8 things you should know about NEXT-GEN QUANT

Contents

Welcome

Welcome to '**8 things you need to know about next-gen quant**' – but might have been afraid to ask. As we navigate the frontier of quant investing, our team at Robeco wanted to help you demystify some of the complex concepts that are rapidly becoming everyday words. This publication covers the fabric of next-generation quant investing, such as alternative data, machine learning and natural language processing. We also address possible applications in the world of sustainability and what all these developments mean for investors.

The most important factors, however, when it comes to next-gen quant are infrastructure and culture. Without robust, innovative versions of both, an excellent next-gen quant program simply can't get off the ground. We discuss these two crucial elements after the more technical aspects, and conclude with a short overview of what Robeco's already doing in this sphere.

Our goal is to share our experience and insights, empowering you to get the best out of the transformative potentials of next-gen quant.

Enjoy the read!

Mike Chen

Head of Alternative Alpha Research

" *Our goal is to share our experience and insights, empowering you to get the best out of the transformative potentials of next-gen quant.*

1

Next-gen quant researchers know how to exploit alternative data

In our increasingly digitalized world, the oceans of data we swim in grow deeper every day. Traditional sources such as financial statements and market prices have long been tapped by investors for insights. But next-generation quant researchers are diving into a new realm: alternative data. This means wading into unconventional or non-traditional types of data that have not been used in the past for investment decisions.
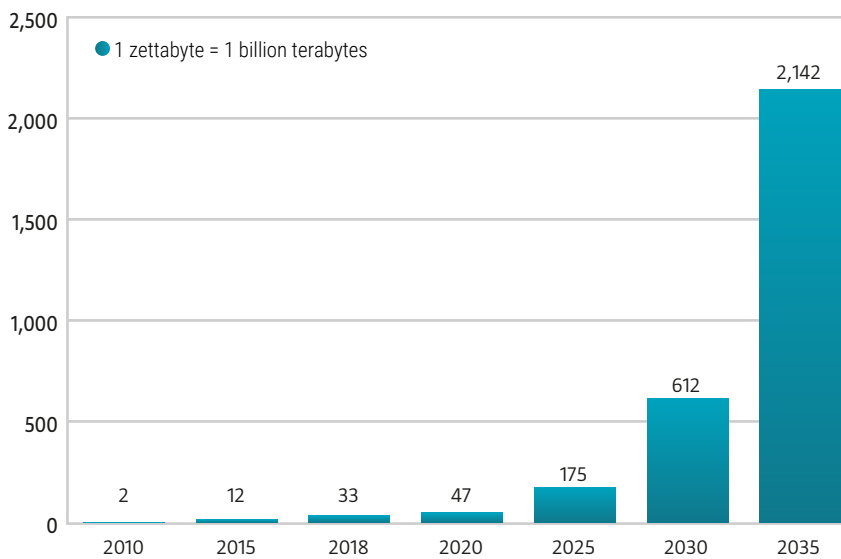
The four Vs of alternative data – volume, velocity, variety, and veracity – can be helpful in understanding what alternative data actually is. The sheer amount of data now available (volume) is staggering and still increasing as more aspects of our lives come online. What's more, this data isn't static but is being generated at an ever-increasing speed (velocity), offering real-time insights into market trends and consumer behavior.

Indeed, while alternative data can be very useful for researchers to extract insights, there is also a lot of noise in this data. In fact, according to some studies, only 0.5%[1] of all data is ever analyzed or used.

Now, this data comes in all shapes and sizes (variety), from news sentiment from which we can cull insights into company performance, to satellite imagery that can give us a much better overview of deforestation. With our long history in deciphering data, Robeco's next-gen quant researchers make sense of this variety, and most importantly, check the veracity (accuracy and reliability); because false data can lead to false conclusions.

Figure 1: Global data creation is about to explode

Actual and forecast amount of data created wordlwide 2010-2035 (in zettabytes)

Source: Statista Digital Econimu Compass 2019

1. https://www.technologyreview.com/2016/08/11/
    158359/the-big-deal-with-big-data-isnt-just-the-data/

So, how do our next-gen quant researchers convert this torrent of alternative data into tangible investment insights? The key lies in innovative data processing and analysis techniques. Advanced algorithms and computational models are used to sift through the noise to identify relevant patterns, and extract actionable information. However, when it comes to extracting useful insights from the ocean of alternative data, creativity, solid economic sensibility and intuition is considered even more important than data processing and techniques. At the end of the day, it's the people who know how to use this data that make the difference.

Think about a tech company that's ready to launch a new product. Next-gen quant researchers could use web scraping to monitor social media sentiment and online reviews in real-time, giving them an edge over investors waiting for quarterly reports to gauge the product's reception.

It's important to remember, however, that alternative data is just one piece of the puzzle. While it can offer unique and timely insights, to truly unlock its potential it is best used in conjunction with traditional data sources, sophisticated analytical techniques, and most importantly, sensible economic hypotheses. This is where machine learning comes in.

" *In fact, according to some studies, only 0.5% of all data is ever analyzed or used.*

1. https://www.technologyreview.com/2016/08/11/158359/the-big-deal-with-big-data-isnt-just-the-data/

2

For next-gen quant, machine learning is par for the course

With the recent release of ChatGPT[2], artificial intelligence (AI) and machine learning (ML) have come into the public's consciousness and created huge excitement about what they may bring to society and the economy. However, these aren't recent developments, and next-generation quant research programs have been using these advanced algorithms in production for more than ten years.

