State of ModelOps 2021

How 100 AI-Focused Executives from Top Global Financial Services Companies are Developing Practices to Ensure Excellence as They Govern and Scale AI Initiatives





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Executive Summary

odelOps is a must-have capability for enterprises seeking to operationalize Al, and this has become apparent in 2021. Enterprises are investing in their ModelOps functions and developing processes for governing, monitoring and managing Al models at scale.

This report summarizes the first ever research into the state of model operationalization. Our survey of 100 executives from top global financial services companies provides a unique snapshot of the practices large enterprises are using to govern and scale mission-critical Al initiatives.

Our findings show that Al is already widely deployed in many large enterprises. To address the operational and compliance challenges that comes with this, organizations are investing in

ModelOps functions to automate and streamline their existing processes.

Most Al-focused executives feel that standardizing ModelOps practices across the enterprise is essential for managing the operational challenges and risk that come with Al deployment at scale.

Models are not like conventional software. As enterprises increasingly recognize this, they are creating new roles, such as the 'model operator'. These will bring focus, flexibility and operational excellence to managing models, in the same way that DevOps, ITOps and SecOps do for conventional software.

Alongside the survey results, we present highlights from several top executives who shared their views regarding the extent of the enterprise Al operationalization problem and how they're addressing it.

Key Takeaways

270

is the average number of models respondents' enterprises have in production

5-7

is the average number of tools respondents' enterprises use for developing Al models

90%

of survey respondents expect to have a dedicated ModelOps budget within 12 months

Source: Corinium Intelligence, 202

80%

say difficulty managing risk and ensuring compliance is a barrier to Al adoption for their enterprise

25%

say their existing processes for inventorying models in production are 'very effective'

69%

say improving the enforcement of Al governance processes is a key reason to invest in a ModelOps platform



Methodology

his representative survey of 100 Al-focused leaders from the financial services sector was conducted in February and March, 2021.

Respondents were selected from the 100 largest financial services companies in North America and Europe, respectively. Of these, 84% are from Global 500 or Fortune 500 organizations, including Charles Schwab, Citigroup, Morgan Stanley, American Express and JPMorgan Chase.

They have job titles ranging from C-level to Directors, VPs or Heads

of Department, and include VPs of Data Science, Global Heads of Risk, Heads of Al and other Alfocused executives.

We asked them 19 questions about their organizations' Al maturity and ModelOps capabilities, as well as the obstacles to model operationalization facing their companies and where they're investing to overcome them.

Then, we combined our findings with commentary from seven industry experts to put these unique insights into the state of enterprise model operationalization into context.

Contributors



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State of ModelOps 202

Foreword

e're delighted to be the sponsor of this first annual State of ModelOps survey. The very fact that we have such a survey speaks to the speed at which our industry is moving in 2021.

ModelOp was founded five years ago with a sole focus on ModelOps. But even a year or so ago the notion of 'ModelOps' still wasn't recognized or understood by many Al practitioners.

That's changed as the barriers to gaining value from Al have shifted from creating models to operating them in production with full efficiency, visibility, compliance and fairness, as well as within risk limits.

In recent months, there's been a rapid increase in attention paid to the critical role of ModelOps as a core capability, especially for Fortune 500 and Global 500 enterprises. We're pleased to have been at the forefront of this effort and excited to serve our customers' needs.

I want to thank Corinium Intelligence for their excellent work, and especially thank the 100 senior leaders who responded to the survey and the seven executives who agreed to go 'on the record' and provide candid interviews.

This report reflects the challenges real businesses are facing today and how they're addressing them in their own words. I hope that they, and all readers, find it valuable.



Stu Bailey Co-Founder and Chief Enterprise Al Architect, ModelOp



Enterprise AI is Driving the Rise of ModelOps

KEY FINDING

With the use of AI in business becoming more widespread and AI budgets continuing to rise across the globe, enterprises are developing better processes for monitoring, managing and governing AI systems in production

odelOps is becoming a critical business function as more enterprises successfully deploy and scale their use of Al models.

