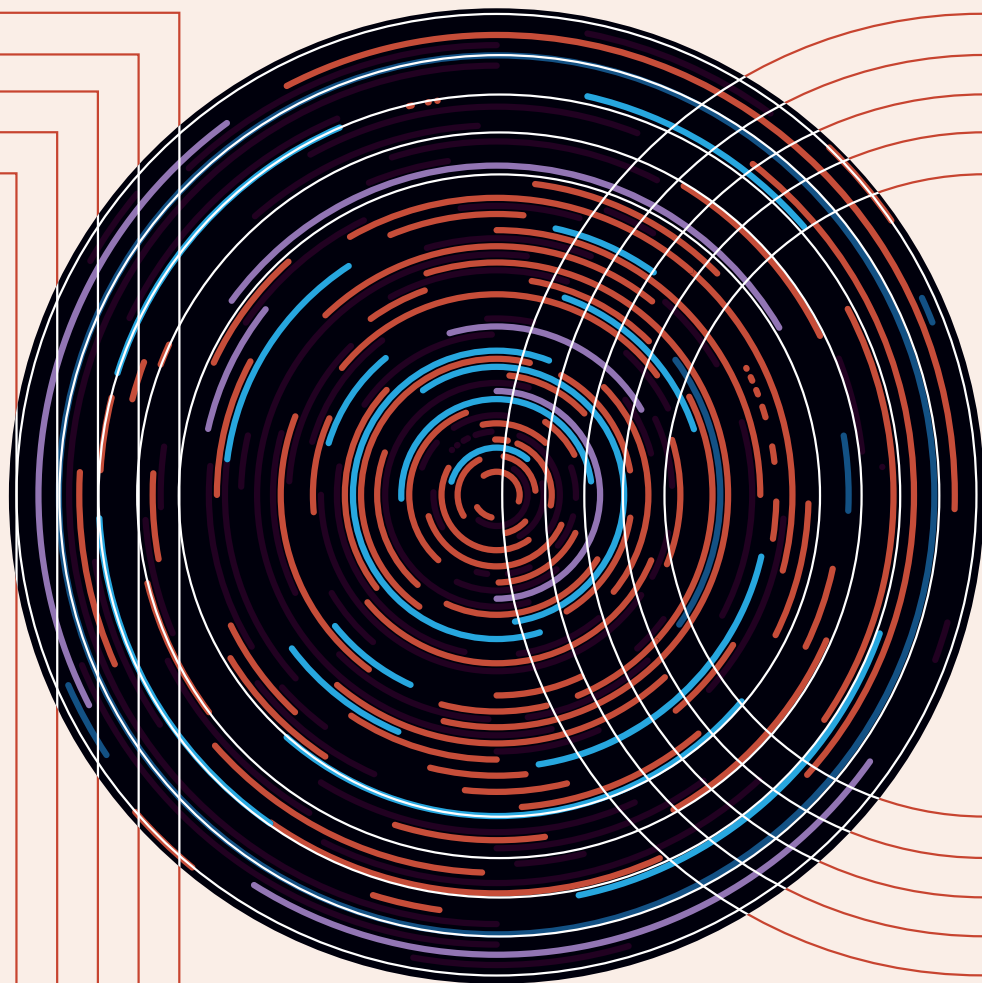




RiskTech 100 2021



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- Credit risk.
- Operational risk and governance, risk 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 including Basel 2 and 3, Dodd-Frank, MiFID II and Solvency II.

Chartis is solely focused on risk and compliance technology, which gives 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 implementing and developing risk management systems and programs for Fortune 500 companies and leading consulting houses.

