Venture capital is built on the business of capitalizing on innovation and disruption. While venture capitalists are adept at identifying entrepreneurs and companies at the forefront of changing trends, the venture capital industry itself has also has been undergoing innovation and change in recent years. There have been many gradual iterations and transformations of the venture model over time that have impacted how firms operate. More recently, the trends of big data, artificial intelligence and machine learning, technology that venture firms have help catalyze advancement in, have converged on venture investing itself. With more data than ever on startups and entrepreneurs, sophisticated models can be built and applied to venture investments processes.

Consequently, the venture capital industry is in the midst of an evolution, increasingly incorporating data-driven processes in decision making. Historically, the traditional venture model relied primarily on i) carefully cultivated personal networks and brands of venture capital firms and individual general partners, ii) an apprenticeship model of developing venture capital investment expertise and acumen, and iii) a reliance on historical pattern recognition and "gut-feel" to make investments. The new, data-driven model brings data analytics to the forefront to inform the various steps of the venture capital investment process, including sourcing, screening, selecting and monitoring investments as well as in aiding portfolio companies post-investment.

Incorporating Data Into Decision Making
A rapidly growing proportion of new venture capital firms are relying on advanced data analytics in their processes. While there is a wide range of intensity in the use of data, it appears that numerous tenured firms and the majority of new firms now have data-driven components to their strategies. The reason for this shift is not all that surprising. The power law dynamics associated with venture capital investing coupled with the high rate of new firm formation in recent years has put pressure on the development of competitive advantages. Many firms are finding advantages in aiding their decision-making with signals generated by algorithms – essentially super-charging traditional venture capital models by leveraging the growth and advancement of machine learning techniques, with data serving as the key input.

For seed and early-stage firms, where performance related signals are typically non-existent, the focus has been on utilizing data to proactively identify new high-

potential entrepreneurs and assessing the potential of new founders and leadership teams. For example, some firms are building models that leverage social media signals to proactively identify high-potential engineers and product managers at top technology companies who might be considering leaving and starting their own companies. These individuals can then be approached by venture capital firms ahead of a company launch.

Beyond the early stage and post-product, team-related data remains vital, but there are significantly more indicators available to assess. A company's industry, its board members, and investor syndicates become factors, as do more quantitative inputs such as deal history, valuation and cap table structure and composition. Growth metrics and other key performance indicators are also often available to assess.

Data Sources for Data-Driven Venture Capital Approaches
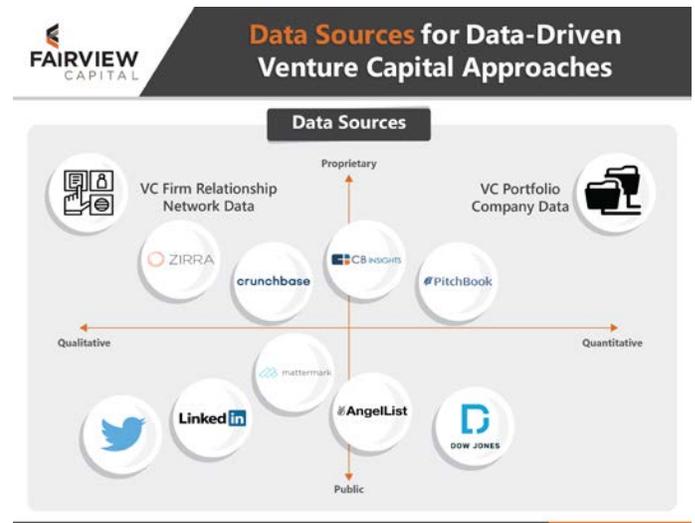
Increasingly tangible variables, as companies mature, serve as more valuable inputs for scoring and predictive models. The approaches firms take, and the usefulness of scoring and predictive models is often dictated by the availability, type, and volume of data, which varies by company category. For example, consumer-facing companies typically have more data available. Venture capital firms may be able to obtain precise data on user growth, retention, and sustainability. For enterprise and software companies, data may be harder to come by, especially for younger companies, requiring more advanced methods. Further, key performance indicators can vary for enterprise and software companies based on business model and vertical, making relative comparisons more challenging.

