Market Quadrants

Climate Risk Modeling Solutions, 2023

Market and Vendor Landscape

Chartis

About Chartis

Chartis Research is the leading provider of research and analysis on the global market for risk technology. It is part of Infopro Digital, which owns market-leading brands such as Risk and WatersTechnology. Chartis' goal is to support enterprises as they drive business performance through improved risk management, corporate governance and compliance, and to help clients make informed technology and business decisions by providing in-depth analysis and actionable advice on virtually all aspects of risk technology. Areas of expertise include:

- Credit risk.
- Operational risk and governance, risk management and compliance (GRC).
- Market risk.
- Asset and liability management (ALM) and liquidity risk.
- Energy and commodity trading risk.
- Financial crime, including trader surveillance, anti-fraud and anti-money laundering.
- Cyber risk management.
- Insurance risk.
- Regulatory requirements.
- Wealth advisory.
- Asset management.

Chartis focuses on risk and compliance technology, giving it a significant advantage over generic market analysts.

The firm has brought together a leading team of analysts and advisors from the risk management and financial services industries. This team has hands-on experience of developing and implementing risk management systems and programs for Fortune 500 companies and leading consulting firms.

Visit **www.chartis-research.com** for more information.

Join our global online community at **www.risktech-forum.com**.

30 NOV 2023

Market Quadrants Report

Authors
Dylan Bassett, Travis Crum and Jake Hoskins

Jump to: Market landscape | Vendor landscape | Chartis RiskTech Quadrant® and tables | Climate risk typologies | Methodology

Executive summary

Despite recent uncertainty around wider environmental, social and governance (ESG) issues, climate risk modeling is still rising up the agenda for banks and asset managers. Both of these groups are looking for new ways to meet increasing regulatory demands, while also finding better ways to integrate new physical and transition risk methodologies into their financial risk workflows. Increasingly, firms want to surmount the challenges around physical and transition risk to achieve detailed calculations of the financial impact of climate risk on their businesses.

But while firms are looking for ways to integrate climate risk across the enterprise risk framework, there is a lack of consensus on how this should be done, and appropriate methodologies are poor. Indeed, the full financial impact of climate change is still beyond the reach of available models.

In this context, as more vendors embed climate risk into their financial impact workflows, physical risk models are getting better at predicting the financial impact of climate change. But these models still need to evolve and mature. Vendors are taking important steps in this space, employing data-centric strategies to enable them to innovate across physical, transition and natural catastrophe risk, by improving data granularity and the parameterization of specific risk factors.

Advances in technology are proving significant, enabling firms to develop more sophisticated climate risk models. And by integrating Big Data analytics and insights driven by advanced technologies, solutions can more precisely assess climate risk.

Ultimately, as the need to address climate risks becomes more urgent, effective climate risk management will require adaptability, data quality, transparent communication and regulatory alignment. By addressing these challenges, organizations can navigate the financial impacts of climate-related events, make informed decisions and boost their resilience and sustainability.

This report uses Chartis' RiskTech Quadrant® to explain the structure of the market. The RiskTech Quadrant® employs a comprehensive methodology of in-depth independent research and a clear scoring system to explain which technology solutions meet an organization's needs. The RiskTech Quadrant® does not simply describe one technology solution as the best; rather, it has a sophisticated ranking methodology to explain which solutions would be most suitable for buyers, depending on their implementation strategies.

This report covers the following providers of climate risk modelling solutions:[1] AIR (Verisk), Ambiental Risk Analytics, Aon, Bloomberg, CARTO, Clarity AI, Climate Alpha, Climate X, COMBUS, ESG Book, Guy Carpenter, ICE, Iceberg Data Lab, ISS ESG, Jupiter Intelligence, LSEG (Refinitiv), Mitiga, Moody's, MSCI, Nasdaq, Ortec Finance, Prometeia, riskthinking.AI, S&P Global Market Intelligence, Sust Global, Swiss Re and WTW.

We aim to provide as comprehensive a view of the vendor landscape as possible within the context of our research. Note, however, that not all vendors we approached supplied adequate information for our analysis, and some declined to participate in this research.

Jump to top

Market landscape

In recent years, the need to address climate-related risks has become more urgent. A long-term rise in the frequency and severity of climate events, coupled with an increase in physical assets and infrastructure, has necessitated the development of models in the physical and transition risk space that are both complex and reliable. This report examines several key dynamics in the landscape:

- The current state of climate risk modeling practice.
- The design of climate risk modeling workflows.
- The challenges and issues that practitioners currently face in this evolving field.

- The emerging signs of where the practice might be heading.

Forces shaping the current climate risk modeling landscape

To assess the state of practice of climate risk modeling, we need to identify key indicators to understand how the profession is evolving. These indicators (assessed in more detail in the following sections) serve as measures of the progress, adoption and maturation of climate risk modeling in various sectors.

- **Regulatory, risk and reporting frameworks**. As governments worldwide implement climate-related reporting requirements, organizations must adapt their risk modeling practices to comply with these evolving standards. Regulatory pressures not only push companies to adopt climate risk modeling, they can also drive advancements in modeling methodologies. While there are many regulatory requirements, banks now have the flexibility to adhere to voluntary frameworks that include market scenarios and broader risk taxonomies. Firms now also use voluntary frameworks to financialize and report on risk attributes to a variety of stakeholders.
- **The financial 'productization' of climate risk**. The increasing influence of climate risk modeling on investment strategies can be seen to some extent in investment decisions, lending practices and insurance underwriting. But while financial firms are looking for ways to integrate climate risk across the enterprise risk framework, this situation is currently in a state of flux because of poor methodology and a lack of consensus. While fund managers are deploying risk models concerned with natural disasters and economic transition risks across asset classes within their investment strategies, the full financial impact of climate change is still beyond the reach of available models.
- **Advances in technology**. Ongoing advances in technology, particularly in data analytics, machine learning (ML) and high-resolution climate mapping, are proving significant. These innovations enable firms to develop more sophisticated climate risk models that can assess a wide range of climate scenarios (such as flood, wildfire or hurricane). Notably, the integration of Big Data analytics and artificial intelligence (AI)-driven insights can make

the assessment of climate risk more precise. (More on the technology specifics can be found in the 'Vendor landscape' section below.)

Regulatory, risk and reporting frameworks

In this section, we consider some of the key frameworks for climate risk modeling.

Stress testing and the banking framework

Stress testing is becoming increasingly important within the banking framework as it helps financial institutions evaluate how they can withstand various climate-related risks. These tests help banks analyze the potential effects of climate stressors on their financial stability. Firms can use them to assess how climate-related factors (such as extreme weather events or a rapid shift toward a low-carbon economy) could impact credit and operational risks and lead to unexpected financial losses. Stress tests also play a key role in helping firms understand how climate risks may propagate through interconnected financial systems, and are therefore essential in strengthening the banking sector's resilience to climate-related risks and averting systemic vulnerabilities.

Stress-testing requirements can help regulators monitor a bank's progress, particularly given the uncertainties involved in climate risk measurement. By combining climate risk disclosure, scenario analysis and stress testing, regulators can gain a holistic view of a bank's vulnerability to climate shocks. Stress-testing requirements can also help to improve banks' understanding of the potential financial impacts of climate change, enabling them to proactively manage their exposures.

Key framework developments

The International Sustainability Standards Board (ISSB) has finalized its initial sustainability disclosure standards, laying the groundwork for global implementation in January 2024, while the Network for Greening the Financial System (NGFS) has sought user feedback from users to help enhance its climate scenarios. These developments underscore the growing significance of climate-related financial risk management and standardized ESG reporting in the financial services sector. The new ISSB S1 and S2 standards include the Financial Stability Board's (FSB) Task Force on Climate-related Financial Disclosures (TCFD) recommendations, as the

TCFD is moving its mandate to the ISSB. **Support for the TCFD** has been strong and steadily growing in recent years.

Key regulatory developments

In a climate of change, there has been considerable progress in addressing climate-related financial risks. The Federal Reserve's groundbreaking **Climate Scenario Analysis (CSA) exercise** engaged six major banks in an assessment of the impact of physical and transition risks on their real estate and corporate loan portfolios.

Simultaneously, the **Securities and Exchange Commission (SEC)** tackled the complexities of ESG investing, including the absence of a universal definition of ESG and the potential influence of regulators on ESG ratings. Moreover, the ISSB's finalization of sustainability disclosure standards and the NGFS's request for user feedback on climate scenarios illustrate the increasing focus in the industry on standardization and risk management in the context of climate change.

