



FINOS

Fintech
Open Source
Foundation

CASE STUDY

Perspective: A financial services open source success story delivering data analysis software for complex, real-time data sets



PERSPECTIVE

PERSPECTIVE OPEN SOURCE QUICK FACTS

Date Open Sourced:
November 2018

Languages:
JavaScript, WebAssembly,
Python

Link:
perspective.finos.org

GitHub:
[https://github.com/finos/
perspective/](https://github.com/finos/perspective/)

An Introduction to Perspective

Perspective is an interactive visualization component for large, real-time datasets, used to build reports, dashboards, applications, and more. It is a powerful set of tools in production use in 1,000's of applications within J.P. Morgan including trader desktops - and is also completely open source. The Perspective project addresses the growing demand in financial services of making complex streaming data sets visually compelling and easy to use.

Making enormous amounts of data viewable and digestible is a pervasive challenge in financial services as is finding ways to make disparate tools and technology work together. Perspective helps address these widespread issues by supporting open collaboration through technology while providing user-driven data analytics and visualization. Together, this enables developers to help end users more quickly and accurately analyze data and meet client demands.

The decision to open source

Deciding to open source proprietary software is a big decision for any company but it's a particularly big decision for a highly regulated organization with a global footprint and widely recognized brand. Before open sourcing Perspective, J.P. Morgan considered a number of important factors. (We won't go through the full process but do highlight some key points below.)

Evaluate: Looking for a good open source candidate

Like many banks, J.P. Morgan has legacy software that still has significant value but needs to be updated in order to meet a changing technology landscape and client expectations. J.P. Morgan wanted to identify software that wasn't considered their "secret sauce" but that was established, valuable across multiple areas of the firm and had the potential to leverage bleeding edge technology. They also needed to make sure that the software wasn't so complicated that it would be impossible for other firms to adopt and make contributions to.

Identify: Valuable and ready for a revamp

Perspective was developed within J.P. Morgan by many developers over a number of years. The years of development and production

use by demanding clients yielded a robust, feature-rich, desktop application built in C++. Increasing demand for “portable” services and recent innovation in development languages, led J.P. Morgan to migrate the platform from desktop to web using WebAssembly. Because the underlying platform was very robust they could quickly move the “older” technology to more modern platforms, improving the user experience and attracting new developers and contributions.

Prepare: Getting ready to open up

As with most code originally designed and developed for internal use, it was essential to embark on some refactoring before entering the world of open source collaboration. In Perspective’s case this meant readying about 80,000 lines of code from the core engine for compilation to WebAssembly to make the software more accessible. Fortunately, this was a relatively quick process for the Perspective team who was able to conduct feasibility analysis and agree on the viability of the project within weeks and then go on to produce a fully working version of the refactored code within 6 months.

Contribute: Open sourcing through FINOS

The financial services industry has been slower to embrace open source collaboration than other industries, particularly when it comes to contributing to existing open source projects or open sourcing their own proprietary code. The Fintech Open Source Foundation (FINOS) was created specifically to help financial services innovate through open source so was a natural candidate for Perspective. FINOS worked closely with J.P. Morgan to provide an accessible, independent, well-governed, forum for collaboration on Perspective that welcomed contributors from within J.P. Morgan as well as from a wider, external community.

Promote: raising the profile of financial services in open source

The financial services industry has a history of innovating to deliver new products to clients, and technology has always played a large part in this innovation. By opening up their technology, J.P. Morgan is reminding the industry of some of the exciting work that takes place in financial services,