Figure 2 below gives a brief history of ML development, in which it can be seen that ML has been the next 'new thing' for a long time coming.

Figure 2: Illustration of machine learning and deep learning algorithms development timeline
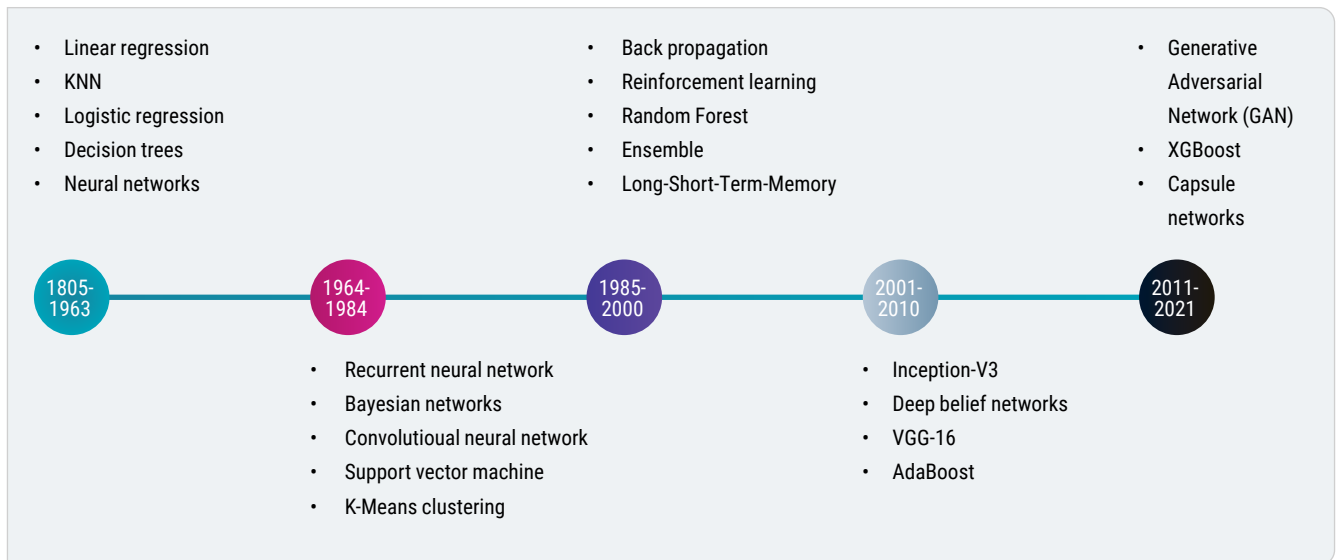

Source: Researchgate[3]

In recent years, ML algorithms have stepped out of research laboratories and moved into the production pipelines of various companies in many industries. What has now made them practical rather than theoretical has to do with the amount of data needed to train ML models and the available computing power to run these algorithms.

ML is essential for next-gen quant investing, thanks to the amount and variety of data consumed in such a program. As we saw in Chapter 1, next-gen investing uses big data to generate alpha. However, the size and complexity of that data can make it difficult for practitioners actually to deduce alpha insights. ML algorithms can help us by detecting patterns in this sea of data, thereby revealing relationships that might have been missed otherwise.

Figure 3 illustrates the new paradigm under which ML is used[4].

2. For more discussion on how GPT may be used in finance, see Howard, Vogel, Marchesini, and Chen (2023).

3. www.researchgate.net/figure/Illustration-of-Machine-Learning-and-Deep-Learning-algorithms-development-timeline_fig2_357525860.

4. Of course, this can lead to potential pitfalls such as data mining, etc. See Chen and Zhou (2023) for more discussions on how to deal with potential pitfalls that applying ML might bring in finance.

Figure 3: Machine learning is a new paradigm compared to traditional programming
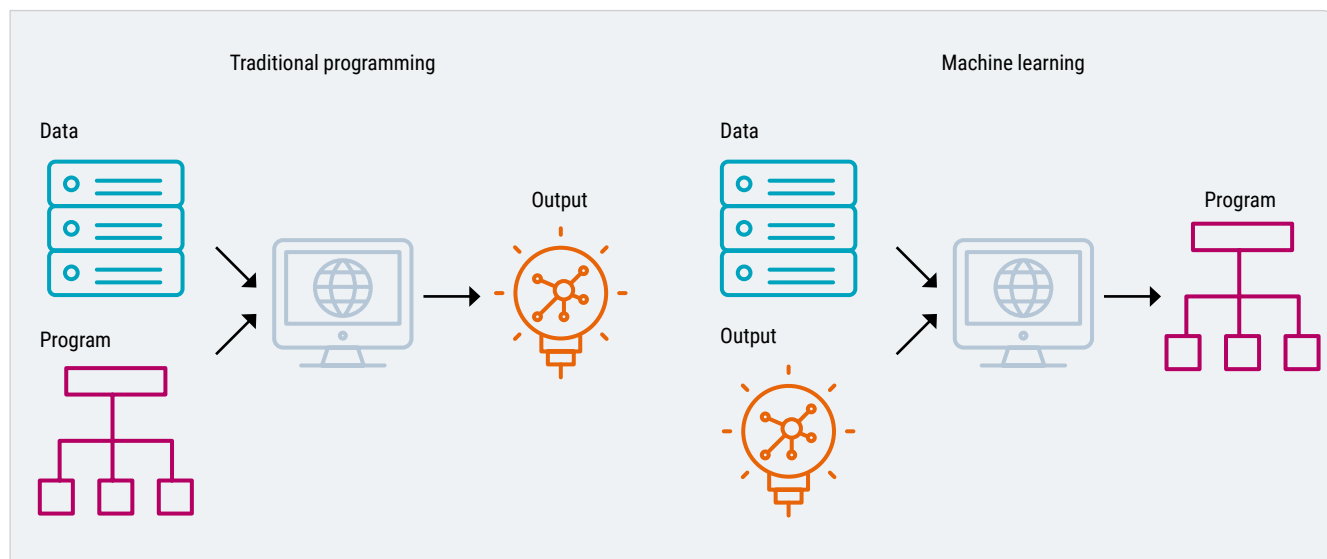
Source: Robeco