On the insurance side, the International Association of Insurance Supervisors (IAIS) has developed a comprehensive climate risk framework to address the escalating financial challenges that are linked to climate change within the sector. This framework underscores the importance of seamlessly integrating climate-related risks into governance structures, risk management practices and internal controls. It aims to help insurance regulators worldwide comprehend, assess and proactively mitigate these evolving risks to ensure financial stability and safeguard policyholders.

In addition to this framework, the IAIS engages in consultations, collaborates with various stakeholders, and pursues the development of advanced data analysis capabilities and innovative climate scenario analysis tools.

Financial market dynamics: the productization of climate risk

There have been notable changes in the financial landscape in response to the challenges presented by climate change. Climate-related financial products have emerged as innovative instruments that are designed to address these challenges, promote sustainability, and align with global climate goals (including those outlined in the Paris Agreement). These products include green bonds, which fund eco-friendly projects, and climate-aligned investment funds that prioritize ESG factors (see Table 1).

Table 1: Climate risk assets

Climate-related financial products	Description	Example
Green bonds	Debt instruments for eco-friendly projects.	Apple Green Bonds
Climate-aligned funds	Investment funds that focus on climate alignment.	State Street SPDR MSCI ACWI Climate Paris Aligned ETF
Carbon offsets	Investments in projects that capture emissions.	Wind farms
Climate risk insurance	Coverage for financial losses caused by climate events.	Flood insurance
Physical risk indices	An assessment of real estate and infrastructure risk.	FEMA National Risk Index for Natural Hazards
Climate futures and derivatives	Financial instruments related to climate factors.	Carbon allowance futures
Sustainable and green real estate funds	Funds that focus on sustainable properties.	Vert Global Sustainable Real Estate Fund
Climate-linked structured products	Structured products tied to climate indices.	Climate-linked bonds

Source: Chartis Research

Climate-related financial products can also play a role in mitigating climate-related risks and promoting climate-resilient investments. Real estate investors, for example, can use physical risk indices to gain insights into how vulnerable their properties are to climate hazards. Structured products linked to climate indices can also offer firms tailored solutions for their climate risk management and investment strategies. And recent rises in the economic losses from natural disasters emphasize the need for a comprehensive understanding of all risk factors, particularly secondary perils.

More broadly, climate risk assets are emerging as an asset class of their own:

- Investment managers are launching climate risk-centric funds.
- Loan portfolios are leveraging climate risk attributes in their credit risk assessments.
- Insurers have been productizing natural catastrophe insurance for some time.

Nevertheless, financial markets run the risk of distorting initial intentions:

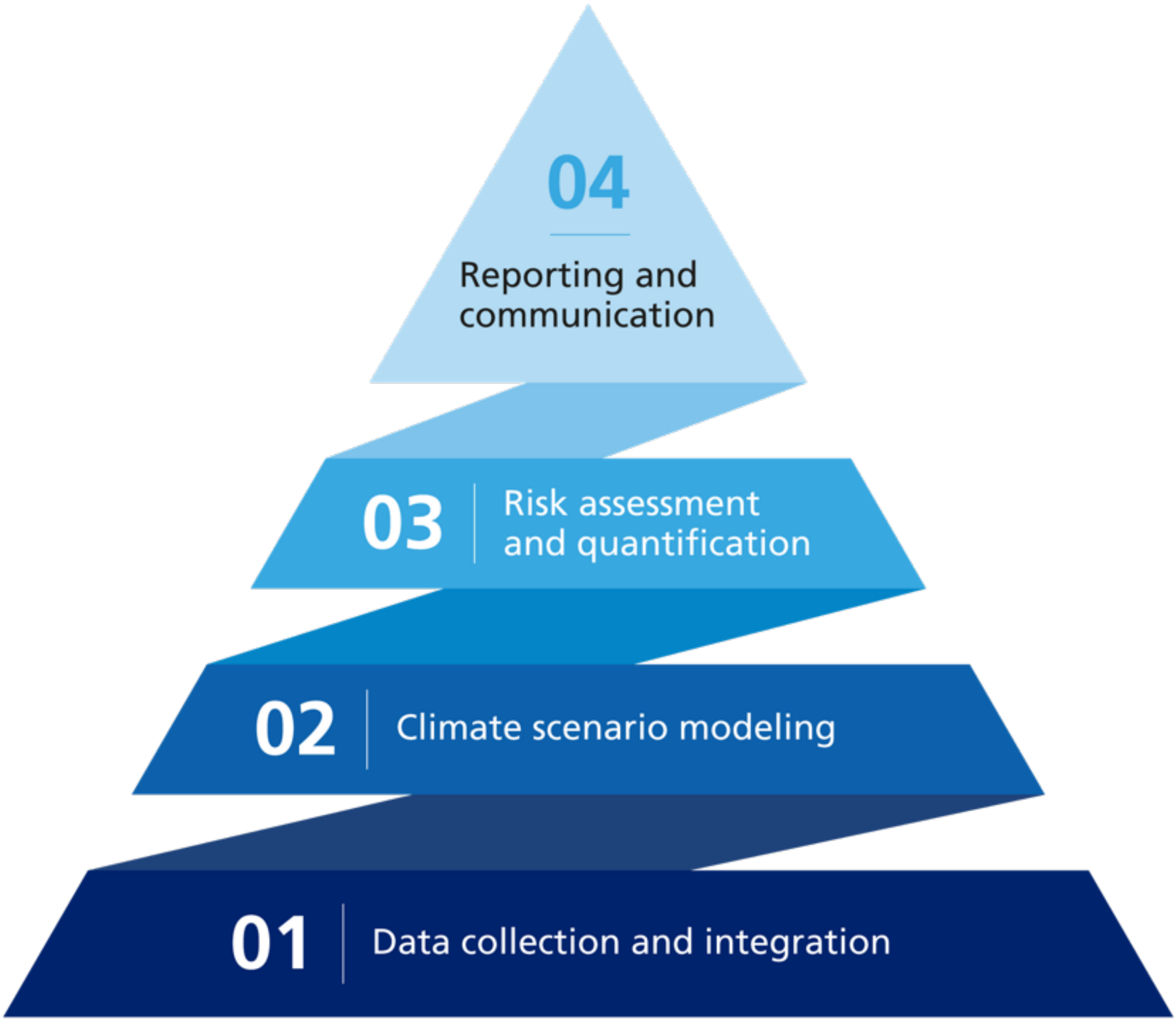
the pre-2022 hype around ESG revealed that market forces could distort thematic investment prices. And given (**according to some research**) that markets appear to be systematically underpricing climate risk, it does not appear that we have yet reached the peak of hype around climate risk.

Technology and the climate risk modeling workflow

To design effective climate risk modeling workflows, firms need a holistic approach that encompasses data collection, analysis, scenario modeling and decision-making processes. The design often involves several components and stages (see Figure 1):

- **Data collection and integration**. In this first stage, firms gather climate data, physical data, economic data and sector-specific information. Advanced software solutions enable users to integrate diverse data sources for more comprehensive risk assessments.
- **Climate scenario modeling**. This is a critical aspect of climate risk assessment. Practitioners design scenarios that span a range of climate futures, from optimistic mitigation scenarios to more severe climate impacts. These scenarios can include flood, drought, wildfire, hurricane and extreme heat across varying future time frames, often at very high resolution.
- **Risk assessment and quantification**. Advanced climate software solutions sometimes use ML and AI algorithms to comprehensively assess and quantify risks. This stage involves the analysis of physical risks (such as extreme weather events) and transition risks linked to policy changes and market shifts. For firms, the accurate translation of these events into financial valuations remains a key challenge.
- **Reporting and communication**. These are essential components of climate risk modeling workflows. Industry practitioners must translate complex modeling results into actionable insights for stakeholders that include board members, investors and regulatory bodies. Transparent reporting is especially important as stakeholders demand increased disclosure.

Figure 1: The stages in climate risk modeling workflows



Source: Chartis Research

Challenges and issues in the landscape

While the evolution of climate risk modeling has been impressive, organizations face several pressing challenges and debates.

- **Data quality and availability**. Practitioners encounter a significant issue when it comes to the quality and availability of climate data, particularly at high resolution. The main issues include:
  - Nuanced data for specific risks. The lack of nuanced data for specific risks (such as localized flooding).
  - Uncertainties in historical data. Issues can arise when firms are dealing

with historical climate data, which may no longer represent future conditions because of the ongoing impacts of climate change. The debate in this context centers on how existing data can be adapted to account for evolving climate trends.

