

HARNESSING THE POWER OF CITIZEN DEVELOPERS

Five Principles to Follow

Summary

Citizen developers are individuals who are not engineers or technology professionals but who use technology to build applications that make work easier and more efficient, and they have driven a great deal of innovation at BlackRock in recent years.

Investment managers can reap significant benefits from harnessing the potential of citizen developers within their organizations, and we want to help them by sharing the five core principles that will allow them to unlock citizen development to help achieve their unique goals.

Start from the top: The first step is for senior leaders to ingrain the citizen developer mindset at the organizational level by letting all employees know that the company values citizen development and views it as integral to achieving long-term objectives.

Tool for success: Next is to remove start-up obstacles and give employees access to the technology that will set them up for success. Simplicity is paramount, and each organization needs to decide which tools, libraries and data employees need and make them easily accessible firmwide.

Get governance right: It is also essential to put a robust governance structure in place to ensure security and control expenses. Making certain that each user has a consistent identity throughout the entire technology ecosystem is the foundation of effective governance, and managing data entitlements is critical.

Create community: To maximize the long-term benefits that citizen developers deliver, it is imperative to create a robust community that continues to innovate over time. To do so, organizations need to incentivize technology professionals to engage with the broader community of citizen developers.

Leave no employee behind: Finally, it is key to make citizen development accessible to all employees, including those with little or no coding experience. Creating a culture where it's okay to be a beginner and running entry-level classes will help to broaden the developer community and bridge the gap between employees with different levels of technology expertise.

We offer our clients the same tools that we use in-house at BlackRock to make citizen development easier, starting with Aladdin® Studio, our workshop for building on top of Aladdin, and we are pleased to share some specific examples of how citizen developers have used these tools to create a variety of innovative solutions.

For more than two decades, investment teams at BlackRock and across the worldwide Aladdin community have counted on Aladdin technology to help solve complex investment and risk management challenges. During that time, we've made countless enhancements to the platform to better serve the needs of our users, and we remain committed to a climate of constant innovation. But over the past few years, we've also seen a great deal of innovation coming from another source: citizen developers.



At BlackRock, we define citizen developers as individuals who are not engineers or technology professionals but who use technology to build applications that make work easier and more efficient. Citizen developers at investment managers span the entire organization — from front to middle to back office — and they have a broad range of day jobs, from traders to portfolio managers to compliance professionals and many more.

While citizen developers have leveraged the Aladdin platform in many ways, the solutions they deliver tend to fall into three broad categories: automating low- or non-value-added workflows or processes, integrating with offline or external systems or processes, and building custom reporting and data analysis.

We've found that employees throughout the firm can make impactful contributions, without an undue amount of time and effort, if you provide them with the right environment and the tools for success. That, however, does require some time and effort, but the end results are worth it: customized applications and solutions to solve myriad challenges, a greater sense of empowerment and ownership among non-technologists, and increased bandwidth for technology professionals to focus on high-profile projects.

With those benefits and more in mind, we are pleased to share five core principles that can help organizations unlock citizen development to help achieve their unique objectives. To highlight what's possible, we are also including examples of some of the innovative solutions that citizen developers have created on top of Aladdin.

1

START FROM THE TOP

Citizen development is a creative process, and like many creative projects, getting started can be the hardest part. Based on our experience, there are a few important steps that organizations can take to kickstart an environment that supports citizen development.

The first and easiest step — but one that is too often overlooked — is simply to encourage the behavior. Leaders need to let employees know that the organization values citizen development and views it as integral to achieving long-term objectives. We've been successful on this front by continually speaking to our employees about citizen developers and how much value they bring to BlackRock, and by encouraging people to experiment, to iterate and to innovate.

2

TOOL FOR SUCCESS

Once you've ingrained the citizen developer mindset at the organizational level, it is critical to give employees the tools that will set them up for success. Simplicity is paramount, and it is imperative to remove start-up obstacles. A few years ago, to be a citizen developer at BlackRock, you had to download Jupyter onto your desktop, figure out how to install Python, decide which libraries to use and take a few other steps that most non-technologists would not describe as "simple." This process also typically took several days to complete, which acted as a significant barrier to entry into the world of citizen development. While some of our more technologically curious employees were able to create valuable applications in this environment, we realized that we needed to make things easier, and faster, if we wanted to grow our ranks of citizen developers.

So we put forth a big effort to create an environment that made it simple for people to get started, and we had strong opinions about what that environment should look like. We coalesced around a set of tools, libraries and data that we believed everyone needed access to — and that was a very deliberate process. And then we built a platform that anyone at BlackRock can come to, with no special permission required, and — with one click of a button — can create an instance of this developer environment that runs inside of a container. These efforts eventually led to the development of Aladdin Studio, a suite of tools and capabilities for building on top of Aladdin that allows citizen developers to quickly create scalable solutions.