City	Tables		Furniture		Supplies		Fasteners		Labels		Art		Office Supplies		Appliances		Storage		Binders		Paper		Machines		
	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	Profit	
TOTAL	-1,765.48	-3,472.56	13,059.14	25,030.17	-1,133.10	948.52	5,046.25	6,587.79	6,954.19	13,130.01	27,210.03	30,221.75	34,053.67	3,364.75											
Philadelphia	-2,530.75	-2,530.74	2,530.74	-1,363.37	-1,361.49	23.22	151.91	116.44	357.41	639.52	-1,163.92	-3,305.23	1,000.54	-2,219.25											
Houston	-625.03	-1,120.42	-104.02	-354.53	-14.62	55.02	84.70	135.91	469.52	-2,027.31	-210.02	-6,094.64	1,162.59	-993.68											
San Antonio	-250.47		-40.65	-184.71		1.84	33.03	19.60		11.69	-154.12	-69.83	-4,204.75	154.23	-1,405.31										
Lancaster	-123.93		22.25	33.67	-64.43		3.60	2.70			65.03	-126.44	-3,924.04	202.33	-6,599.98										
Chicago	-1,445.93	-311.20	-1,130.59	-627.95	7.89	25.65	43.81	49.54	34.11	-2,224.29	-110.25	-4,911.35	253.67	188.78											
Burlington	-652.79	1,013.13		113.80			11.29	4.45	166.57	406.72	-1,303.95	63.92	-3,899.99												
Dallas	-471.50	-520.19	-751.30	-234.19	-3.09	1.60	9.15	49.39	177.95	-462.49	67.41	-1,565.71	225.51	55.00											
Phoenix	-1,491.93	-356.95	20.02	-1.00	-34.75	-0.95	7.13	1.33		43.05	39.25	-1,207.30	375.19	-305.95											
Aurora	-1,721.42	-247.00	-478.04	-151.10	3.50	1.67	9.20		94.00	-145.65	-771.54	-323.39	145.11												
Jacksonville	-1,344.73	-7.77	12.95	107.55	1.05	7.73	11.31	71.01	46.51	154.69	-271.35	-375.71	529.67	-1,055.33											
Memphis	-237.01		10.14	3.47			27.72	7.29		47.99	30.51	-145.14	-1,249.70	25.13											
Louisville	-99.27	-152.93	59.90	633.79	0.77		8.33	1.20	55.92	7.43	68.53	349.67	130.60	59.29	-3,309.98										
Medina	-15.48	-244.33						0.09					-13.47												
Round Rock		-11.60		-427.45		-706.01	0.76				2.72														
Knoxville	-1,150.65		29.07	-46.29			23.07	15.32			15.72	-24.59	-42.14	25.93											
Miami	-110.76	-36.29	0.47	-578.66	-1.04	2.33	93.69	19.45		31.13	15.84	1.64	-1,642.39	162.50											
Rockford	-538.45			-13.19				12.07					-827.28	77.53											
Clarksville		-14.52	-11.69				1.05	12.01				11.25	-1,065.37												
Bethlehem		-76.00	-5.45	-7.10							0.71		-913.19												
Colorado Springs	-249.77	-930.53	80.95	-169.30		9.30		5.75			4.57		-50.92	50.13											
Pueblo								0.09				84.57		-49.07											-930.20
Cleveland		-305.11	-1.99	-54.60			1.75	5.52	15.20		71.89	-71.51	-152.05	55.11											
Nashville	-20.22		23.90	10.95		1.10	3.34	13.22		13.84	-53.99	-942.55	134.05	-272.58											
Concord	-1,059.02	14.70		-24.29	0.45		13.05	71.00			33.72	65.41	143.00												
Lorain	-734.53		23.19			1.71					2.40	-14.33	15.49												
Mesa	-339.53	-191.65	33.15	-49.72				15.92	14.41		-194.02	-130.59	90.83												
Greenville		5.00		-22.14	3.51		3.34					-14.03		-572.00											
Troy	-126.39	-378.69	35.02	2.79				23.00	124.66		60.21	-123.93	39.07												
Oswego							4.11						-540.24												
Waco											0.71		-431.45												
Carrollton			-20.90		0.50	6.19		0.67			-52.03		-522.48	0.91											
Yuma							1.10						-35.00												-479.99
Tyler			-41.85								-7.99		-399.57												
Charlotte	-477.04		12.07	15.15	-34.76	7.33	67.19	6.00			-45.04	19.65	-197.97	201.03	-944.99										

Perspective addresses common, but challenging, needs to represent large, high-speed, financial services data sets.

inviting talented engineers to collaborate on new technology that delivers value to its users. Open sourcing a visible project like Perspective has the added benefit of showing the thousands of developers within J.P. Morgan that this software is both available for their use and that it is possible to do more with open source.

Perspective continues to grow its open source footprint with new contributors getting involved on a consistent basis and a steady stream of new releases with exciting new features.

A contribution story

They met at a FINOS conference...Scott Logic first learned about the Perspective team's open source work during an Open Source Strategy Forum (OSSF) presentation. This sparked an idea, a conversation, and ultimately a successful collaboration.

Scott Logic is a UK-based software consultancy and an active member of the FINOS open source community with deep experience in financial services. One of the open source projects that Scott Logic supports is D3FC, a collection of components that make it easy to build interactive charts with D3. So when individuals from Scott Logic saw a presentation on Perspective they identified clear synergies between elements of the software and their own work. The D3FC library seemed like a perfect fit for the Perspective plugin framework, with an opportunity to enhance the existing options for chart views.