- **Model uncertainties**. These are a central point of contention within climate risk modeling for several reasons, including:
  - Communication to decision-makers. There is an ongoing debate about how practitioners convey the uncertainties inherent in climate models to stakeholders and investors.
  - Accuracy and reliability. The accuracy and reliability of climate models remain contentious. Experts are divided on how precisely models can predict climate-related financial risks.
- **Integration of non-financial metrics**. The integration of non-financial metrics (especially social and governance factors) into climate risk modeling workflows is fraught with debate. Specific issues include:
  - Balancing financial and non-financial considerations. Striking the right balance between financial and non-financial factors in climate risk models is a topic of ongoing discussion. There is also some controversy around how to weigh the significance of non-financial metrics against traditional financial indicators.
  - Social and governance risk measurement. Measuring the social and governance risks associated with climate change remains a complex endeavor that is hotly debated. Defining standardized and universally accepted metrics and indicators for these factors is a challenge for firms.
- **Regulatory disparities**. Different regulatory requirements across jurisdictions make climate risk modeling more complex. Specific issues include:
  - Standardization challenges. This issue revolves around the standardization of climate risk modeling practices across regulatory frameworks. Practitioners and organizations grapple with the difficulty of adhering to multiple, often divergent, regulatory standards.
  - Global regulatory compliance. Regulatory compliance is particularly challenging for firms to navigate when they are operating in international

markets with diverse climate risk disclosure requirements.

- **Transition risk assessment**. The debate around how to assess the risks associated with transitioning to a low-carbon economy is multi-faceted, but specific issues include:
  - Modeling transition risk. Issues can arise around the appropriate methodologies that firms can use to model transition risks and their potential financial impacts. The debate centers on how to accurately represent the complexities involved in transitioning to a more sustainable business model.
  - Policy, technology and market dynamics. Transition risks encompass policy changes, technology advances and market dynamics. There is some controversy around the degree to which these factors should be incorporated into models, and how they might affect an organization's financial outlook.

Jump to top

Vendor landscape

Context: data differentiation

Providers of climate risk modeling solutions are in constant competition to incorporate the best data into their models. The two major factors involved in locating this 'best' data are *completeness* and *timeliness*. However, the scope, accessibility and standardization of available data make the technical aspects of building reliable models the biggest hurdle that firms will have to overcome.

In this context, *data completeness* refers to the depth and scope of data that are available to help firms properly measure the drivers of physical and transition risk, and to measure the exposure to climate risk of the economy overall, the sub-sectors within it, and the financial institutions that exist within them. Ultimately, the differences in data requirements between physical and transition risk models are stark.

Physical risk: financial impact and modeling

The physical risks of climate change and its effects on non-financial entities are a threat to the resilience of society and the global financial system. Natural disasters have increased fivefold in the past 50 years, causing huge financial losses – a trend that will likely accelerate, according to the predominant models of physical climate risk scenarios.

Against this background, physical risk models are still evolving, and now include longer time-horizon predictions and more granular geospatial data year on year. However, given the technical limitations of data storage, the variation in global data coverage, and inconsistencies in the granularity and validity of data, current physical risk models still struggle to properly model the wider financial impact that physical catastrophes have on assets. Firms need a more holistic approach to physical risk to properly model exposure to their own assets geographically and to the sector, jurisdiction and macroeconomic context within which they sit.

Several dynamics are at work. First, as already noted, providers are competing to use the most granular and up-to-date data possible in their models. In terms of the data challenge, there are several sources for providers to consider: raw climate data, along with data relevant to modeling specific perils. The Coupled Model Intercomparison Project (CMIP) is an attempt by climate scientists to integrate academic climate models into consensus models. CMIP6 is the most up-to-date generation of consensus models, on which some vendors have built their physical climate models, while other vendors are still leveraging CMIP4 and CMIP5. On top of CMIP, firms are also building geomorphological and other specific weather-type models to understand how climactic events will affect increasingly specific locations on Earth.

Building datasets to model physical climactic phenomena in detail is a massive technical challenge in terms of the collection, storage and validation of the data. Incumbent physical risk solution providers will have fewer issues in building such an infrastructure, but those vendors seeking to expand into physical risk, or start-ups seeking to innovate, may, in many cases, struggle to build this infrastructure from scratch. Inevitably, this widens the skill gap between veteran and newer software providers, limiting the overall innovation in physical risk modeling. In practice, many physical risk vendors are aggregators of a wide variety of public and proprietary climate and climate event models.

Second, financial institutions that require geographically specific physical risk models may find that they lack appropriate data for their chosen geography. Many countries in the world lack suitably deep climate model data, leaving a comparable black hole in terms of data and modeling for physical risk – and creating a big opportunity for vendors that can source or build remote-sensing datasets. By expanding their data horizons to include underrepresented areas of the world, particularly in East Asia, Southeast Asia and Central and South America, firms could boost the overall validity and scope of their models. Typically, these areas are both heavily at risk of massive financial losses following natural disasters, and make up the backbone of industrial supply chains for much of the Western world.

Third, there are inconsistencies in granularity, newness and validity of data. This introduces inconsistencies into the measurement of the physical drivers of climate risk, and the subsequent scenario analyses. Providers of physical risk models have an opportunity to develop tools that can synthesize and validate a wide range of non-standardized and non-geospatial data.

Finally, the evolution of overall physical risk modeling also prompts an evolution in the financial impact models that are based on physical risk. The typical solution for measuring financial impact combines data about factors such as a firm's current physical asset market value, facility type, construction method and materials, and then estimates the overall exposure by hazard type based on geospatial data (on floods, wind, fires and so on).

Newer methodologies are emerging that borrow heavily from estimation models in the insurance industry. These methods take firm-level data to measure general asset damage, combine it with geographic risk and infrastructure data, and measure the overall losses from business interruption or infrastructure damage. Some providers are finding success with these new approaches, but they are much more methodologically and technically demanding than the more common physical risk, financial impact models.

Transition risk modeling

The data used in transition risk models measures the effect on non-financial entities of the move toward a low-carbon economy (via legal regulations, customer preferences and advances in technology, among other factors). These measurements can be unreliable, as they are often aggregates of self-reported metrics from public firms that are then used to predict the cost changes for households and corporates caused by climate change. The ways in which different transition risk tools compile, measure and use these metrics in their methodologies is a key differentiator in terms of their efficacy.

Generally, there are more variables with which to build transition risk models than there are for physical risk. This is because of the ever-increasing number of firms that report their exposure to transition risks via metrics such as greenhouse gas (GHG) emissions, green and brown investment shares and stranded asset risk. This company-reported data, along with the wide array of factors that influence the market (such as policy, evolving technology and customer preferences) is a primary variable influencing the outcomes of transition risk modeling.

However, these disclosures are too inconsistent across sectors, and even similar firms, to create reliable and useful models. Even as regulatory demands move toward global standards, and voluntary disclosures among private firms increase, companies are still relaying incomplete information about their climate risk management programs to stakeholders and outside agencies. A **2022 report** from the TCFD found that, while '80% of companies surveyed disclosed … in line with at least one of the 11 recommended disclosures … only 4% disclosed in line with all 11 recommended disclosures … and only around 40% disclosed in line with at least five". Furthermore, company disclosures are inconsistent with actual reported data across sectors and jurisdictions. Without complete disclosure, investors and data producers face the arduous task of estimating a much wider array of variables to use within their models.

This leads to the major issue facing transition risk models: the lack of data accessibility, verification and cross-sector standardization of key attributes (such as emissions disclosures and alignment with taxonomies of sustainable economic activity). There have been some recent developments in transition risk models to address these issues, however. Providers of transition risk tools have made advances in the use of ML techniques such as natural language processing (NLP), alongside other AI tools, to analyze and predict gaps in public and private disclosure data. It will take time to measure the effectiveness of these new methods. But as experimentation persists, the predictive capability of these tools – and future ones – will increase.

Estimating carbon emissions in practice

Assessing carbon emissions is a critical component of climate risk modeling, enabling organizations to understand their environmental impact and vulnerabilities. Firms employ two main approaches – 'top-down' and 'bottom-up' – to estimate carbon emissions. Vendors in the field are actively implementing these methods to provide effective climate risk solutions.

The top-down approach

To estimate carbon emissions, firms assess emissions at the sector and product levels. While this approach provides a macro-level view of emissions, it may be less precise when it comes to specific activities within an organization. Vendors employ several strategies for top-down estimation:

- **Integrating sectoral emissions data**. Vendors integrate sectoral emissions data from authoritative sources (such as government agencies) into their software solutions. These data sources provide industry-level emissions data, allowing organizations to assess their relative performance.
- **Product-level emission factors**. To estimate emissions for specific products or services, vendors incorporate product-level factors. These are derived from industry standards, and are applied to an organization's production and supply chain data to estimate any emissions associated with its offerings.
- **Custom emission scenarios**. Some vendors enable organizations to create custom emission scenarios based on their industry and operations. Organizations can modify sectoral and product-level data to align with their specific circumstances and objectives.