This paradigm shows how in traditional quantitative investing, analysts create models (programs) based on economic theories and use these to analyze market data and make investment decisions. In next-gen quant investing, ML is used. Here, historical market data and the associated investment outcomes are fed into ML algorithms. These algorithms then learn patterns and generate investment strategies (programs) that can be applied to new data. This can uncover insights and investment opportunities that may not have been apparent using traditional methods, allowing for more complex and adaptive investment strategies that can navigate the rapidly changing conditions in financial markets.

ML algorithms can spot non-linear and interactive relationships between inputs and outputs and has the ability to discover complicated patterns. This is ahead of classical quant strategies, which usually only look for simple, linear relationships. The ability to find more intricate linkages has many financial applications for alpha and risk.
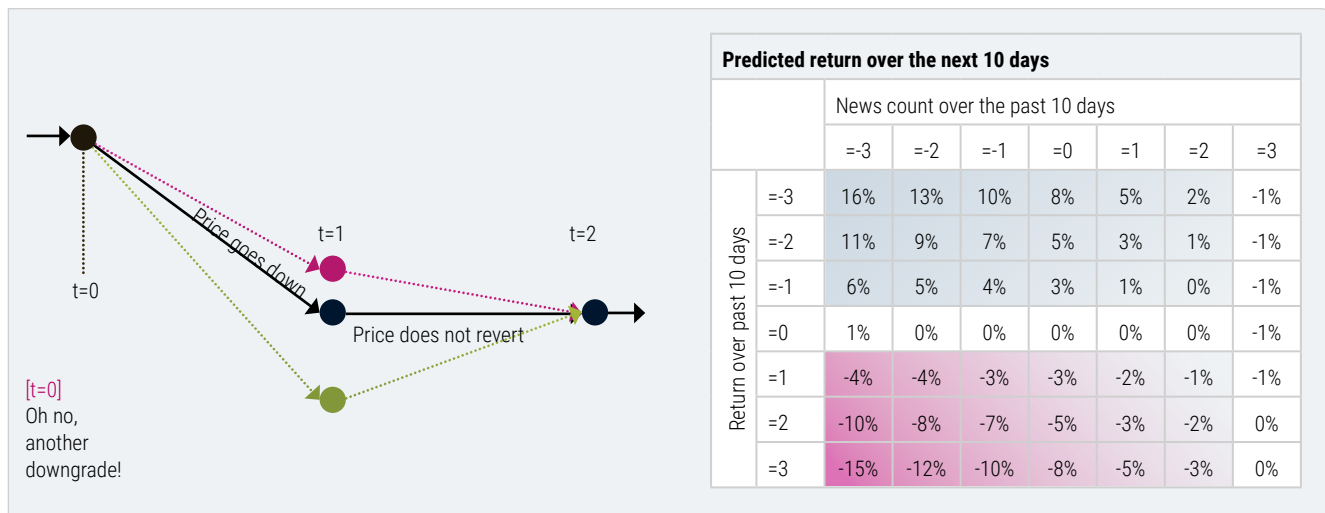
Here's a concrete example, illustrated in Figure 4 below. Using ML, Robeco's next-generation quant team discovered an interesting connection between reversal and abnormal news volume. Reversal is when securities that have seen large price movements tend to mean-revert – swing back to their previous price. This is a well-known pattern in finance and one of the strongest short-term dynamics commonly used in quant models.

Robeco found that the reversal effect for a given security is stronger when there's not much unusual news volume associated with that security. But if there's a surge of abnormal news, the reversal effect weakens or even disappears.

" *This can uncover insights and investment opportunities that may not have been apparent using traditional methods, allowing for more complex and adaptive investment strategies.*

This makes intuitive sense. If a security's price moves a lot and there's no significant news, those price movements were probably driven by speculation, FOMO, and so on. But if there's a lot of news accompanying the price changes, then it's likely the price is reacting to new information revealed in news flow.

Figure 4: An interaction dynamic regarding the reversal effect, discovered using machine learning

Predicted return over the next 10 days								
		News count over the past 10 days						
		=-3	=-2	=-1	=0	=1	=2	=3
Return over past 10 days	=-3	16%	13%	10%	8%	5%	2%	-1%
	=-2	11%	9%	7%	5%	3%	1%	-1%
	=-1	6%	5%	4%	3%	1%	0%	-1%
	=0	1%	0%	0%	0%	0%	0%	-1%
	=1	-4%	-4%	-3%	-3%	-2%	-1%	-1%
	=2	-10%	-8%	-7%	-5%	-3%	-2%	0%
	=3	-15%	-12%	-10%	-8%	-5%	-3%	0%

The figure also shows a price-path diagram with points at t=0, t=1, and t=2. Labels: "Price goes down", "Price does not revert", and "[t=0] Oh no, another downgrade!"

