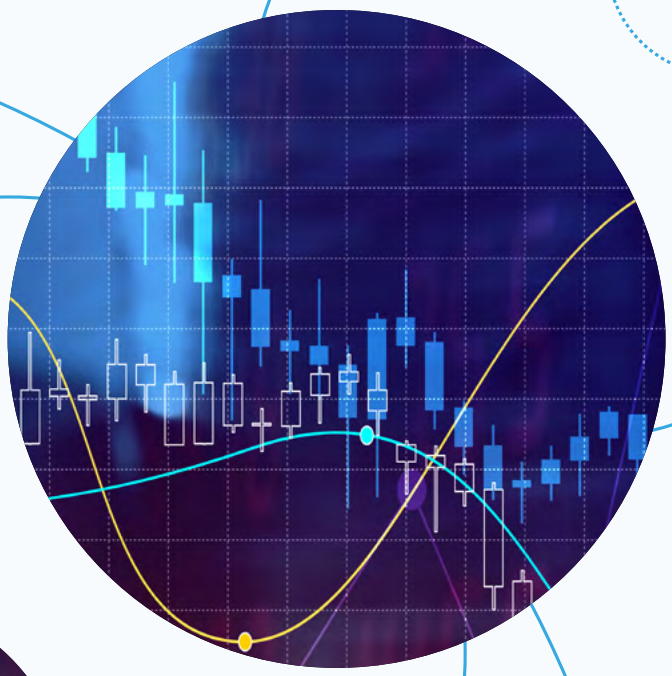
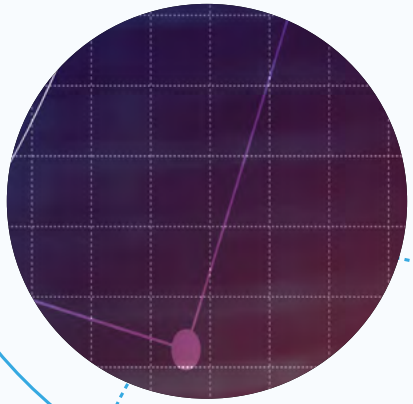
Market Quadrants

ALM Technology Systems, 2023

Market Update 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.

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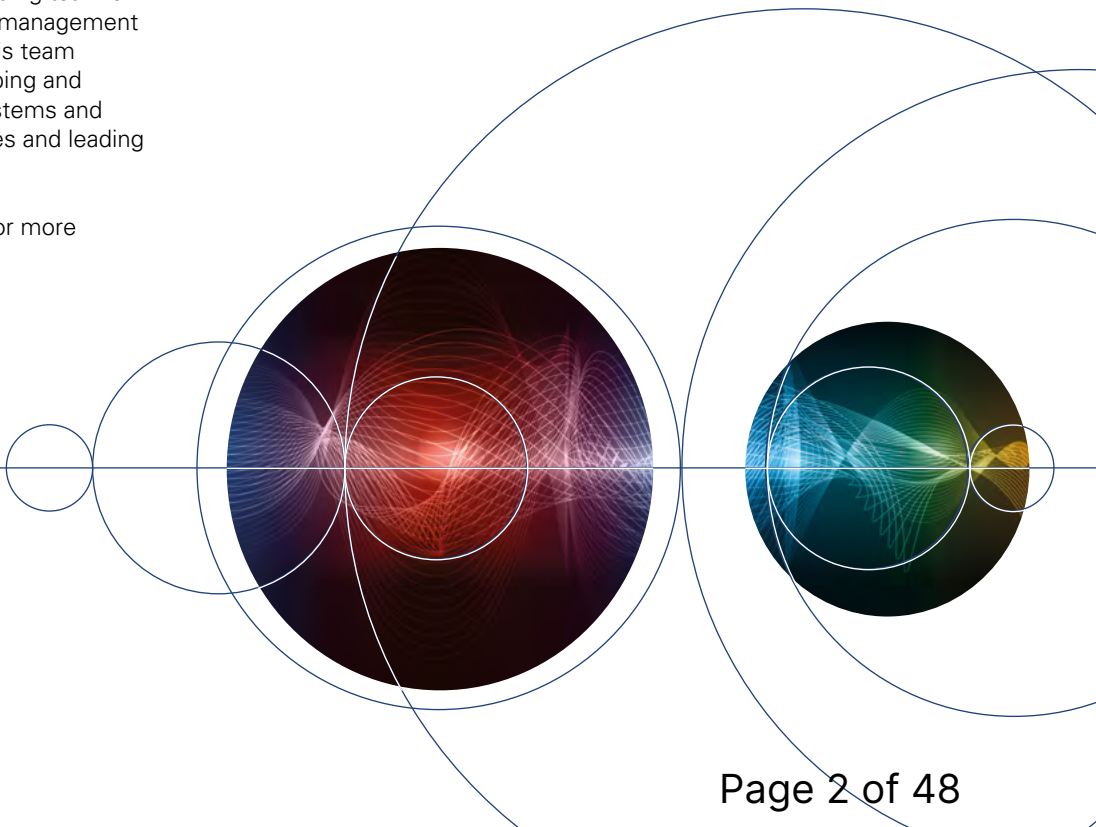

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Market Quadrants Report

Authors
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Executive summary

Since the last Chartis asset and liability management (ALM) industry report in 2021, the banking industry has faced substantial balance sheet challenges, triggered by ongoing volatility and uncertainty around interest rates. Liquidity risk has evolved into high-profile deposit outflows, with ensuing solvency incidents for institutions such as First Republic and Silicon Valley Bank (SVB). For more than a decade, the banking sector has operated in a low interest rate environment, with the last comparable surge in interest rates dating back to the 1980s. Current continued hikes in interest rates by central banks, as they battle persistent inflation, mark the end of the 'interest rate holiday' and the era of cheap money.

The ramifications of relaxed balance sheet rigor and investment approaches designed for lower, more stable interest rate regimes are already playing out in the mark-to-market losses for US banks. And the new interest rate environment is prompting a wide range of institutions – including those in the 'shadow banking' industry – to re-evaluate their ALM and investment strategies.

Given these new industry conditions and the evolving monetary environment, our 2023 report returns to the key themes highlighted by our 2021 industry report. In this update, we re-evaluate the complex ALM framework, which broadly comprises distinct segments that include funds transfer pricing (FTP), liquidity risk management (LRM) and reporting, capital and balance sheet optimization, and ALM analytics and

quantification. We examine the various challenges firms face as industry and regulatory standards push them to integrate their ALM operations and unify their ALM policies under a comprehensive internal strategy. Among the key trends we highlight is the renewed focus on LRM in the context of different types of institution and their specific liquidity dynamics. We also consider the adjacent focus on interest rate risk, including 'straightforward' interest rate risk.

In addition to our industry analysis, we also highlight trends in the regionally defined, fragmented vendor market. We explore the different ALM requirements that emerge from varying perspectives within an institution, from the standpoint of both the asset-liability committee (ALCO) and the treasury department. We make the distinction between 'operational ALM', which focuses on day-to-day ALM calculations, and ALM from a trading and hedging perspective. We also note the approach to ALM that closely aligns with regulatory reporting and compliance and, in addition to regional trends, we highlight the institution types and product and balance sheet strategies that drive different ALM requirements. Finally, we consider these trends through both operational and technological lenses, to determine how financial institutions and the vendor landscape are evolving under new pressures.

Since our analysis focuses on ALM analytics as a wide-ranging and diverse universe, we will outline our broader findings in follow-up publications. Our future coverage will include the challenges of modeling 'run risk' in financial markets, evolving regulation, and an examination of behavioral modeling – and, specifically, details around liquidity strategies and metrics.

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 best for buyers, depending on their implementation strategies.

This report covers the following providers of ALM technology solutions: Adenza, ALM First, The Baker Group, Bloomberg, Cognext.ai, Coherent, Detech, Empyrean, FIMAC Solutions, Finastra, FIS, Intellect Design, Kiya.ai, Mirai, Moody's, MORS Software, Numerical Technologies, Oracle, Prometeia, QRM, SAS, SS&C Algorithmics, Surya, Thomas Ho Company, Wolters Kluwer and zeb.control.

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 provided adequate information for our analysis, and some declined to participate in this research.

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Market update

Overview and context

ALM is a broad framework that comprises a complex set of interlocking analytical and operational activities. An essential part of ALM is the effective capture of liquidity requirements and interest rate sensitivities to inform funding decisions, as well as hedging and investment strategies. In essence, ALM is the process of managing and optimizing the assets and cashflows that financial institutions use to meet their obligations.

Since the 2008 financial crisis, however, ALM as a discipline has matured. Under the Basel era, the ALCO's oversight has become wider than ever, as banks' ALM programs encompass more and more integrated risks. Converging regulatory requirements, including credit accounting standards and capital requirements, are pushing banks to assign greater strategic importance to broader ALM programs. Despite the regulatory overhaul following the 2008 financial crisis and the emphasis on stress tests, the SVB incident more recently has caused regulators to take another look at the way aspects of the banking sector are governed. US regulators, in particular, are re-evaluating liquidity frameworks and insured deposit thresholds.

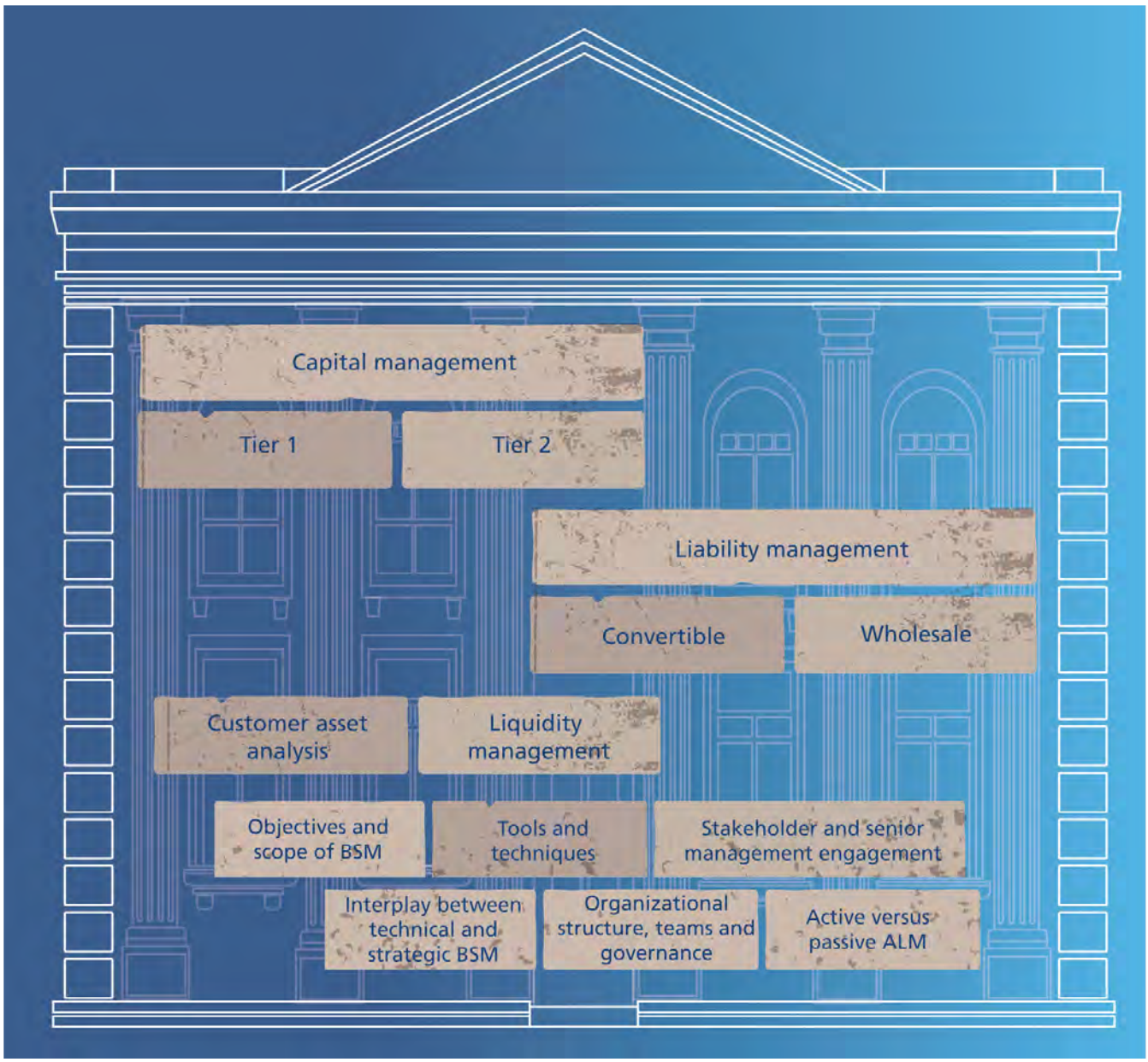
The confluence of factors that led to SVB's collapse – duration risk, treasury bond performance and deposit flight – has signaled to the industry that inadequate ALM can cause banking failures and considerable distrust among depositors and investors. More than ever before, banks are expected to forecast their short- and long-term cashflows and product strategies under a range of scenarios, including stressed conditions. With that expectation comes a focus on analytics and data management.