Our survey of 100 Al-focused leaders from top financial services companies shows that these enterprises currently have 270 models in production each, on average. One in five report that all business units in their organizations use Al regularly, while a further 60% report that at least some business units do so.

This is not entirely surprising, as the organizations we surveyed are highly advanced in their use of Al. However, the growing number of models at use in these enterprises is creating new challenges for Al-focused executives.

"For straight transactional processing, I think the model that we have works very well," says Patricia Flynn, VP, Information Governance and Solution Delivery at State Street. "For machine



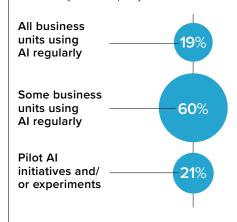
learning and Al, it's not really clear that our existing process works."

The term 'ModelOps' generally refers to the enterprise capability focused on governance and lifecycle management of all types of decision models, such as traditional statistical models, as well as Al models. ModelOps touches everything that happens with a model from the point at which its released into production until (and beyond) its ultimate retirement.

Al models have unique characteristics and cannot be managed and governed in the same way as conventional software. So, while the enterprises we surveyed have decades of experience with models, the growing number of Al models at use in these enterprises is placing new strains on their business processes.

Enterprises are Now Scaling AI Capabilities

When it comes to Al initiatives, where is your company?



270

The average number of models our respondents' companies typically have in production





Al and ModelOps Investment is Increasing in 2021

The prevalence of AI in business is only going to increase in 2021. Our research shows that 71% of financial services companies have increased their AI budgets in 2021, with 13% reporting an increase of more than \$1 million USD.

At the same time, enterprises are also investing in ModelOps. More than half of our respondents say their enterprises already have a dedicated budget for ModelOps. A further 37% expect theirs to have one within 12 months.

Wells Fargo is one example of a large corporation that is prioritizing aspects of ModelOps such as monitoring and governance as it scales up its Al initiatives.

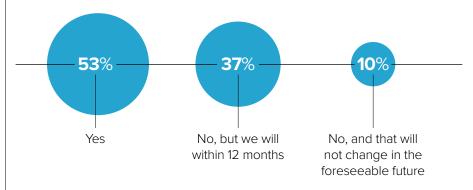
"That's something that was really heavily invested in over the last four years," says Eli Bernstein, Head of Data at Wells Fargo Asset Management. "We are in the middle of building out the infrastructure that will scale."

However, our findings show that the maturity of the ModelOps processes enterprises currently have in place varies greatly from company to company.

Many executives are running into trouble with fairly basic tasks, such

ModelOps is Seen as a Key Business Capability

Does your company have a dedicated budget for model operations?



Source: Corinium Intelligence, 2021

as inventorying the models that are currently deployed within their organizations. Just 25% of survey respondents say the processes they have in place for this are 'very effective'. Meanwhile, 43% would describe theirs as 'ineffective'.

"I think it's because a lot of Al projects are so approachable now," suggests Skip McCormick, Data Science Fellow at BNY Mellon. "It's very easy to get ahead of whatever model governance organization you already have in place for more traditional models."

"You have this Wild West of people doing exciting things with software they download," he adds. "Then, they encounter [ops] guys, who are like, 'Wait, you're working on a model? We have a whole governance process and you're supposed to submit forms to us before you start."

Governance is emerging as a key driver for investment in ModelOps. Our survey respondents cite 'maintaining model audit trails for regulatory compliance' and 'ensuring visibility into the status of models' as two of the top ModelOps challenges facing enterprises today. Respectively, only 31% and 32% say they have 'very effective' processes for these tasks in place.

The companies we surveyed had already been working to address model management challenges. But less than half rate their current practices as 'very effective'. Indeed, just 41% claim they have very effective processes for standardizing model operations, 46% say they have very effective processes for monitoring Al models and 48% believe their model governance processes are very effective.

