Vendor Analysis

# Vendor Analysis: SAS

## Credit Portfolio Management Solutions, 2023

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.

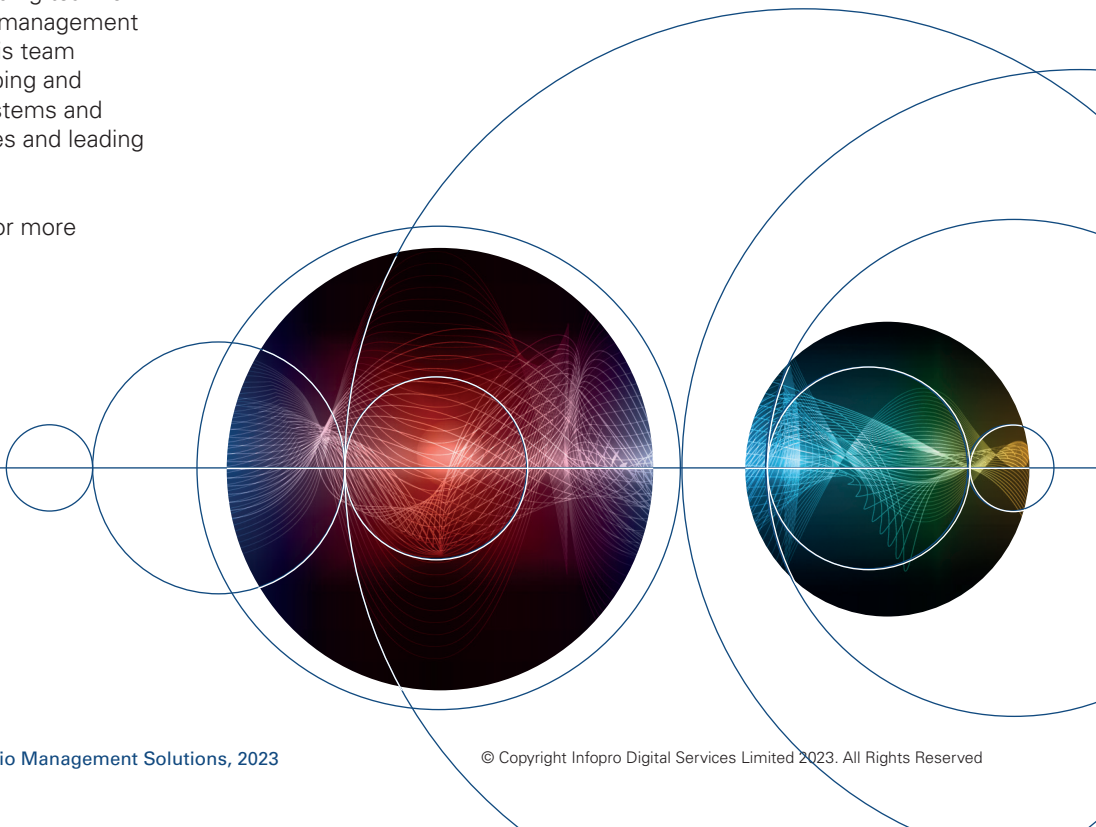
Chartis focuses on risk and compliance technology, giving it a significant advantage over generic market analysts.

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**.





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# 1. Report context

This Vendor Analysis is based on the Chartis quadrant report *Credit Portfolio Management Solutions, 2023: Market and Vendor Landscape* (published in October 2023). This section summarizes the key theses in that report; subsequent sections take a detailed look at SAS' quadrant positioning and scoring, and Chartis' underlying opinion and analysis.

## Key thesis

As a business function, credit portfolio management and monitoring has changed considerably in the past few decades, evolving from a paper-driven, relatively minor element of the credit lifecycle into a core focus. This transformation has been enabled by the growing use of such technologies as artificial intelligence (AI), machine learning (ML), robotic process automation (RPA) and Big Data analytics, and by increased adoption of cloud infrastructures. Despite this heavier reliance on technology, there are some parts of the CPM process that involve important decisions (such as adding or terminating a high-value/high-risk line of credit). These decisions are still not being made using more innovative technology, as they are too sensitive to risk unintended exposure to data leaks or privacy issues.

Alongside new ways of managing their credit portfolios, firms are also considering more assets and risks (such as counterparty risk). Consequently, we have expanded our coverage of CPM into the areas of enterprise risk and treasury/asset and liability management (ALM). As this expansion has occurred, managers and traders have been looking for solutions that can enable them to stay abreast of rapidly changing markets and aware of potential risks. This is especially important in the current financial landscape, in which firms require 24-hour monitoring to stay up to date with fast-moving information.

Implementing effective CPM is not without challenges, however, notably around data quality and the wider financial environment. Non-financial risks – including the power of public opinion – are also creating issues for firms. To address these challenges, financial institutions will have to break the cycle of data and risk issues, investing in better-quality data and more due diligence.

The CPM solutions market is defined largely according to the types of institution – retail/corporate bank or wealth management firm – using the system, and their requirements. Vendors of CPM solutions should focus on providing high-quality analytics, simple integration and easy scalability, and capitalize on technology trends that include more diverse data, analytics scenarios and automation.

## Demand-side takeaways

The scope of CPM technology is changing rapidly. For years, the biggest hurdle for firms was a lack of information and, even today, portfolio managers may have to make assumptions based on limited financial data. Digitized solutions have become the new standard among firms attempting to address this, but despite more technological innovation, some tools are still manual and labor-intensive. In a drive to minimize the level of manual work in their processes, firms increasingly value robust CPM technology and services.

The composition of credit portfolios continues to change, largely in response to the COVID-19 pandemic and the ongoing economic slowdown in most parts of the world. Key changes include the diversification of portfolios and a more conservative approach to financial risk to minimize potential losses and make portfolios recession-proof.

### The CPM process: an overview

The end-to-end CPM process and workflow depend on asset class and banking segment – i.e., retail banks, commercial banks or private wealth management (PWM) firms. The data that informs the actual CPM process, however, can come from specific areas and systems within the business, such as customer relationship management (CRM), lending operations, limits systems and forex systems.

Data gathered is then correlated and analyzed by the CPM system. In this step, various scenarios are run, including industry risk scoring, sensitivity analysis, stress-test analysis, value at risk (VaR)-based analysis, 'what-if' scenarios and capital handling and management.

### Addressing and implementing CPM: key challenges

The dynamics in the CPM market are developing mainly in response to issues and challenges that portfolio managers face when monitoring their credit portfolios. These challenges can be divided into three categories that are related in part to current financial conditions.

#### *Data challenges*

Firms currently face data-related challenges in three main areas: variable data quality, a lack of appropriate resources and high costs. The most common cause of data-quality issues is the source of the data, not least because the quality of third-party sources can vary considerably.