Managing the balance sheet across departments – aligning perspectives

The interlocking analytical and operational activities that constitute ALM are spread across different departments in financial institutions. The responsibilities of these departments define distinct perspectives of the balance sheet, and the significance of the role they play in ALM depends on a bank's business model and its trading-related exposure (see Figure 1). The Chief Risk Officer's (CRO) department sets the risk appetite for different risk categories, while the Chief Finance Officer's (CFO) department is responsible for liquidity, capital management, accounting and reporting. The treasury department defines FTP and monitors liquidity, while the ALCO steers the overall direction of an institution's ALM (see Figure 2). The significance of the treasury unit in ALM activities is often defined by the level of a bank's trading activity.

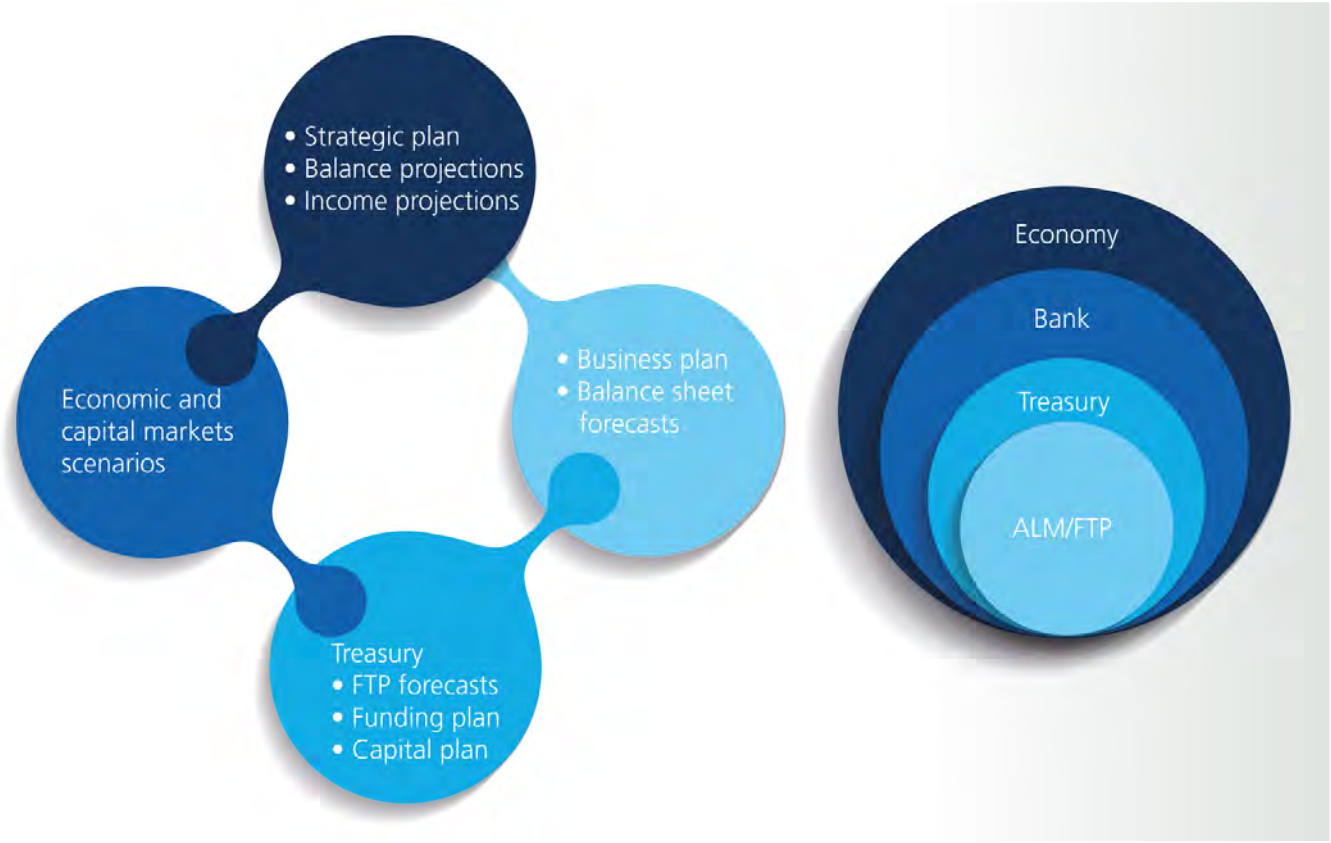
The way that different institutions structure and organize their ALM operations varies tremendously across the banking sector. However, the challenge of aligning these perspectives across disciplines is industry-wide. The operational and risk management processes that ALM requires cannot be neatly compartmentalized into departments, especially in larger and more complex businesses. Advanced modeling processes, dynamic balance sheet forecasting and granular data can all support an increasingly integrated view of the balance sheet and strategic planning. Processes such as FTP enable product design and planning to be linked to the whole balance sheet.

Figure 1: Managing the balance sheet – an overview



Source: Chartis Research

Figure 2: Managing the balance sheet – functions and segments

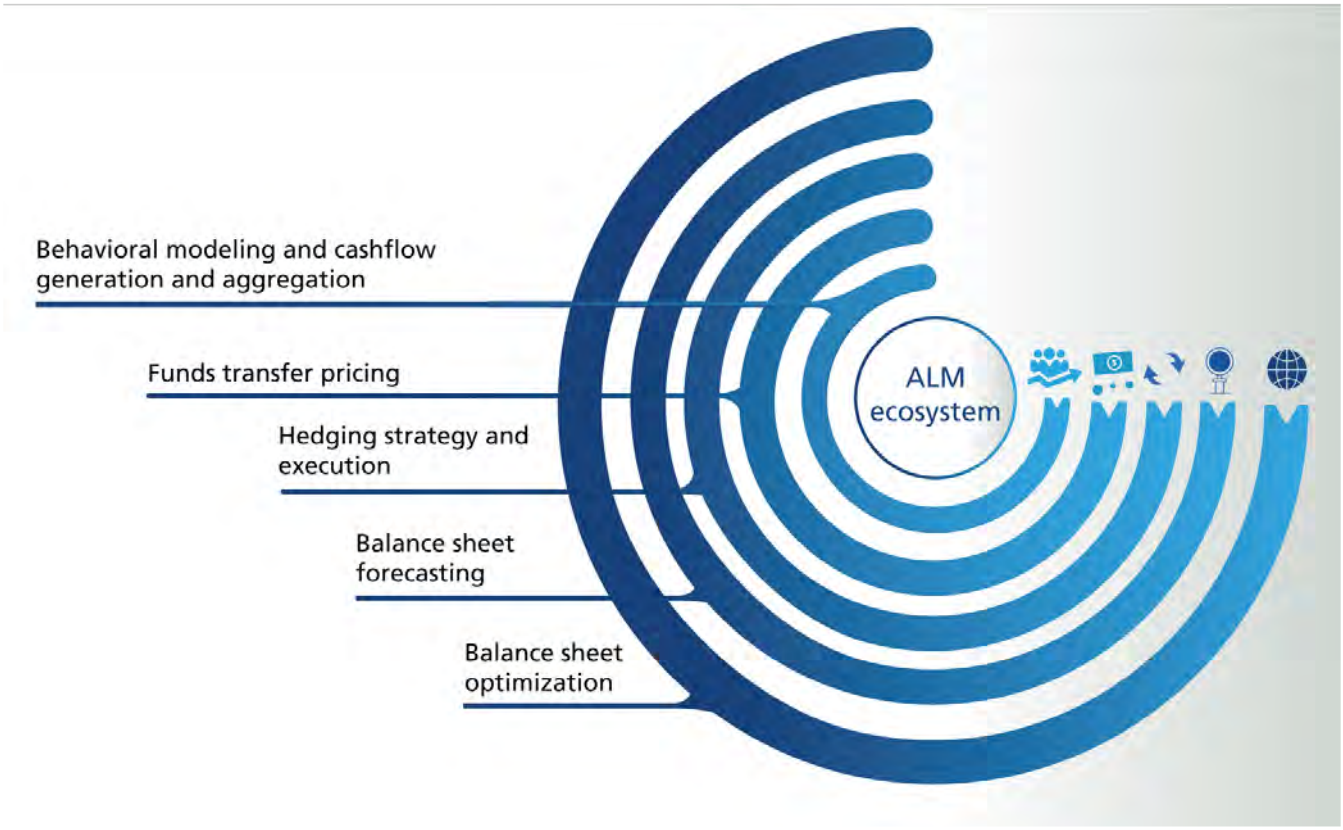


Source: Chartis Research

ALM as a complex set of interlocking analytical and operational activities

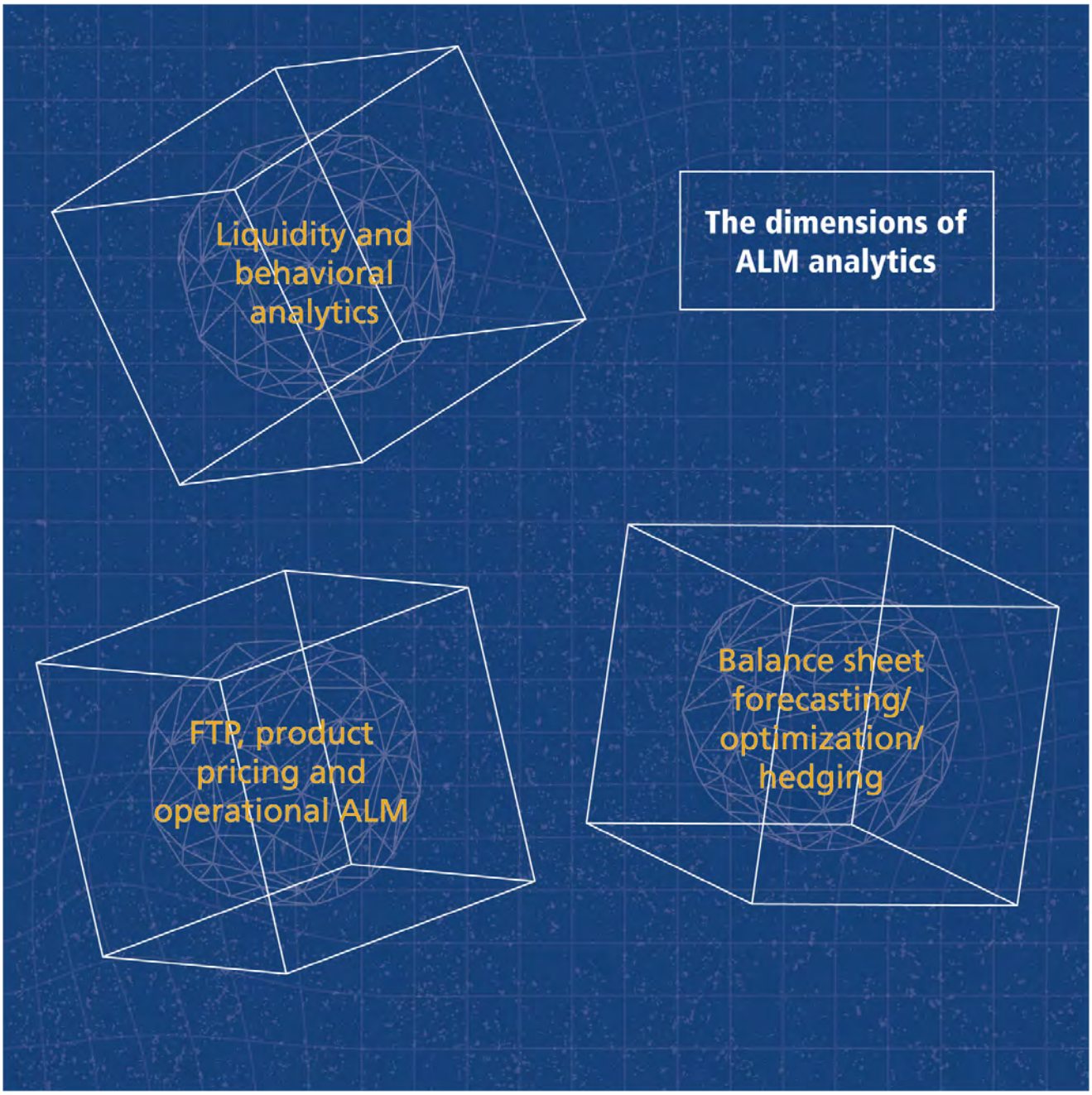
For effective ALM, firms must forecast and manage the risks and market conditions to which their balance sheet is exposed. A range of interlocking analytical and operational activities has developed to support these forecasting and management demands (see Figure 3). Multiple vendor solutions and varied models have also evolved to meet the complex and varied demands of different institution types. Despite this complexity, ALM analytics can be split into three dimensions that encompass the various demands facing financial institutions (see Figure 4).