Source: Robeco

When using machine learning, putting all your eggs in one basket by relying on a single algorithm might not be the best idea. It's often better to use a variety of different algorithms and horizons to get predictions that are both more accurate and more robust. This approach is called ensembling, and its power comes from leveraging the strengths of different models, compensating for their weaknesses, and reducing the risk of overfitting.

3

NLP, GPT and beyond

If you're looking for a revolution within the evolution of next-gen quant, look no further than natural language processing (NLP). NLP, a branch of artificial intelligence, involves the interaction between computers and human language.

While financial information has traditionally been derived from structured data like financial statements and market prices, the next generation of quant researchers recognizes that words (and how they are used) also convey a vast amount of investment-related information.

The evolution of NLP techniques started with simple keyword-based methods like the 'bag of words' model, which treated each word in a document as an individual unit, devoid of context or order. While revolutionary in its time, this technique lacked the sophistication needed to capture the nuances of human language.

Nowadays, the power of NLP goes beyond the written word. It also encompasses how the words are said. Tone, sentiment, and emotion are vital aspects of human communication often overlooked by traditional data analysis. By incorporating these elements, NLP can glean insights from earnings calls, interviews, news articles, and other verbal communications that a purely numerical analysis would miss.

Applying NLP to investments

Source: Robeco

Suppose a company's CEO uses unusually optimistic language during an earnings call. An NLP model could pick up on this positive sentiment and predict an upward trend in the company's stock price. Alternatively, consider the analysis of social media sentiment towards a brand or product. By processing thousands of tweets or posts, NLP can gauge public sentiment in real-time, providing a unique lens through which to view potential investment opportunities.

In the realm of regulatory filings, NLP can help identify 'red flags' that might be buried in the fine print. For instance, an increase in negative sentiment or uncertainty in a company's annual report could be a warning sign of trouble ahead.

With its ability to understand the nuances of language and a model view of the world (as instructed by its training data on items, events, people, etc., that likely occur together), GPT is the new champion of NLP. And it's transforming the quant landscape[6]. The advent of these models has led to rapid evolution and vivid applications in the AI domain, a game-changing innovation that will advance, not replace, quant strategies.

In conclusion, NLP is revolutionizing the way we analyze financial information. By leveraging the power of words, we can uncover deeper insights and make more informed decisions. The key to harnessing this power lies in effectively integrating these technologies into the investment process.

Advanced NLP techniques, a world unto their own, are headlined by Transformers (a specific neural-net architecture for NLP applications) and the GPT (Generative Pretrained Transformer) model. Transformers represent a significant leap forward in NLP technology. Unlike its predecessors, Transformers efficiently capture the contextual meaning of words based on their position in a sentence and within its neighboring sentences. This approach enables Transformers to understand not just individual words but the overall sentiment of a piece of text. Transformer represents the T in GPT, which has the potential to take NLP technology even further.

Unlike traditional machine learning models, which are discriminative models, GPT is a generative model[5] that captures the joint probability of items occurring together based on the sample data it has been trained on. That's why when you ask GPT to tell you the history of ancient Rome, it'll likely tell you about Caesar and Pompey and the civil war that led to the conversion of Rome from a republic to an empire, even though you didn't specifically ask it to tell you about those individuals and periods in history. This is because whenever the topic of Roman history comes up, the civil war between Caesar and Pompey features prominently.

5. Discriminative models divide the data space into classes by learning the boundaries, whereas generative models understand how the data is embedded into the space. For more information, see: https://www.turing.com/kb/generative-models-vs-discriminative-models-for-deep-learning.

6. However, we must caution that generative models such as GPT are not without their issues and pitfalls and should be used carefully. See Howard, Vogel, Marchesini, and Chen (2023) for more details.

4 How to consciously innovate in next-gen quant

Can alpha and sustainability go hand-in-hand?
When investment buzzwords constantly veer between returns and sustainability, asset managers often find themselves in a conundrum. How do they reconcile the demand for alpha with the growing call for sustainability?

Historically, generating alpha was often seen as incompatible with sustainability . However, corporate valuation has become increasingly dominated by intangible assets (see Figure 6), and today's intangible economy has given rise to corporate assets like brand value and intellectual property.

Under the right conditions, corporate sustainability performance can be positively linked to its intangible assets, joining the tasks of corporate sustainability evaluation and corporate intangible asset pricing. The link between sustainability and corporate valuation is termed 'financial materiality' , and it is the Rosetta stone of having your cake, eating it, and becoming healthier to boot!

Figure 6: Corporate valuation is increasingly dominated by intangible assets.

