious calculations, and without much conscious thought.

It's hardly news that people absorb and process large amounts of data through visual signals. What has advanced is our understanding of how this happens. Correspondingly, the computer science field of information visualization has developed and grown over the last few decades. Information visualization pivots on the idea that data can be visually represented in useful and insightful ways that enhance our understanding of the information. The flip side is that complex data can often be grasped quickly and intuitively when rendered visually. The field ropes together advancements in human-computer interaction, graphic design, cognitive science, statistics and other areas.

Information visualization's lineage traces back through the demigod of information



design, Edward Tufte, French theorist Jacques Bertin and John Tukey, the visionary statistician who sired the statistics subfields of exploratory data analysis and robust estimation. (He also coined the computer words "software" and "bit," helped develop the U-2 spy plane, and in the 1950s criticized the sampling methodology in the famous Kinsey report, *Sexual Behavior in the Human Male*.) Even before this 20th-century spurt of activity, fueled by advances in statistical methods and computing, there was William Playfair, the late 18th-century Scottish creator of time-series charts and data displays such as line plots, bar charts and pie charts.

But all that's background. The main question for people in finance is why the Aunt June effect hasn't been put to greater use. Trading, risk management and the financial services generally are built on the steep back of data. Numbers drive these worlds. So why so little imaginative depiction of financial data?

People want to stick with what they're familiar with . . . If someone says they should look at a three-dimensional isosurface or volume rendering, it's kind of scary.

— Jeremy Walton, senior visualization consultant, Numerics Algorithm Group

The answers are varied. Until the last decade or so, data visualization software wasn't all that mature. Data rendering and 3D capabilities weren't as developed as they now are. Dynamic visualization software eats up a lot of processing power and until recently was too cumbersome to run effectively on many systems. The technical limitations of vendors that distribute data also restrict what can be shown on a screen. Meanwhile, risk managers were too busy staking their ground to requisition cool visualization tools from IT departments. And traders were (and often

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are) too bullheaded or conservative to be readily won over by a new and unfamiliar technology.

“People want to stick with what they’re familiar with,” says Jeremy Walton, senior visualization consultant at Numerical Algorithms Group (NAG), a data visualization and analytics firm based in Oxford, England. There’s a tremendous amount of sophisticated modeling and optimization in finance, but the majority of graphical data visualization is done through Excel. A user, for instance, can plot a stock’s share price over time, depict one variable as a function of another, display complex charts that highlight shifting relationships between various financial instruments, and so on. “People can see the lines, they know what it all means, they know what a particular curve is doing,” Walton explains. “If someone says they should look at a three-dimensional isosurface or volume rendering, it’s kind of scary. They can’t see the benefit of bringing a new type of visualization into their system.”

It can also be hard to relate financial data to a picture of that data. Not surprisingly, sophisticated visualization techniques were first developed for chemistry. Chemists deal with complicated three-dimensional shapes — for example, big molecules that bump into each other. “They can calculate what molecules do using a computer simulation,” Walton says. “There’s a real correlation between what they see on the screen and what’s actually going on. The atoms are represented as balls, the bonds as sticks, etc.”

Science and engineering jumped aboard the visualization bandwagon. Pharmaceutical companies use visualization tools for drug lead identification and optimization. Geographers can take a satellite image and drape it over a topographical map to get a 3D impression of the landscape. Oil companies, astronomers, weather scientists, military intelligence experts, fraud detection specialists — all of them use 3D visualization, volume rendering, isometric surfacing, multidimensional visual analysis, treemaps, fisheye views, clustering or other innovative tools to explore and analyze data.

To be sure, there have been financial companies in the data visualization space for a while. The Heatmaps visualization products of SS&C Technologies are perhaps the most omnipresent on trading desks. Traders, port-

folio managers, analysts and risk managers use customizable Heatmaps to get a quick, color-coded, real-time view of stock performance, a trading book’s risk level, or whatever other variable is selected. NeoVision Hypersystems, which developed the technology, was bought by SS&C last year. There are also a handful of companies that provide treemapping tools that display large amounts of information in a simple geometric image instead of a spreadsheet. The advantage of this technique for users is that vast amounts of data can be seen in one fell swoop — and simply. The fundamental data can then be accessed through zooms, sliders, hierarchical views or other ways of drilling down into the information.