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Ultimately, the goal at the front end of the investment process is to better source and screen opportunities so that entrepreneurs can be proactively approached in a more focused manner to eventually increase chances of making a successful investment at the right time. Beyond sourcing and screening opportunities, data is also increasingly changing how venture capital firms approach monitoring and aiding portfolio companies post-investment.

The monitoring of existing portfolio companies is beginning to shift from board-level issue-driven engagement between CEOs and venture capitalists to a more embedded relationship. Venture capital firms increasingly have direct access to front-line data on the health of the business which can be used to anticipate company-level issues and proactively address them. Additionally, direct access to information allows venture capital firms to share data signals across portfolio companies in a way that was not scalable previously. As an example, identifying the effectiveness of marketing spend in one company's approach to a single vertical can be beneficial to all portfolio companies that address the same vertical. Post-investment, data is also increasingly being used to help teams better understand drivers of growth, uncover new opportunities, optimize resources and identify potential weaknesses or risks.

### Key Elements of Data-Driven Processes

Venture capital firms employing data-driven tactics today generally feature different approaches, exhibiting a wide range of sophistication. Despite this being the case, there appears to be an emergence of common elements and techniques. Data remains the most critical input, consistent with any other application of machine learning or artificial intelligence. Ideally, a large volume of high-quality, trustworthy, and organized data is needed. For the majority of applications, perfect data sets are often challenging to obtain.

Most firms use a combination of third-party and proprietary data. Often, data from sources such as Twitter, LinkedIn, Pitchbook, Crunchbase, and AngelList are obtained and then pooled and organized. The organization and manipulation of third-party data can be time and labor-intensive. Pooled third-party data that is improved and arranged in a customized manner can eventually become proprietary in nature. Many firms also combine third-party data with their own internal data, primarily from their existing portfolio companies. Some firms hire data collection professionals or outsource data collection to third-parties.

Once a high-quality data set is obtained and organized, machine learning techniques such as logical regression and deep learning models are applied with a goal of gaining valuable insights. Generally, scoring functions are developed to assess a model's ability to successfully

evaluate relevant metrics such as team, growth, momentum, funding, capital efficiency, and other essential characteristics. Many firms develop prediction models which can generate predictions on variables such as future growth, valuation and the probability of attracting additional funding. Signals that tend to be more predictable are used to score and prioritize companies pre-investment, and flag potentially valuable insights post-investment. Determining the efficacy of models is vital before firms can fully rely on them. Backtesting is commonly used to validate effectiveness by applying functions and models to historical industry data or historical data from the firm's own portfolio.

Models will vary based on a firm's investment strategy, stage, and sector. They are usually modified and updated continuously or as needed, based on training data and results from testing. Some firms take a strategy-driven approach, whereby data and algorithms are compiled and built around a specific investment strategy. Other firms are more driven by the data and models which are then used to identify new strategies.
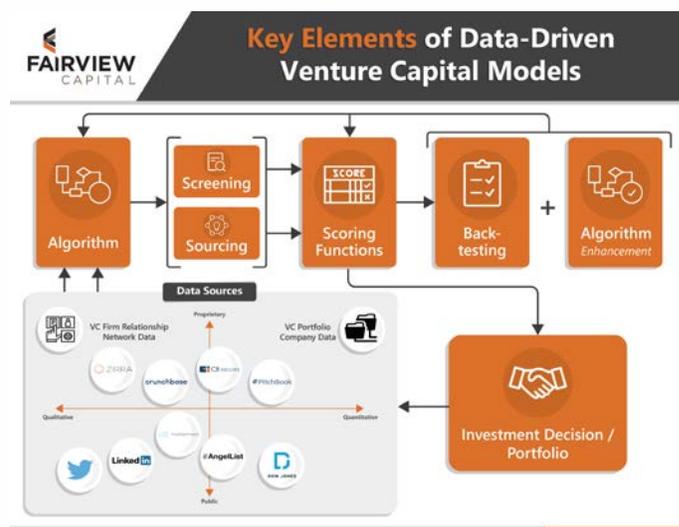
Building Effective Data-Driven Investment Capabilities