● Intangible assets   ● Tangible assets
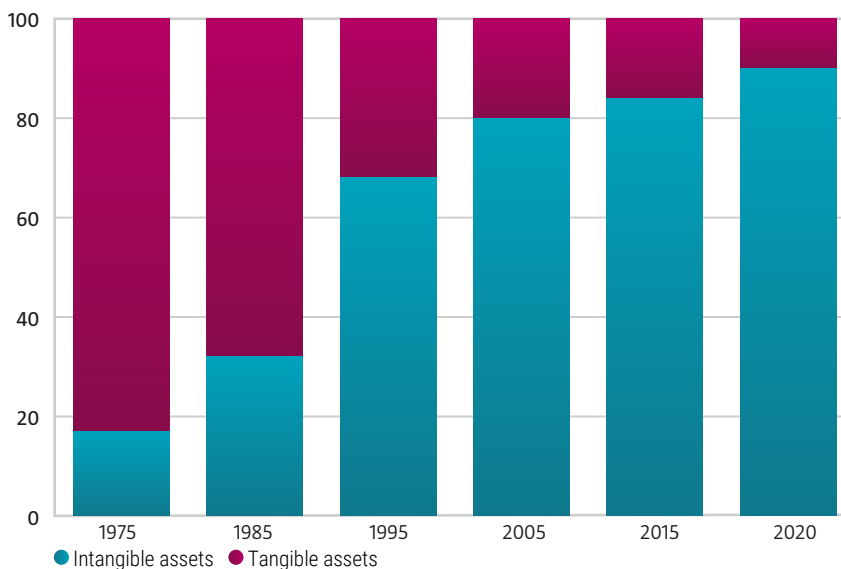
Source: Ocean Tomo, LLC

Unlocking sustainable alpha with next-gen techniques

The main challenge here is to understand how to assess sustainability and intangible assets simultaneously, as traditional financial data isn't suitable for such analysis. Sustainability data produced by companies is notoriously unreliable, and most commercial sustainability ratings devised to compensate for this also have flaws[10]. The development of next-gen quant investing means new opportunities for investors to integrate sustainability into the investment fabric. With innovative data and techniques, we can now analyze financially material sustainability performance and its relationship with intangible assets valuations – previously thought impossible using traditional methods.

" *Under the right conditions, corporate sustainability performance can be positively linked to its intangible assets, joining the tasks of corporate sustainability evaluation and corporate intangible asset pricing.*

7. This is commonly referred to as Friedman's Doctrine, after Nobel-winning economist Milton Friedman, en.wikipedia.org/wiki/Friedman_doctrine

8. For more discussions on financial materiality and how investors may evaluate sustainability and valuation simultaneously, see Schneider, Chen, and Rohof (2023)

9. https://oceantomo.com/intangible-asset-market-value-study/

10. For example, see Chen, Mussalli, and von Behren (2021).

Take corporate resource efficiency, for example. Every company's actions produce carbon emissions as a by-product. Investors who care about sustainability prefer companies with lower carbon emissions. But we could also view carbon emission as input into the production process. By doing this, we can evaluate how efficiently a company uses carbon emissions to deliver its products and services. At Robeco, we've found that favoring resource-efficient companies can boost a portfolio's expected alpha and lower its carbon footprint. We call this 'sustainable alpha' because this method can enhance portfolio sustainability and its expected returns[11].

What about customization?

As a pioneer in sustainable investing, clients often ask us which sustainability goals should be incorporated into their portfolios. But we appreciate that sustainability varies from place to place and client to client. It's a matter of personal values. That's why customization is essential in sustainable investing. Currently, the traditional approach to customization is to apply exclusions, but these can compromise portfolio performance without necessarily leading to a positive impact.

At Robeco, we've developed a new approach to customization based on portfolio optimization. This method incorporates sustainability goals into the optimization step of the portfolio construction process along with alpha, evolving the investment problem from 2D to 3D, as shown in Figure 7. The benefit of our 3D approach is that it results in a Pareto Optimal portfolio, which means that it's impossible to improve one aspect (alpha, sustainability, risk) without negatively impacting another. For more discussion on this next-gen quant approach, see Howard, Chen, Lohre, and Blitz (2023).

Figure 7: Portfolio customization via optimization means evolving the investment problem from 2-dimensions to 3-dimensions
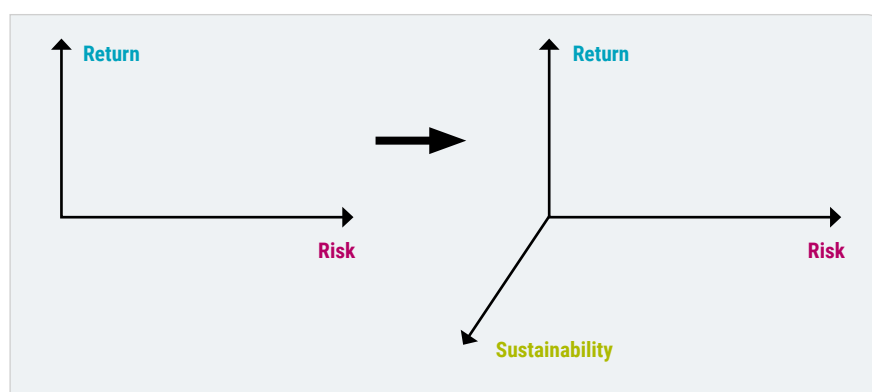
Source: Robeco

5 What does it mean for asset owners and quant investors?

We've explored the four core areas of a robust next-gen quant program: alternative data, machine learning (ML), natural language processing (NLP), and sustainable alpha. But what is the role of next-gen quant investing within the broader evolution of quant investing?

What are some key takeaways for asset owners and quant investors?