The process of collaboration was a smooth and efficient one, which is a testament to the collaborative spirit and pragmatic approach of developers on both sides. In a nutshell the process went something like this:

1. Small teams from J.P. Morgan and Scott Logic had initial conversations to explore the value of

a Perspective D3FC plugin. It turned out that J.P. Morgan had already been considering D3FC so there was strong alignment.

2. The teams had a few more meetings and Scott Logic became familiar with relevant parts of the Perspective code.
3. Scott Logic built a proof-of-concept (PoC) to prove out the idea at a high level and confirm interest with the Perspective team.
4. After J.P. Morgan accepted the PoC the two teams agreed on a development approach and established regular meetings to ensure that the new contribution could be seamlessly incorporated and then adequately supported moving forward.
5. Perspective's plug-in model enabled the Scott Logic team to work independently, yet still collaboratively, making the process even more efficient.
6. After only a few months Perspective had a full integration with D3FC.

This successful collaboration resulted in the addition of the D3FC open source charting module to

Top tips for collaborating successfully...

- Establish a set of "shared rules" or an expected code of conduct between collaborators.
- Before submitting major changes, increase familiarity with the code and help establish a working relationship with existing developers by submitting bug fixes.
- Keep open lines of communication, sharing approaches and validating assumptions frequently.
- Start small with specific deliverables that provide value and keep building on those.
- Promote active knowledge sharing where you can. For example, in this collaborative effort the Perspective team implemented a new D3FC chart type on their own.
- Improve the documentation as you go making future contributions from new individuals even easier.



At Scott Logic, it's always been important to us to be active contributors to the open source community, and our advocacy of open source in finance is demonstrated through our long-standing membership of FINOS. We were delighted to have the opportunity to collaborate so closely with J.P. Morgan on Perspective and D3FC, combining two great open source projects together in a way that resulted in an even better contribution to the community.”

- COLIN EBERHARDT, SCOTT LOGIC CTO AND BOARD MEMBER OF FINOS

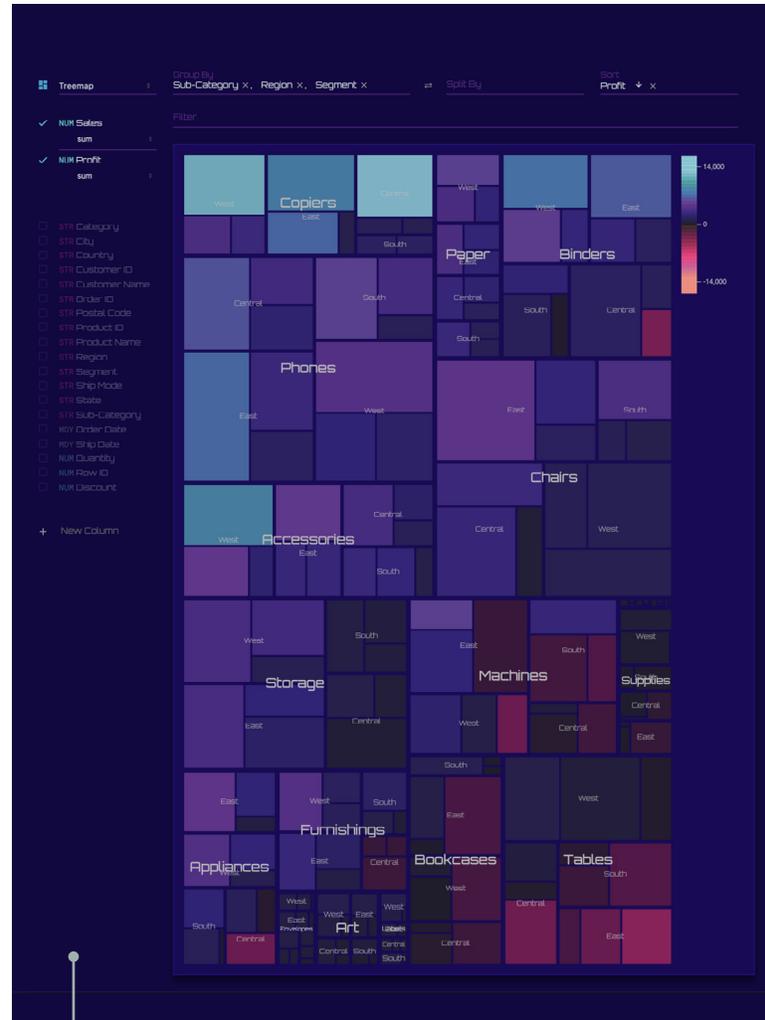
Perspective. This has enabled developers to more quickly add new types of high-value charts for end users, such as candlestick charts and complex charting on dual axes.

