

Challenges in Financial Visualization Panel

Richard Brath, Lancelot Comrie, David Keller, Elaine Knuth, Eugene Sorenson

Abstract—Financial visualization has existed for more than 100 years. Ongoing growth of financial markets increases the frequency, complexity and scale of data while users need to discern meaningful insights for many different types of tasks and objectives. This panel brings together four established practitioners from the financial industry who use visualization tools every day. Each works with a different type of financial firm (buy-side, sell-side, advisory, information provider) bringing a unique perspective to their challenges. This panel represents an opportunity for VisWeek participants to learn more about the challenges of financial visualizations; understand real-world constraints, tasks and usecases; and identify new potential application areas.

Index Terms—Financial visualization, financial charts, portfolio analysis, technical analysis, market data.

1 INTRODUCTION

Financial markets have grown significantly in size and complexity since the start of the millennium. In the capital markets, a single stock may have hundreds of thousands of trades per day and thousands of quotes per second. A single buy order may be split into hundreds of pieces, tagged with rules, distributed across dozens of exchanges with trades measured in microseconds. Successive credit obligations create complex networks of obligations. News, analyst reports, required filings, legal rulings, policies, patents, blogs and tweets create a massive ecosystem of commentary.

Beyond data, the typical trader may have 4-10 screens (Fig. 1). There is no patience for applications that are slow to load, have a cluttered UI, require multiple steps to configure, and/or require effort to decipher. And whatever is found may need to be communicated, promoted or justified.

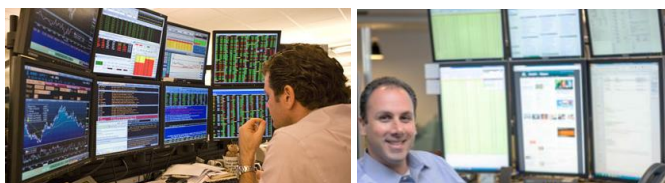


Fig. 1. Typical trading desks with many screens. Images courtesy Wall Street & Technology, used with permission [1].

It has been 23 years since treemaps were introduced in InfoVis. While treemaps have had moderate success in financial services, many other techniques have been proposed but not gained widespread adoption and some visualization startup companies focused on finance have started and faltered. A discussion between the InfoVis community and a panel of active day-to-day financial professionals provides the opportunity to review the unique needs and challenges of this community, such as:

- Why has finance invented some of the most esoteric visualizations that no other domain uses: candles, clouds, stacks of letters, etc.?
- Treemaps are 23 years old. What are the big advances that financial visualization has achieved in the last 10 years?
- Could the right visualizations have saved us from the 2008 financial crisis and the following Eurozone debt crisis?

Richard Brath is with Oculus Info Inc: richard.brath<at>oculusinfo.com.

Lancelot Comrie is with Morgan Stanley & Co. LLC:

lancelot.comrie<at>morganstanley.com

David Keller is with Fidelity Investments david.keller<at>fidelity.com

Elaine Knuth is past president of International Federation of Technical Analysts: elkmath<at>gmail.com

Eugene Sorenson is with Bloomberg L.P.: esorenson1<at>bloomberg.net.

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- What are the big challenges and big opportunities for financial visualization in the next 10 years?
- Many new visualizations have been promoted to the financial markets community and many have flopped. Why?

2 BACKGROUND

2.1 100+ years of visualization in finance

Visual representation of financial data has existed since the late 1800's [2] and evolved a wide variety of finance-specific charts e.g. candle, point and figure [3,4,5,6], market profile, renko, etc (Fig. 2).

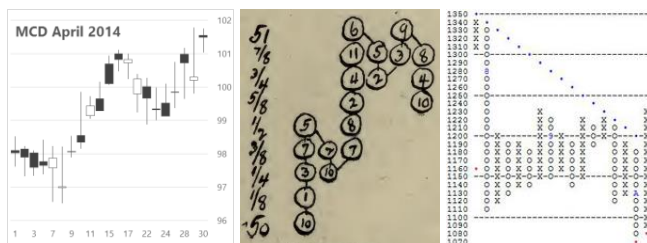


Fig. 2. Sample candlestick chart (left), volume figure chart from 1910 (middle [4]) and modern point and figure chart (right [6]).

Technical analysts developed a visual literacy for a wide variety of patterns indicative of market behaviour such as support and resistance, head and shoulders, trend channels, lightning bolts, etc (Fig. 3). *Annotations* were added to evaluate trends, establish thresholds, define alerts and record analyses for future reference.