There are several elements that go into building effective data-driven investment capabilities at a venture capital firm. The first is acknowledging the importance of, and prioritizing the quality of data. The biggest challenges are around building good structured and unstructured data sets, and incorporating proprietary data with publicly available data. Second, venture capital firms need the right talent and resources in place to effectively incorporate data-driven processes. This has already translated into an observable shift in the hiring strategies of venture capital firms. Importantly, it may call for a different talent sourcing model and organizational structure, with resulting implications for the structuring of compensation and incentives. Indeed, if the data and algorithms account for a larger share of a venture capital firm's competitive advantage, the traditional partnership

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model may not be an ideal organization structure. Third, effectively interpreting and incorporating the outputs of a data-driven investment process is extremley important. Venture capital firms understand that they cannot be over-reliant on early outputs since the approach is still untested. Hence almost all firms that adopt data analytics combine it with the traditional approaches of company and deal evaluation. Data analytics is a tool in the investment process and does not replace the process itself. Fourth, even venture capital firms that are farthest along in the adoption of data analytics understand that continuous improvement is critical. Algorithms must be constantly updated against outputs to determine their effectiveness and data sets need to be enhanced on an ongoing basis. As an increasing number of venture capital firms converge on this trend, first-mover advantages are likely to erode over time. If firms utilize these tools effectively, they must continue to invest time, talent and resources to constantly improve them.

Mitigating Bias
Using data analytics to screen and identify promising new entrepreneurs based on quantifiable factors can play a role in reducing the prevalence of unconscious bias in venture capital decision-making. Decision-making based on gut instinct, pattern recognition, and established networks has, over time, contributed to the diversity issues in venture capital. Built to eliminate these biases, data-driven decision models can be impartial to gender and race.

For example, the venture capital firm Social Capital has built an automated system to invest in startups without meeting them. Companies upload data about themselves, and if the firm's algorithms score the companies well, the firm backs them with an investment. The process was designed to keep bias from entering the equation. By mid-2018, the firm had assessed over 5,000 startups and invested in 60. Most of the investments were in companies based outside the major venture capital markets of the Bay Area and New York, and many were based overseas. About 80% of the companies featured non-white founders and 30% featured female founders.
If approached conscientiously, there seems to be a clear ability for data-driven decision-making to reduce unconscious bias. Firms that utilize data analytics as part of their processes must be careful not to introduce biases in their models themselves. If implemented successfully, these models may not only help increase diversity in the portfolios of venture firms but also ultimately lead to better returns that are associated with diversity.

Fairview Experience
Fairview has built relationships with several data-driven firms in the venture capital industry. Although the sample size is as yet too small to draw defensible conclusions, the investment performance of Fairview relationships in

this category illustrates the early attractiveness of these strategies. Of the venture capital funds that take a data-driven approach to investing in the Fairview relationship set, 83% have generated 1st quartile returns against the Cambridge venture capital benchmarks for their respective vintage years, and 17% have generated 2nd quartile returns. In addition, their portfolios significantly over-index for ethnic and gender diversity of management teams. Within the Fairview relationship set of firms that utilize data-driven approaches to investing, in aggregate 38% of invested capital was into companies led by women or minority founders. This compares favorably to the venture capital industry average of between 8% and 14% according to CB Insights.

Conclusion
The venture capital industry has always been recognized for its dynamism, not only for the innovation driven by portfolio companies but also in how the industry itself continues to evolve. The recent emergence of data-driven decision-making reflects the continuous change the industry has exhibited. These new tools have the potential to be tremendously powerful if applied appropriately. They will also undoubtedly become increasingly influential as algorithms advance, training improves through better feedback loops and more experience, and of course data, the key input, will continue to get better and increase in volume over time. However, venture firms and investors should be wary of becoming overly reliant on technology as data may never be perfect, not all factors can be quantified, and not all externalities and their impact can be predicted. Further, the human element of venture capital investing and company building will always remain vital for long-term success.

As the venture capital model continues to change, investors should not be surprised by what today may seem like radical shifts, such as allowing artificial intelligence algorithms to vote on investment committees or the emergence of purely data-driven platforms. Limited partners must adapt to the forthcoming changes. In particular, the ability to conduct proper due diligence on new approaches and data-driven models will become more critical. Sophisticated limited partners will build these skill sets proactively, not reactively and will likely be advantaged in the long-run. Fairview, through its progressive approach to building venture capital portfolios, continues to monitor these changes and to selectively incorporate data-driven processes in its own investment processes.

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