Information visualization itself can serve many gods. It can visualize relationships within complicated multidimensional datasets while allowing users to manipulate the resulting image or zoom in and out of areas of interest. Data visualization tools can portray abstract relative information graphically and dynamically through the smart use of shapes and colors. It can depict the impact of a change in one variable on other variables, or trawl through mounds of data to detect patterns or see outliers.

**New reporting requirements and the focus on best execution in the securities market also give visualization tools ‘more clearance.’**

— Richard Laughton,  
CEO, Fractal:Edge

Another reason for the lack of data visualization takeup in financial services may be that IT has focused on the back office in recent years. “The emphasis has been on databases and real-time securities transaction processing,” says Sam Giertz, cofounder and vice president for sales at Panopticon Software, a Stockholm-based data visualization company geared toward the financial services industry. But as those pressing IT needs are addressed and as the volume of data continues to grow, banks and asset managers need smarter tools to extract information from that data. Data mining software has become critical for just this reason.

Richard Laughton, CEO of Fractal:Edge, a visualization and analysis software firm founded in 1998, agrees that data visualiza-

tion is rising in priority. “It’s more critical because of greater automation of trading and the expected expansion of market volumes — in particular, the volume of quotations,” he says. He adds that new reporting requirements and the focus on best execution in the securities market also give visualization tools “more clearance.”

**It’s not enough to have a visualization tool . . . it must illustrate the relationships that people care about in real time.**

— Jeff Bandman, senior vice president,  
Cantor Market Data

Data visualization in the finance industry may finally be poised to take off. According to Giertz, various factors are coalescing: the maturity of the data visualization industry, increasingly large datasets, the pervasive need for tools that can make sense of vast quantities of data and search for trends and software vendors supplying more mature products. He points out that Panopticon’s treemapping software is now in its fourth product release. Potential clients are also more familiar with the idea of data visualization. If they’re considering treemapping tools from an outside vendor, they may now be choosing between Panopticon and a couple of other companies, as opposed to Panopticon (or some other vendor) and nothing.

Visualization tools have become more prominent in the mainstream in recent years. In finance, however, another challenge is developing dynamic solutions that scale to handle large datasets. Statistical analysis and mathematical algorithms model vast quantities of data, but there is little interaction with that data, notes Sean Fitzgerald, vice president of technology and a consultant Financial Engineering News for Visual Numerics Inc., a software developer of visualization and analytic solutions based in San Ramon, California. As visualization tools become more flexible, they can be integrated with traditional statistical analytical tools.

A further obstacle to the introduction of visualization tools into the finance services industry has been the need for what could

be called double domain expertise. Developing good visualization tools requires a background in visualization, but the tools themselves must be geared to the particular needs of those using the data.

Visualization must be appropriate to the subject matter. "It's not enough just to have a visualization tool," says Jeff Bandman, senior vice president at Cantor Market Data, a subsidiary of Cantor Fitzgerald. "It must be a visualization that focuses on the important relationships between X and Y in that particular market, and it must illustrate the relationships that people care about in real time." In the Treasury market, he adds, that's the active market, the limit order book, intraday activity and the last 10 trades.

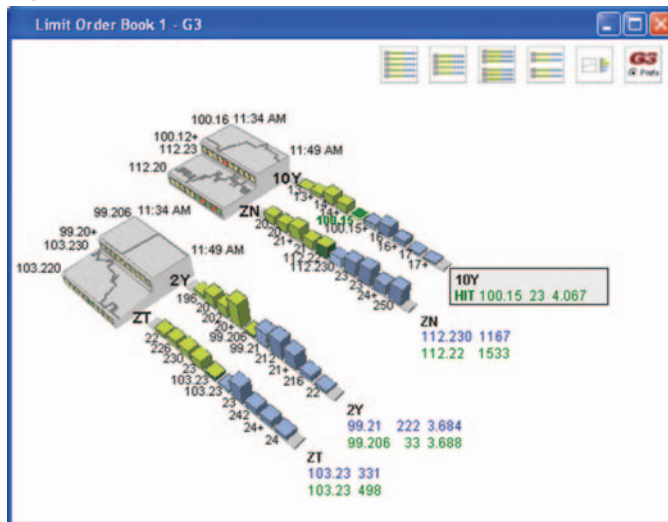
Cantor Market Data has geared up to aggressively meet the data needs of increasing numbers of black-box fixed-income traders. In 2003 it offered clients more market depth, from the composition of the best bid and offer to the full limit order book. In 2004 the company did extensive research and decided to differentiate itself from competitors promoting fixed-income content by embracing data visualization. According to Bandman, research showed that different parts of the brain absorb information differently — for example, the part of the brain that looks at a screen filled with numbers is different from the part that responds to color, shapes and the movement of objects.

