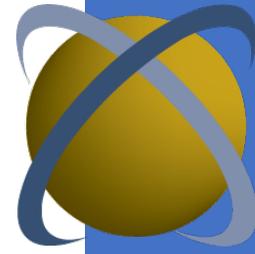


Intersect360 Research White Paper: AI AND THE NEW HPC: REVOLUTIONIZING FINANCE



MARKET DYNAMICS

Reducing Risk, Maximizing Reward

By any measure, financial services is a mature industry. It has existed almost as long as there has been money. Capital is the most fungible of commodities, and the basic driving factors—supply and demand, risk versus reward—remain immutable drivers for pricing and investment. Yet despite the supposedly unchanging nature of the market, or perhaps because of it, competition for innovation among financial institutions is fierce and fast-moving, as banks angle for any quantitative edge they might find.

As a result, the financial services market is one of the largest consumers of high performance computing (HPC) technologies and services, with over \$4.5 billion in investment in 2018 worldwide, more than was spent on HPC for national security (\$4.1 billion), national research labs (\$3.6 billion), automotive and aerospace manufacturing (\$3.0 billion), bio-sciences and pharmaceuticals (\$3.0 billion), or any other commercial segment.

This investment is driven by intense competition to make smarter, safer monetary decisions. Quantitative applications for HPC in financial services fall into four major categories:

- *Risk management:* In the largest and fastest growing category of applications, financial institutions can evaluate their value at risk (VaR) for individual assets or portfolios, by testing against a battery of millions of hypothetical econometric scenarios.
- *Trading:* In a well-documented “arms race” of the 2000s, investment firms aimed to have the fastest, most responsive networks, enabling them to gain a speed advantage in trading against their competitors. While some of the attention has waned, the use of HPC for algorithmic trading continues.
- *Pricing:* Derivatives and other complex financial products can have sophisticated pricing models. HPC is used to control for (and take advantage of) arbitrage scenarios, as well as to set optimal prices for financial products according to their risk profiles.
- *Analytics:* The broad field of “big data” applies in finance as well as it does anywhere. High-performance systems can provide an advantage in finding hidden patterns in data across a spectrum of use cases, including fraud detection and predictive econometric modeling.

None of these applications is “solved” to the extent that it won’t continue to evolve in the years to come. Taking risk management as an example, the best-of-breed financial institutions today might recalculate all their risk positions overnight in response to what happened during the day. This is good, but it provides the organization with only a single daily adjustment. Moving to intraday or even real-time risk reassessment, in response to changing market conditions, would be a job for new generation of supercomputing power.

One financial services user described the relentless drive for HPC as follows:

There’s a whole hierarchy that happens in every product in finance. When people start trading a product, the first thing they need is a price. They need to be able to compute an arbitrage-free price based on other securities. ... That involves having a model that you can calibrate to the market and price the security. That’s one level of computation. If it’s a complicated model, it can take significant computing power to do it.

Now, the next level up, once you can do that, you want to say, how is the price going to change if the market changes? Now you have to perturb all the market input models, and there could be five or 10 or 20 or 30, and recompute, so now you’re talking about increasing the level of computation you need by an order of magnitude.

And then once you can do that, there’s two other directions it goes. Now I want to analyze the strategy that’s involving the security, so I want to pull historical data and try running out the strategy using this model every day over the last five years. So now you have a huge amount of computation to run each of these tests, another couple orders of magnitude. And then once you’re trading these successfully you have a portfolio of them that you need to analyze how the whole portfolios going to behave, so it’s another several orders of magnitude. ...

As the computing gets faster it makes more things possible. ... Once your computing catches up and you can do it on an interactive basis, you can respond to market changes, and it opens up a whole new world. When you have to do your portfolio analytics overnight, then it’s a different world than when you can do them in real time, interactively, where I can say, ‘Oh, the market moved suddenly. How does that impact my entire portfolio? Can I track my VaR [value at risk] as the market moves?’ That’s an innovation that could have a major impact on the markets.¹

AI and the New HPC

The very nature of HPC applications is that they are constantly reinvented. Once one problem is solved, it unlocks the approach to a new, harder category of problem, which itself spurs investment to solve it. New HPC applications, architectures, and approaches are driven by the perpetual need to solve the next big problem. Thanks to advancements in the availability of

Across financial services, there is a deep wealth of data. If harnessed, it can be activated for significant reward.

¹ U.S. Council on Competitiveness and Intersect360 Research, “Solve. The Exascale Effect: The Benefits of Supercomputing Investment for U.S. Industry,” October 2014, <https://www.compete.org/reports/all/2695>.

data, the scale of HPC, and investment by hyperscale web companies, there has been a revolution in using artificial intelligence (AI)—or more specifically, *machine learning*—as a complement or component of HPC.

Historically, most scientific applications have been *deterministic*, based on a set of inputs, a program runs a bunch of calculations and comes up with an output, which is the answer. A second type of applications is *probabilistic*. Rather than computing one answer, we test a multitude of scenarios to see what happens. This would be the approach to answering the question, “If you shuffled together ten decks of cards at random, what is the probability that some sequence of 20 cards would contain at least 18 spades?” It is a very difficult math problem to compute exactly, but relatively simple to have a computer try it 10 million times to come up with a likely answer. In HPC, this is called a Monte Carlo simulation, and it is a common approach in financial services.