The bottom-up approach

Estimating carbon emissions focuses on environmental input-output (I-O) analysis, to provide a more granular understanding of the sources of emissions within an organization. Vendors adopt various methods for making bottom-up estimates:

- **Data collection and integration for process modeling**. Vendors facilitate data collection and integration by giving organizations the tools to compile comprehensive activity data. This may include data on energy consumption, production processes, transportation and supply chains.
- **Environmental I-O models**. Vendors use sophisticated environmental I-O models to analyze the interconnectedness of economic activities. The models trace emissions through the entire value chain, enabling organizations to understand the environmental impact of specific activities and processes.
- **Granular emissions estimation/lifecycle assessment (LCA)**. This enables organizations to accurately pinpoint the sources of emissions. This level of detail can enable firms to identify areas where emissions can be reduced and implement targeted strategies via the method known as product LCA. How rigorously it is possible to perform an LCA without private information is likely to vary widely.

Choosing the right approach

In practice, vendors often provide a combination of both top-down and bottom-up approaches, enabling organizations to benefit from the strengths of each method. Some climate risk software solutions, for example, enable firms to import top-down sectoral data while also providing tools for bottom-up data collection and analysis.

Furthermore, leading vendors are integrating ML and AI algorithms to enhance the accuracy of their emissions estimates. These technologies can learn from historical data and continuously improve their estimations, making them more reliable and responsive to operational changes.

By combining macro-level sectoral data with granular bottom-up analysis, and by leveraging advanced technologies, firms can make informed decisions to reduce their carbon footprint, mitigate climate risks and align with sustainability goals more effectively.

Models and scenario analysis

Predicting the financial impact of climate change on a portfolio is beyond the scope of either transition risk or physical risk modeling on their own. Recent trends among solution providers show that there is a push toward a more holistic approach to climate risk solutions that can compound the data and methodology issues listed previously. The prospect of creating a model that is methodologically sound with adequate data and a solid user-friendly experience is a challenge not currently met by the market at large.

Currently, there is a renewed focus on the links between the secondary effects of climate change and the financial market. Increases in migration flows, changes in agriculture and natural resources and disruptions in global supply chains are just a few of the challenges facing economies in the coming decades. So far, the full financial effect of these indirect climate risks is not completely understood. However, a proper understanding of the secondary effects of climate change is the key to effective modeling of the financial impacts of physical and transition risks.

But this is easier said than done. Properly modeling these financial effects is still some way off. It would require data that does not yet exist outside other predictive models or academic research (such as data on predicted migration patterns, the degradation of farmland and water reserves, the decline in biodiversity and rising sea levels). And it would also require firms to synthesize methodologies from a multitude of major scientific and economic discipline.

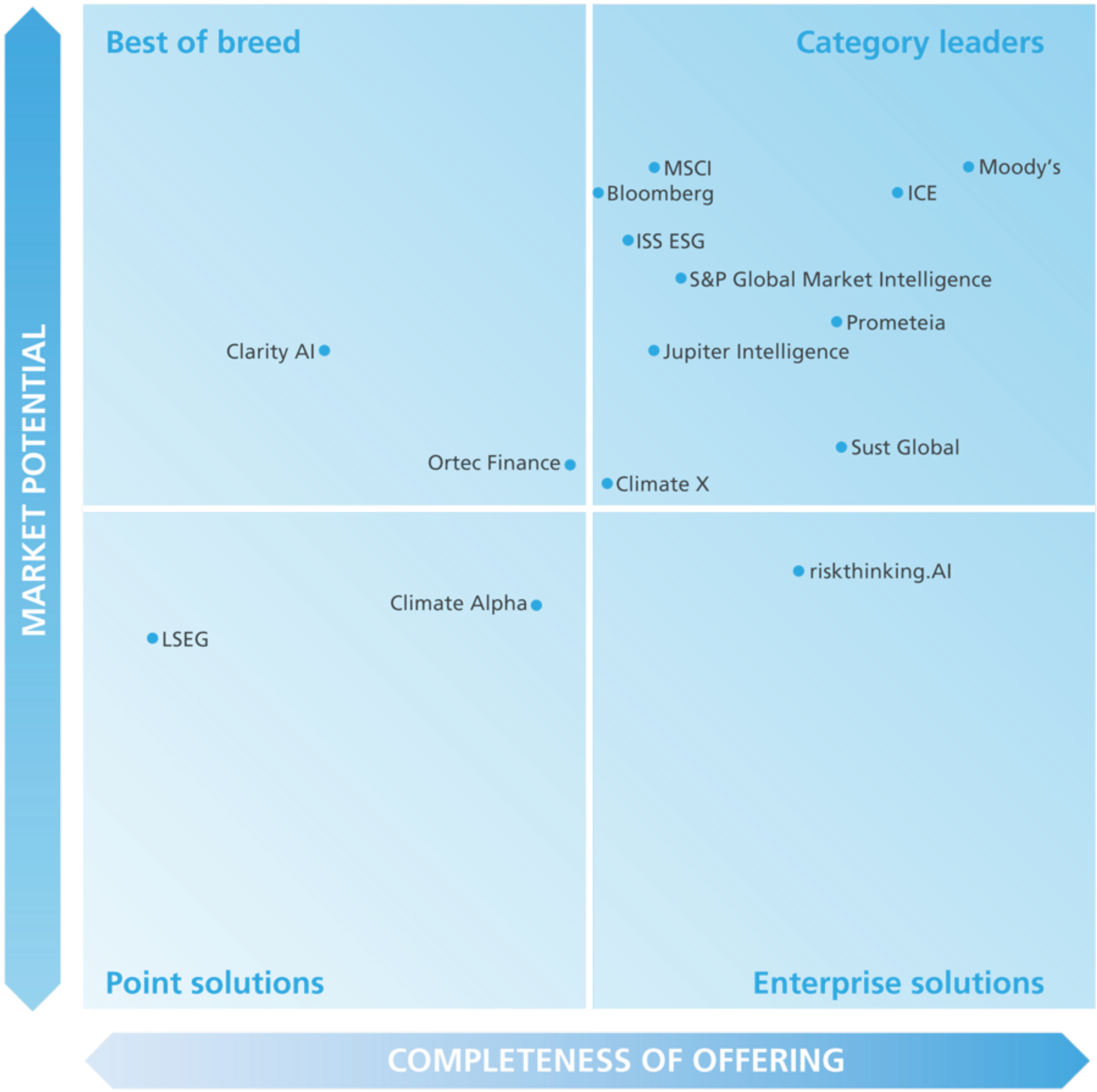
Despite these challenges, however, there is space for models that are more narrowly focused and more sector-oriented in their analyses. Theoretically, the secondary effects of climate change differ by financial sector. The agriculture, energy and retail sectors, for example, would each face vastly different repercussions from a physical risk event such as a hurricane, or from the transition to a net zero economy. By using methods that are currently available and reliable, and understanding and incorporating the details of each sector and modeling those differences, it should be possible to produce tools that can still be used by those in the market without the need for massive data infrastructure, market-wide disclosure data or ostentatious modeling techniques. Climate risk models should therefore become more specialized within a particular market, and consequently more methodologically reliable and useable by financial institutions. Indeed, Chartis is seeing certain vendors specialize in data and analytics stacks that are targeted at agriculture and real estate already; it is likely that more sizable niches remain to be discovered.

Jump to top

Chartis RiskTech Quadrant® and vendor capabilities for climate risk modeling solutions, 2023

Figures 2, 3 and 4 illustrate Chartis' view of the vendor landscape for physical, transition and natural catastrophe modeling solutions respectively. Tables 2, 4 and 6 list the completeness of offering and market potential criteria we used to assess the vendors in each case. Tables 3, 5 and 7 list the vendor capabilities in each area.