Cantor's resulting visualization product, called G3, takes advantage of developments in understanding how people perceive and absorb information. The product displays Cantor's active Treasury market as a row of blocks that expand and contract in real time as the market moves; these blocks are further composed of different colored sandwich slices that indicate the composition of the active market (mousing over a block will pull up the number of participants and the exact size of the top bidders). Another image displays the intra-

day market, and a tick strip of colored lights indicate the direction of the market over the last 10 trades.

The product is used not only by traders of cash Treasuries, but by mortgage traders, sales traders and others who need a visual feel for the market. "They can see the buildup of demand all at once," says Bandman. "A trader, for example, can see that there are more bidders on the 10-year Treasury or that there's a robust two-year market with bids and offers on both sides." Cantor played around with the 3D images to get them right and make them easy to comprehend with just a quick glance. After the first version rolled out, it got feedback that traders wanted to see the futures market as well. Cantor arranged to redistribute the Chicago Board of Trade's data, and in the most recent version of G3, Cantor offers side-by-side views of the five critical cash Treasury benchmarks and their counterparts in the futures market (see Figure 1 on page 20 for a side-by-side view of two Treasury benchmarks and their futures). All of the colors as well as aspects of the layout are also customizable.

Figure 1



### Cantor Market Data

#### 2 x 2 View of Treasuries and Treasury Futures

This image compares the Cantor two-year and 10-year Treasuries to their respective CBOT future counterparts, allowing traders to immediately understand the supply/demand dynamics and identify trading opportunities.

*Credit: Cantor Market Data*

Both NAG and VNI have a substantial background in developing 3D and other sophisticated visualization tools. VNI couples its

PV-WAVE visualization engine with its popular IMSL analytics, which include numerical and statistical libraries in C, Fortran, Java and C+. VNI's Fitzgerald points out that robust and scalable visualization tools provide not only an opportunity for cost savings but a better understanding of the data in question. "There's an ability to do knowledge discovery in the data if users can interact with it, zoom in and out, do analyses and view it in different ways," he says.

**The ripest areas for treemapping technology are asset management, equities research and market data, the fixed-income markets and customer relationship management.**

— Sam Gierz, cofounder and vice president of sales, Panopticon Software

Fitzgerald adds that as interest builds in visualization techniques, more potential users are coming to them. "They do the quantitative analysis in their specific areas of interest. We provide the specific, customized visualization techniques required for them to gain insight into specific problems," he says. VNI's visualization expertise includes the ability to model a system in which a number of variables are dependent on other variables. This kind of 3D simulation is popularly used, for example, in models that simulate the air flow over an airplane's wing. "Visualization may not provide much value in predicting the future, but it may in seeing how variables react to each other and how changes in one variable affect a slew of other variables," Fitzgerald says.

NAG's Walton says that NAG also sells itself on the basis of its visualization, rather than financial, expertise. "Finance is sort of a black art as far as we're concerned," he admits. Research analysts are continually dreaming up new ways to get a handle on what's going on in a portfolio or

with certain instruments, and are developing more complex models. “They might say they want to plot this against that and see what happens when they do this other thing,” Walton says. “If we produce a picture, they may say they’re interested in a specific small area of the image. They don’t want us to know what they’re doing. And if they said, ‘Now we can rule the world, or take over the FTSE,’ they’d probably have to shoot me afterwards.”

NAG’s visualization tool is called IRIS Explorer. The company also has a set of numerical libraries that solve linear equations, optimize systems of equations or solve differential equations. Just as these tools, which were originally developed for use in science and engineering, gradually made their way into the realm of finance, so too are data visualization tools making the same trip. NAG’s visualization toolkit includes isosurfacing, bump mapping, surface plotting and X-Y graphs.