Figure 3: ALM is a complex set of interlocking analytical and operational activities



Source: Chartis Research

Figure 4: ALM analytics can be seen in three dimensions



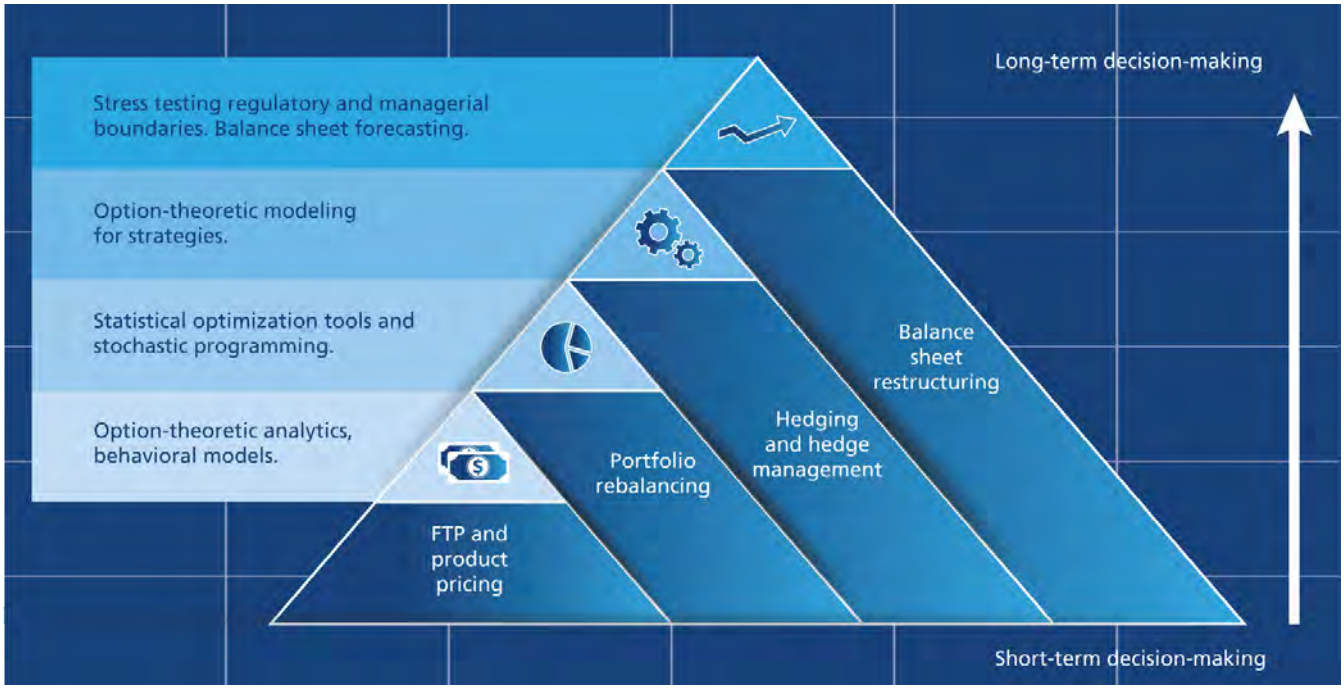
Source: Chartis Research

In addition to dealing with interlocking analytical requirements, financial institutions must manage and reconcile varying perspectives of the balance sheet and income statement that are generated by distinct calculations across different time horizons. Besides accommodating diverse modeling methodologies and computational and data requirements, firms also need to reconcile different metrics. Net interest income (NII), for instance, is designed to measure an institution's short-term income sensitivity to interest rate changes. The economic value of equity (EVE), however, is measured over a longer time horizon, and assesses the degree of a bank's

interest rate risk exposure by calculating the net present value of the cashflows on its balance sheet. These metrics were developed to show the effects of interest rates on banks' earnings, as well as the market value of fair-valued instruments. Despite their different scope and purpose, when these metrics offer inconsistent views of a firm's position in certain market conditions, they can be hard to reconcile, especially from the perspective of a balance sheet strategy.

Firms are also facing pressure to implement effective performance attribution analytics and optimization methods for their portfolios and balance sheets. Sophisticated optimization strategies go beyond income simulation, and can support optimal strategy insights; however, in general, this is a relatively less mature part of the ALM value chain. While the ALM analytics ecosystem is complex, with challenging integration demands, a broad range of mathematical tools is becoming more widely available (see Figure 5). These tools can handle both short- and long-term ALM demands, and we will examine their applications and uptake in this report.

Figure 5: A broad range of mathematical tools is required for both short- and long-term ALM and balance sheet challenges



Source: Chartis Research

ALM in action: key market trends

This section provides an overview of the key ALM trends in 2023, some of which are explored in more detail later.

Mathematical frameworks in ALM are becoming increasingly sophisticated

ALM practitioners are benefiting from a wider range of tools, including reverse stress testing, standardized and structured stress and scenario-generation mechanisms, and better cashflow and consolidation engines for the banking book. By being able to access detailed, granular cashflow for the banking book, firms can subject it to more effective and formal analytical techniques.

A broader recognition of interest rate risk on the balance sheet

Over the next 10 years, the banking industry will experience a period of greater interest rate volatility. A persistently low interest rate environment has put sustained pressure on banks' margins. Current high interest rates, however, are creating liquidity and capital issues, as banks' liability payments risk becoming greater than their asset earnings.

Chartis has identified the following high-level challenges that are emerging from this new environment:

- **Embedded leverage risk exists in a wide variety of locations**, such as the repurchase agreement (repo) market, elements of collateral, and non-banking institutions (including asset managers and pension funds). Exposure to these risks has already been seen in the market in the shape of the crisis in UK pension fund gilts, which has highlighted the issues with liability-driven investment (LDI).
- **Interest rate risk is embedded in a variety of products**, such as guaranteed products within the insurance industry.
- **Institutions** including retail banks, money market mutual funds and life insurance companies, as well as long-dated investment vehicles, **are exposed to customer behavior dynamics** that relate to interest rate risk. During higher interest rate periods, for instance, customers display an increasing unwillingness to hold long-dated assets, and shift toward the use of cash. These dynamics also emerge in areas such as bank loans that are made to wholesale institutions exposed to interest rate risk.

Increasing convergence in ALM across financial services

ALM is converging across the capital markets, banking and insurance sectors. Methodologies, mechanics and techniques differ, but cross-pollination between these sectors is causing these differences to lessen. The banking book, for example, looks at interest rate risk derived, analyzed and extracted from other markets. There are elements of convergence between the capital markets side and the banking-book side of a bank, while loan markets are now being reasonably priced by Current Expected Credit Losses (CECL) or International Financial Reporting Standard (IFRS) 9, both of which take a forward-looking view of risk management. Insurance ALM, particularly in the US, is becoming marketized, and, in buy-side and insurance contexts, optimization tools are comparatively more mature.

Liquidity risk analysis will be a central feature of ALM

Chartis believes that, going forward, liquidity risk analysis will be a central feature of ALM. But it is important that regulators carefully consider the causes of the current crisis, rather than 'fighting the last war'. The current issues in the market around liquidity risk are in some ways fundamental to the banking business model, and are inherent in interest rate transformation (such as converting short-dated rolling deposits into long-dated assets).

The Chartis view: the implications of the Silicon Valley Bank collapse for ALM – regulators and financial institutions respond

Market practitioners are examining the consequences of the collapse of SVB for ALM. The bank's duration risk and lack of asset and liability balance is highlighting the ability of ALM and banks to meet withdrawals with enough liquidity. SVB's collapse also triggered wider conversations about government intervention, regional bank requirements and supervisory oversight. Despite current speculation around the missteps that may have contributed to SVB's collapse, Chartis is focusing on the structural challenges.

Many of the issues SVB faced are common to other institutions, for example. The problems at SVB re-emphasized the central challenge surrounding institutional/semi-institutional counterparties and

> concentration risk (around regional, sectoral and interlinked counterparties). The incident also highlighted the heightened risk of runs against financial institutions when comparatively less-regulated, higher-yielding products are available (such as money market mutual funds, for example), as well as the effects of the deep structural changes in the information environment in which institutions operate. Digitalization that enables the rapid/instantaneous movement of money, as well as social media and information networks, all contributed to the conditions that led to a bank run.
>
> The core structural challenge – which Chartis will continue to analyze in future research – is how to handle a large concentration of depositors and counterparties. We will examine what a run on a financial institution entails, considering which features initially attract investors (such as contract flexibility), and which may drive runs when market conditions change in times of stress.

Trends in detail

A new banking landscape: navigating shifting interest rate regimes

Interest rate risk in banking

Interest rate management, a process of risk and term transformation, is central to the banking business. Interest rate modeling has a long legacy in ALM, and interest-derived income is a central aspect of banks' business models. Fluctuations in money and capital-market interest rates impact the value of a bank's assets and liabilities, the timing of cashflows and the effectiveness of hedging strategies. Deposits are behaviorally sensitive and vary over time, for example, while other assets, such as mortgages and loans with prepayment rights, may also have similar uncertainties embedded in the system.

Prepayment without penalty is a very specific characteristic of the US banking industry, and has essentially created enormous structural risks within the banking book. Indeed, prepayment risk has been a major aspect of interest rate risk management in the US, but is increasingly a dynamic in other regions. Extremely sophisticated models and frameworks have been established to handle this type of interest rate risk. The residential

mortgage-backed securities (RMBS) market, for example, developed around this requirement. Interest rate risk in the banking book (IRRBB), part of the Basel Committee on Banking Supervision's Pillar 2 capital framework, was developed to enable institutions to identify embedded interest rate risk in their balance sheets. The framework also covers embedded optionality in banks' interest rate-linked portfolios, and provides guidance on how to value them appropriately.

The evident challenges with SVB's business model have sparked a wider debate about the adequacy of supervisory requirements, and there is also a sense that SVB was flying under the regulatory radar. Its collapse highlights the problems created by the two-tier regulatory system in the US. Requirements such as the net stable funding ratio (NSFR) and the liquidity coverage ratio (LCR), which apply widely to European and Asian institutions, have not been applied to smaller and non-qualifying US banks. As a result, the US system has been left with a small pool of banks that are highly regulated to international standards, and a second tier of smaller, less well-regulated institutions – particularly where liquidity requirements are concerned.

Chartis believes that this will become a second-order problem over the next few years. Regulators may try to unify and create a single regulatory regime, rather than having different liquidity regimes for small banks, an approach that substantially undercuts the basic premise of unified regulations. The current liquidity regime for smaller institutions also creates additional risks for these firms, compared to very large institutions. In periods of stress, investors (particularly depositors) are more likely to move toward more regulated institutions. The lack of liquidity restrictions will therefore be a medium-term problem for many smaller and mid-sized institutions.