Figure 8: Evolution of quantitative investment research
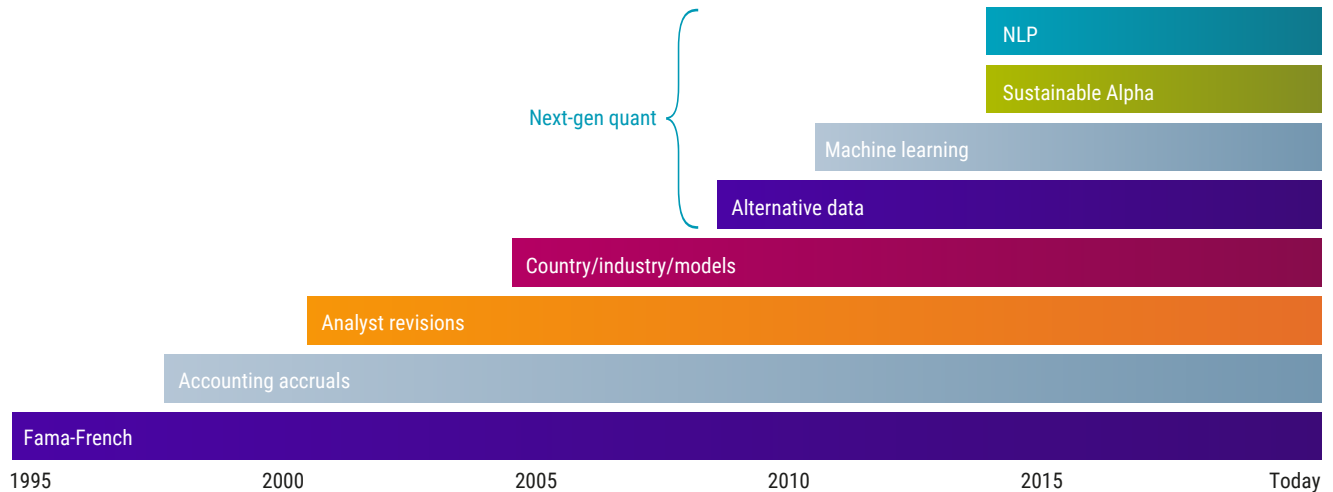
Source: Robeco

Figure 8 illustrates the evolution of quantitative investment research. A key observation is that while next-gen quant research areas have recently blossomed, quant investing itself is a discipline that continues to evolve. From the early '90s, with factor investing inspired by Fama and French (1993), quants have continuously explored new data and techniques to refine their investment models. The approaches in next-gen quant may be new, but the underlying principle behind them isn't. As is true in life, change is the only constant in quant investing.

Given the data, algorithms, and computing power available today to quantitatively literate investors, next-gen quant investing is set to thrive. It is essential to recognize that next-gen quant is not a replacement for classical models like Fama-French's factor investing; rather, it complements them. Classical models such as value, quality, and momentum are built on fundamental economic or behavioral theories that remain relevant.

However, as these models become more popular, the risk of market crowding increases, leading to diminishing returns. This is where next-gen quant comes into play. It can bolster strategy performance during periods when classical factors are faltering. And, as we discussed in the sustainable alpha section when applied carefully with financial considerations in mind, next-gen quant can potentially generate higher returns and create more sustainable portfolios.

" *However, as these models become more popular, the risk of market crowding increases, leading to diminishing returns. This is where next-gen quant comes into play.*

That said, next-gen quant is not a final destination. In time, these approaches will become part of established models, similar to what happened with value, quality, and momentum. Innovation will always be the heartbeat of success in quantitative investing. With the right setup, a quant team can continually innovate and explore new frontiers of quant investing, whatever they may be. This is discussed further in Chapters 6 and 7.

For asset owners, next-gen quant enhances existing products' risk and alpha, opening the door to new invention and sustainability possibilities[12]. These aren't just limited to data and methods used in next-generation quant but are common benefits of innovation in general. Asset owners should encourage their managers to keep innovating.

However, separating the wheat from the chaff is essential to avoid 'next-gen washing': the temptation to seem smart in front of the asset owners. Hiring genuinely innovative managers with robust next-gen quant capabilities has the added benefit of knowledge transfer. These managers offer insights and training in next-gen data and techniques, helping to guide the way.

For quant practitioners who want to establish a strong next-gen quant program, we would say: embrace change and innovate proactively. You can kick-start a next-gen quant program in various ways – you can build, buy, or blend infrastructural elements. There's no one-size-fits-all. The important thing is to early, or, failing that, start today.

Cultivating a culture that values innovation is equally crucial. Be bold and experiment – don't wait for academic validation to try something new. Cutting-edge research often takes shape in practice before academia catches up. McLean and Pontiff (2016) observed that quant portfolio returns tend to diminish after academic publication. Therefore, dare to innovate! In the next two chapters, we shed some light on the essential infrastructure and the critical role of people and culture in fostering the development of next-gen quant intellectual property.

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6 Next-gen quant only works with a robust, scalable foundation

Like the age-old dilemma faced by builders, "Good, fast, or cheap? Pick two", building a robust, scalable foundation for next-gen quant has its challenges.

Imagine a construction crew rushing in to lay a shallow slab as the foundation of a building. True, this approach is quick and cheap, and to the casual observer, it may look fine. The shoddy foundation, hidden beneath, isn't immediately apparent. But any experienced builder knows the long-term implications: structural problems such as cracked walls, slanted floors, or worse, the risk of the entire structure collapsing.