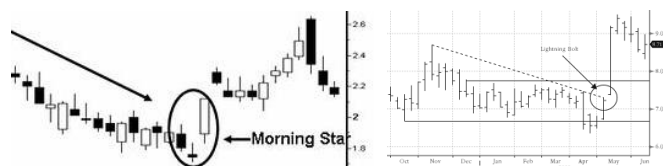


Fig. 3. Portion of stock charts annotated to indicate patterns e.g. morning star (left, via Wikipedia) and lightning bolt (right [7]).

Analytics (*indicators* or *studies*) were added to aid insight, support hypotheses and generate signals, such as mathematical transformations e.g. moving averages, relative strength index, Ichimoku, Bollinger Bands, Elliott Wave (Fig. 4); ratios and correlations, e.g. put/call, implied volatility; and summaries, e.g. advance/decline, money flow.

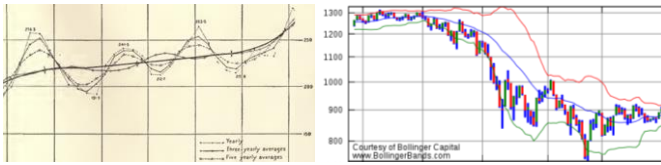


Fig. 4. Historic chart with moving averages (left [8]), modern chart with Bollinger Bands (right, via Wikipedia).

With the popularization of information visualization, new representations are available to financial markets, such as treemaps [9], sparklines [10], horizon graphs [11], sunbursts [12], correlation graphs [13,14] and more [15] (Fig. 5).

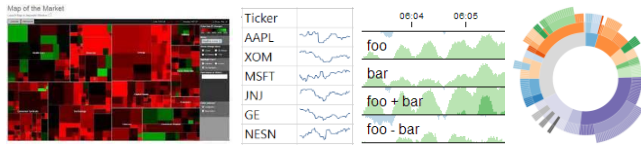


Fig. 5. Sample Treemap, Sparkline, Horizon and Sunburst.

2.2 Unique aspects of financial markets

Unlike one-off data science projects or corporate data analysis, all users in financial markets have access to the same core data: financial data and news on companies, countries and commodities. Each participant must draw their own unique insights in order to gain benefit.

Users often have screens filling entire desktops (or walls) with 6-15 megapixels of display, i.e. 3-8x more resolution than current HD displays. Large displays can set out a large amount of information which allows the user to shift gaze between elements more quickly than interactively navigating between windows; utilizes spatial memory to find information; enables spatial workflows and aids awareness via peripheral vision. However, displays are very dense and visuals often need to work in very small areas.

User tasks can vary widely: such as monitoring (e.g. tracking markets, gauging performance, managing trades, attending to news); analysing (e.g. comparing ratios, generating scenarios, modelling risk, assessing estimates); explaining (e.g. promoting a strategy, providing context) and taking action (e.g. executing a trade, contacting a counterparty, getting confirmation from a colleague). The scope of these tasks can be very narrow, e.g. a single security or a single transaction; broader across peers, sectors and regions; or across multiple markets and different types of assets.

Time to value is a key consideration. Ideally, applications need to load quickly, with immediate insight, results in a click or two, have low to no training requirement, and have low CPU utilization (many other items on screen are continuously updating).

Complexity is a challenge: there isn't a one-to-one correspondence between companies, news and people; or between stock markets, future markets and debt markets. More data sources, more countries, more history and more analytics increases the scale. However, fewer people work in the financial industry now than the mid-2000's. Is automation, visualization and efficiency a factor?

3 PANEL

This is an exciting panel. Each panellist has extensive personal experience with visualization in financial services.

3.1 Industry Perspectives

The panellists bring a diverse set of perspectives on the financial industry ranging from the *buy-side* (Fidelity, one of the largest fund companies in the world); the *sell-side* (Morgan Stanley, one of the top firms in global equity trading), the *information provider* (Bloomberg, provider of an information system used by 300,000 professionals globally) and *advisory* (Davenport Advisors, focused on the commodity sector).

The panellists also have different outlooks ranging from the trading floor needing immediate actionable insight; to research analysts evaluating macro-scale long-term strategies or sector-based opportunities; to the vendor creating new tools. Panelists also bring a broader user view with executive responsibilities for industry associations such as Market Technicians Associations, International Federation of Technical Analysts, as well as authoring books on technical analysis and visualization.