Figure 2: RiskTech Quadrant® for physical risk modeling solutions, 2023



Source: Chartis Research

Table 2: Assessment criteria for vendors of physical risk modeling solutions, 2023

Completeness of offering	Market potential
Entity and asset coverage	Customer satisfaction
Physical climate data	Market penetration
Physical risk modeling	Growth strategy
Risk analytics	Business model
Financial impact analytics	Financials
Technology and delivery architecture	

Source: Chartis Research

Table 3: Vendor capabilities for physical risk modeling solutions, 2023

Vendor	Entity and asset coverage	Physical climate data	Physical risk modeling	Risk analytics	Financial impact analytics	Technology and delivery architecture
Bloomberg	****	****	****	****	****	****
Clarity AI	**	**	**	**	***	***
Climate Alpha	*	****	****	***	**	****
Climate X	**	****	****	**	***	***
ICE	*****	***	****	***	****	****
ISS ESG	***	***	***	***	***	***
Jupiter Intelligence	***	***	***	***	***	***
LSEG	***	**	**	**	**	**
Moody's	****	*****	****	****	****	****
MSCI	***	***	***	***	***	***
Ortec Finance	**	**	***	****	***	****
Prometeia	***	***	****	****	****	***
riskthinking.AI	****	****	****	*****	*	****
S&P Global Market Intelligence	***	****	***	****	***	**
Sust Global	***	****	****	****	***	*****

Key: ****** = Best-in-class capabilities; **** = Industry-leading capabilities; *** = Advanced capabilities; ** = Meets industry requirements; * = Partial coverage/component capability*

Source: Chartis Research

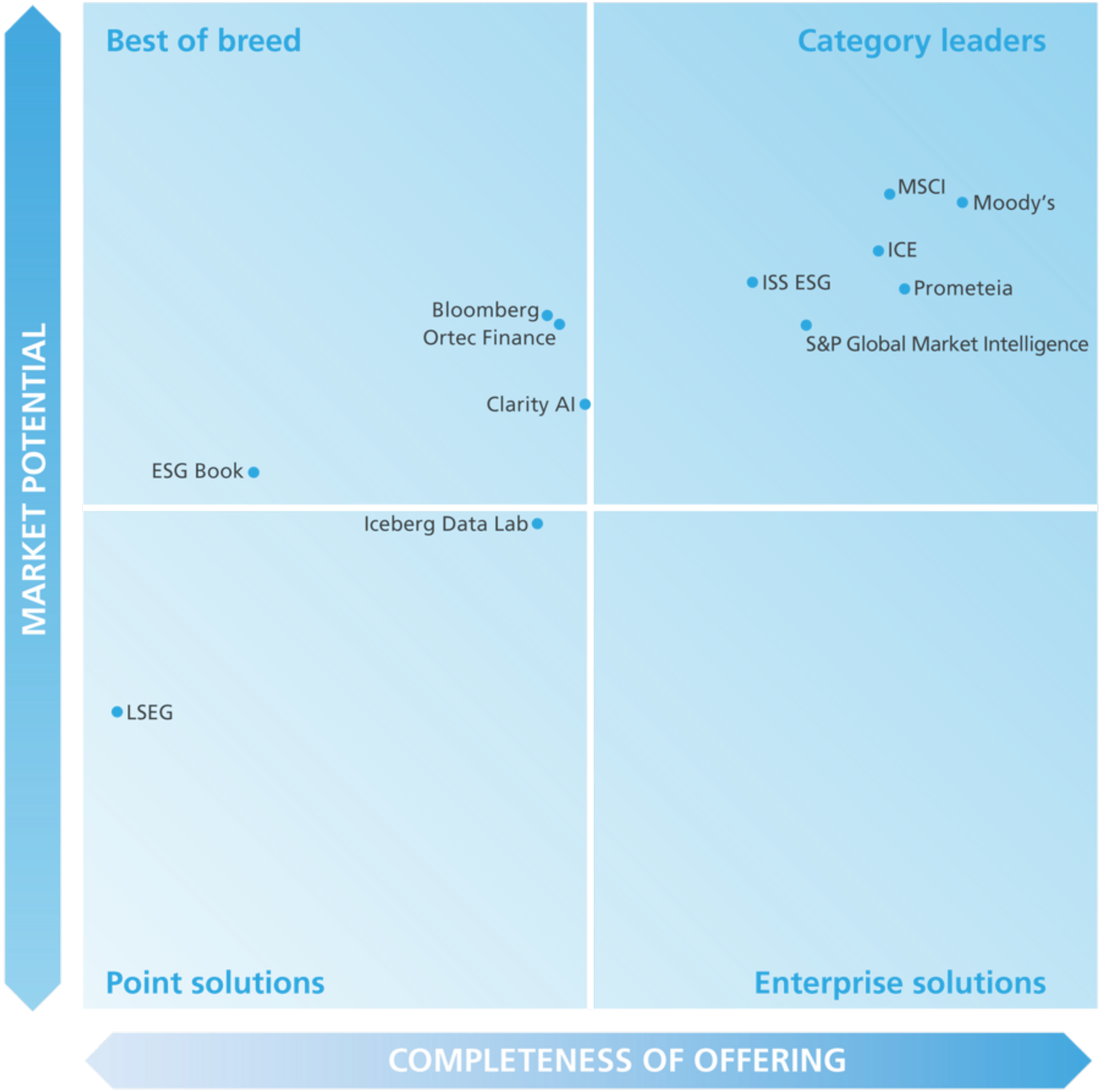
Quadrant dynamics – the financial impact of physical risk modeling

The main quadrant dynamics for physical risk solutions are:

- Financial impact modeling has itself become significantly more advanced since we last considered this landscape, in 2022.
- Some firms are more specialized in terms of their climate modeling depth and breadth. Others in the market are aggregators of climate modeling, but go to a much greater depth within financial impact modeling

- Start-ups specializing in the geospatial and climate modeling areas of the landscape are rapidly expanding into risk and financial impact modeling, while incumbent, economically focused firms work to hold their advantage.
- For now, firms specializing in economic modeling, with their rigorous and explainable approach to quantification, are able to add a greater layer of rigorousness to the last mile of financial impact modeling. Nevertheless, the tech stack might begin to fragment, as firms begin to adopt best-of-breed components around:
  - Entity and securities location data.
  - Climate and geospatial modeling.
  - Peril modeling.
    - By geography.
    - By peril.
    - By attribute.
  - Economic impact modeling on top of peril modeling.
  - Last-mile financial risk integration.
    - Fundamental modeling.
    - Asset pricing.
    - Liability pricing.

Figure 3: RiskTech Quadrant® for transition risk modeling solutions, 2023



Source: Chartis Research

Table 4: Assessment criteria for vendors of transition risk modeling solutions, 2023

Completeness of offering	Market potential
Entity and asset coverage	Customer satisfaction
Emissions data and modeling	Market penetration
Transition risk modeling	Growth strategy
Risk analytics	Business model
Financial impact analytics	Financials
Technology and delivery architecture	

Source: Chartis Research

Table 5: Vendor capabilities for transition risk modeling solutions, 2023

Vendor	Entity and asset coverage	Emissions data and modeling	Transition risk modeling	Risk analytics	Financial impact analytics	Technology and delivery architecture
Bloomberg	***	***	***	***	**	****
Clarity AI	**	****	***	***	***	***
ESG Book	***	***	**	**	*	**
ICE	*****	***	****	****	****	****
Iceberg Data Lab	***	****	***	***	**	***
ISS ESG	***	*****	*****	***	***	***
LSEG	**	***	*	*	**	**
Moody's	***	****	*****	*****	*****	***
MSCI	****	****	****	****	***	****
Ortec Finance	**	***	***	***	***	***
Prometeia	***	***	*****	***	*****	*****
S&P Global Market Intelligence	****	****	****	***	****	***

Key: ***** = Best-in-class capabilities; **** = Industry-leading capabilities; *** = Advanced capabilities; ** = Meets industry requirements; * = Partial coverage/component capability