The same choices – and consequences – exist when we're talking about building a quant data and computing infrastructure, the foundation of any quant investment program. Believe it or not, it's possible to cobble together a basic quant codebase relatively easily, even a technically competent grad student could achieve this from their dorm room. Just download data to your local PC, get machine learning (ML) and natural language processing (NLP) algorithms from an online open-source code repository, throw together some basic wrapper and connector codes, and start generating outputs. Fast, cheap – but as with the hurriedly laid foundation, you'll start seeing cracks.

Then, you're dealing with scalability issues, struggling to handle the data volume and computing demands. Next there's the issue of replicability – with a lack of documentation and version control, it's difficult or even impossible for others to verify your research and its implementation, casting doubt over the entire operation. And let's not forget maintainability and iterability. Without clear coding standards and logical organization, finding and modifying or improving specific functionalities will essentially be like looking for a needle in a haystack.

Avoiding these pitfalls requires a different approach, one that may seem slower and costlier initially but will pay off in the long run. So what does a properly built quant infrastructure, one that's robust, scalable, and state-of-the-art, look like? We've built ours with three key elements:

1. **DATA STORAGE AND MANAGEMENT SYSTEM**
Capable of handling a large volume and variety of data and data with high throughput.

2. **COMPUTING STRUCTURE**
Scalable and flexible enough to handle the demand for an ever larger variety of processes, including those that run on CPUs, GPUs, and either a single node or multiple clusters.

3. **CODE STACK**
Well-structured with strong documentation, logical interface, consistent style, and version control.

This solid foundation enables multiple researchers to collaborate, contribute to R&D projects, validate accuracy, and reliably deploy production systems. When you amortize the initial investment over its usable life, you get quality output (it's good), quick development and evolution (it's fast), and fewer breakdowns and emergency fixes (it's cheap in the long run).

Like the unseen groundwork beneath a building, the infrastructure for a quant investment program isn't always glamorous. And the difference between a good and a shoddy one isn't always immediately obvious. Both can work, at least initially. However, their difference becomes as clear as night and day over time.

At Robeco, we understand the importance of a strong foundation for our next-gen quant investment program. That's why we've devoted significant time and resources to building our infrastructure correctly and thoughtfully because we know it's not about choosing between fast, good, and cheap – it's about creating a structure with strong foundations, a structure that is actually worth building on.

7 You'd enjoy hanging out with our next-gen quant researchers

If that solid infrastructure we discussed in the previous chapter is the hardware, then the people and culture of the team are the software. Without the software, the hardware is useless! At Robeco, we understand people and culture's critical role in every aspect of our business, including quantitative investing.

People and culture are two sides of the same coin: the right people foster a positive culture, while a positive culture fosters, retains, and attracts the right people, enabling them to work more effectively.

The people factor

What makes a great quant researcher? It's a relentless trio of curiosity, drive, and a scientific mind. We seek people who are genuinely enthusiastic about financial markets and obsessed with investment success. And in the quant world, where competition is fierce, diversity is key. Be it background, skills, knowledge, or experience – we need a team that thinks globally. We achieve this through:

- Searching the world by bringing highly competent and motivated individuals from international firms on board. This adds fresh perspectives and insights.
- Knowing the locals by connecting with people in different parts of the world. That means sometimes you need to speak their language (quite literally). For example, knowing Chinese or Japanese is a plus for understanding local market sentiment.
- Understanding the clients by keeping current on their ever-changing needs, no matter where they are.

The culture code

What kind of corporate culture makes our next-gen quant team thrive? Figure 9 outlines the core ingredients.

> " *Great workplace is not espresso, lush benefits, sushi lunches, grand parties, or nice offices. A great workplace is stunning colleagues.*
>
> *Netflix culture deck[13]*

Figure 9: Robeco quant culture
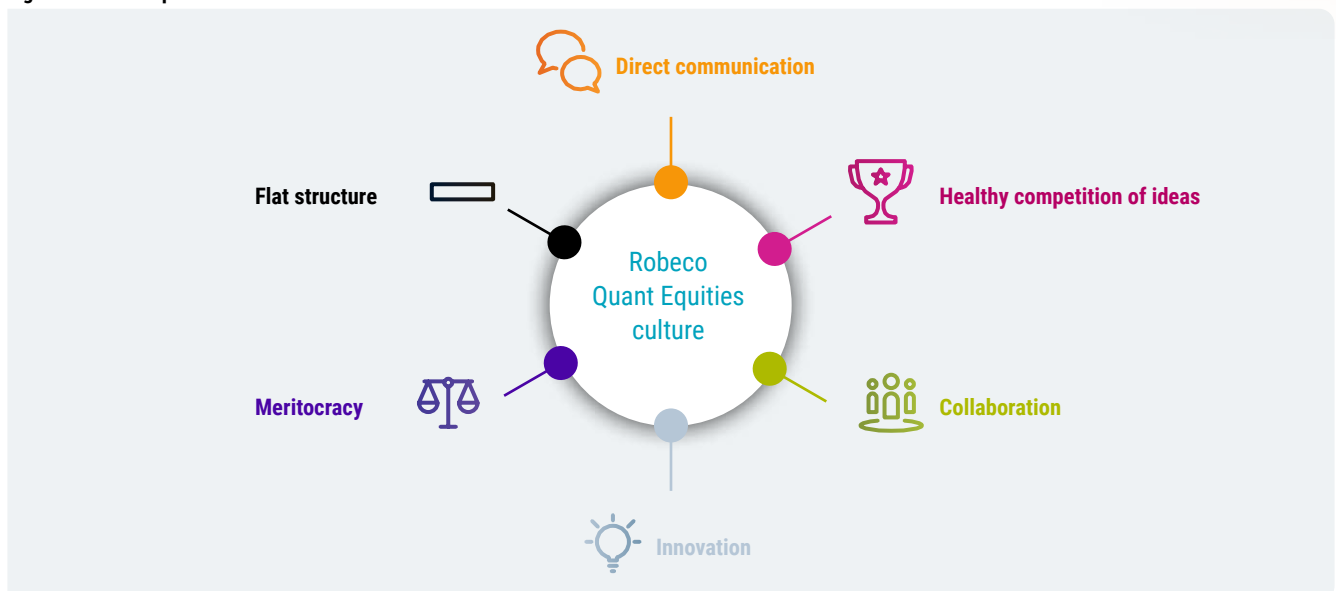
Source: Robeco