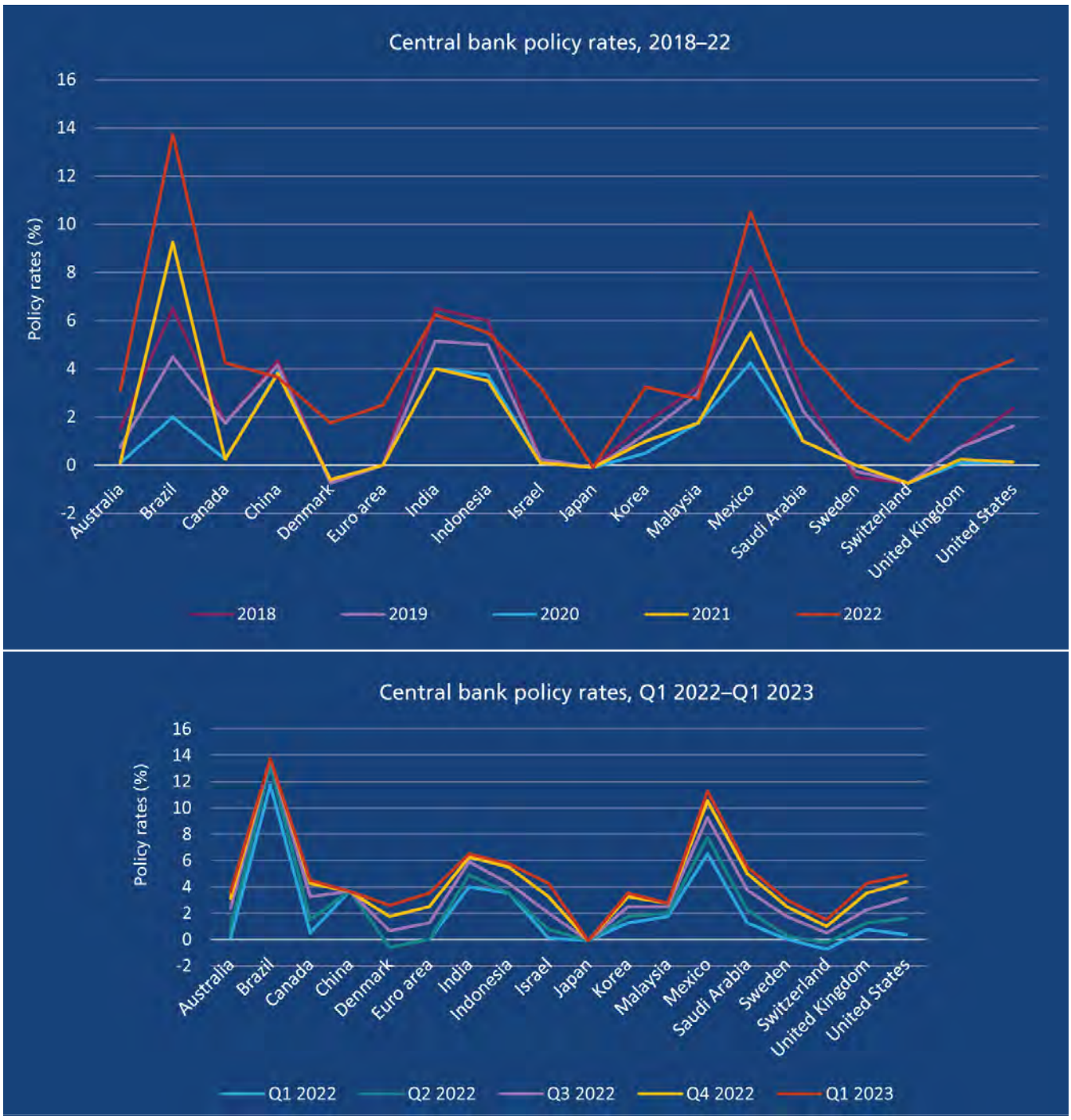
Economic outlook: higher rates drive funding and liquidity challenges

The status of interest rate risk and liquidity risk regulation and supervision is likely to be the focus of significant debate over the coming years. This focus will extend to how appropriately institutions manage balance sheet risk. Going forward, investors, regulators and counterparties (including retail counterparties) are likely to pay considerable attention to signs of weakness in broad balance sheet management strategies, increasing the importance of effective and efficient financial risk management. The overall current

economic volatility is putting financial risk management at the core of institutions' planning. Another aspect of the debate is the influence that monetary policy is having on the stability of the financial system (see Figure 6).

Over time, an expectation has developed that interest rates would never shift – and even if they did, it would only happen very slowly or by small amounts. Clearly, currently high and persistent levels of inflation have upended many of these assumptions.

Figure 6: Central bank policy rates



Source: Bank for International Settlements

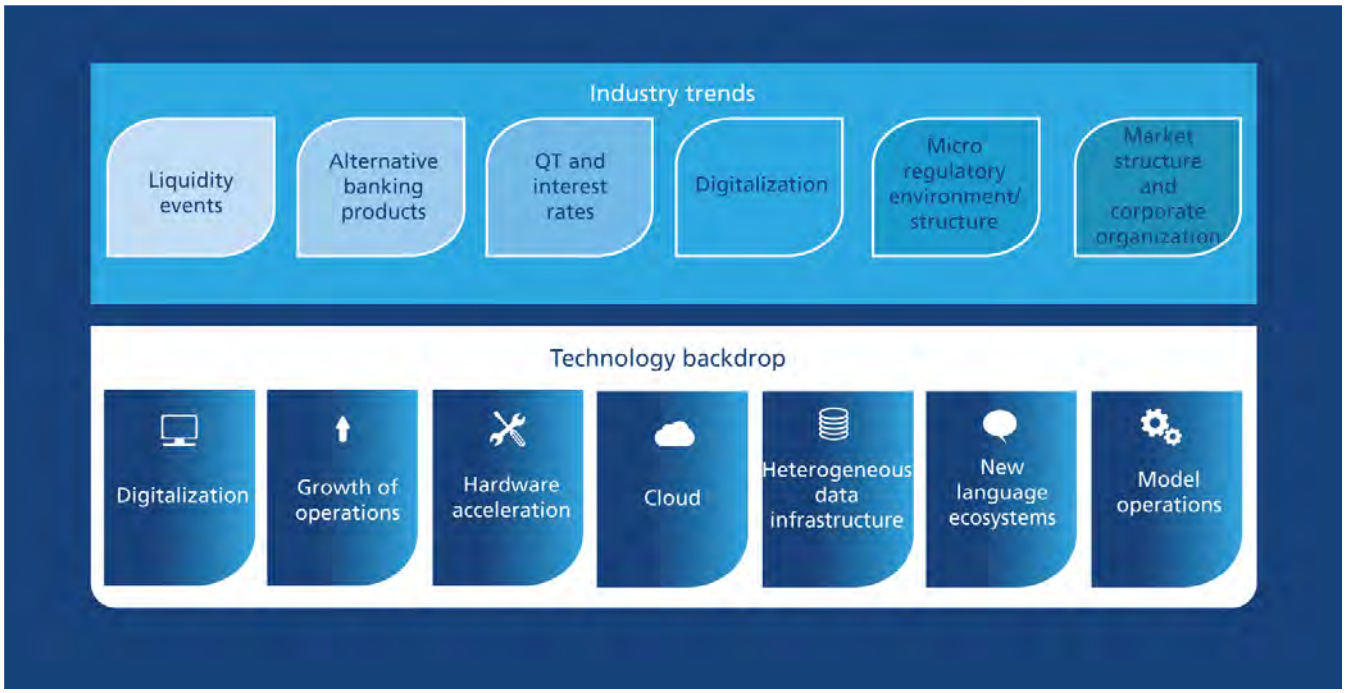
Shifts in ALM analytics and balance sheet modeling/management

We are witnessing a major shift in ALM analytics and balance sheet modeling and management in banking. The combination of market conditions and regulatory requirements is encouraging a stronger focus on modeling techniques and methodologies (see Figure 7). Firms are employing an advanced approach known as 'complex dynamic cashflow modeling' to forecast future cashflows, by taking into account potential changes in a

firm's balance sheet composition in response to fluctuating interest rate environments. Uncertainty around cashflows and drawdowns during periods of economic stress can create challenges for financial institutions from the perspective of liquidity risk pricing and funding costs.

In the period of economic stress during the pandemic, levels of credit facility drawdowns were at unprecedented highs, as corporate borrowers sought to shore up their liquidity. These drawdown rates contributed to banks' funding issues, with a portion of banks having to resort to wholesale market borrowing for liquidity. The liquidity risk profile of revolving credit facilities is especially challenging, as borrowers have the option to draw down additional credit or repay; these options need to be charged accurately by the treasury. As a practice, FTP has come of age, and within financial institutions there is a strong desire to charge every banking product accurately across all business lines – this includes under stressed conditions and when customer behavioral dynamics are incorporated.

Figure 7: Industry trends and technology backdrop



Source: Chartis Research

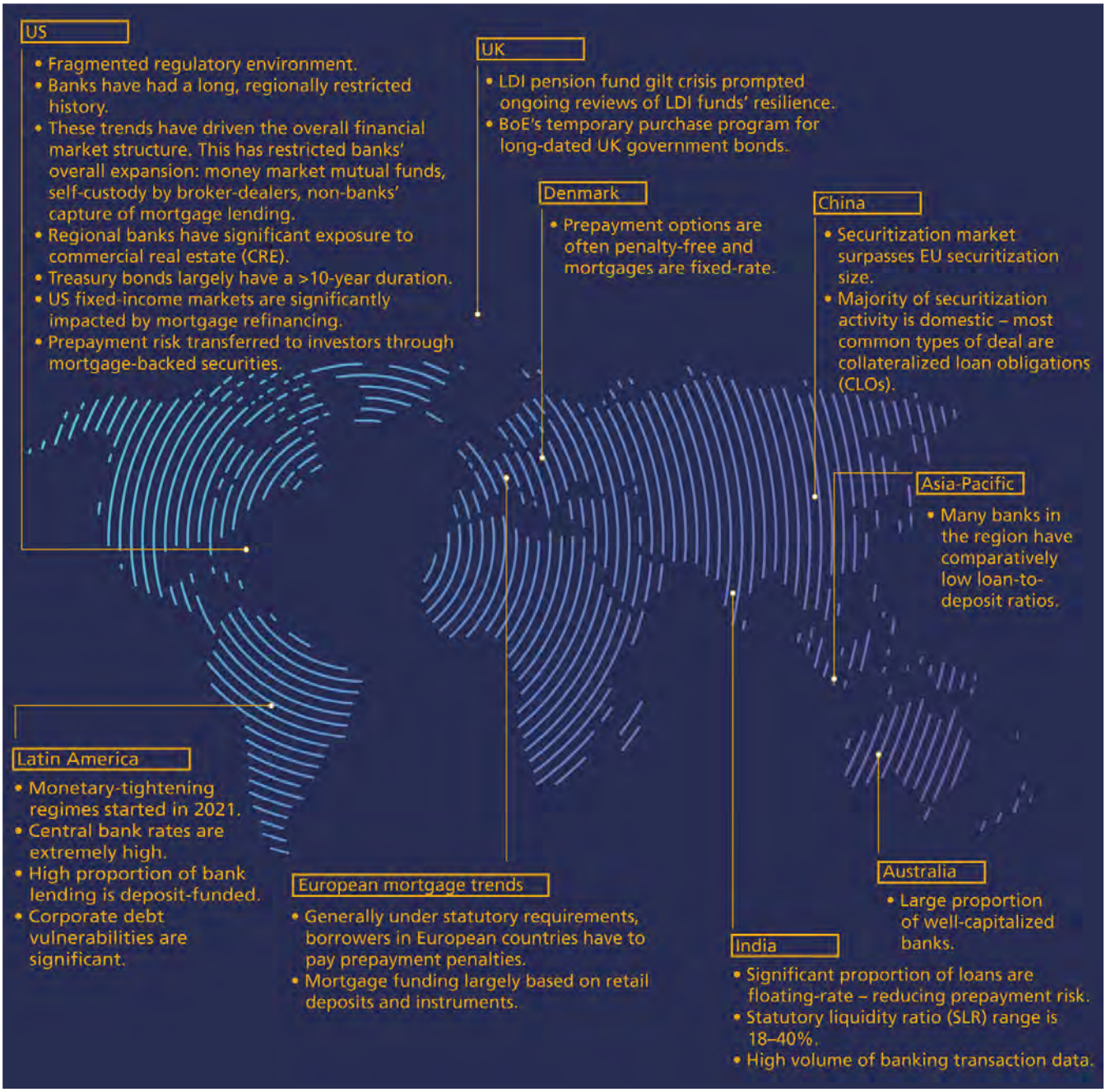
Regulatory updates and regional trends

Liquidity – a central focus

The Basel liquidity measurements were set up as an alternative to the intervention of regulators in ALM at a granular level. The NSFR and LCR