#### *Challenges in the fiscal environment*

The effects of a recession and a liquidity crisis in the current global fiscal environment have created several challenges for firms around interest rate hikes, volatility in the market and a need to constantly monitor risk. In terms of CPM, firms must address these challenges with more monitoring, more due diligence and more money. They may also require a more innovative – perhaps proprietary – approach to CPM.

#### *Non-financial challenges and risks*

Climate and geopolitical risks remain vital in managing credit portfolios – perhaps now more than ever, as natural disasters proliferate and conflicts continue. Joining these more established non-financial risks, however, is a relatively new one: public opinion. Public opinion has always played a role in how businesses perform, but a 24-hour news cycle and the power of social media now make it more difficult for companies to control and mitigate it.

## Supply-side takeaways

We can consider the current state of the CPM solutions landscape by looking at the requirements of each category of financial institution that uses them. In some cases, an overlap of requirements means that a specific CPM solution could be a good fit for multiple target institutions.

- **Retail banks**. Retail banks need CPM to help them manage and optimize their credit risk exposure more effectively, while keeping the portfolio balanced between loans and credit products.
- **Corporate banks**. Corporate banks have similar CPM requirements to those of their retail counterparts. But because they tend to work with large rather than small businesses, they need to focus more on managing the credit exposure associated with corporate clients.
- **Private wealth management**. In contrast to retail and corporate banks, PWM firms by their nature seek solutions that are more geared toward services and the safeguarding of assets for high-net-worth individuals.

### Technology trends: the advantages of more sophisticated tools

Financial institutions understand that they need data, advanced analytics and emerging technologies to navigate the complex management of credit portfolios and address such challenges as variable data quality, changing geographical risks and a complex and rapidly shifting fiscal environment. By employing increasingly sophisticated technologies such as AI, ML, RPA and simulation engines, financial institutions can:

- Gather and process large and diverse volumes of data to help analysts identify patterns and trends.
- Increase the efficiency and accuracy of the portfolio monitoring process, enabling real-time monitoring and identification of potential risks and opportunities.
- Run analytics and risk scenarios so that analysts can make more informed decisions about specific investments or lines of credit.
- Bring automation into the CPM space to create more streamlined workflows.

# 2. Quadrant context

## Introducing the Chartis RiskTech Quadrant®

This section of the report contains:

- The Chartis RiskTech Quadrant® and vendor capabilities for credit portfolio management solutions, 2023.
- An examination of SAS' positioning and its scores as part of Chartis' analysis.
- A consideration of how the quadrant reflects the broader vendor landscape.

### Summary information

***What does the Chartis quadrant show?***

The RiskTech Quadrant® uses a comprehensive methodology that involves 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 option as the best CPM solution; rather it has a sophisticated ranking methodology to explain which solutions are best for specific buyers, depending on their implementation strategies.

The RiskTech Quadrant® is a proprietary methodology developed specifically for the credit risk technology marketplace. It takes into account vendors' product, technology and organizational capabilities. Section 4 of this report sets out the generic methodology and criteria used for the RiskTech Quadrant®.

***How are Chartis' quadrants used by technology buyers?***

Chartis' RiskTech Quadrant® and FinTech Quadrant™ provide a view of the vendor landscape in a specific area of risk, financial and/or regulatory technology. We monitor the market to identify the strengths and weaknesses of different solutions and track the post-sales performance of companies selling and implementing these systems. Users and buyers can consult the quadrants as part of their wider research when considering the most appropriate solution for their needs.

Note, however, that Chartis Research does not endorse any vendor, product or service depicted in its research publications, and does not advise technology users to select only those vendors with the highest ratings or other designation. Chartis Research's publications consist of the opinions of its research analysts and should not be construed as statements of fact.

***How are Chartis' quadrants used by technology vendors?***

Technology vendors can use Chartis' quadrants to achieve several goals:

- Gain an independent analysis and view of the provider landscape in a specific area of risk, financial and/or regulatory technology.
- Assess their capabilities and market positioning against their competitors and other players in the space.
- Enhance their positioning with actual and potential clients and develop their go-to-market strategies.

In addition, Chartis' Vendor Analysis reports, like this one, offer detailed insight into specific vendors and their capabilities, with further analysis of their quadrant positioning and scoring.

## Chartis Research RiskTech Quadrant® for credit portfolio management solutions, 2023

Figure 1 illustrates Chartis' view of the CPM vendor landscape, highlighting SAS' position.

## Quadrant dynamics

### General quadrant takeaways

Vendors catering to the financial services industry recognize the growing need for end-to-end CPM products, and have adapted to the trends in the market. They are taking steps to align their solutions with the needs of financial institutions, and to address the challenges posed by growing market complexity and data availability. Firms have adated in several ways, including:

- **Customization and scalability**. Vendors have noted the demand for customization and scalability in the ever-changing and growing CPM market. Given increased data availability and changing regulations around CPM, the aquisition of an end-to-end solution to accommodate these

**Figure 1. RiskTech Quadrant® for CPM solutions, 2023**


*Source: Chartis Research*

components is now paramount. As a result, vendors offer customizable solutions that can be altered to meet the specific needs of each institution and scaled up or down as needed.

- **Integration of new technologies and advanced analytics**. Vendors are making it a priority to improve the technology in their solutions, helping to keep financial institutions at the forefront of all monitoring and enabling best practices. Vendors are also prioritizing seamless integration with existing technologies as they add new tech to their stacks, to enable organizations to adopt new technology without a complete system overhaul.
- **Partnerships and collaborations**. Vendors have recognized the potential for strategic partnerships in the market and are increasingly collaborating with other technology providers, data vendors and consulting firms to offer integrated credit portfolio solutions that cover all key areas of CPM.

## Vendor positioning in context – completeness of offering

SAS stands out in the CPM landscape for its strong suite of advanced analytics capabilities. In an industry where practical insights are crucial, SAS' expertise in handling complex statistical models and predictive analytics is particularly advantageous for financial institutions looking for a nuanced approach to credit management. This capability isn't just theoretical – it is a practical tool for those dealing with the complexities of CPM for which there is value in actionable analysis.

SAS' comprehensive solutions can integrate various components smoothly throughout the credit management process – from data management and credit scoring to risk modeling and compliance, the platform creates a unified environment. This integration also helps to engender a comprehensive understanding of a credit portfolio, offering a more connected and strategic perspective.

Our analysis emphasizes SAS' strength in data and analytics, which provides a versatile framework for portfolio management. Beyond robust risk analytics, SAS' platform adds a real-time element to the monitoring of changes in risk factors. This real-time tracking can give managers timely and comprehensive information, bolstering their decision making capabilities.