This accomplished a few important objectives. It made it incredibly easy for users to set up the development environment. And because that environment runs in a segregated container, it doesn't compete for resources with the applications that are running on users' computers, and there is no potential to damage any of the day-to-day processes that operate outside of that container.

Creating this environment, and making a concerted effort to encourage employees across BlackRock to use it, quickly grew the size of our citizen developer community. But we soon discovered that in a broad organization like ours, different teams have different opinions about what their development environments should look like. So we decided to allow teams to author their own environments that are only available to their employees. This lets teams include the proprietary data and intellectual property that they need to create robust applications, while maintaining the same security and ease of use that characterize the firmwide developer environment.

3

GET GOVERNANCE RIGHT

In addition to encouraging citizen development and providing the necessary tools to make it as easy possible, it is essential to put a robust governance structure in place to ensure security and control expenses. There are several steps that we've taken to help users develop successfully — and securely — on top of Aladdin.

Making sure that each user has a consistent identity is the foundation of effective governance. So we've developed a comprehensive audited platform of permissions that allows organizations to determine what each of their users can do across the entire Aladdin ecosystem. And those permissions are consistent throughout the ecosystem, from [Aladdin Enterprise](#) to [Aladdin Data Cloud](#) (our managed data-as-a-service solution) to a Python Notebook calling our [APIs](#).

We also make it easy to manage data entitlements so that users will have consistent access to all of the data for which they have permission, and that they won't be able to access data that is restricted. Again, these data entitlements are consistent throughout the Aladdin platform.

Besides offering users a control plane that lets them dictate what citizen developers can do and which data they can access, good governance also entails putting guardrails in place to prevent developers from running up massive bills for computing power and services. Organizations need to have oversight of resource consumption and spending, at both the firmwide and the individual-user levels. To make this process easier and more efficient, we have put frameworks in place to monitor usage and, where appropriate, to preapprove certain transactions.

4

CREATE COMMUNITY

Getting people curious about citizen development and encouraging them to start is one thing. Creating a robust community of citizen developers that continues to innovate over time is another, and it is the latter that will bring the greatest long-term benefits to organizations using Aladdin. To attain this level of success, it is critical to incentivize technology professionals who know the Aladdin platform well to engage with the broader community of active and potential citizen developers. At BlackRock, we support approximately 1,500 users by embedding a small group of technology evangelists in different teams and incentivizing them to engage with the community to help create solutions on top of Aladdin, build connectivity throughout the firm, and grow the ranks of citizen developers.

One of the keys to achieving long-term engagement with citizen developers is to give them the means to continually build new applications. One tool that's been very successful at building a community of developers — and building community within the ranks of those developers — is a gallery of projects created by our citizen developers that functions like an app store. Anyone in our organization can go to an internal webpage to access those projects and start building on top of that code.

By making very small adjustments, citizen developers can create a Python environment, download code from Git, and start editing that code and understanding how it works. Often, they don't even realize that is the process they are going through, because we've made it so simple for users to download relevant projects and edit them to meet their specific use cases. And if users do run into trouble or have questions, they can get help from our tech evangelists, who are invested in the success of our citizen developers.

Once citizen developers realize the power of this platform, they start to understand that they don't need to rely on a special group of people called engineers to create the solutions that they are looking for. And they often become developers for life.

5

LEAVE NO EMPLOYEE BEHIND

It's probably not surprising that at BlackRock some of our most prolific citizen developers are also some of our youngest employees. Three-quarters of the graduate program analysts who have joined the firm in 2021 know at least one computer language, and more than half know two or more. This digital-native cohort isn't afraid to try out new technologies and to make developing part of what they do — even if it's not part of their job description. We expect that the same is true at many of the firms that use Aladdin.

While having a steady stream of incoming technologically savvy employees can bring great benefits to an organization, it can also create a perceived threat to some existing employees who don't have the same skills and experience. Many times, members of this group want to improve their tech IQs and are curious about citizen development, but they are afraid to raise their hands and say, "This is something that I don't know nearly as much about as the person whom I just hired two levels below me."

So organizations need to work hard to create a culture where it's okay to be a beginner, even if you're a senior person. We have run several training courses where we specifically targeted more senior employees, and we made it very clear that these were entry-level classes with no development experience required.

We've seen some managing directors take these classes and become leaders in transforming their teams through their own education. Even those who don't go on to pursue citizen development find the insights helpful in understanding how their employees are using technology to improve their work environment.

By making these courses easily accessible, we've been able to grow the ranks of technologists at BlackRock to nearly 4,500 individuals. And perhaps most importantly, everyone seems to walk away from the courses with an understanding that citizen developers don't represent a threat to anyone at the firm.