Machine learning represents a third category of application that is *experiential*. Based on patterns seen previously, a machine learning algorithm makes inferences about current or future situations. This approach is called “artificial intelligence” because it mimics how humans learn: *Although I have never seen this cat before, I am confident it is a cat based on my lifetime of experience and learning involving cats.*

Machine learning can be deployed any time there is a wealth of data to draw on, coupled with a reward from making more intelligent inferences based on that data. Here the financial services industry is described perfectly. HPC using organizations in general are trending toward the incorporation of AI, and in this regard, financial services organizations are perhaps ahead of the pack. In a 2018 survey, 61% of HPC users said they are already running machine learning as part of their environments; that figure goes up to 67% when considering only financial services organizations.

One of the immediate areas in which machine learning is showing promise is in pricing. For decades, most prices (often in the form of interest rates, such as for credit cards or mortgages) have been based on risk tranches. A *tranche* is a stratum of risk-worthiness. One person gets a 4.99% credit card offer while another gets a 3.99% offer for the same card because they are in different tranches. With machine learning, banks have the opportunity to revolutionize this approach by driving toward individualized pricing, in which each person’s risk is evaluated, and priced, independently. But this also needs to be done mindfully, so that pricing isn’t predatory or discriminatory. This additional constraint is challenging but not insurmountable; the exact type of problem that drives innovation in HPC.

For financial services organizations, there is an additional effect of the incorporation of AI with the already-existing thirst for relentless performance. Now systems must be tunable for high performance across a wider range of applications. HPC users in banking and beyond are exploring solutions with new types of processing elements for application acceleration.

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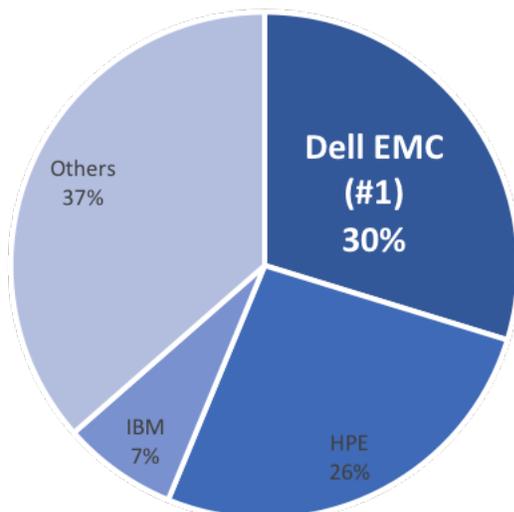
INTERSECT360 RESEARCH ANALYSIS

Today's challenges in financial services are representative of the "new HPC," combining scientific computing with large-scale data analytics and artificial intelligence. Successful solution providers will be those that have technologies that can span this expanded workflow, combined with domain-specific expertise in helping organizations achieve meaningful breakthroughs.

Dell EMC is just such a company. With trusted products across both computation and data management, Dell EMC is the industry leader in total HPC solution revenue.² Dell EMC leverages this breadth of offerings with converged solutions that incorporate HPC, data analytics, and AI³ and offers tailored solutions incorporating the latest in AI for financial services and other key vertical markets.⁴

Share of Combined Worldwide HPC Server and Storage Revenue, 2018

Intersect360 Research, 2019



Dell's HPC solutions for finance leverage the company's close partnership with Intel. Not only has Intel refreshed its line of x86 high-performance processors with the second-generation "Cascade Lake" Xeon Scalable family, but the company also offers a breadth of additional solutions for HPC and AI. Reprogrammable FPGAs (field programmable gate arrays) can be tuned for specific applications, particularly those that are highly scalable and reliant on a high degree of integer-based (or fixed-point) arithmetic. These types of applications are common in banking, and Dell leverages Intel FPGAs in its solutions for financial services. According to Intel's Stefano Zammattio, "This versatility enables you to provision fast processing power efficiency,

Intel FPGAs enable 'fast processing power efficiency, and low-latency service – potentially lowering your total cost of ownership, and maximizing compute capacity within the power, space, and cooling constraints of your data centers.'

² Intersect360 Research, "Vendor Overview and Outlook: Dell EMC in HPC," 2019.

³ https://www.dell.com/en-us/collaterals/unauth/brochures/solutions/hpc_ai_convergence_brochure.pdf.

⁴ <https://www.emc.com/collateral/solution-overview/ready-solns-for-ai-machinedeep-learning-sol-overview.pdf>.

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Most importantly, Dell EMC is helping its customers derive real value from their investments in HPC, analytics, and AI. In one example, Mastercard is leveraging Dell EMC solutions in deploying AI to improve fraud detection for its two billion cards in use worldwide. With 1.9 million rules generated by machine learning, Mastercard takes milliseconds in approving (or denying) an average of 165 million transactions per hour.⁶ Keeping cards active for legitimate charges but flagging those that are fraudulent provides value and peace of mind for cardholders and delivers measurable monetary benefit to Mastercard.

For financial services, the new HPC is fueled by analytics and AI. Across banking, insurance, credit cards, and investments, there is a deep wealth of data. If harnessed, it can be activated for significant reward. Although the fundamental drivers in finance remain the same, these converged, high-performance solutions are critical to maintaining innovation and leadership in making faster decisions and safer investments. With its industry-specific knowledge and technology solutions across data management and computation for HPC, analytics, and AI, Dell EMC is well-positioned to help its customers in financial services achieve their new levels of innovation.

For more information about Dell EMC solutions for HPC, visit <https://www.dell EMC.com/en-us/solutions/high-performance-computing/index.htm>.

For more information about Intel FPGA solutions for financial services, visit <https://www.intel.com/content/www/us/en/financial-services-it/financial-services-overview.html>.

⁵ <https://www.intel.co.uk/content/www/uk/en/financial-services-it/fpga-2019.html>.

⁶ <https://www.dell EMC.com/en-us/collaterals/unauth/white-papers/services/mastercard-fighting-fraud-the-smart-way.pdf>.