SAS' platform also excels in model management and stress testing throughout the CPM lifecycle, enabling firms to conduct a thorough evaluation of credit portfolio risk factors. Modeling capabilities contribute to in-depth analysis that can provide a nuanced understanding of the various influences on credit portfolio risk.

This analytical versatility gives managers a broader perspective and a deep understanding of the intricate dynamics shaping credit portfolio risk.

Table 1 shows Chartis' rankings for the vendor's coverage against each of the completeness of offering criteria.

## Vendor positioning in context – market potential

The growing emphasis on climate risk, environmental, social and governance (ESG) considerations and the need for enhanced risk quantification of external events is creating a growing market for advanced modeling approaches. The increasing acceptance and adoption of impact and scenario analysis at the executive level underscores the evolving priorities within the industry. SAS, with its capacity to provide an interactive and flexible environment, is well-positioned to cater to these emerging demands. Its adaptability in incorporating various data types and modeling techniques positions it as a suitable solution for organizations navigating the intricate landscape of climate risk, ESG considerations and evolving external event scenarios.

The consistent utilization of data and analytics throughout the credit journey presents a significant market potential for SAS in the financial sector, as financial institutions increasingly recognize the pivotal role of data-driven decision-making in optimizing investments.

**Table 1: Completeness of offering – SAS (CPM solutions, 2023)**

| Completeness of offering criterion | Coverage |
|---|---|
| Platform capabilities | High |
| Product capabilities | High |
| Workflow management; integration with other credit operations areas/processes | High |
| CPM analytical models (descriptive, diagnostic, prescriptive, predictive) | High |
| Adoption of emerging technologies | High |
| Use cases linked to the CPM lifecycle | High |

*Source: Chartis Research*

**Table 2: Market potential – SAS (CPM solutions, 2023)**

| Market potential criterion | Coverage |
|---|---|
| Customer satisfaction | High |
| Market penetration | High |
| Growth strategy | Medium |
| Financials | High |
| Business model | Medium |

*Source: Chartis Research*

SAS' potential lies in offering a comprehensive solution that seamlessly integrates data and analytics into every phase of the customer journey. By doing so, SAS enables financial institutions to enhance customer protection while extracting maximum value from their investments.

SAS' market potential is grounded in its ability to provide a unified and efficient platform for leveraging data and analytics across diverse touchpoints in the customer journey. This aligns with the industry's growing awareness of the importance of comprehensive data utilization and marks a potential avenue for SAS to contribute further to the evolving landscape of decision-making in financial institutions.

Table 2 shows Chartis' rankings for SAS' coverage against each of the market potential criteria.

# 3. Vendor context

## Overview of relevant solutions/ capabilities

Table 3 provides a summary of the vendor and its solutions.

### Capabilities summary

Kamakura Risk Manager (KRM) and Kamakura Risk Information Services (KRIS) are now integrated into the larger SAS platform. KRM can be installed on clients' sites or accessed on Viya, the SAS processing and data cloud. There are many advantages to a cloud implementation. These include the availability of massively parallel processors, which are ideal for high-volume stochastic processes, and the direct application of SAS desktop tools to data for summarization, visualization and further analysis.

KRIS data is now migrated to Viya, with the same advantages applied to proprietary risk and valuation modeling; visualization and reports are also available for consumption by members of client organizations. SAS and KRIS clients are expected to overlap increasingly in the future, and demand for an integrated product suite will encourage growth and enhance joint expertise.

KRM, a solution that provides integrated risk, ALM, valuation, deposit simulation, transfer pricing and credit analysis, was built with consistency as a design principle. For instance, interest rate models that drive valuations will simultaneously generate credit events given their inputs to default intensity models. Market and credit risk can be assessed separately or together via a control on the user dashboard.

SAS Risk Modeling and Decisioning combines enterprise data management and the breadth and depth of SAS' risk analytics with intuitive decision authoring for real-time portfolio monitoring and decision-making. SAS' broad capabilities in data preparation and analytics, with open-source integration, model governance and lineage, lead in the market, while the SAS platform helps financial institutions build and deploy analytics with the lowest risk and fastest speed. SAS' integrated Risk

**Table 3: SAS – company information**

| | |
|---|---|
| **Company** | SAS |
| **Headquarters** | Cary, NC, US |
| **Other offices** | SAS has offices in 56 countries worldwide. |
| **Description** | SAS, one of the largest privately held software companies inthe world, is a provider of AI and advanced analytics tools that are used by 91 of the top 100 companies in the global Fortune 500. |
| **Solution** | SAS KRM/KRIS combine proprietary model risk data with a valuation and simulation software engine that can perform closed-form, Monte Carlo and lattice-type simulations that together estimate market- and default-adjusted results for large institutional balance sheets and investors. It is a global solution that covers financial markets on every continent, generating precise cash flow forecasts and accurate financial accounting outputs. For the purposes of market coverage and client convenience, it implements multiple valuation methods and offers clear migration paths for best practice. For credit, it likewise offers reduced-form, Merton-consistent and constant rate/dynamic transition matrix processes. In addition to the three Basel prescriptive calculations, it also implements credit valuation adjustment (CVA), International Financial Reporting Standard (IFRS) 9, etc. It also features innovations such as maximum smoothness curve-fitting and reduced form-default models, authored by the firm's principals. |

*Source: SAS*

Modeling and Decisioning platform supports the end-to-end credit value chain, including real-time acquisitions, dynamic account management, and the active management of distressed exposures.