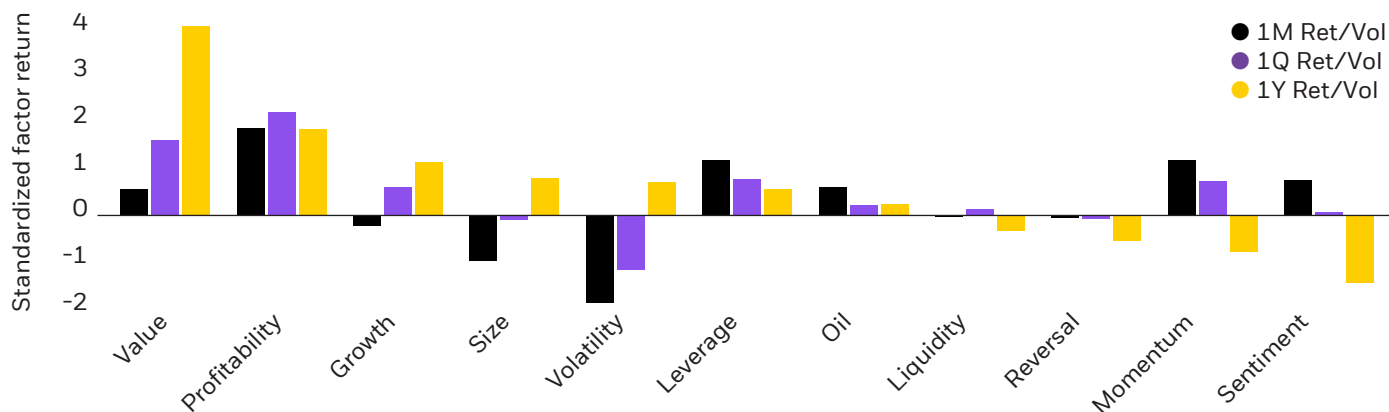
CITIZEN DEVELOPMENT IN ACTION

To bring some of the ideas we've discussed to life, we thought it would be helpful to share a few of the innovations that citizen developers at BlackRock have created to make their workflows more efficient, to mitigate risks, and to improve their ability to serve clients and stakeholders.

Our first example involves automating and improving an equity risk factor dashboard that analyzes recent investment factor trends. (See the graph below.) The dashboard combines time series data from various sources with derived calculations, and it adds a visual component through Microsoft's business intelligence tool, Power BI.

When the dashboard was first built, we had to run all the data on-demand each time we updated the analysis, which took several hours to run and several more to perform quality-control checks on the outputs. Then some of the citizen developers in our analytics and quantitative solutions team stepped in. They were able to create an automated pipeline to deliver and store the data in [Aladdin Data Cloud](#) and to connect to the Power BI software with open database connectivity. Now the dashboard is constantly updated as new data is received, allowing us to refresh it more frequently while eliminating manual effort and reducing potential human error.

Equity risk factor dashboard



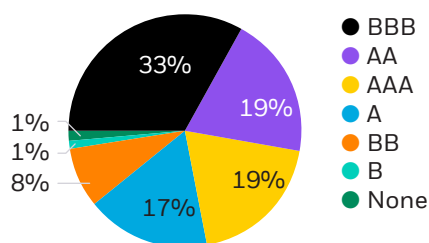
Source: BlackRock, October 2021. Chart shows the realized factor return divided by its ex-ante volatility.

For our next example, we highlight a portfolio optimization tool called the ESG Optimizer that helps portfolio managers and product strategists conduct sustainability research and build more robust ESG-focused fixed income funds. The tool combines several Aladdin APIs with internal and external ESG data and leverages Aladdin's portfolio construction and optimization capabilities to help build model portfolios, suggest potential trade ideas and answer clients' sustainability-related inquiries.

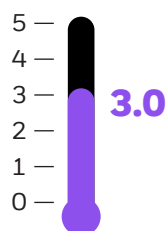
The ESG Optimizer can help with high-level questions such as, *How will increasing ESG scores affect tracking error?* It can also provide more granular detail on portfolio constraints such as minimum trade sizes, yield and risk trade-offs (such as OAS, duration and spread duration), industry tilts and more. Importantly, it includes climate, net zero, and temperature alignment metrics, and it can instantly confirm whether a model portfolio is eligible to be labeled as a