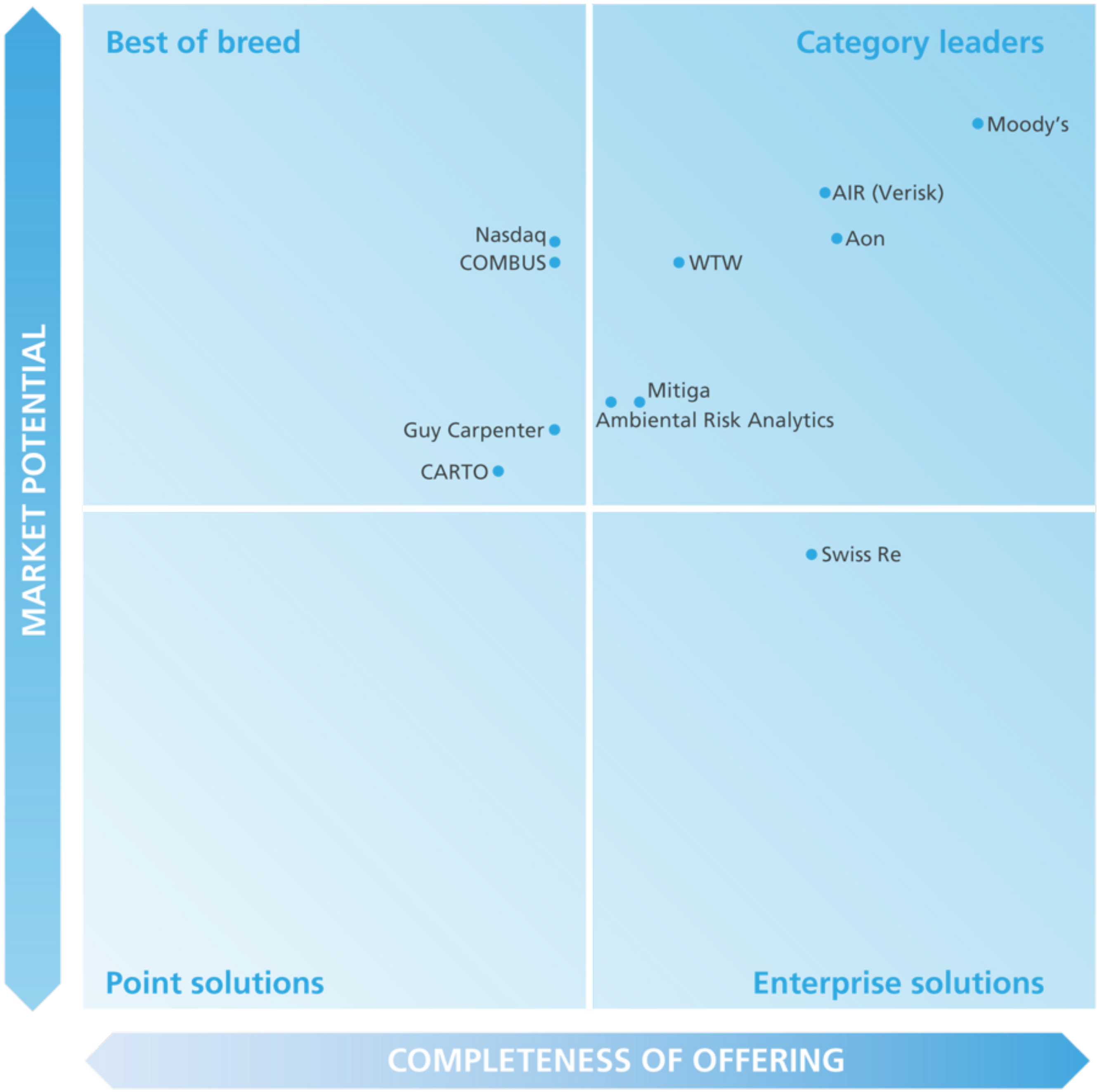
Source: Chartis Research

Quadrant dynamics – the financial impact of transition risk modeling

The main quadrant dynamics for transitional risk solutions are:

- Innovation in the transition risk space has slowed.
- There is a significant gap between the leading economics-focused players and everyone else in terms of the core financial impact models in this space.
- Firms with a heritage in using NLP to power better carbon emissions data and firm net zero analytics are having to expand their offerings to better serve the full transition risk modeling workflow, including financial impact analytics.
- Firms that offer a comprehensive statistical engine that can not only model scenarios but also support stress testing or model financial impacts in minute detail will find themselves significantly ahead of their more qualitative competitors.
- Transition risk models are becoming more standard; however, they are still nowhere near as standard as physical risk models. More research is needed to determine the suitability of different variables in transition risk models, as a variety of inputs are used by various providers.

Figure 4: RiskTech Quadrant® for natural catastrophe modeling solutions, 2023



Source: Chartis Research

Table 6: Assessment criteria for vendors of natural catastrophe modeling solutions, 2023

Completeness of offering	Market potential
Breadth of perils and climate factors	Customer satisfaction
Depth of peril models	Market penetration
Geographic coverage	Growth strategy
Technology and delivery architecture	Business model
	Financials

Source: Chartis Research

Table 7: Vendor capabilities for natural catastrophe modeling solutions, 2023

Vendor	Breadth of perils and climate factors	Depth of peril models	Geographic coverage	Technology and delivery architecture
AIR (Verisk)	*****	****	***	***
Ambiental Risk Analytics	**	***	**	***
Aon	****	****	***	****
CARTO	*	***	*	***
COMBUS	**	***	**	***
Guy Carpenter	**	***	*	***
Mitiga	***	***	***	***
Moody's	*****	*****	*****	*****
Nasdaq	****	*	****	***
Swiss Re	****	****	****	**
WTW	***	***	***	***

Key: ****** = Best-in-class capabilities; **** = Industry-leading capabilities; *** = Advanced capabilities; ** = Meets industry requirements; * = Partial coverage/component capability*

Source: Chartis Research

Quadrant dynamics – natural catastrophe modelling

The main quadrant dynamics for natural catastrophe solutions are:

- Dominant firms continue to rule in this relatively mature market.

- There are moderate barriers to entry in specific niches within the market, along with continued innovation in specific verticals/sectors.
- Being a cross-peril and multi-geography provider remains a challenge, given the divergent requirements of technology stacks between perils, and the divergent datasets between geographies.
- New distribution models are growing in importance. The OASIS open-source initiative continues to become more relevant to how firms look to ingest natural catastrophe models.
- No single disruptive force is currently affecting the market, but continued growth in the availability of computational tools, along with a vast diversity of data management options, is providing considerable scope for firms to improve the efficiency and economics of solutions.

Jump to top

Notes

1. Note that references to companies in the text of this report do not constitute endorsements of their products or services by Chartis.

Appendix A: Climate risk typologies

Table 8: Climate risk typologies

Risk factor	Description
Physical risk	All businesses have some kind of footprint in the physical world, whether it is the location of their facilities, the transit routes leveraged by their supply chains or the geographies where their target customers reside. Each of these is vulnerable to 'physical' climate risk (i.e., the environmental changes and hazards created by shifting climate conditions). The main categories of physical risk are: • **Acute physical risk**. These are represented by the increasing occurrence of extreme weather events, including hurricanes, tornadoes, wildfires, drought, flooding and even plagues of insects. Due to climate change, these events may occur more erratically or in areas where they were not present previously. • **Gradual physical risk**. Gradual physical risks are caused by changes in the environment associated with changes in climate. This could include increased scarcity of water because of the onset of a more arid climate, or the effect of higher temperatures on the varieties of plants that may grow in an area. • **Second-order physical risk**. Because of changes in climate and weather, second-order risks can include potential consequences such as forced migration (which will change consumption patterns), supply chain disruptions and increased biohazards affecting human health.
Transition risk	Transition risks are the second-order effects of governments, the market and customers responding to climate change. As the focal points of responding to climate change are decarbonization and carbon emissions, carbon-related risks are at the heart of transition risk and can serve as a proxy for it. • **GHG emissions**. GHG emissions are the foundation of transition risks, which have the biggest impact on businesses with naturally high marginal cost curves for GHG abatement. As a foundation for assessing transitional risk, investors are concerned with accurately quantifying GHG emissions for all emission scopes. • **Policy risk**. Policy risks due to climate change include carbon pricing and taxation. These emerge as the potential costs of doing business in a world where governments are pushing markets to decarbonize via policy tools. Carbon pricing includes emissions cap-and-trade schemes in which companies in some specific sectors are forced to pay for the right to emit. A carbon tax is a price on carbon issued at the point of transacting. Voluntary carbon offsets are not currently a policy risk, but may evolve into one if net zero requirements are formalized. • **Energy transition risk**. Energy transition risk reflects firms' ability to decarbonize power production or purchasing decisions to reduce their Scope 1 and 2 emissions. (Although this can also impact Scope 3, it will probably be managed more through supply chain risk management.) • **Market risk**. Market risk includes risk premia placed on carbon-intensive assets, as well as the volatility that higher-risk assets may face in the market as investors continue to integrate climate risk assessment into their portfolio analysis processes. Market risks are heavily connected to the behavioral factors involved in integrating climate risk management into institutional investment workflows and the market at large (via low-carbon exchange-traded funds [ETFs] and other products). • **Second-order transition risks**. Some second-order transition risks (including forced migration, the impact of climate change on underlying economic demand, and the increased prevalence of novel human diseases from animals due to the destruction of wildlife habitats) are poorly understood and documented at present by major providers.

Source: Chartis Research

[Jump to top]

Appendix B: RiskTech Quadrant® methodology

Chartis is a research and advisory firm that provides technology and business advice to the global risk management industry. Chartis provides independent market intelligence regarding market dynamics, regulatory trends, technology trends, best practices, competitive landscapes, market sizes, expenditure priorities, and mergers and acquisitions. Chartis' RiskTech Quadrant® reports are written by experienced analysts with hands-on experience of selecting, developing and implementing risk management systems for a variety of international companies in a range of industries, including banking, insurance, capital markets, energy and the public sector.