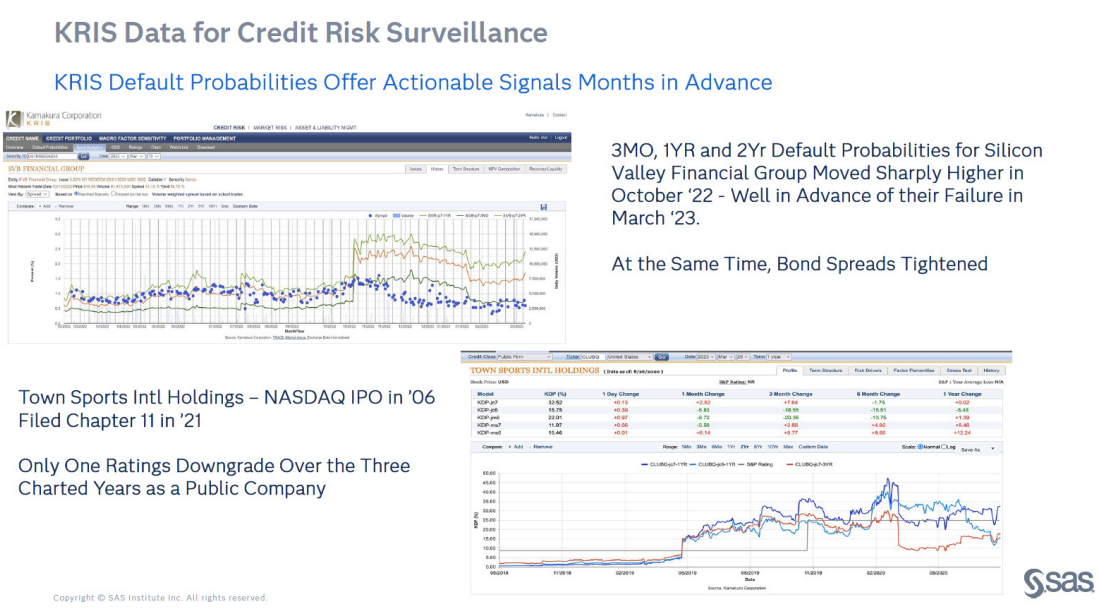
***Key features***

- Sophisticated yield-curve modeling. This includes the original maximum smoothness forward rates technique.
- Dynamic term structure of interest rate models.
- Comprehensive financial instrument modeling that uses a building-block approach to specify optionalities, prepayment behaviors, amortizations, payment timing, valuation method, accrual basis, Gregorian vs. Hijri calendars, etc.
- Open market and econometric risk-factor modeling and simulation of given coefficients.
- Open specification of risk factor correlations and volatilities across processes.
- Multiple default intensity models.
- Multiple recovery models. Common factors link default intensity and recovery rate to capture wrong-way risk.
- Precise cash flow and balance information across all financial products and processes.
- Correct financial accounting outputs for balance sheet and income simulation.
- Extensive portfolio scenario and stress testing based on true valuation at t=0.
- Selectable stochastic processes for risk factor simulations. This includes the choice of randomizer and factor distributions as inputs and drivers of valuation, prepayment, default and recovery.

## Vendor leading practices

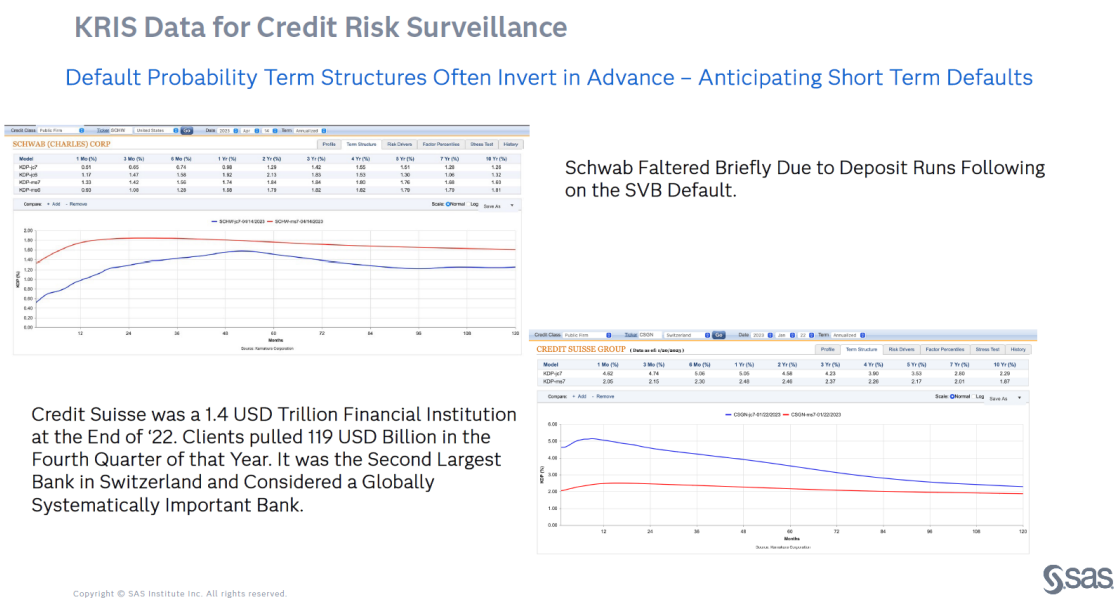
The SAS KRIS risk data service can claim several innovations. These include the first commercial application of reduced-form default probability modeling (now in its eighth release) to public companies, sovereign nations, US banks, and non-public companies (see Figure 2). Default probabilities are updated daily for more than 42,000 companies in 76 countries. Full term structures of default probabilities for each public company are produced, requiring 120 separate regression passes to obtain monthly estimates for 10 years.

**Figure 2: Default probability modeling**




*Source: SAS*

**Figure 3: Inverting the default probabilities term structure**

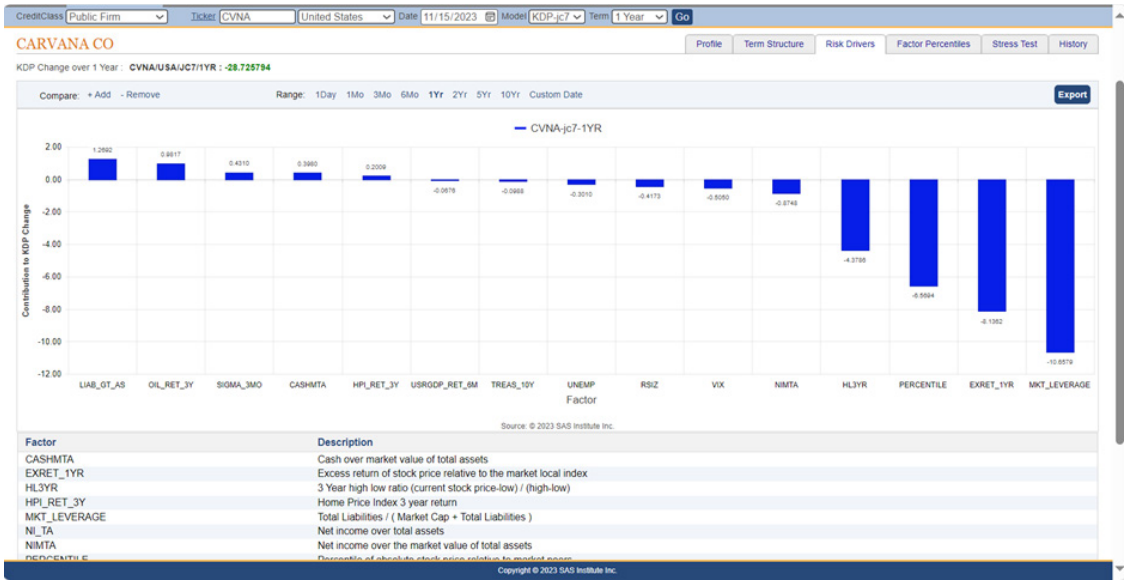



*Source: SAS*

Innovative credit analytical capabilities explicitly link bond spreads and default probabilities at their matched maturities.