3.2 Format and Schedule

The panel format will offer sufficient time for interaction with the audience. The panel organizer, Richard Brath, will act as convener, manage the schedule, coordinate audience participation and moderate the different opinions. The schedule is planned as follows:

0:00	Introduction to the topic and panel	5 min
0:05	Presentation of Lancelot Comrie	10 min
0:15	Presentation of David Keller	10 min
0:25	Presentation of Elaine Knuth	10 min
0:35	Presentation of Eugene Sorenson	10 min
0:45	Q&A with audience participation	45 min
1:30	Summary statements	10 min

4 POSITION STATEMENTS

4.1 Lancelot Comrie

Financial markets are as complex as ever, and with recent market volatility, multi region & multi asset class correlation, it's important to identify new hypotheses to generate alpha for our clients (alpha is a financial term used to indicate performance of an investment after adjusting for risk).

Even if you're able to successfully navigate global markets and the massive quantity of data available, our clients may miss out on the maximum alpha because they're not attuned to the full range of events that might trigger price movements.

When sitting in the middle of a trading floor, you need to be able to quickly assess these potential alpha generating signals from various sources including exchanges, market data providers, external market participants, and internal sources.

Being able to capture and distribute these signals efficiently including identifying and responding to significant inflection points is key to helping our clients generate consistent alpha.

In a global market, opportunities can be fleeting and systematically visualizing how, where and when alpha is generated is critical to achieving success.

4.2 David Keller

When the Fidelity Chart Room was first created in the 1950's, it represented the "cutting edge" for the visualization of financial data. Charts were hand drawn on large scale paper displays, and the competitive advantage for the firm was having a team of associates who could acquire and manipulate financial data.

As the markets evolved over the subsequent sixty years, the Chart Room remained at the forefront of financial visualization by transitioning from the collection of data to the synthesis of thematic displays focusing on actionable investment themes. The current space features ultra HD digital displays that allow for more dynamic and immersive views into portfolio analytics, idea generation, and risk management.

In the coming years, asset managers are faced with a number of questions that should lead to new innovation in terms of how we help our clients meet their financial needs:

- As financial information is more widely accessible, and financial media focus more on intraday market movements, how do we connect the short-term market gyrations with the long-term investment horizons of the individual investor?
- As financial markets become more global, and investors focus more on asset allocation, how can we more effectively identify

relationships and highlight opportunities across sectors, industries, regions, and asset classes?

- How can we leverage recent developments in text analytics and image recognition to better quantify investor behavior and take advantage of market inefficiencies?
- How can we make esoteric financial data more intellectually accessible to inexperienced investors, allowing them to make better informed investment decisions?.

4.3 Elaine Knuth

Data Visualization techniques and methods are the key stone of Financial Technical Analysis. From the earliest days of amassing large data streams of changes in price (and sometimes volume), the technical analyst relied on visualization of price information using techniques such as candle stick visuals or point and figure charting/visualization. In the late 70's, as computing and calculating power became widely available, the tools of technical analysis expanded with addition of analytical indicators(i.e. price momentum, relative strength, on balance volume) to measure and detect market characteristics and change. These innovations contributed to developments in greater visualization of market price behavior, and also to application of rule-based and algorithmic trading strategies used today.

Now, with advances in managing and organizing massive amounts of data with new visualization technologies (and sources of data), we find ourselves at the threshold of ground-breaking advancements for technical analysis of the financial markets.

Data Visualization (Technical Analysis in our world) technologies may give us, for example, the possibility to free the trader from a desk top of multiple screens where he or she must simultaneously take in, evaluate and act upon streams of data and text. Current advances in data visualization can give this trader the tools to immediately capture, organize, visualize and analyze data and text from multiple sources into a single – and customized – visualization. These resulting tools will help us see previously undetected relationships and causalities, and lead us to new insight and questions.

4.4 Eugene Sorenson

The challenges of financial visualization are multifaceted: data, technology, user and design.

- **Data:** “Sipping information from a fire hose” captures the central problem of financial markets. As a software provider, our challenge is to process over a billion ticks an hour and transform this data into actionable information that meets the needs of a diverse client base ranging from the trader whose investment horizon is measured in minutes to the portfolio manager who is focused on long term returns and will hold positions for months to years.
Variation in data is a compounding problem. While data is structured there is substantial variance in distribution and reporting of data across markets, exchanges, asset classes, differing labels and classification systems - there is no single standard. And, as the world has become smaller and inter-relationships better understood, there is increasing interest in cross-sectional analysis and the inclusion of new data sets, such as Twitter and other social media content.
- **Technology:** The speed of market action makes performance a priority for our clients and a central challenge for the financial software vendor. Traders and analysts frequently have four to ten screens which they are continually scanning to optimize their workflow. They may monitor thousands of securities and use hundreds of charts and graphic applications to stay abreast of market activity. Millions to billions of dollars are at stake if there are delays or downtime.