ESG Optimizer

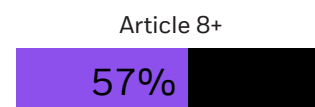
ESG rating breakdown



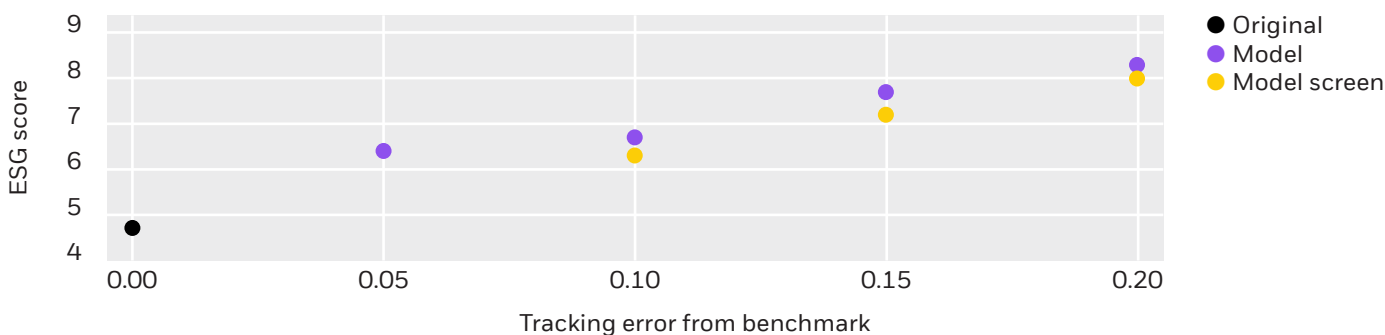
Temperature alignment value



SFDR



ESG efficient frontier choice



Source: BlackRock, October 2021.

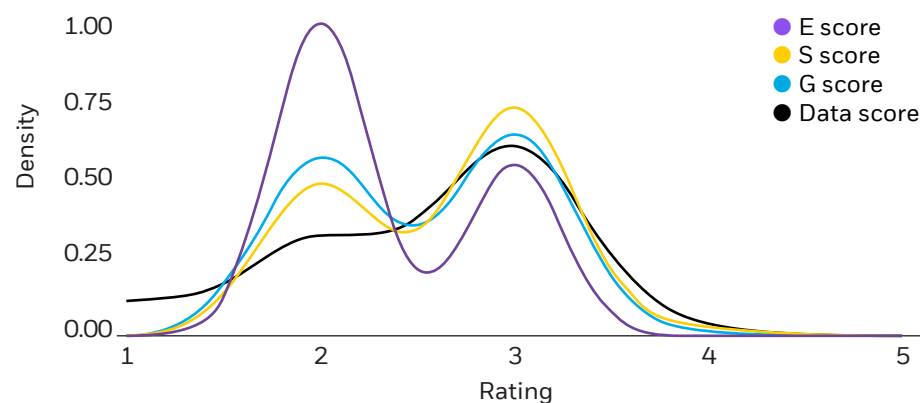
sustainable product according to industry regulations. And thanks to the efforts of our citizen developers, all of this information is available in an easy-to-read GUI that can be called up with the click of a button. (See the graphic above.)

Our final example brings robust ESG analytics to an asset class that is historically opaque and difficult to measure: private credit. Given our firm's strong conviction that ESG risk is investment risk, our private credit team wanted a way to measure ESG scores across the entire portfolio. So some of the citizen developers in our portfolio analytics group built a tool that systematically scrapes and cleans deal-level ESG scores and uploads them to a single database that allows users to pull updated time-series data for tracking and analysis. (See the graphic below.) This tool fully democratizes ESG data for private credit, and, because different groups have different reporting requirements, each group has the ability to build custom dashboards that utilize the relevant data.

ESG in private credit

Risk rating breakdown by ESG pillars

% funded capital weighted, from best to worst rating



Source: BlackRock, October 2021.



DEVELOPING THE FUTURE

At BlackRock, there are now more non-engineers than engineers coding in Aladdin, and, in the future, we suspect that this will increasingly be the case at many of the firms that use Aladdin. While we recognize that each organization's path to unlocking the power of citizen developers will be unique, we hope that the principles, the insights, and the experience that we've shared here will help you along the way.

We also realize that many members of the Aladdin community aren't fully aware of the tools and the opportunities that are available to help them do more with Aladdin. In fact, in a recent survey, we learned that only 27% of the worldwide community was aware of the ways that Aladdin Studio — our workshop for building on top of Aladdin — could be harnessed by citizen developers. That's one of the reasons we wrote this paper and why we will continue to educate community members about how they can build a culture where employees utilize citizen development as a tool to solve their problems.

To help achieve this goal, we also offer our clients the same tools that we use in-house at BlackRock to make citizen development easier, starting with Aladdin Studio. If you'd like to learn more about Aladdin Studio, or about any of the topics discussed here, please don't hesitate to contact us.

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