Powerful predictive insights derive from relative spread and default probability movements. Default probabilities typically jump early on, in response to published financial data and macro factors that are known drivers of default probabilities. The term structure of default probabilities will exhibit run-ups in short-term default probabilities for troubled companies well in advance of reactions in the bond market and rating assignments. The inversion of the default probabilities term structure is a consistent early-warning indicator (see Figure 3). The ratio of the five-year to one-year default probabilities is used by clients as a surveillance trigger: when the ratio approaches 1.0, it's time to reassess (see Figure 4).

**Figure 4: The default probabilities ratio**




*Source: SAS*

**Figure 5: Implied ratings**


*Source: SAS*

Another area of innovation is implied and future ratings (see Figure 5). The first tool estimates ratings for every public company covered by KRIS, regardless of whether it has ever been rated, providing a statistical analysis of rating behavior beginning in 1990. It produces a distribution of possible current ratings, together with the probability that an investment versus a non-investment grade rating will be assigned.

The second produces a distribution of future ratings, this time using the current company rating as an input. Probabilities denote the likelihood that there will be transitions away from the current rating assignment to a given rating at future time intervals.

A special KRIS feature provides daily mappings of default probabilities to ratings, spreads to ratings and default probabilities to spreads. The need for this arises because ratings are slow to change and frequently misalign with daily estimated default probabilities. As shown in Figure 6 on page 14, companies with the lowest default probabilities are allocated across ratings grades from triple A to single B minus. Each cell can be exploded into a list of entries, where a range of default probabilities and specific ratings intersect.

The same allocation matrix applies to bond spreads, which will display a much more consistent pattern – a diagonal from upper left to lower right, which is from low spreads and high ratings to wider spreads and lower ratings (see Figure 7 on page 14).

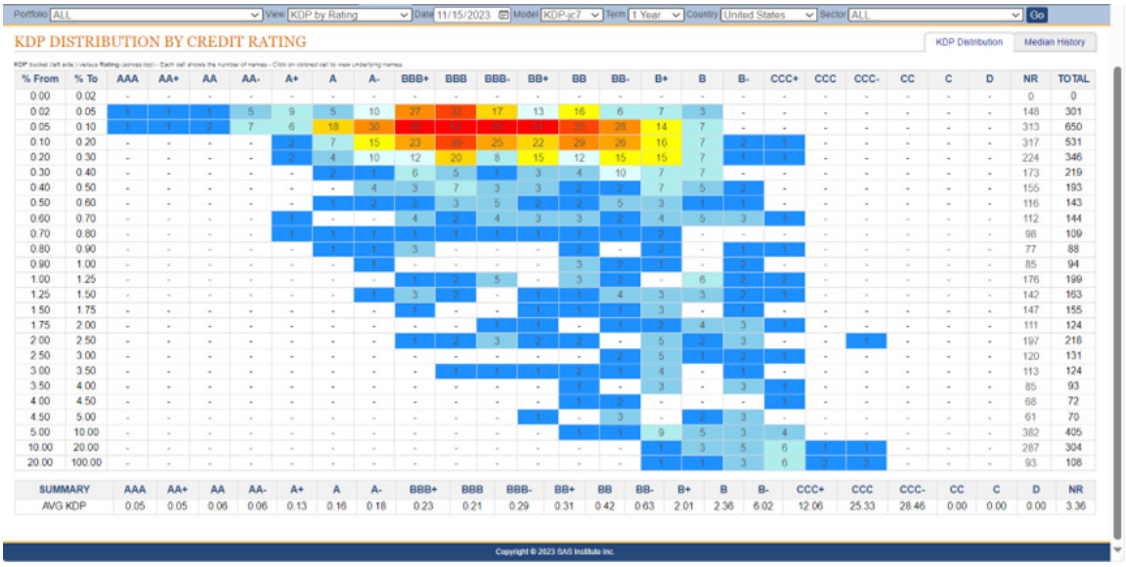
KRIS enables clients to download data directly from KRIS screens and FTP data downloads. The latter is especially important to clients who use KRIS default probabilities as inputs to proprietary models.

KRIS offers raw and transformed factor data, factor correlations, estimated model factor coefficients, default probabilities (monthly and cumulative) and time-series data. Use cases include proprietary credit modeling, factor inputs to KRM and legacy client risk solutions, data for estimating correlations and volatilities, and credit benchmarking.

KRIS fixed-income analytics enable users to effectively isolate the credit component in bond spreads. There are two approaches. One is calculated as the ratio of the average paid daily bond spreads for a given issue and the maturity-matched default probability for the debt issuer, also updated daily. The ratios vary from day to day, and alert fixed-income portfolio managers of changes in a bond's market liquidity versus its perceived credit premium. Default probabilities are linked to spreads and often reveal mis-priced bonds. Spread/alphas fluctuate over time and high spread/alphas indicate under-priced or illiquid bonds.

The second approach is to employ a sophisticated grid search technique to fit all the daily bond prices for a given debt issuer to a combination of factors, including their default probabilities. The technique takes advantage of several unique insights.