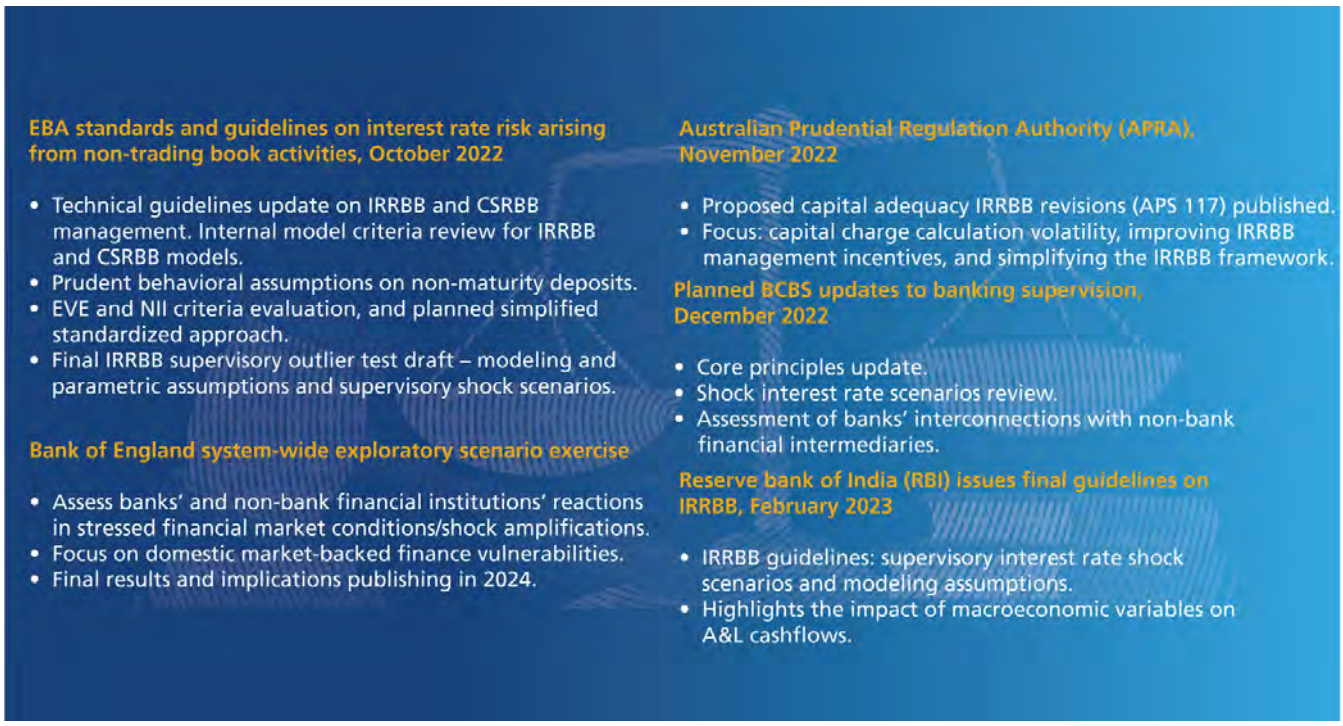
were seen as mechanisms to prevent liquidity runs on institutions (see Figures 8 and 9).

Figure 8: Regional trends in banking



Source: Chartis Research

Figure 9: Regulatory updates



Source: Chartis Research

There are several ways in which liquidity risk can be managed. One is to increase both deposit insurance limits and the cost of deposit insurance, so that investors are paying appropriately for liquidity. Regulators must also ensure that the cost of liquidity is borne not just by the banks, but also by any other institutions that offer banking-like, contingent, liquidity-type products. Banks should be competing on a level playing field with these other forms of liquidity (such as money market mutual funds). Given that these institutions provide on-demand liquidity risk products, they should be regulated as such and have comparable deposit insurance programs in place. Regulation would ensure that situations where liquidity risk simply migrates from banks to other types of institution could be avoided, preventing bank-style runs in other firms.

Regardless of regulation, however, the core issue does not go away. Liquidity risk is a central issue any time an institution conducts liquidity transformation (i.e., takes short-dated assets and converts them into long-dated ones). The key issue is to price liquidity risk reasonably, and to ensure that it is priced into individual products. The aim is not to stop liquidity transformations altogether, or to privilege certain kinds of institutions that conduct them. Banking institutions have been conducting liquidity transformations for a long time, and it is an easily understood process.

However, transferring that liquidity risk from banks to other institutions makes the transformation process less well understood, potentially opening it up to even more risk.

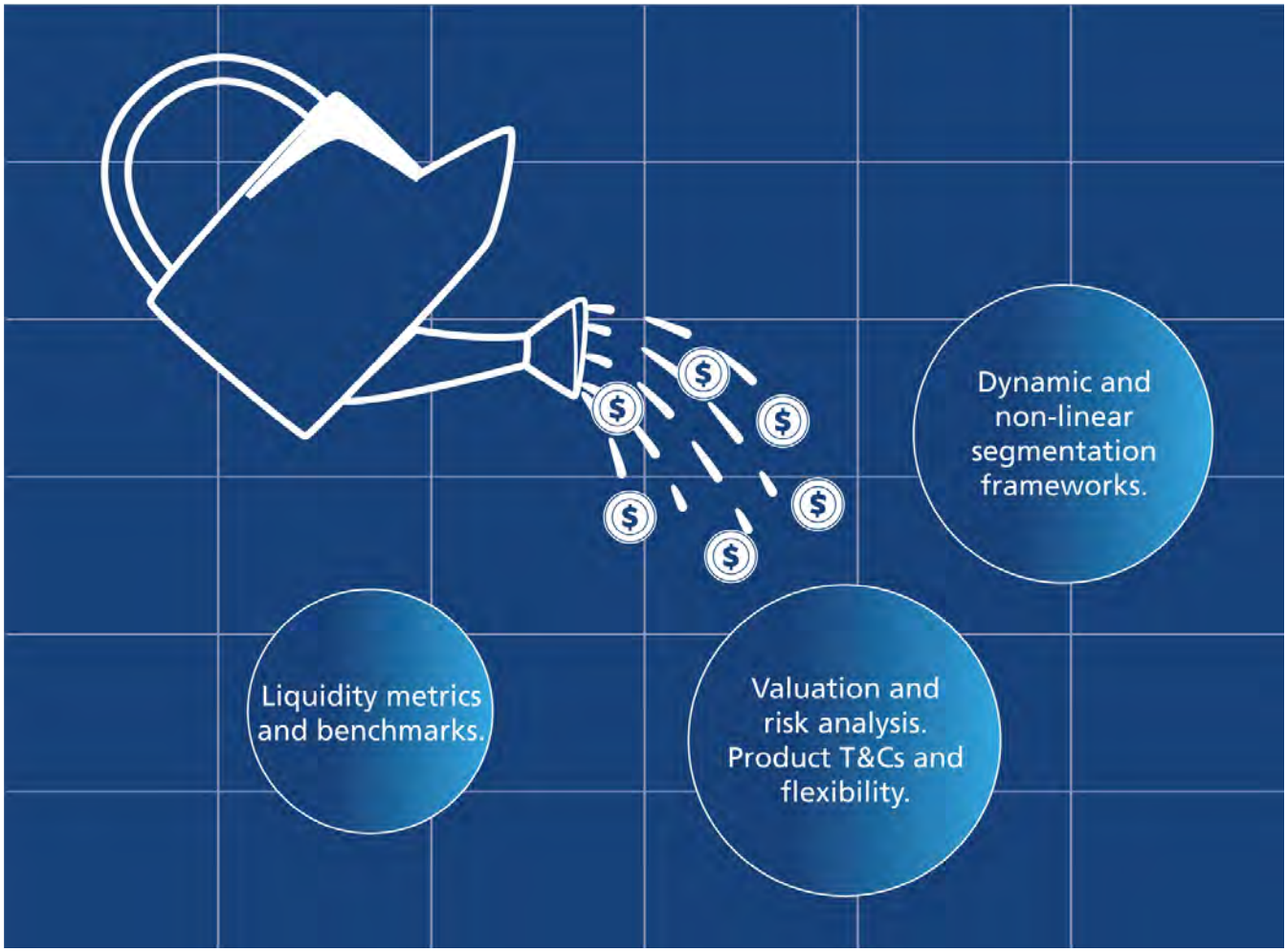
From a regulator's perspective, a balance of different types of liquidity risk is not a bad thing. Certain kinds of institutions (such as private equity and real-estate firms, as well as many of the private funds for private credit) have a different liquidity profile, and tend to offer liquidity at much lower rates than banks and money market mutual funds.

Taxonomizing liquidity risk

Chartis believes that there is a central lesson that should be learned from recent crises: a proper taxonomy and analysis of the many different types of liquidity risk must be conducted on every type of institution in the market – and these different types of liquidity must be appropriately regulated. Regulation should not simply be applied across the board without considering the specific nature of the liquidity risk run by different institutions. In our view, a well-defined, carefully analyzed and well-taxonomized liquidity risk framework would enable different institutions to offer a variety of liquidity risk products, and would lead to a generally more stable financial system. Regulators need to think about the varying costs of different forms of liquidity. On-demand liquidity should be the most expensive form, whereas the more that assets are locked in, the lower the payable liquidity premium should be.

It is vital that financial institutions and regulators think more carefully about the dimensions of their liquidity risk. Liquidity risk covers a broad range of dimensions, and is far from straightforward. Historically, ALM terms were often highly restrictive. While the market has now moved to more sophisticated ALM frameworks, Chartis believes that many dimensions of liquidity risk are still not being properly addressed. Analytics are becoming increasingly sophisticated across the board, but liquidity analytics in particular are being affected by methodological innovations (see Figure 10).