- **Flat structure**: We believe good ideas can come from anywhere. By keeping the hierarchy flat, we make sure the best ideas don't have to climb a mountain to be heard. This makes people fearless in sharing thoughts.

13. https://igormroz.com/documents/netflix_culture.pdf

- **Direct communication**: We reward honesty and openness. The freedom to suggest, challenge, and call out anything even slightly tricky keeps our culture healthy. The inclusion of team members from different cultural backgrounds enriches this trait.
- **Healthy competition of ideas**: Our team is a playground for ideas, and a little friendly rivalry keeps things moving forward. It also fosters an entrepreneurial spirit.
- **Meritocracy**: Good ideas are all about enhancing investment results. We are the guardians of our clients' assets, and we take that responsibility seriously. This creates a sense of ownership among the team.
- **Collaboration**: Everyone has a stake in the team's success, meaning there are no lone wolves. We have fluid project teams, so we can move fast and adapt quickly. The focus is on alignment and information sharing rather than rigid control. This also encourages smart risk taking.
- **Innovation**: In the fast lane of next-gen quant, being able to swiftly launch-and-iterate is key. Innovation rarely happens in a straight line, so speed and agility are our allies. The rapid pace at which we adapt and evolve isn't just an asset, it's an absolute necessity for staying ahead of the curve.

The leaders

To encourage motivation, we keep the energy high and the atmosphere positive. And although everyone contributes to the culture, our senior leaders are the torchbearers. They set the bar high by embodying the cultural traits we value. Culture is also very delicate. Once it takes a hit, the scars can last even after those responsible have left the stage. That's why safeguarding our culture is a continuous mission. A world-class next-gen quant investment program can only be built with the right infrastructure, people, and culture.

8 New signals across existing strategies: an evolutionary journey

As Robeco, our journey of integrating alternative signals into our investment strategy began in 2009, with the use of a shorter-horizon timing model in our enhanced index strategies.

Originally assigned a weight of 10%, this timing indicator, built on innovative and fast-moving signals, helped us identify moments to buy and sell stocks. Over time, we refined the signal, reducing trading costs and allowing us to raise its weight to 25%.

A significant evolution came with adopting machine learning and natural language processing (NLP). The former was used to help predict distress risk, identify stocks likely to take a fall, and exploit interaction effects, such as the short-term reversal effect. Meanwhile, NLP was introduced in 2019 to analyze news sentiment, earnings call transcripts, and audio files, using sentiment scores to influence decisions.

Maintaining the robustness of new signals has been critical. We leverage various sources and observations for inspiration and examine signal performance under varied market conditions. We scrutinize these signals in different regions and during different market phases – like bull and bear markets or times of high volatility. A 'spanning alpha test' also ensures the new data sets offer value beyond our existing models.

Sustainability factors also play a big role in our alternative signals. We've started to consider signals derived, for example, from employee engagement and resource efficiency. The former, a 'social' factor in ESG, is gauged through platforms like Glassdoor, and has shown a correlation with higher sales and future stock returns. The latter, an 'environmental' factor, examines resource usage relative to company sales. Resource-efficient companies tend to exhibit higher future stock returns and lower carbon emissions.

In sum, we don't adopt new alternative datasets lightly; they must truly add value to our strategy by enhancing alpha, aiding diversification, or improving the risk profile. Below is an overview of some of the next-generation signals we use across various quant strategies.

A selection of alternative signals

- **Short-term reversal component**: This involves looking at stocks that have shown a short-term reversal in their performance.
- **Liquidity characteristics**: We also look at stocks whose liquidity profile has improved, which we view as a positive sign.
- **Information from the lending market:** We use information from the short lending market, considering a high level of shorting on a stock as a negative sign.
- **Web script data (job vacancies)**: We monitor the number of job vacancies at firms, viewing an increase as an expectation for future growth.
- **Sustainability information:** Since 2010, we've included sustainability information as part of our Quality theme.
- **Information from the credit market:** We use the performance of a company's bonds to predict future stock returns and vice versa.
- **News sentiment**: We analyze the type of news coming out about a company, viewing more positive news as a good sign for future stock returns.
- **Machine learning techniques to predict distress risk**: We use machine learning techniques to predict the risk of a company going bankrupt.

Further reading

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