"ModelOps is the logical next step after DevOps. We're looking for a systematic way to make sure that the models we're putting into play actually do what they should do"

Skip McCormick

Data Science Fellow, BNY Mellon





How Al Adoption is Giving Rise to ModelOps

Of course, enterprises have had ops teams to manage software and legacy (non-Al) models in production for years. But the constantly evolving nature of Al models means new processes are needed to operationalize them effectively.

"We have a very formal and rigorous model governance process and model risk management organization," says McCormick. "What we're doing now is extending that to cover these continuously improving models."

Our research shows that enterprises are facing a range of operational ModelOps challenges as they put more Al models into production.

Not surprisingly, risk is a key issue in the financial services sector: 80% say that difficulty managing risk and ensuring regulatory compliance is a barrier to operationalizing Al in their enterprises.

Additional barriers include 'integration with existing systems', 'gaps in staff and skills', 'process inefficiencies', 'lack of standardization' and 'cost'. Respectively, 72%, 70%, 64%, 65% and 62% of respondents cite these five hurdles as barriers to ModelOps in their organizations.

This reflects in part a historic focus on building models rather than deploying and operating them, as McCormick points out.

"A lot of Al capabilities are still at the stage where it's a lot of potential," he concludes. "Few organizations are simultaneously putting sufficient resources into the infrastructure they'll need to have beneath that in a production environment."

The rise of ModelOps can be seen as a response to the increasing recognition of the unique challenges of operationalizing models at scale.

Models have long been seen as critical enterprise assets, and Al models are showing their ability to deliver very significant value.

"Few organizations are simultaneously putting sufficient resources into the infrastructure they'll need to have beneath that in a production environment"

Skip McCormick Data Science Fellow, BNY Mellon





Enterprises are Investing in Their ModelOps Functions

KEY FINDING

ModelOps Processes are Still Maturing

ModelOps is becoming a core business capability, with enterprises investing in creating more efficient processes and systems for operationalizing AI models

Please rate the systems and processes your company currently uses for the following aspects of model operations? Not Effective Not Very Effective Somewhat Effective Very effective Inventorying models that are deployed Maintaining a compliance audit trail Model governance Monitoring of models Standardizing model operations Ensuring visibility into the status of models 0% 20% 40% 60% 80% 100%

ModelOps is Seen as a Key Business Capability

Does your company have a dedicated budget for model operations?



ModelOps Must Integrate with the Full Enterprise AI Stack

Which of the following systems or applications should be integrated with your company's model operationalization process?

Already is integrated

O Should be integrated

















I tech stacks are constantly evolving. Data scientists want to be able to use the best tools for the job and enterprises are generally happy to accommodate this. As a result, the ecosystems emerging to develop, deploy and manage Al in enterprise settings have become complex.

Our research suggests that multiple teams are now actively deploying AI models in most large enterprises. Of the 100 AI-focused executives we surveyed, 81% report that their organizations have more than five teams deploying AI models, and 29% say they have more than 10.

There's a great variety in production environments, with models deployed across a mix of on-premises and cloud environments.

While 48% of respondents say their models are executed on-

premises, 58% execute models using AWS, 58% do so using Google Cloud, 27% deploy on Microsoft Azure and 12% use other cloudbased services. A full 94% use at least two deployment environments.

There are also multiple data science tools in use at the vast majority of companies – 81% use at least two data science tools to develop Al models, with 43% reporting that they use more than five.

"On the production side, we've mostly standardized to one platform," reports Glenn Hofmann, Chief Analytics Officer at New York Life Insurance Company. "All the models get deployed on that platform. They can be consumed by any production system in the company via an API."

He adds: "We still have a few legacy models on other platforms. Maintenance of those gets increasingly difficult."

"We still have a few legacy models on other platforms. Maintenance of those gets increasingly difficult"

Glenn Hofmann

Chief Analytics Officer, New York Life Insurance Company





"You can't trust a single person and you can't trust small groups of people with different philosophies"

Scott Zoldi

Chief Analytics Officer, FICO

Hofmann agrees that standardizing ModelOps practices is vital for ensuring Al models can be put into production, scaled and managed over time efficiently. Without this level of consistency, there's a danger that some models an enterprise develops may become unusable.