Figure 10: The transformation of liquidity analytics



Source: Chartis Research

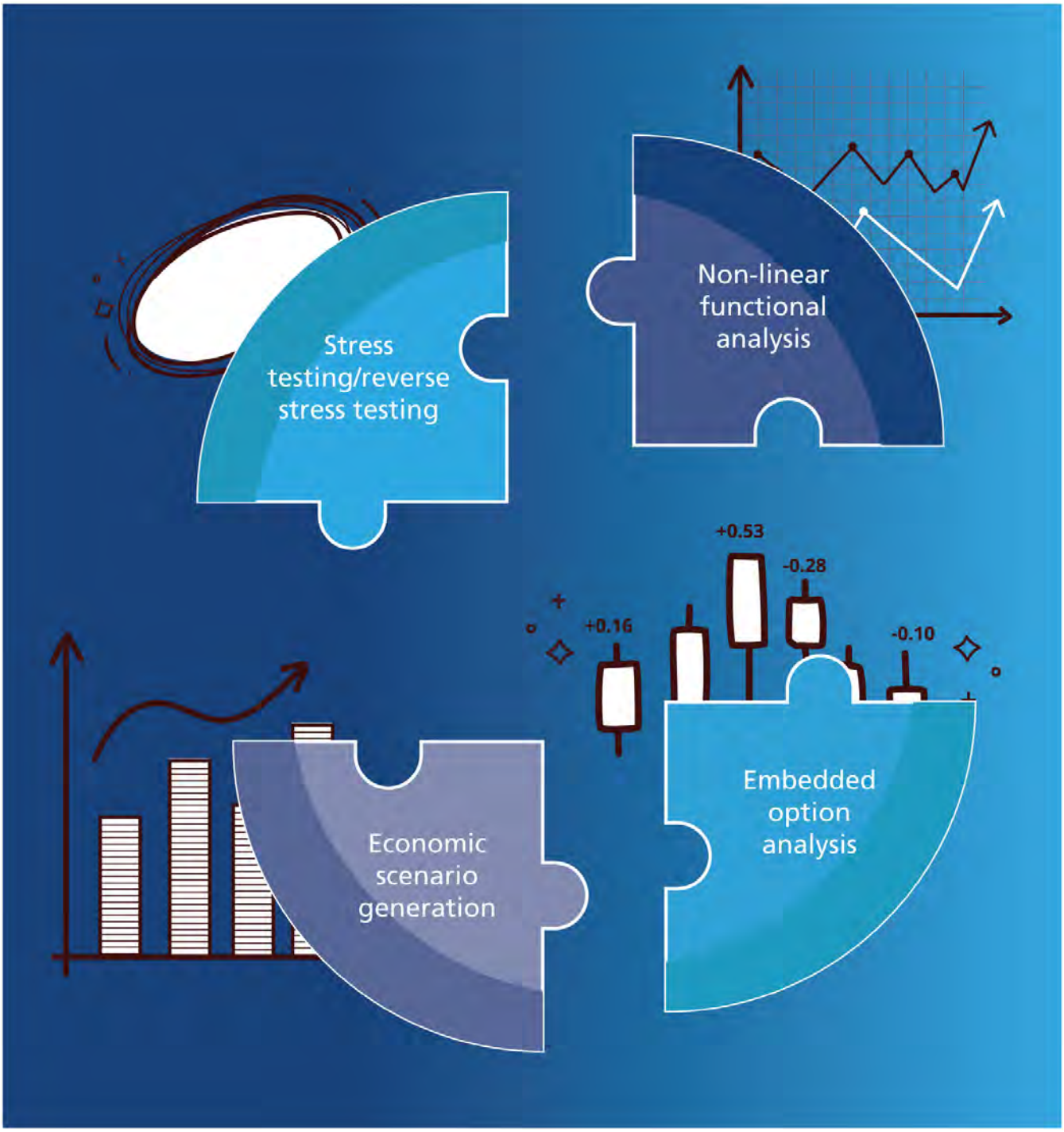
Core analytics frameworks: a process of integration and differentiation

The evolving industry standard for ALM requires multiple modeling regimes, varying views of the balance sheet across different time horizons and conditions, and challenging data integrations. Increasingly, firms require sophisticated analytics to handle the expectation for better-informed granular cashflows. Despite the development and greater availability of sophisticated modeling regimes, larger, more complicated banks are still lumbered with patchwork legacy systems.

The kind of vendor solution that financial institutions are looking for is defined by their institutional complexity. While more complex systems can handle a greater level of bespoke requirements, they also contribute to longer implementation times. Processing speed is a specific computational cashflow-generation challenge for institutions with large volumes of

transaction data. Innovative technical architectures are required so that financial institutions can process data at the frequencies required for cashflow generation, risk management and balance sheet planning. There are also significant benefits for financial institutions that can bring core mathematical techniques together across the trading, analytics and operational cycles (see Figure 11).

Figure 11: Core mathematical techniques



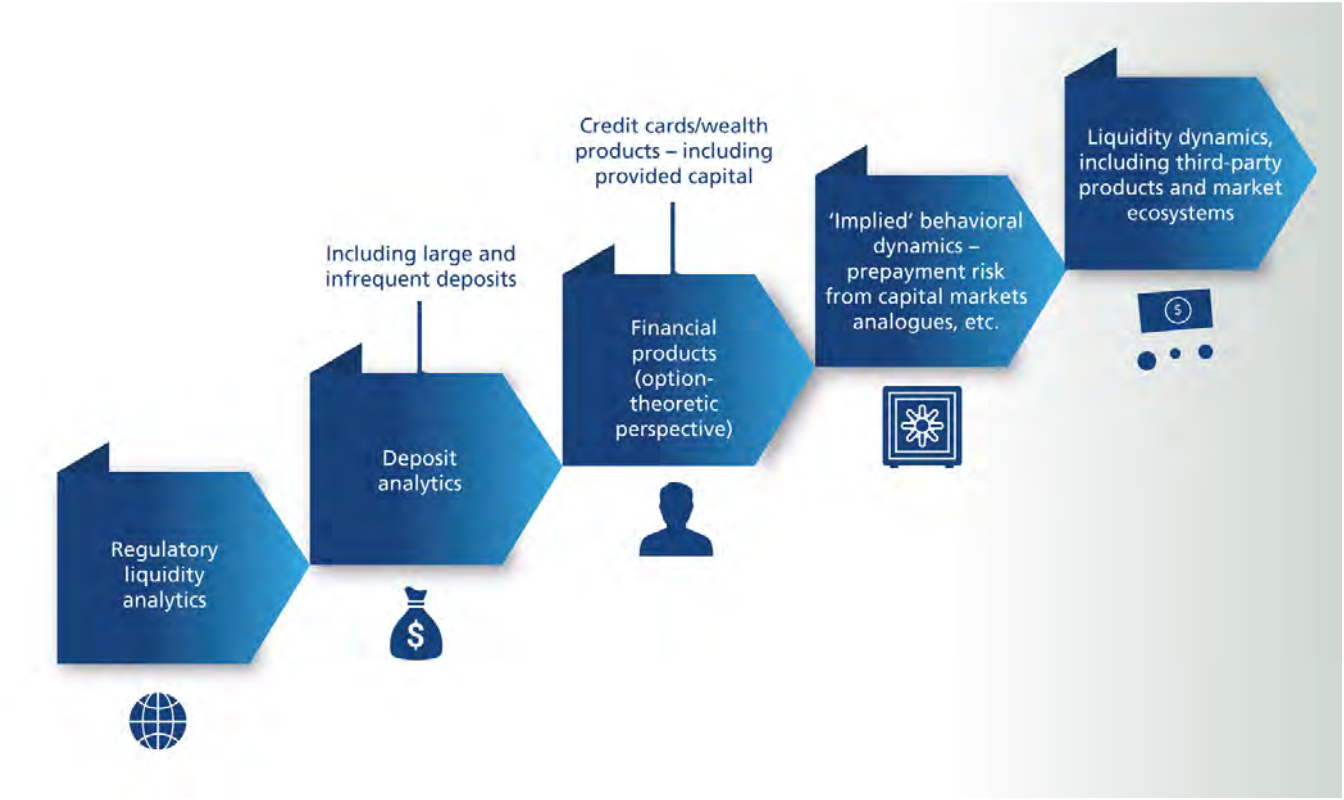
Source: Chartis Research

Behavioral modeling

Behavioral modeling is a key aspect of the emerging, more sophisticated ALM ecosystem, and is rapidly becoming an industry standard (see Figures 12 and 13). There are several approaches to behavioral modeling, including importing data from capital market analogues, such as prepayment models for securitization assets. An essential part of behavioral modeling is the ability to model the nature and structure of clients and counterparties accurately. When clients and counterparties are highly distributed and largely 'retail'-focused, the behavioral dynamics that describe them can be vastly different from those that describe highly concentrated, largely institutional structures. Chartis argues that firms should leverage, or at least evaluate, behavioral and client-segmentation models used in other areas, such as financial crime, compliance, supply chain analytics and fraud analytics. Client segmentation analysis has the potential to provide significant insights for the behavioral models used in ALM.

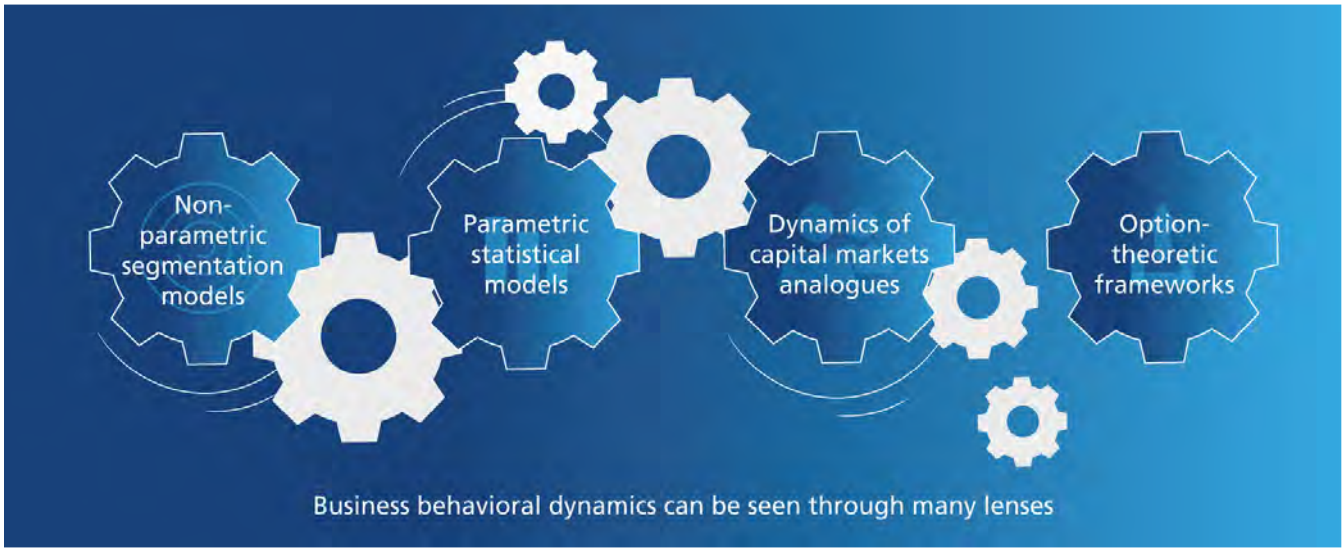
It is also important to take into account the contractual 'flexibility' afforded to clients and counterparties using an option theoretic perspective. There is an opportunity for firms to leverage the vast theoretical and practical work that exists in the option modeling, pricing and analysis space. From the standpoint of financial stability, it is also important that contract flexibility is not restricted to banks, as it can lead to runs, and affects any institution that provides this flexibility to a substantial degree.

Figure 12: All aspects of behavioral modeling are developing



Source: Chartis Research

Figure 13: Business behavioral dynamics can be seen through many lenses



Source: Chartis Research

Data integration and managing transaction data

Data integration challenges have complex supply and demand dynamics. More data is being generated from diverse sources – both internally and externally. At the same time, a large number of new tools and techniques are hitting the market, as well as new databases, data management tools and integration capabilities. We are also seeing strong growth in new techniques to filter, structure and search available data. Generating cashflows from transaction data is a core activity for most enterprises, and new technologies (such as data grids, as well as other scalable database tools) can help to improve efficiency.

Cloud migration

ALM analytics are well-suited to the cloud. Cloud deployments allow financial institutions to consolidate cashflows, develop aggregations and run behavioral models in their internal frameworks. Cloud deployments also enable firms to move consolidated cashflows to manage risk, and to run the balance sheet through appropriate liquidity models, hedge analytics and balance sheet forecasting risk and attribution models. The cloud is proving an increasingly popular choice for new deployments, although institutions' general readiness for cloud adoption varies by region.

Climate risk scenarios

Increasingly, some institutions and many vendors have started to incorporate climate risk scenarios. This is a developing area, and Chartis believes that the integration of climate risk into the ALM environment is not yet analytically mature. However, we expect considerable and rapid progress in the context of scenario analytics.

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Vendor landscape

Vendors in the ALM space continue to evolve and build increasingly sophisticated tools to meet market requirements. The structure of solutions varies considerably, and the functionality vendors have developed is highly dependent on the requirements of the regions and institutions they serve. The US asset-backed securities (ABS) market is a key dynamic for US institutions, and requires a degree of specialization on the vendor side. A cluster of US vendors focuses on ALM from a risk management, trading and hedging perspective, and these vendors are experienced in supporting

financial institutions in managing their MBS. These providers support almost trading-quality interest rate management systems; however, hedging in this context is far less frequent than in trading.