Chartis' research clients include leading financial services firms and Fortune 500 companies, leading consulting firms and risk technology vendors. The risk technology vendors that are evaluated in the RiskTech Quadrant® reports can be Chartis clients or firms with whom Chartis has no relationship. Chartis evaluates all risk technology vendors using consistent and objective criteria, regardless of whether they are a Chartis client.

Where possible, risk technology vendors are given the opportunity to correct factual errors prior to publication, but cannot influence Chartis' opinion. Risk technology vendors cannot purchase or influence positive exposure. Chartis adheres to the highest standards of governance, independence and ethics.

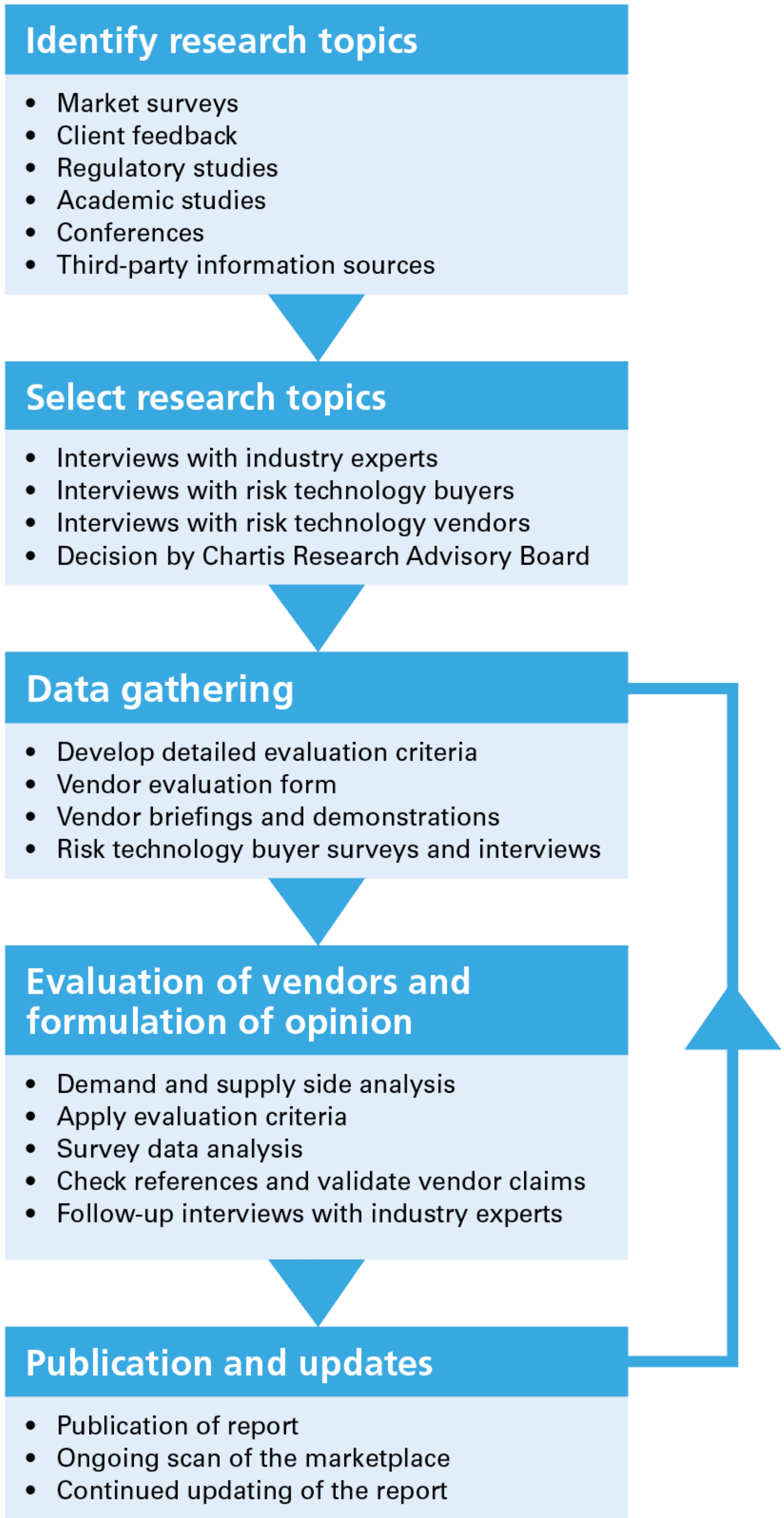
Inclusion in the RiskTech Quadrant®

Chartis seeks to include risk technology vendors that have a significant presence in a given target market. The significance may be due to market penetration (e.g., large client base) or innovative solutions. Chartis does not give preference to its own clients and does not request compensation for inclusion in a RiskTech Quadrant® report. Chartis utilizes detailed and domain-specific 'vendor evaluation forms' and briefing sessions to collect information about each vendor. If a vendor chooses not to respond to a Chartis vendor evaluation form, Chartis may still include the vendor in the report. Should this happen, Chartis will base its opinion on direct data collated from risk technology buyers and users, and from publicly available sources.

Research process

The findings and analyses in the RiskTech Quadrant® reports reflect our analysts' considered opinions, along with research into market trends, participants, expenditure patterns and best practices. The research lifecycle usually takes several months, and the analysis is validated through several phases of independent verification. Figure 5 below describes the research process.

Figure 5: RiskTech Quadrant® research process



Source: Chartis Research

Chartis typically uses a combination of sources to gather market intelligence. These include (but are not limited to):

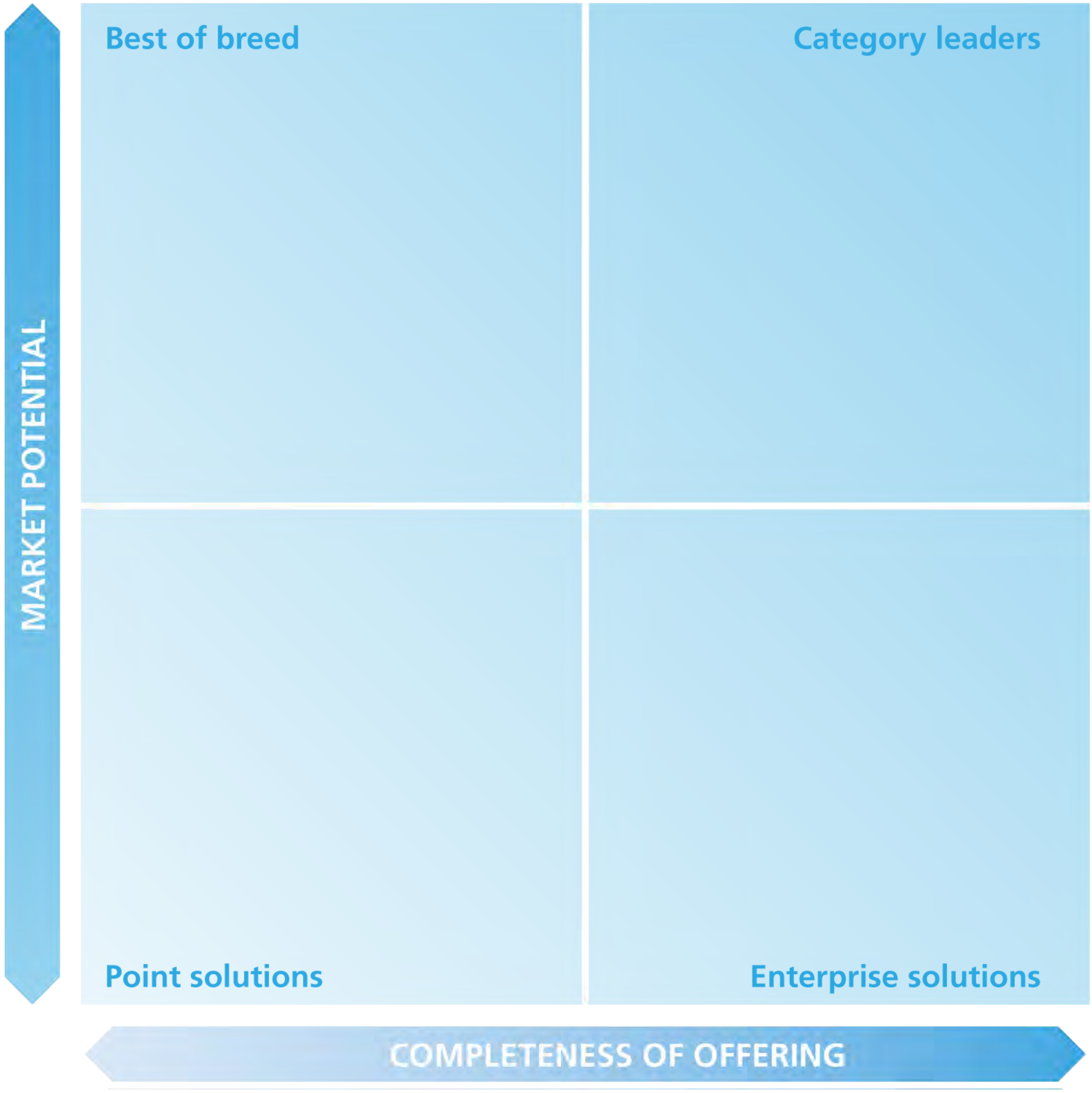
- **Chartis vendor evaluation forms.** A detailed set of questions covering functional and non-functional aspects of vendor solutions, as well as organizational and market factors. Chartis' vendor evaluation forms are based on practitioner-level expertise and input from real-life risk technology projects, implementations and requirements analysis.
- **Risk technology user surveys.** As part of its ongoing research cycle, Chartis systematically surveys risk technology users and buyers, eliciting feedback on various risk technology vendors, satisfaction levels and preferences.
- **Interviews with subject matter experts.** Once a research domain has been selected, Chartis undertakes comprehensive interviews and briefing sessions with leading industry experts, academics and consultants on the specific domain to provide deep insight into market trends, vendor solutions and evaluation criteria.
- **Customer reference checks.** These are telephone and/or email checks with named customers of selected vendors to validate strengths and weaknesses, and to assess post-sales satisfaction levels.
- **Vendor briefing sessions.** These are face-to-face and/or web-based briefings and product demonstrations by risk technology vendors. During these sessions, Chartis experts ask in-depth, challenging questions to establish the real strengths and weaknesses of each vendor.
- **Other third-party sources.** In addition to the above, Chartis uses other third-party sources of information such as conferences, academic and regulatory studies, and collaboration with leading consulting firms and industry associations.