More software firms are also now focusing exclusively on the financial services industry. Panopticon’s Giertz notes that currently the ripest areas for treemapping technology are asset management, equities research and market data, the fixed-income markets and customer relationship management. He expects interest from the hedge fund and prime brokerage areas to grow as well.

**Data visualization is slowly but finally starting to gain ground in the financial services industry...when it comes to visualization there’s a bit of a BlackBerry effect.**

— Richard Laughton,  
CEO, Fractal:Edge

In asset management, for instance, treemaps can be used to track the performance of portfolios or a desk’s risk exposure more quickly and seamlessly than existing alternatives. Users can track the relative performance of, say, 1,000 stocks in real time and drill down to get

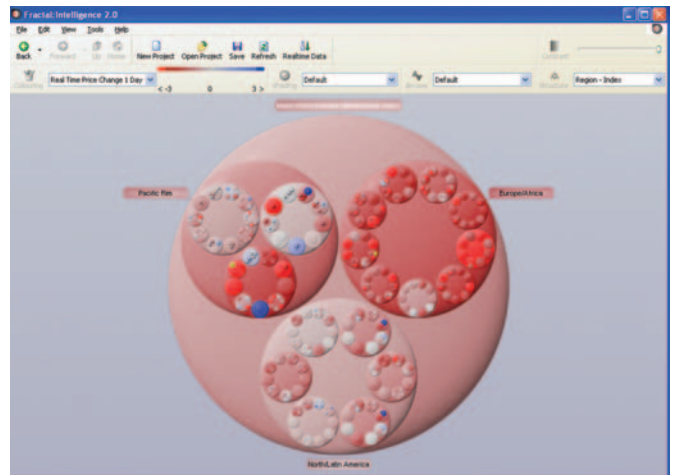
more detailed information, instead of looking at those 1,000 stocks in a 30-page spreadsheet. Panopticon’s software links to any data source and trading system, and can be applied to any kind of data, including historical prices and non-numerical data. Customers include UBS, JPMorgan and Deutsche Bank. JPMorgan uses Panopticon’s HeatMapping toolkit to produce Credit Map, a visualization product that enables the bank’s institutional customers to visualize real-time developments in the credit markets.

Fractal:Edge takes a different approach to visualizing data, but one that’s also easy to understand intuitively. Its Fractal Maps technology is based on the idea of fractals and can be grasped in moments. In Figure 2, for example, the company’s real-time chart of the global equities market looks like necklaces of LifeSavers tucked inside a Venn Diagram. In this depiction, the regions of the world are shown as large circles. Within those circles are LifeSaver-like rings containing what look like small beads. The rings represent indexes in that region and the beads within each of them depict the sectors within that index. Each circle, ring and bead is color-coded based on performance, and a viewer can drill down from a global level to the individual stock level in moments. The advantage of this depiction is that in a glance the viewer can see that the Hang Seng index was a poor performer (and why) or that the CAC 40 outperformed all the European benchmarks in early trading.

Fractal:Edge has focused on the financial services industry for two years. Laughton notes that “trading and the risk management of real-time trading are the sweet

spot for us.” This is the case across equities, fixed income and credit trading. Fund-of-fund managers and derivatives traders are also users of Fractal Maps. Laughton notes that a large bank uses Fractal:Edge’s product in credit derivatives. “It’s a quick and easy way to see exposures across books or regions,” he says. The P&L of a book is represented by a color value that ranges from red to blue, while the shading or glossiness of the circle can be set to portray the book’s net delta. Since data can be broken down by book and account within an institution or

Figure 2



### Fractal:Edge Global Equities Indices

This is a Fractal Map of equity indexes around the world. Within each of the three global regions are rings representing different indexes. Within each index-ring, the smaller circles denote sectors. A viewer can drill down from a global view to an individual stock. The colors reflect price movement at each level.

Credit: Fractal:Edge

region, a risk manager can easily see emerging exposures or spot a position he may want to cut, he adds.

Data visualization is slowly but finally starting to gain ground in the financial services industry. As this happens, the adoption of visualization tools is likely to be rapid, particularly as electronic trading takes off and market data products become more innovative. When it comes to visualization, Laughton enthuses, “there’s a bit of a BlackBerry effect.” ■