Key themes in the landscape

Vendor consolidation

One key theme that Chartis has identified is consolidation among some of the leading vendors, which has been driven by general-purpose vendors acquiring specialists. As a result, some of the more analytics- and platform-oriented vendors have now incorporated considerable methodological capabilities, increasing the ability for sophisticated analysis and driving competition at the top end of the market. Considering the current market context, this consolidation is especially timely. There will be substantive evolution in the way financial institutions think about ALM, in terms of not only more sophisticated simulations, but also more careful analysis of individual products and more focus on integrating product details, terms and conditions and other elements.

This evolution brings the much-neglected IRRBB to the fore. IRRBB needs to be expanded in a more sophisticated way to handle embedded risk options in the trading book and in all aspects of a bank's business. Non-banking institutions also have massive embedded interest rate risk profiles, which need to be analyzed more carefully, especially given the expected interest rate volatility in the next five to 10 years.

Chartis' vendor analysis recognizes the consolidation trend that is bringing methodology and platform together with general tool capacity, and increasing the ability for sophisticated analysis. We have incorporated this as part of our scoring cycle.

The ALM vendor market – continued diversity and fragmentation

Despite this consolidation, it is important to recognize the wide variety of dimensions in which vendors continue to differentiate themselves – arguably, every major vendor has significantly different capabilities. This perspective is critical in understanding the vendor landscape and its continued diversity and fragmentation. Some of the differentiating dimensions include:

- The quality of behavioral analytics, and modeling and risk aggregation for counterparties (including depositors).
- ALM metrics and ALM metrics attribution.
- Hedge analytics and balance sheet management (a financial perspective).
- Balance sheet management and optimization (an operational perspective).
- Extendibility/customization.
- Data and workflow integration.
- Scalable cashflow generation, which is important for many Asian institutions.
- Operational support and effective product pricing.
- Liquidity risk analytics.
- Regulatory focus and reporting.

Although mergers and acquisitions have been a key dynamic in the ALM vendor market, as financial institutions across different regions continue to emphasize different elements, the variation in the vendor landscape has grown. The vendor capabilities tables (Tables 2, 4, 6, and 8) give a detailed perspective of vendors' strengths in particular areas.

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Chartis RiskTech Quadrant® and vendor capabilities for ALM technology solutions, 2023

Figure 14 illustrates Chartis' view of the vendor landscape for ALM solutions. Table 1 lists the completeness of offering and market potential criteria we used to assess the vendors. Table 2 lists the vendor capabilities in this area.

The ALM quadrant is an omnibus category for ALM analytics, and the scoring criteria cover a broad spectrum of modeling frameworks. Liquidity risk in this context is centered more on computational ALM than on liquidity risk ratios and reporting. The boundaries between different types of ALM solutions are not trivial. Some vendors may focus on hedge/balance sheet management, while other solution types focus on 'what-if' analytics for finance departments, accounting linkages between portfolios, and the integration of credit risk events.

Figure 14: RiskTech Quadrant® for ALM solutions, 2023

Source: Chartis Research

Table 1: Assessment criteria for vendors of ALM solutions, 2023

Completeness of offering	Market potential
Capabilities and breadth of analytics	Customer satisfaction
Scenario management systems (including specific ESG support)	Market penetration
Stress testing/reverse stress testing	Growth strategy
Interest rate modeling	Business model
Simulation engine(s) capability	Financials
Liquidity risk analytics	
Balance sheet analytics	
Behavioral modeling	
Data management	
Integration capabilities	

Source: Chartis Research

Table 2: Vendor capabilities for ALM solutions, 2023

Vendor	Capabilities and breadth of analytics	Scenario management systems (including specific ESG support)	Stress testing/reverse stress testing	Interest rate modeling	Simulation engine(s) capability	Liquidity risk analytics	Balance sheet analytics	Behavioral modeling	Data management	Integration capabilities
Adenza	**	**	**	***	**	***	***	**	****	****
ALM First	**	**	**	**	**	**	**	**	**	**
The Baker Group	**	**	**	**	**	**	**	**	**	**
Bloomberg	**	**	**	****	***	****	**	**	**	**
Cognext.ai	***	**	**	**	**	**	**	**	***	***
Detech	**	**	***	**	***	**	**	**	***	**
Empyrean	***	***	***	**	**	**	***	**	****	****
FIMAC Solutions	**	**	**	**	**	**	**	**	**	**
Finastra	**	**	**	**	**	**	**	**	***	***
FIS	**	**	**	****	****	****	**	**	***	****
Intellect Design	***	**	**	**	**	***	**	**	**	****
Kiya.ai	**	**	**	**	**	**	**	**	**	**
Mirai	**	**	**	**	**	**	**	**	***	**
Moody's	****	*****	****	****	****	****	****	***	***	***
Numerical Technologies	**	**	***	**	***	**	**	**	**	***
Oracle	***	***	**	**	**	***	***	**	*****	****
Prometeia	****	****	***	***	***	***	****	***	***	****
QRM	****	****	****	*****	****	****	****	***	***	***
SAS	****	***	****	*****	****	****	****	*****	****	***
SS&C Algorithmics	***	****	****	****	****	***	***	**	***	**
Surya	**	**	**	**	**	**	**	**	****	****
Thomas Ho Company	****	***	***	****	****	**	***	**	**	**
Wolters Kluwer	***	***	***	***	***	***	***	**	****	***
zeb.control	***	***	**	**	***	**	***	**	**	**

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

Source: Chartis Research

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Chartis RiskTech Quadrant® and vendor capabilities for FTP technology solutions, 2023

Figure 15 illustrates Chartis' view of the vendor landscape for FTP solutions. Table 3 lists the completeness of offering and market potential criteria we used to assess the vendors. Table 4 lists the vendor capabilities in this area.

The FTP quadrant covers an assortment of functions and processes, including funding, fund price calculation and allocation/attribution. Effective FTP frameworks provide granular detail at the product and transaction levels. These frameworks are able to support flexible calculation methodologies that incorporate the multiplicity of risk types.

Figure 15: RiskTech Quadrant® for FTP solutions, 2023

Source: Chartis Research

Table 3: Assessment criteria for vendors of FTP solutions, 2023

Completeness of offering	Market potential
Business line management	Customer satisfaction
Hedge management	Market penetration
Simulation	Growth strategy
Data management	Business model
Pricing	Financials

Source: Chartis Research

Table 4: Vendor capabilities for FTP solutions, 2023

Vendor	Business line management	Hedge management	Simulation	Data management	Pricing
Adenza	***	**	**	****	**
ALM First	**	**	**	**	**
The Baker Group	**	**	**	**	**
Cognext.ai	**	**	**	**	***
Empyrean	***	***	***	***	***
FIMAC Solutions	**	**	**	**	**
Finastra	**	**	**	**	**
FIS	***	***	**	**	**
Intellect Design	**	**	**	***	**
Kiya.ai	**	**	**	**	**
Mirai	**	**	**	***	**
Moody's	****	****	****	***	***
MORS Software	**	**	**	***	**
Numerical Technologies	**	**	**	**	**
Oracle	***	***	****	*****	****
Prometeia	***	***	***	***	**
QRM	***	*****	****	**	****
SAS	**	****	****	***	****
SS&C Algorithmics	***	***	***	***	**
Surya	***	***	**	**	**
Thomas Ho Company	**	****	****	**	***
Wolters Kluwer	**	**	**	****	**
zeb.control	**	**	***	**	**

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

Source: Chartis Research

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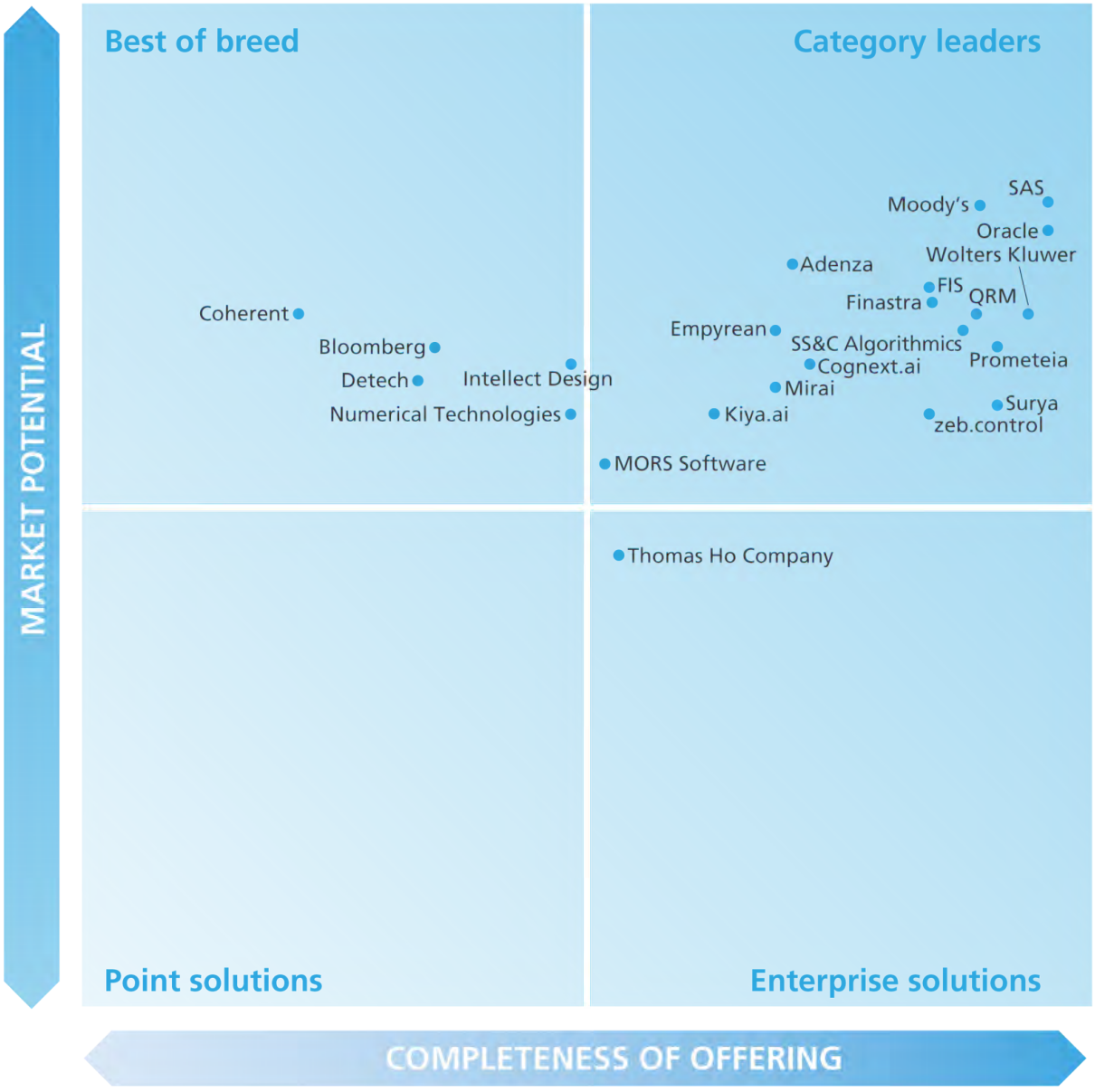
Chartis RiskTech Quadrant® and vendor capabilities for LRM and reporting technology solutions, 2023

Figure 16 illustrates Chartis' view of the vendor landscape for LRM and reporting solutions. Table 5 lists the completeness of offering and market potential criteria we used to assess the vendors. Table 6 lists the vendor capabilities in this area.

The LRM and reporting quadrant focuses largely on Basel reporting for NSFR, LCR and the internal liquidity adequacy assessment process (ILAAP), as well as data integration. LRM is often an integration challenge, requiring portfolio and instrument data from different silos.