Evaluation criteria

The RiskTech Quadrant® (see Figure 6) evaluates vendors on two key dimensions:

1. Completeness of offering
2. Market potential

Figure 6: RiskTech Quadrant®



Source: Chartis Research

We develop specific evaluation criteria for each piece of quadrant research from a broad range of overarching criteria, outlined below. By using domain-specific criteria relevant to each individual risk, we can ensure transparency in our methodology and allow readers to fully appreciate the rationale for our analysis.

Completeness of offering

- **Depth of functionality.** The level of sophistication and number of detailed features in the software product (e.g., advanced risk models, detailed and flexible workflow, domain-specific content). Aspects assessed include: innovative functionality, practical relevance of features, user-friendliness, flexibility and embedded intellectual property. High scores are given to firms that achieve an appropriate balance between sophistication and user-friendliness. In addition, functionality linking risk to performance is given a positive score.

- **Breadth of functionality.** The spectrum of requirements covered as part of an enterprise risk management system. This varies for each subject area, but special attention is given to functionality covering regulatory requirements, multiple risk classes, multiple asset classes, multiple business lines and multiple user types (e.g., risk analyst, business manager, CRO, CFO, compliance officer). Functionality within risk management systems and integration between front office (customer-facing) and middle/back office (compliance, supervisory and governance) risk management systems are also considered.
- **Data management and technology infrastructure.** The ability of risk management systems to interact with other systems and handle large volumes of data is considered to be very important. Data quality is often cited as a critical success factor and ease of data access, data integration, data storage and data movement capabilities are all important factors. Particular attention is given to the use of modern data management technologies, architectures and delivery methods relevant to risk management (e.g., in-memory databases, complex event processing, component-based architectures, cloud technology, software-as-a-service). Performance, scalability, security and data governance are also important factors.
- **Risk analytics.** The computational power of the core system, the ability to analyze large amounts of complex data in a timely manner (where relevant in real time), and the ability to improve analytical performance are all important factors. Particular attention is given to the difference between ‘risk’ analytics and standard ‘business’ analytics. Risk analysis requires such capabilities as non-linear calculations, predictive modeling, simulations, scenario analysis, etc.
- **Reporting and presentation layer.** The ability to present information in a timely manner, the quality and flexibility of reporting tools, and ease of use are important for all risk management systems. Particular attention is given to the ability to do ad hoc ‘on-the-fly’ queries (e.g., what-if analysis), as well as the range of ‘out-of-the-box’ risk reports and dashboards.

Market potential

- **Business model**. Includes implementation and support and innovation (product, business model and organizational). Important factors include size and quality of implementation team, approach to software implementation and post-sales support and training. Particular attention is given to 'rapid' implementation methodologies and 'packaged' services offerings. Also evaluated are new ideas, functionality and technologies to solve specific risk management problems. Speed to market, positioning and translation into incremental revenues are also important success factors in launching new products.
- **Market penetration**. Volume (i.e., number of customers) and value (i.e., average deal size) are considered important. Rates of growth relative to sector growth rates are also evaluated. Also covers brand awareness, reputation and the ability to leverage current market position to expand horizontally (with new offerings) or vertically (into new sectors).
- **Financials**. Revenue growth, profitability, sustainability and financial backing (e.g., the ratio of license to consulting revenues) are considered key to scalability of the business model for risk technology vendors.
- **Customer satisfaction**. Feedback from customers is evaluated, regarding after-sales support and service (e.g., training and ease of implementation), value for money (e.g., price to functionality ratio) and product updates (e.g., speed and process for keeping up to date with regulatory changes).
- **Growth strategy**. Recent performance is evaluated, including financial performance, new product releases, quantity and quality of contract wins, and market expansion moves. Also considered are the size and quality of the sales force, sales distribution channels, global presence, focus on risk management, messaging and positioning. Finally, business insight and understanding, new thinking, formulation and execution of best practices, and intellectual rigor are considered important.

Quadrant descriptions

Point solutions

Point solutions providers focus on a small number of component technology capabilities, meeting a critical need in the risk technology market by solving specific risk management problems with domain-specific software applications and technologies.

They are often strong engines for innovation, as their deep focus on a relatively narrow area generates thought leadership and intellectual capital.

By growing their enterprise functionality and utilizing integrated data management, analytics and BI capabilities, vendors in the point solutions category can expand their completeness of offering, market potential and market share.

Best-of-breed

Best-of-breed providers have best-in-class point solutions and the ability to capture significant market share in their chosen markets.

They are often distinguished by a growing client base, superior sales and marketing execution, and a clear strategy for sustainable, profitable growth. High performers also have a demonstrable track record of R&D investment, together with specific product or 'go-to-market' capabilities needed to deliver a competitive advantage.

Focused functionality will often see best-of-breed providers packaged together as part of a comprehensive enterprise risk technology architecture, co-existing with other solutions.

Enterprise solutions

Enterprise solutions providers typically offer risk management technology platforms, combining functionally rich risk applications with comprehensive data management, analytics and BI.

A key differentiator in this category is the openness and flexibility of the technology architecture and a 'toolkit' approach to risk analytics and reporting, which attracts larger clients.

Enterprise solutions are typically supported with comprehensive infrastructure and service capabilities, and best-in-class technology delivery. They also combine risk management content, data and software to provide an integrated 'one-stop-shop' for buyers.

Category leaders

Category leaders combine depth and breadth of functionality, technology and content with the required organizational characteristics to capture significant share in their market.

Category leaders demonstrate a clear strategy for sustainable, profitable growth, matched with best-in-class solutions and the range and diversity of offerings, sector coverage and financial strength to absorb demand volatility in specific industry sectors or geographic regions.

Category leaders will typically benefit from strong brand awareness, global reach and strong alliance strategies with leading consulting firms and systems integrators.

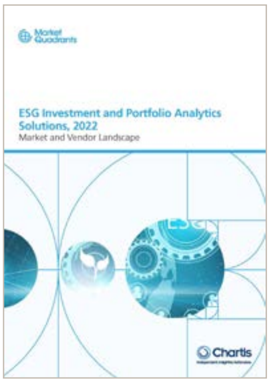
Jump to top

Further reading

ESG Data and Scoring Solutions, 2023: Market Update and Vendor Landscape

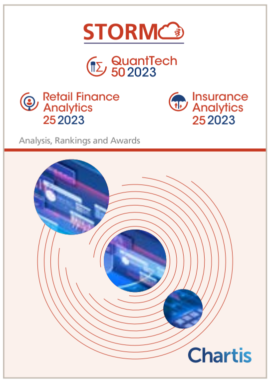
ESG Investment Data and Analytics, 2022: Climate-Focused; Market and Vendor Landscape

ESG Data Aggregators and Scorers, 2022: Market and Vendor Landscape



ESG Investment and Portfolio Analytics Solutions, 2022: Market and Vendor Landscape

Buyside50 2023



STORM 2023

For all these reports, see **www.chartis-research.com**