**Figure 6: Providing a risk map**



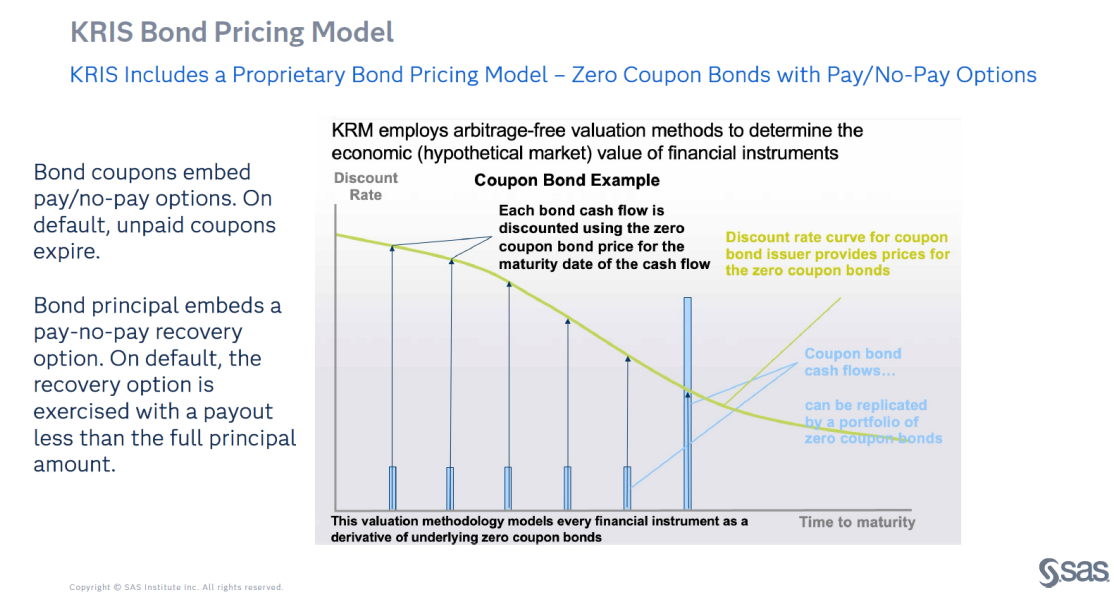

RISKMAP DRILLDOWN

**KDP Range (%):** 0.10-0.20
**Rating:** A
**Companies :** 7

| Ticker | Company | Country | KDP |
|---|---|---|---|
| RGA | REINSURANCE GROUP AMER INC | USA | 0.197637 |
| MSEX | MIDDLESEX WATER CO | USA | 0.192953 |
| TGT | TARGET CORP | USA | 0.188810 |
| BEN | FRANKLIN RESOURCES INC | USA | 0.178810 |
| TRV | TRAVELERS COS INC | USA | 0.174595 |
| AWK | AMERICAN WATER WORKS CO INC | USA | 0.130800 |
| L | LOEWS CORP | USA | 0.102411 |

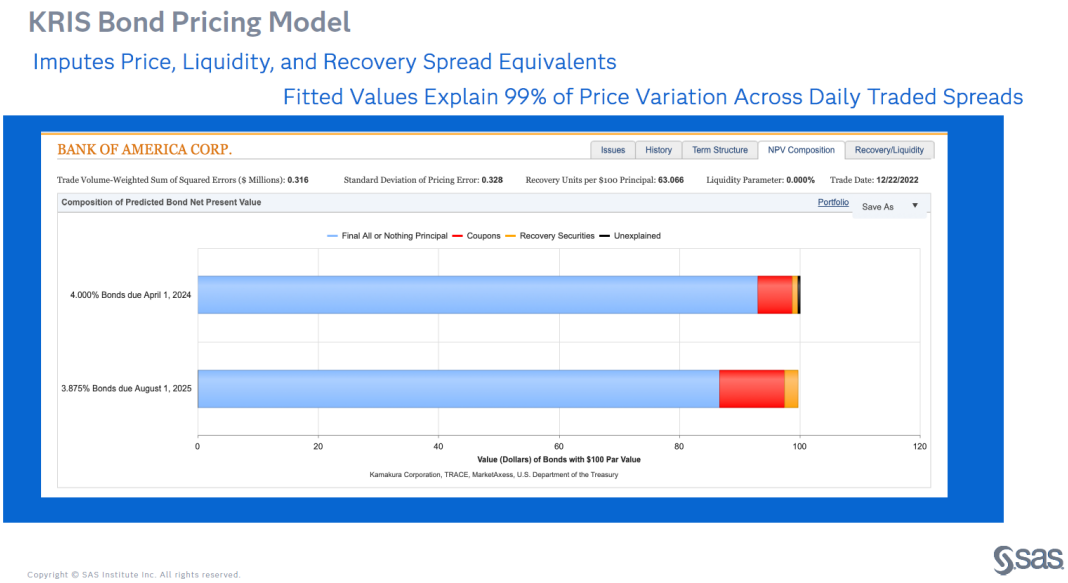
*Source: SAS*

**Figure 7: A bond spread-allocation matrix**




*Source: SAS*

**Figure 8: Bond pricing model**




*Source: SAS*

One, for example, is that bond spreads implicitly assume that outstanding coupon payments will be subject to the same recovery rate as principal when, in fact, on default, coupon payments are unrecoverable. As shown in Figure 8, each coupon payment incorporates a digital pay/no pay option, which is either worth $1 or $0. The principal also incorporates this digital option. There is also a third pricing component, which is a recovery security. Its value is either the recovery rate times the principal value or $0.

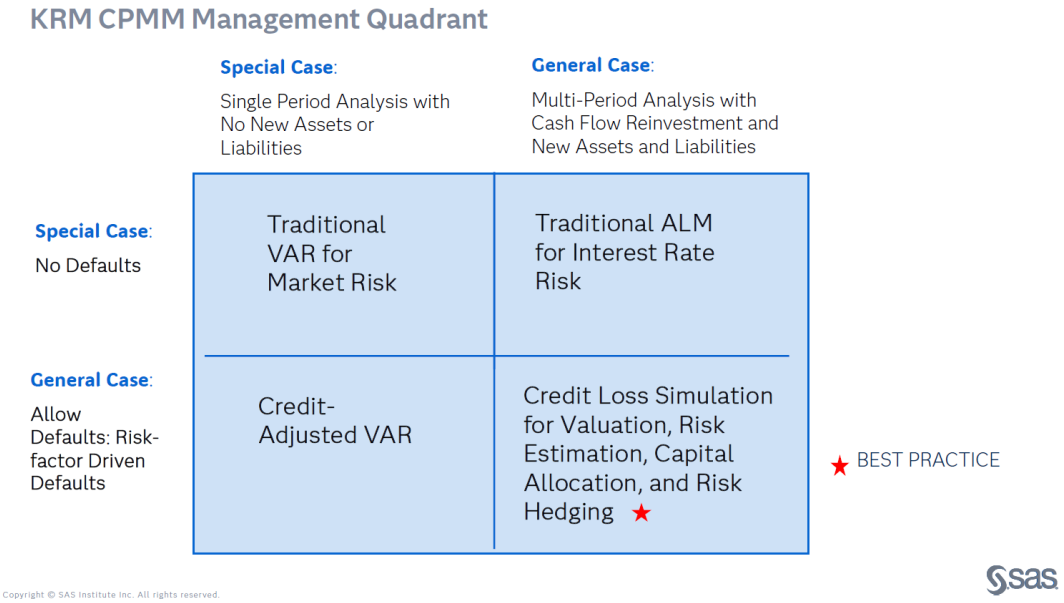
The bond pricing model is currently in its third release. The aim is to estimate and track daily liquidity and recovery spread components, offering fixed-income traders and portfolio managers a way to take advantage of relative values in the market.

Effective CPMM connects the following four essential components:

- Cash flow engine: comprehensive product coverage.
- Valuation engine: a variety of analytical and numerical methods.
- Simulation engine: NILL and FTP forecasting with rollovers and new business, along with sensitivity and stress testing.
- Risk and performance engine: complete risk measures with high-speed performance.

SAS KRM is tightly integrated with KRIS credit risk data. Credit model variables are mapped into its data tables, from which KRM can estimate factor correlations and volatilities for simulations. As factors are randomly simulated, default probabilities are generated. KRM's dynamic survival weight formula then computes a time-to-default migration value for each path. Default is simulated independently for every debt issuer/borrower/derivative counterparty. Their default in any path will trigger default in KRM for other assets linked to them, including loans, derivative contracts, bonds, guarantees and commitments.