Figure 16: RiskTech Quadrant® for LRM solutions, 2023



Source: Chartis Research

Table 5: Assessment criteria for vendors of LRM solutions, 2023

Completeness of offering	Market potential
Scenario generation	Customer satisfaction
Cashflow projections	Market penetration
Integration capabilities	Growth strategy
Reporting	Business model
LCR + NSFR	Financials

Source: Chartis Research

Table 6: Vendor capabilities for LRM solutions, 2023

Vendor	Scenario generation	Cashflow projections	Integration capabilities	Reporting	LCR + NSFR
Adenza	**	**	****	****	***
Bloomberg	***	**	**	**	**
Cognext.ai	**	**	**	***	***
Coherent	***	*	**	**	*
Detech	***	**	**	*	*
Empyrean	***	***	**	***	**
Finastra	***	***	***	**	****
FIS	****	***	***	***	**
Intellect Design	**	**	**	**	***
Kiya.ai	**	**	**	**	****
Mirai	**	****	**	***	***
Moody's	*****	***	**	***	***
MORS Software	**	**	**	**	**
Numerical Technologies	**	**	**	**	**
Oracle	***	****	****	****	****
Prometeia	****	***	***	****	***
QRM	****	****	**	***	**
SAS	****	****	****	***	****
SS&C Algorithmics	****	****	**	***	***
Surya	**	*****	****	***	***
Thomas Ho Company	***	***	**	***	*
Wolters Kluwer	***	***	****	***	****
zeb.control	***	****	**	***	***

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

Source: Chartis Research

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Chartis RiskTech Quadrant® and vendor capabilities for capital and balance sheet optimization solutions, 2023

Figure 17 illustrates Chartis' view of the vendor landscape for capital and balance sheet optimization solutions. Table 7 lists the completeness of offering and market potential criteria we used to assess the vendors. Table 8 lists the vendor capabilities in this area.

As a discipline, balance sheet optimization continues to develop and mature. The demand for dynamic and frequent optimization is growing; the optimization value of managerial decisions within a regulatory context is a core dynamic of balance sheet optimization processes. In addition to various optimization approaches, the quadrant includes financial planning and budgeting. The vendor capabilities table (Table 8) reflects the strength of certain vendors in financial planning and budgeting, while other vendors approach the market from the perspective of optimization frameworks.

Figure 17: RiskTech Quadrant® for capital and balance sheet optimization solutions, 2023

Source: Chartis Research

Table 7: Assessment criteria for vendors of capital and balance sheet optimization solutions, 2023

Completeness of offering	Market potential
Breadth of asset class/business line coverage	Customer satisfaction
Optimization engine	Market penetration
Scenario and simulation frameworks	Growth strategy
Data management	Business model
Business planning and analysis	Financials

Source: Chartis Research

Table 8: Vendor capabilities for capital and balance sheet optimization solutions, 2023

Vendor	Breadth of asset class/business line coverage	Optimization engine	Scenario and simulation frameworks	Data management	Business planning and analysis
Adenza	**	**	***	****	**
Bloomberg	**	**	***	**	***
Cognext.ai	**	**	**	***	***
Detech	***	***	***	**	**
Empyrean	***	**	**	***	****
Finastra	***	***	***	***	**
FIS	****	**	***	***	**
Intellect Design	***	**	**	**	**
Kiya.ai	***	**	**	***	**
Mirai	**	**	**	***	****
Moody's	***	***	*****	****	****
Numerical Technologies	**	**	***	**	**
Oracle	***	**	***	*****	*****
Prometeia	****	****	****	***	****
QRM	****	***	*****	**	***
SAS	****	****	****	****	****
SS&C Algorithmics	***	****	****	****	***
Surya	**	**	**	****	**
Thomas Ho Company	**	***	****	**	***
Wolters Kluwer	**	**	**	****	**
zeb.control	***	**	***	***	**

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

Source: Chartis Research

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Appendix A: 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.

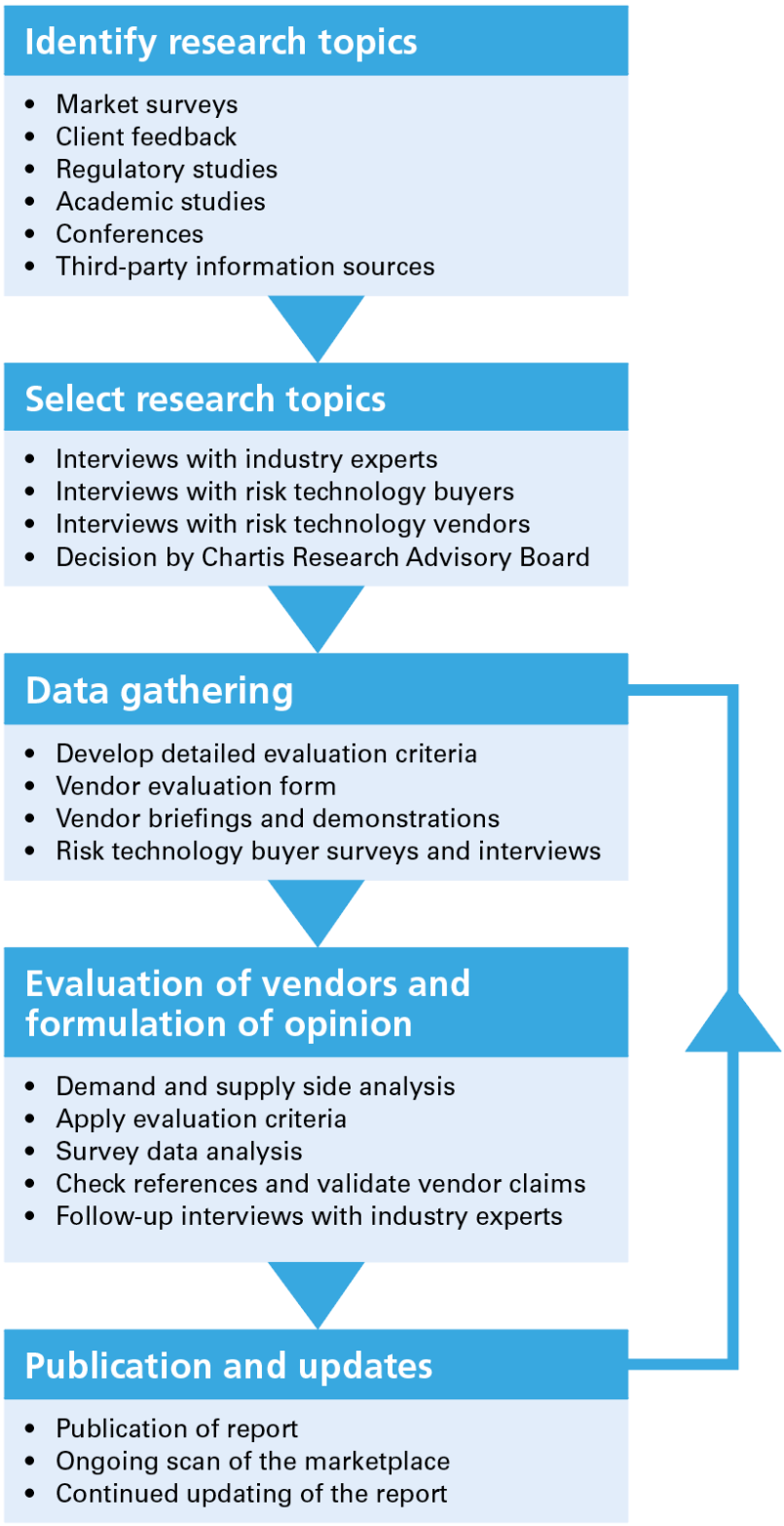
Inclusion in the RiskTech Quadrant®

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 18 below describes the research process.

Figure 18: 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):

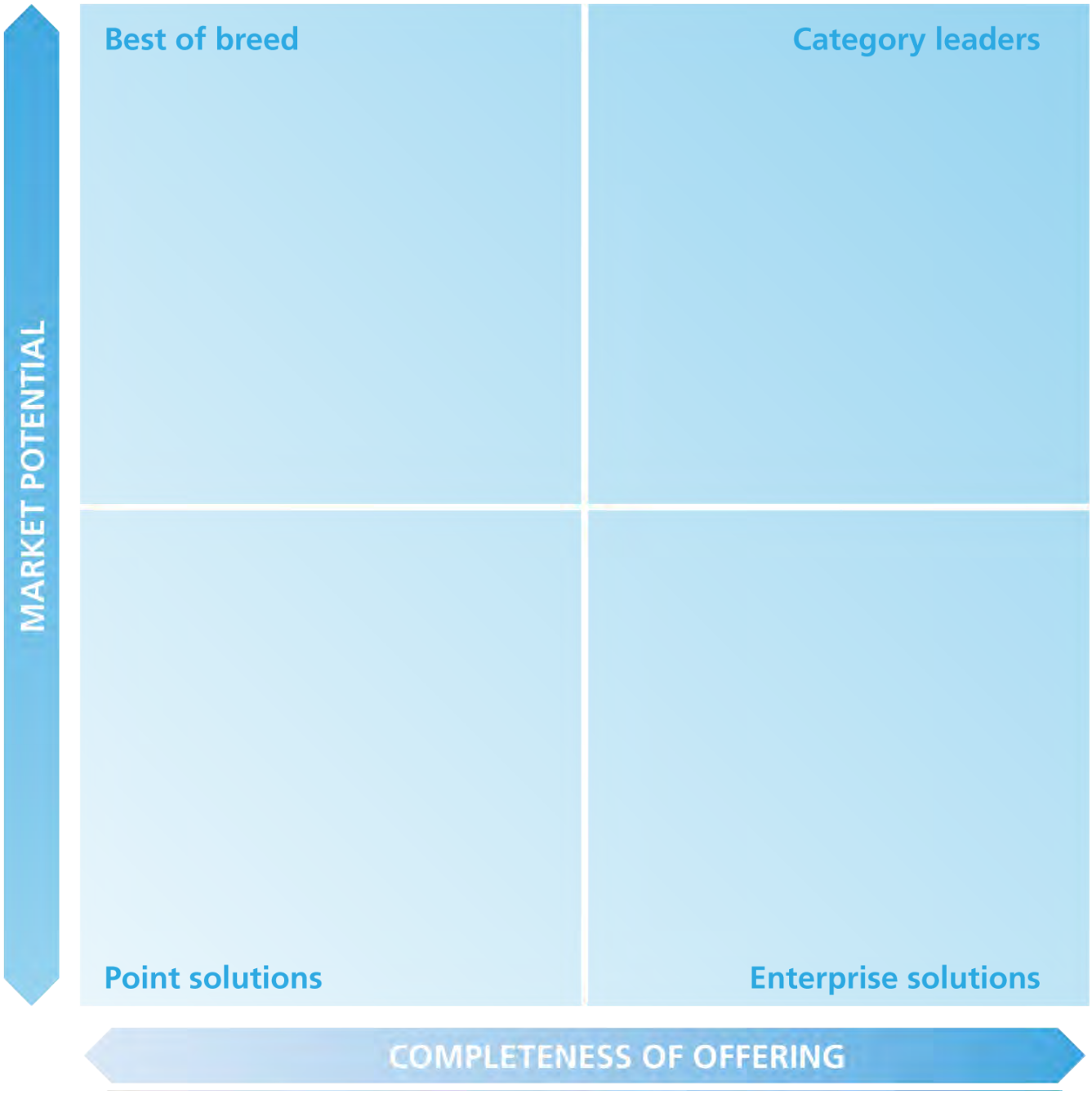
- **Chartis vendor evaluation forms.** A detailed set of questions covering functional and non-functional aspects of vendor solutions, as well as organizational and market factors. Chartis' vendor evaluation forms are based on practitioner-level expertise and input from real-life risk technology projects, 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 19) evaluates vendors on two key dimensions:

1. Completeness of offering
2. Market potential

Figure 19: 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.

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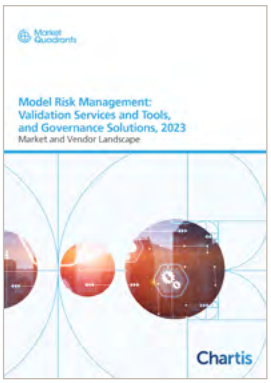
Further reading

ALM Technology Systems, 2021: Market and Vendor Landscape

Credit Risk Reporting Solutions, 2023: Market and Vendor Landscape



Model Risk Management: Validation Services and Tools, and Governance Solutions, 2023; Market and Vendor Landscape

Actuarial Modeling and Financial Planning Systems, 2022: Market and Vendor Landscape

RiskTech100 2023

STORM 2023

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