"If you have models that are not really deployed, per se, they're just built and live in a development environment, you have a 'recall problem'," he says. "It can be very difficult to recall their functionality."

ModelOps: Standardization Versus Centralization

There is no one 'right' way to do ModelOps. However, the trend is toward standardizing and centralizing the ModelOps functions across the enterprise. Even in enterprises that prefer a more distributed approach to ModelOps, standardizing processes is proving popular, in particular to ensure conformance with compliance and risk management policies.

A full 61% of survey respondents say their companies are working to centralize or standardize their model operationalization practices, with 44% reporting that they already have.

FICO Chief Analytics Officer Scott Zoldi suggests that putting enterprise-wide standards in place is the only way to ensure Al is used responsibly.

"You can't trust a single person and you can't trust small groups of people with different philosophies," he says. "Centralization or standardization is a big part of Al growing up."

Of course, standardization is possible without centralization. But increasingly, companies are ensuring that their Al-focused teams are monitoring the same things, following the same risk management processes and defining a shared

vision of what's important.

Kathryn Zhao, Global Head of Electronic Trading at Cantor Fitzgerald, says putting uniform model operationalization processes in place has helped her business unit to manage risk more effectively.

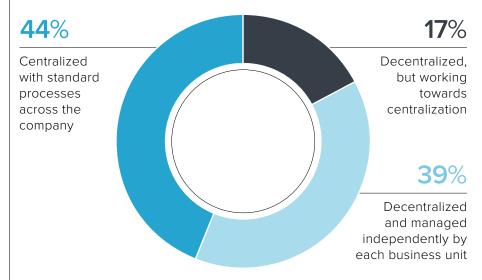
"It's definitely related to adding more safety guards and de-risking," she says. "Our risk appetite is very small. That's the main reason that I added those extra steps – just to make sure that we stay within the risk parameters and limit our exposure in production."

With respect to managing risk and providing governance, key focus areas for ModelOps include processes for approvals, validations, inventorying models in production and tracking model changes and activity throughout the Al lifecycle.

"It's a very extensive process," Zhao concludes. "But we think it's necessary to keep us within the accepted risk parameters."

Enterprises are Favoring ModelOps Standardization

Which of the following best describes your company's model operationalization practice?









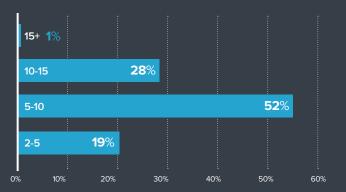
The Enterprise Model Deployment Landscape

KEY FINDING

With many teams executing different types of AI in a range of environments and using multiple data science tools, standardized processes are needed to tame enterprise ModelOps

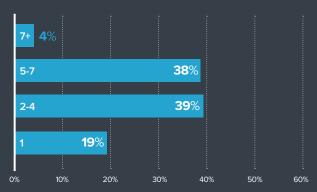
Multiple Teams Deploy AI Across an Enterprise

How many different teams are deploying models in your entire company?



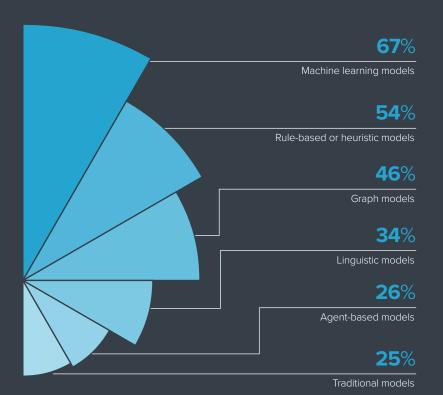
Data Science Staff Generally Use a Range of Tools

Across all business units, how many different data science tools does your company use for developing models?



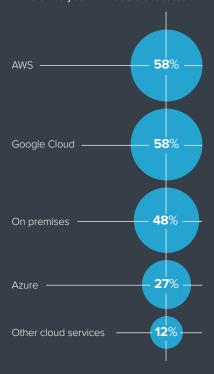
Enterprises use Many Types of Models

What types of models does your company use for Al initiatives?