**Figure 9: CPM management**



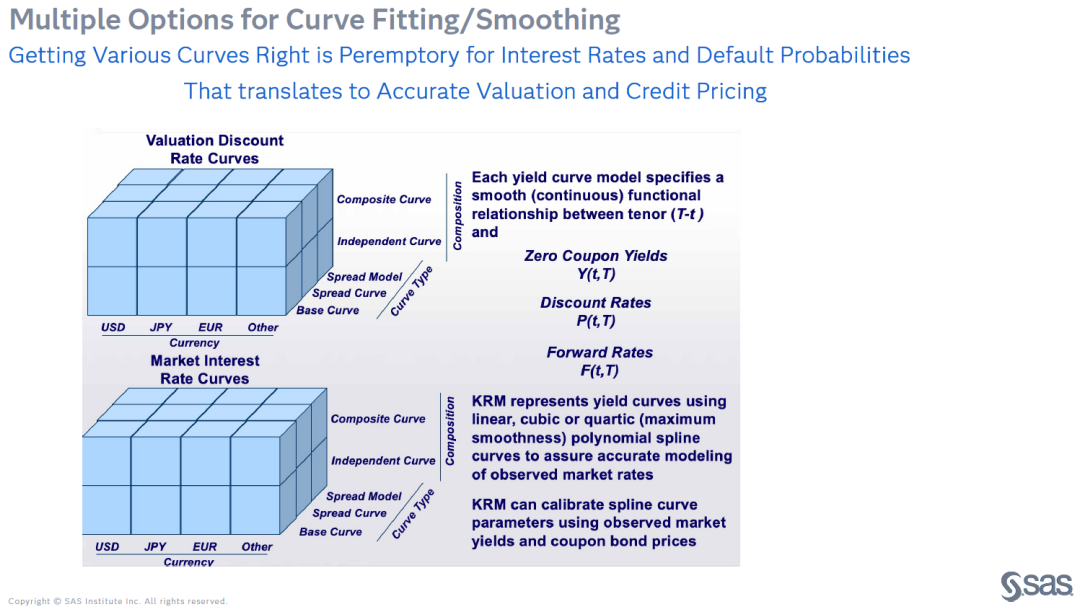

*Source: SAS*

Credit portfolio solutions and their options are summarized by referring to the matrix shown in Figure 9. All four options are available in the solution; however, the ideal solution is multi-period analysis in which risk factor distributions are re-estimated for every period, such that the default intensities generated are newly random, yet feasible in relation to prior-period values. Innovations in these risk factors drive defaults, and factor correlations and volatilities determine their path.

## KRM CPM tools

KRM offers a variety of industry-standard and proprietary credit risk models (see Figure 10). Accuracy depends on the choice of model, as well as the range of user options.

**Figure 10: A variety of options**




*Source: SAS*

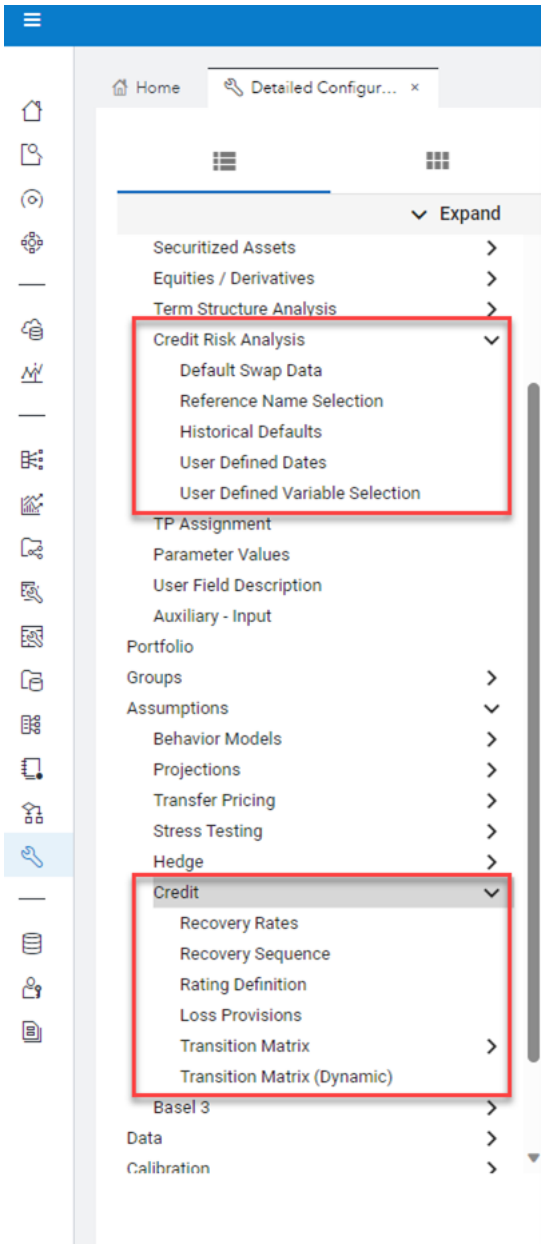
- Non-random default probability modeling.
  - Common practice: copula.
- Default, driven by Merton/copula modeling with user-specified volatility and correlation for returns on company assets.
  - Transition matrix.
  - Term structure of default probability.
- Random default probability modeling.
  - Best practice: macro factor-driven.
- Default probabilities driven by risk factors using logistical regression and reduced-form models.
- Allows counterparty default probabilities to vary:
  - In each period.
  - For every counterparty.
  - For every scenario.
- Gives explicit answer to the question 'what's the hedge?'
- Default probability by name/industry as risk factor.
- User-specified volatility and correlation in counterparty default probabilities.
- Monte Carlo historical sampling:
  - Sampling of default probability returns from historical database.

The KRIS public company default probabilities are based on the Jarrow (1999-2001) model and are its first commercially available implementation. The original model had a single factor as a default driver; in its current version there are more than 40. Model data extends back to 1990, when daily equity prices were first commercially available. SAS' statistical tools analyze the relationships between real company failures and candidate variables.

**KRM valuation engine**

- KRM models financial instruments using attributes that describe all the contractual features of each, as these are required to precisely determine cash flows, economic value and income and expenses under various accounting conventions.
  - KRM covers all types of amortization, scheduled and unscheduled, and variable rates and frequencies for cash flows.
  - KRM allows users to define the characteristics of complex index formulae, and to specify regular periodic and absolute rate caps and floors, as well as odd first coupon dates and rates.
  - KRM supports all day-count accrual conventions (12, including actual/actual Thai), discount day bases, all currencies, and holiday schedules and multinational settlement conventions.
- KRM generates multiple-yield, discount-rate, decimal-discount, continuously compounded and forward-rate curves for each currency, and offers six smoothing methods (i.e., maximum smoothness, linear and four variations of cubic spline).
- KRM offers multiple models for simulating default, recoveries and prepayments. Models are assigned at the financial instrument level.
- KRM offers arbitrage-free and risk-neutral methods (such as closed-form, trinomial lattice and Monte Carlo) to evaluate optionalities in instruments and derivative contracts.