A consumption story

They met at a FINOS conference. (Really, they did.) RBC Capital Markets was already thinking about different ways to help their users make sense of large data sets so when they saw Perspective it made sense to learn more.

RBC Capital Markets, like J.P. Morgan and every other investment bank, must help a wide range of internal users make sense of vast amounts of data, which often means adapting existing systems to leverage new technology. When introducing new software, technology teams must consider how to do this as seamlessly and quickly as possible while keeping costs down and considering security and support concerns. Choosing the right open source software can help firms achieve these goals.

After learning more about Perspective's functionality and the technology behind it, a team within RBC Capital Markets made the decision to run a pilot in which they would implement several Perspective front-end components into an existing RBC Capital Markets production system. It was relatively straightforward for the team to download the software from the GitHub repository and they



Perspective makes it simple to build real-time & user configurable analytics entirely in the browser.

“ The open source community has become an integral part in driving innovation within the financial services industry, and it is important for our team to get involved and be a part of this collaboration. RBC is making strides in contributing to the open source community, and in the interim has been focused on improving our efficiency and competitiveness through adopting new tools, such as Perspective. Data visualization is at the forefront of our UI/UX strategy and Perspective integrates well into our workflow.”

- **KIM PRADO, GLOBAL HEAD OF CLIENT, BANKING & DIGITAL TECHNOLOGY, RBC CAPITAL MARKETS**

found Perspective easy to work with. The RBC Capital Markets technology stack is fairly different to the Perspective technology stack so there were some challenges to overcome. The RBC Capital Markets team created a wrapper to streamline the implementation as much as possible.

Within only a few months of learning about Perspective, RBC Capital Markets had implemented new Perspective visualization tools into their existing trader desktop for a handful of pilot users to test. After receiving positive feedback they rolled these tools out to over 300+ users. The RBC Capital Markets team is now evaluating how to use Perspective in several more internal applications.

RBC Capital Markets found that Perspective is a useful tool to include in their overall strategy as it affords complex interactions with data with a relatively low learning curve. They enabled internal users to do more for themselves with reduced development overhead and accelerated time to market.

Delivering greater value together

This case study is a great example of collaboration in financial services actively taking place through open source. It highlights how the entire community can benefit, including:

- Growth in the developer community delivering new features and bug fixes in Perspective
- Wider adoption of and new features added to open source charting tool D3FC
- New visualization functionality quickly implemented, with minimal cost in trading software at another bank
- Developer collaboration across companies promoting new types of engagement and stimulating innovation

Given the high expectations of flexibility, speed, visualization, and usability in today's financial landscape it makes sense to work together. As an open source solution, firms and individuals across the industry now have an opportunity to leverage this software as well as a chance to improve it even more.

Growth through open source

The Perspective project continues to benefit from new contributions from a growing community.

46+ contributors and growing
10+ new J.P. Morgan contributors from outside of the core development team
30+ individuals from outside of J.P. Morgan have contributed to the project
500 stars gained in 2020 YTD

These statistics are from August 2020.

Perspective Features

Perspective makes it simple to build real-time & user configurable analytics entirely in the browser. Users can build reports, dashboards, notebooks, and other essential applications to make routine work more efficient. Some notable features (on the more technical side) include:

- Access to a wide range of common data structures, including time series, tabular, order book, and complex object structures, found across financial services, in both static and streaming forms.
- A fast, memory efficient streaming pivot engine written principally in C++ and compiled to WebAssembly.
- An embeddable, framework-agnostic configuration UI, based on Web Components, and a Web Worker engine host for responsiveness at high frequency.
- A suite of simple visualization plugins for some common JavaScript libraries such as D3FC and Hypergrid.
- A symmetric Python library with embedded Jupyterlab component.

About FINOS

FINOS (The Fintech Open Source Foundation) is a nonprofit whose mission is to foster adoption of open source, open standards, and collaborative software development practices in financial services. It is the center for open source developers and the financial services industry to build new technology projects that have a lasting impact on business operations. As a regulatory compliant platform, the foundation enables developers from these competing organizations to collaborate on projects with a strong propensity for mutualization. It has enabled codebase contributions from both the buy- and sell-side firms and counts 30+ major financial institutions, fintechs and technology consultancies as part of its membership. FINOS is also part of the Linux Foundation, the largest shared technology organization in the world.

Important Disclaimers: The Linux Foundation is not aware of any particular commercial relationship between the Perspective project contributors regarding their participation in the project. The Linux Foundation's antitrust policy is available at <https://www.linuxfoundation.org/antitrust-policy/>.

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