Al Models are Deployed in a Range of Environments

Where are your AI models executed?





Emerging Trends in ModelOps Optimization

KEY FINDING

Enterprise priorities are shifting from simply getting models out of the lab and into production toward maximizing ROI and ensuring AI is used fairly and compliantly

ntil fairly recently, companies have focused on arming data scientists with the tools they need for rapid AI development.

But with model development capabilities starting to scale, a new hurdle has emerged. Enterprises are now targeting their investments toward getting models into production in an efficient, compliant and transparent manner, while maintaining their efficacy and value.

"It's been a common problem for a while now for analytics teams to build models that then sit on a shelf and never actually get deployed into production," notes Glenn Hofmann, Chief Analytics Officer at New York Life Insurance Company. "We've now largely resolved that. But I think it's a relatively recent phenomenon that this is getting easier to resolve."

Our research shows that managing risk and ensuring regulatory compliance is the top barrier to model operationalization in business today. The 100 Al-focused executives we surveyed also cite reducing the cost of ModelOps and improving model governance as the top two benefits of investing in the function.









Strategic Priorities for ModelOps Optimization

A core element of ModelOps is the ability to automate and streamline processes so that Al systems can be deployed, scaled, monitored and maintained.

Our research shows that executives are becoming aware of the benefits of investing in technology to help automate and standardize ModelOps practices.

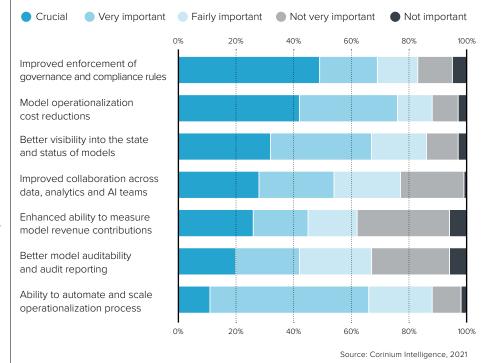
One key focus is integrating their ModelOps systems with their current software stacks. Of the 100 executives we surveyed, 70% say their enterprise has integrated data from its risk management applications with its ModelOps processes. Meanwhile, 62% say they've integrated data from their business applications and 59% report doing the same with IT and security systems data.

At the same time, 58% say they've integrated the data from their IT services management systems, 54% say they've integrated the data from their DevOps tools and 50% say they've integrated the data from their data science development tools, frameworks or platforms.

A full 76% of respondents say achieving cost reductions is at least a 'very important' benefit of such an investment, with 42% describing it as crucial.

ModelOps Can Improve the Efficiency of Al Projects

Please rate the following model operationalization platform benefits according to how important they are to your company



Meanwhile, 69% view improving the enforcement of Al governance and compliance rules as a 'very important' benefit of investing in a ModelOps platform, and 66% say the same about improving the scalability of ModelOps processes with automation.

It's easy to see why these things are so highly valued, when you consider what must be done to ensure Al systems in production continue to perform over time. For example, Cantor Fitzgerald's electronic trading business has extensive processes in place to manage its models in production.

"I would say we have a very comprehensive and mature ModelOps governance structure in place," say Kathryn Zhao, Global Head of Electronic Trading at Cantor Fitzgerald.

Zhao's team monitors all models in production and reports data on key operational metrics to the firm's model 'best execution committee' to ensure this data is rigorously appraised and acted on, where necessary.

"We have a performance quality checklist that I do on a monthly basis," Zhao adds. "On the annual basis, I also have the 'algo attestation'. For that, I create a list of things like, 'What's the algorithm inventory? What's the model inventory? What's the algorithm performance quality? And, are there any red flags?"

"It's a very extensive process. But we think it's necessary to keep us within the accepted risk parameters"

Kathryn Zhao

Global Head of Electronic Trading, Cantor Fitzgerald







The Future of Enterprise ModelOps Functions

The rigorous processes needed to manage and govern full model life cycles may become unwieldy when an enterprise starts to scale their Al programs from dozens to hundreds of models in production. So, it's not surprising that some of the executives we interviewed predict that automation will play a key role in the future of enterprise ModelOps functions.