**Figure 11: KRM risk factors**




Default parameters can be:

- Derived from credit default swap (CDS) market prices.
- Reference name assignment.
- Historical default rates.
- Arbitrary user-timed events.
- User-specified variables and hazard functions.

Recovery rates can be:

- Arbitrarily lagged.
- Specified as percentage.
- Assigned by ratings.
- Specified as linear or logistic functions.
- Assigned per instrument.
- Scheduled admin costs.

Transition matrix:

- Legacy rating transitions.
- Credit scoring transitions.
- Factor-driven transition intensities.

*Source: SAS*

Best practice in credit portfolio risk management combines default and recovery models for credit VaR and stress testing in such a way that valuation and credit, including loss given default, are consistently simulated across the balance sheet. The risk factor setups in KRM, as shown in Figure 11, provide the means to investigate the effects of both random and constant factors in multiple applications. This includes spreads by rating, swap rates, sector performance, default probability term structures, underlying reference names for credit guarantees, etc.

# 4. Methodology

## Overview

Chartis is a research and advisory firm that provides technology and business advice to the global financial services 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® and FinTech Quadrant™ reports are written by experienced analysts with hands-on experience of selecting, developing and implementing financial technology solutions for a variety of international companies in a range of industries, including banking, insurance and capital markets. The findings and analyses in our quadrant reports reflect our analysts' considered opinions, along with research into market trends, participants, expenditure patterns and best practices.

Chartis seeks to include RiskTech and FinTech vendors that have a significant presence in a target market. The significance may be due to market penetration (e.g., a large client base) or innovative solutions. Chartis uses detailed vendor evaluation forms and briefing sessions to collect information about each vendor. If a vendor chooses not to respond to Chartis' request for information, Chartis may still include the vendor in the report. Should this happen, Chartis will base its opinion on direct data collated from technology buyers and users, and from publicly available sources.

Chartis' research clients include leading financial services firms and Fortune 500 companies, leading consulting firms and financial technology vendors. The vendors evaluated in our quadrant reports can be Chartis clients or firms with whom Chartis has no relationship.

Chartis evaluates all vendors using consistent and objective criteria, regardless of whether they are Chartis clients. Chartis does not give preference to its own clients and does not request compensation for inclusion in a quadrant report, nor can vendors influence Chartis' opinion.

## Briefing process

We conducted face-to-face and/or web-based briefings with each vendor1. During these sessions, Chartis experts asked in-depth, challenging questions to establish the real strengths and weaknesses of each vendor. Vendors provided Chartis with:

- A business update – an overview of solution sales and client satisfaction.
- A product update – an overview of relevant solutions and R&D roadmaps.
- A product demonstration – key differentiators of their solutions relative to those of their competitors.

In addition to briefings, Chartis used other third-party sources of data, such as conferences, academic and regulatory studies, and publicly available information.

## Evaluation criteria

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. The specific criteria used for CPM olutions are shown in Table 4.

### 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,

[1] *Note that vendors do not always respond to requests for briefings; they may also choose not to participate in the briefings for a particular report.*

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 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 and 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.

**Table 4: Evaluation criteria for Chartis' CPM solutions, 2023 report**

| Completeness of offering | Market potential |
|---|---|
| • Platform capabilities | • Customer satisfaction |
| • Product capabilities | • Market penetration |
| • Workflow management; integration with other credit operations areas/ processes | • Growth strategy |
| | • Business model |
| • CPM analytical models (descriptive, diagnostic, prescriptive, predictive) | • Financials |
| • Adoption of emerging technologies | |
| • Use cases linked to the CPM lifecycle | |

*Source: Chartis Research*

- **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 covered are 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 the 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 construction process

Chartis constructs its quadrants after assigning scores to vendors for each component of the completeness of offering and market potential criteria. By aggregating these values, we produce total scores for each vendor on both axes, which are used to place the vendor on the quadrant.

### Definition of quadrant boxes

Chartis' quadrant reports do not simply describe one technology option as the best solution in a particular area. Our ranking methodology is designed to highlight which solutions are best for specific buyers, depending on the technology they need and the implementation strategy they plan to adopt. Vendors that appear in each quadrant have characteristics and strengths that make them especially suited to that category and, by extension, to particular users' needs.

***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 business intelligence (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.
- Because of their focused functionality, best-of-breed solutions will often be packaged together as part of a comprehensive enterprise risk technology architecture, co-existing with other solutions.

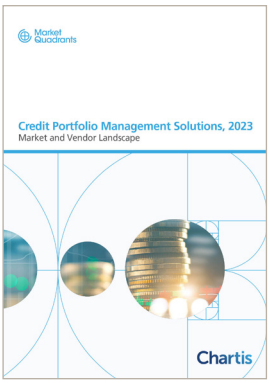
***Enterprise solutions***

- Enterprise solution 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***

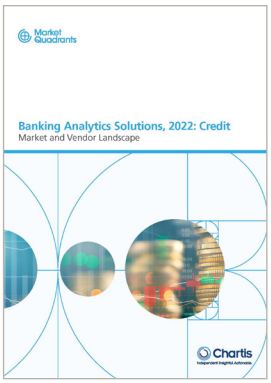
- Category leaders combine depth and breadth of functionality, technology and content with the required organizational characteristics to capture significant share in their market.
- They demonstrate a clear strategy for sustainable, profitable growth, matched with best-in-class solutions and the range and diversity of offerings, sector coverage and financial strength to absorb demand volatility in specific industry sectors or geographic regions.
- They typically benefit from strong brand awareness, a global reach and strong alliance strategies with leading consulting firms and systems integrators.

# Further reading

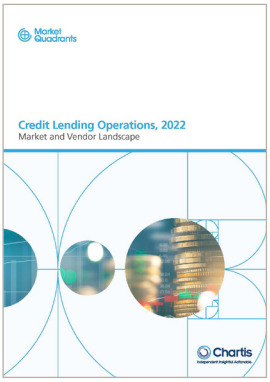



**Credit Portfolio Management Solutions, 2023: Market and Vendor Landscape**


**Credit Risk Reporting Solutions, 2023: Market and Vendor Landscape**




**Banking Analytics Solutions, 2022: Credit; Market and Vendor Landscape**




**Credit Lending Operations, 2022: Market and Vendor Landscape**


**Credit Data Solutions, 2022: Market and Vendor Landscape**


**RiskTech100 2024**

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