- **Users:** Our clients are seeking new ways to differentiate themselves and news ways to add value for their firms. Technology has commoditized much of what they do. Techniques that used to be proprietary are now commonplace. Accordingly, they must find new ways to gain an edge and this must be done with smaller staffs that are frequently more active in more markets.
Clients must be able to tell a story using visual tools. These need to be updated and regenerated on a regular basis.

- **Design:** Visual analysis solutions need to be robust applications reused multiple times per day, week, month. The investment process is frequently differentiated by subtle differences in the analytical approach or data transformation. Our solutions must support this variance in methodology and workflow.
Our applications do not need to attract attention as our clients are highly motivated; however, unique data points must attract attention. It is essential to identify outliers and patterns and understand if is meaningful, e.g. a high P/E ratio may be simply the result of a poor earnings report with a one-time write off.
Solutions that work across a variety of form-factors, touch vs. mouse, and support cross-platform distribution is becoming an increasingly a critical delivery issue.

The bottom line is that we must provide a visual foundation that enables our clients to analyse the full spectrum of financial data content and develop their own workflow and process.

5 BIOGRAPHIES

5.1 Richard Brath

Richard Brath has actively been involved in strategy, research, design and development of data visualization and computer graphics since the mid-1980s in both academia and industry. He is currently a partner at Oculus Info Inc. designing and building interactive visualizations for applications in financial services, marketing analytics, sports and web analytics. Richard is also pursuing a PhD at London South Bank University. Research areas of interest include financial visualization, visual attributes such as shape and font, visualization aesthetics, guidelines and metrics.

5.2 Lancelot Comrie

Lancelot Comrie is the Global Head of Alpha Services at Morgan Stanley where he is responsible for the identification, optimization, distribution and monetization of alpha signals and associated services to Institutional AMs, HFs and SWFs for Quant strategies, or as part of systematic stock selection, portfolio construction & asset allocation strategies for Chief Investment Officers & PMs. Previously he started and ran the Equity Electronic Trading Businesses in the Far East and Europe. Lancelot received his B.S in Electrical Engineering from Rensselaer Polytechnic Institute (RPI). He is a registered representative of the UK's SFA, and is a Chartered Engineer and Fellow of the IET.

5.3 David Keller

David Keller, CMT, is a Managing Director of Research for Fidelity Investments in Boston. He manages the Technical Analysis team at Fidelity Management and Research, as well as the legendary Fidelity Chart Room. David teaches a course in technical analysis as an Adjunct Professor at the Brandeis University International Business School in Waltham, Mass.

David is a Chartered Market Technician, and is currently serving as Past President and Nominating Committee Chair for the Market Technicians Association. He is also a member of the American Association of Professional Technical Analysts and the International Federation of Technical Analysts.

David was formerly a Technical Analysis Application Specialist with Bloomberg L.P. in New York, and was a regular contributor to

Bloomberg Markets magazine. He is the editor of the book "Breakthroughs in Technical Analysis: New Thinking from the World's Top Minds", published August 2007 by Bloomberg Press. He received degrees in Music and Psychology from The Ohio State University, and currently serves on The Ohio State University Alumni Advisory Council..

5.4 Elaine Knuth

Elaine Knuth is the Principal Partner of Davenport Advisors, LLC and author of the book, *Trading Between the Lines: Pattern Recognition and Visualization of Markets*. Prior to this, she was managing director at AQX Securities, advisor to the board of AQ Advisors, managing partner of the Zurich Commodity Trading Advisory. Prior to her career in financial markets, Knuth worked as a journalist for publications, including *Investor's World*, *Forbes*, and the *Journal of European Business*. She is a member of the Swiss Association of Market Technicians (SAMT) and the American Association of Professional Technical Analysts (AAPTA). Knuth was president of the International Federation of Technical Analysts (IFTA) from 2007 to 2010.

5.5 Eugene Sorenson

Eugene Sorenson is the Global Product Manager responsible for charts, visualization and monitors in the Bloomberg Terminal. Prior to Bloomberg, Eugene has held positions in financial software products at Cantor Fitzgerald and CQG; and founder of River Associates Futures Trading. Eugene has a BA in Economics from University of California San Diego.

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