"We are in the process of digital transformation, naturally," says Eli Bernstein, Head of Data at Wells Fargo Asset Management. "So, automating most of the pipelines will be the key to success."

Other executives are calling for greater investment into 'ground truth' systems to allow organizations to monitor and verify the veracity of model predictions. "It's just as hard and it's essential because, without it, you cannot claim to make a forecast that can be relied upon," says Skip McCormick, Data Science Fellow at BNY Mellon. "[It] usually means that it's a separate system, because that kind of access to a production system will oftentimes impact production."

In McCormick's view, this is something that many businesses are still underinvesting in. But our research shows that enterprises are starting to integrate essential data from business systems and applications into their ModelOps processes.

Clearly, there's still a long way to go before enterprise ModelOps functions start to mature in most organizations. But the investments Al-focused executives are prioritizing today show many are committed to changing that.

"We are in the process of digital transformation, naturally. So, automating most of the pipelines will be the key to success"

Eli Bernstein

Head of Data, Wells Fargo Asset Management





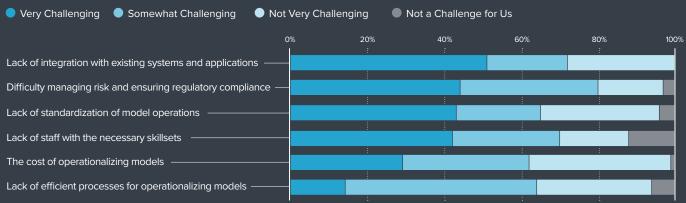
AI has an Operationalization Problem

KEY FINDING

Enterprises are racing down the path to AI maturity. But there's no consensus around who's responsible for managing and monitoring models once they're in production

Al-Focused Executives Face Many ModelOps Challenges





But There's No Concensus On Who Owns ModelOps

Who is responsible for the 24x7 operations and monitoring of models, in your company? (Select all that apply)





Who Should Be Responsible for ModelOps

KEY FINDING

Enterprises are establishing dedicated roles, such as the 'model operator', to oversee the effective monitoring, governance and maintenance of AI models in production

he ModelOps function is underdeveloped in many enterprises because it has initially fallen to established organizations such as DevOps.

This arrangement is not ideal, due to factors including the unique characteristics of models compared with conventional software, the internal and external compliance and regulatory requirements around Al models and the need to support many stakeholders and teams.

Enterprises often lack a dedicated team with the knowledge, remit or authority to orchestrate ModelOps as a cross-functional capability. Some say that data science teams should be responsible, but others feel that this isn't the way to go.

"You have to have this third-party that knows what they're looking at and knows how to measure it," argues BNY Mellon Data Science Fellow Skip McCormick. "You never let the data scientists create their own paper because they're too close to the problem."



There are many differing views as to where responsibility for ModelOps should live. Perhaps not surprisingly, respondents in IT functions are the least likely to say that they feel responsible for ModelOps. Executives in these roles believe data scientists, model operators or model engineers should have this responsibility.

However, some experts suggest that people skilled in ITOps have a strong foundation for ModelOps and may be best positioned to become model operators, as they have deep experience keeping production systems running 'round the clock'.

"You never let the data scientists create their own paper because they're too close to the problem"

Skip McCormick

Data Science Fellow, BNY Mellon







The Rise of the Model Operator

Until recently, DevOps professionals oversaw model operationalization in most enterprises. One 2019 Gartner study **found that** this was the case in 61% of organizations.

"That's why my group was introduced," recalls Patricia Flynn, State Street's VP for Information Governance and Solution Delivery. "I support five businesses within Global Markets, and I sit in the risk organization. I'm independent to the business lines, so I don't have the revenue concerns."

But over the past 12-24 months, a new class of AI professional has emerged: the model operator.

Our research suggests that 60% of enterprises now have model operators or model engineers overseeing model operations across their businesses. By contrast, just 26% of the 100 executives we surveyed say their DevOps teams are responsible for ModelOps.

"You should not have data scientists governing and maintaining their own models. In the past that was often true, and it was not effective"

Glenn Hofmann

Chief Analytics Officer, New York Life Insurance Company

"From a monitoring perspective, we have a couple of dedicated people on my team," says Glenn Hofmann, Chief Analytics Officer at New York Life Insurance Company. "All they do is post-deployment monitoring and reporting."

The creation of this new class of AI professional reflects the growing consensus that managing AI models is different from managing traditional software or statistical models.

Yet, despite the fact that data scientists are generally not skilled (or interested) in running 24x7 production operations, 62% of respondents say their data scientists should have a role in ModelOps.

For McCormick, this indicates that many enterprises still have some maturing to do. In particular, he argues that having data scientists manage their own models creates a conflict of interests.

At the same time, having data scientists monitor and manage their own models is inefficient.

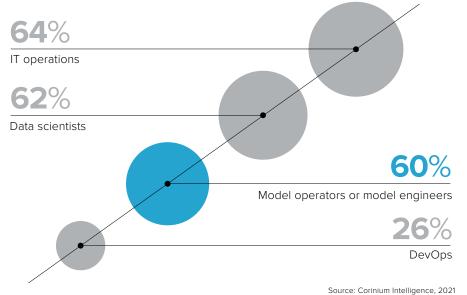
Data scientists have unique expertise in model development and are expensive. So, it makes sense to ensure they can spend as much of their time as possible actively driving business value and innovating with new ideas.

"You should not have data scientists governing and maintaining their own models," Hofmann agrees. "In the past that was often true, and it was not effective."

Today, 40% of enterprises still lack dedicated model operators to handle day-to-day ModelOps tasks. But if current trends continue, this should be expected to decrease.

Enterprises are Creating Model Operator Roles

Who is responsible for the 24x7 operations and monitoring of models, in your company? (Select all that apply)





(C)

Conclusion

KEY FINDING

Enterprises have invested to build their capabilities for creating AI models in recent years, with significant success

cross many industries and companies, the strategic power of AI has been established thoroughly. This has led to a surge in model creation. But investments in the people, processes and tools for operationalizing models – i.e. ModelOps – has lagged behind.

That's now starting to change. More than half of the enterprises we surveyed now have a dedicated ModelOps budget, and that figure is set to rise to 90% within 12 months. The key drivers for this increased investment are managing risk, reducing costs through automation and providing visibility through improved monitoring.

Al-focused executives in financial services, an industry that is relatively mature in its use of traditional and Al models, report confidence in the effectiveness of their ModelOps functions. But they face challenges and see significant room for improvement. They also understand that these challenges limit their ability to

extract the full value from their Al investments while limiting risk and maintaining efficacy, transparency and compliance.

Organizations are creating dedicated model operator or model engineer roles to take on day-to-day ModelOps duties.

On the other hand, fewer organizations are placing ModelOps in the DevOps organization.

Meanwhile, our expert contributors generally agree that data scientists have highly specialized, valuable skills and are not best suited or positioned to manage the operationalization of their models.

In 2021, the state of ModelOps is encouraging. There's a growing recognition of the function, the problems that it addresses, the opportunities it creates and the investments that need to be made to support it. Like DevOps, ITOps and SecOps before it, ModelOps looks set to grow into a core business function in its own right as global Al use matures. But there is still a long way to go.

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About ModelOp

ModelOp is a pioneer of ModelOps software. The company enables large enterprises to address the critical governance and scale challenges necessary to fully unlock the transformational value of enterprise Al and machine learning investments.

Core to any Al orchestration platform, Global 2000 companies use ModelOp Center to govern, monitor and orchestrate models across the enterprise and deliver reliable, compliant and scalable Al initiatives.

For more information, please visit: https://www.modelop.com/



About the Editor

Solomon Radley is an experienced editor and reporter with a deep understanding of the data, analytics and CX space and close relationships with many of the sectors' most prominent C-level executives.

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