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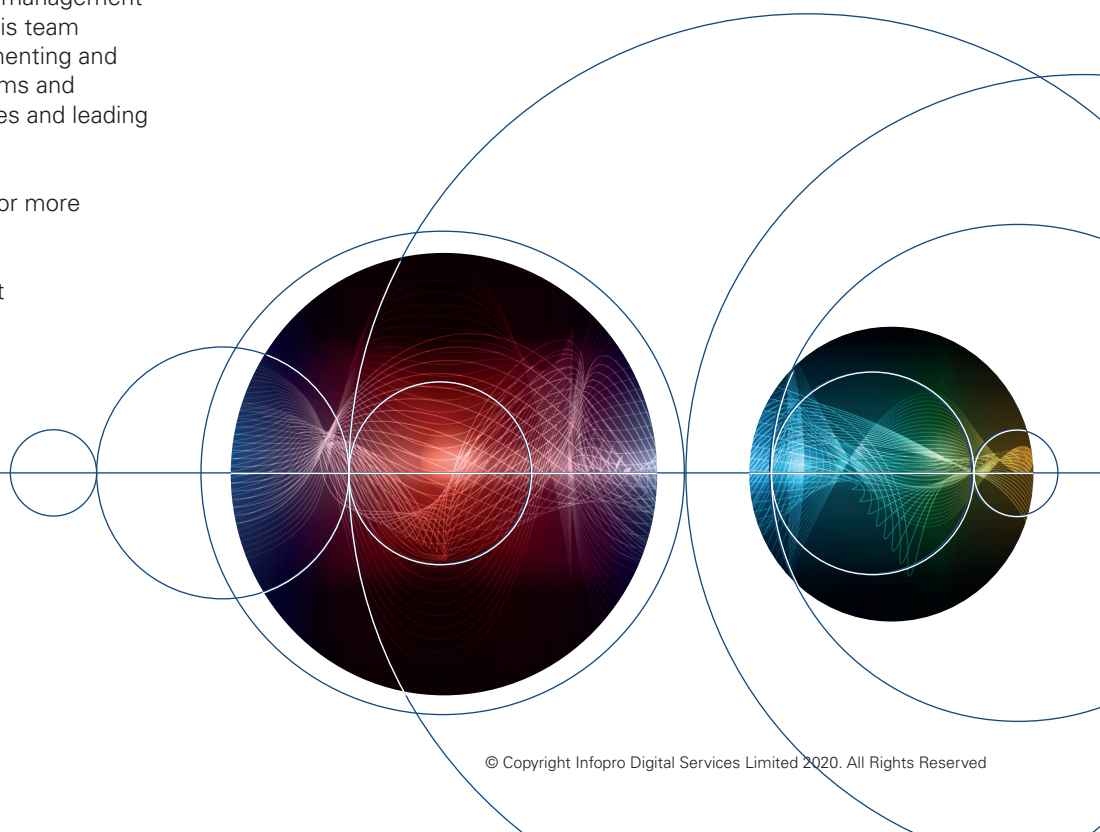


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1. Foreword



I'm delighted to welcome you to RiskTech100® 2021. Still the most comprehensive independent study of the world's major players in risk and compliance technology, RiskTech100® is globally acknowledged as the go-to place for clear, accurate

analysis of the risk technology marketplace. Together with its accompanying awards, the RiskTech100® ranking provides a valuable assessment and benchmarking tool for all participants in risk technology markets.

Marking something of a milestone, RiskTech100® is now in its fifteenth year – and what a year it's been. There's little left to say about the COVID-19 pandemic that hasn't already been covered, but the conclusion is still the same. Coronavirus has had a profound effect on societies, economies and markets, with impacts that may be longer-lasting than anyone has predicted.

Notably, however, in a RiskTech context, COVID-19, rather than introducing new dynamics to RiskTech markets, has accelerated and amplified those that were already there. This is especially true in the areas of credit risk and governance, risk management and compliance (GRC), where the pandemic has highlighted serious issues around defaults and business continuity that had been lurking beneath the surface for some time.

In previous RiskTech100® reports, alongside the central rankings, we have traditionally featured two additional chapters: a 'Key highlights' section, summarizing our research output since the previous report, and a featured article on a specific research topic. (In recent years these topics have included our ongoing research into risk-aware accounting and the use of quantitative and statistical methods in the finance industry.)

In this milestone year, however, we thought we'd do something different. In four short articles in this report we assess the view of RiskTech that we have developed and refined over the years. Looking back at some of the key research trends we've covered recently, we highlight where the Chartis View has ultimately been borne out by market events. First we assess the various key elements of the Chartis View, before examining three specific areas – artificial intelligence (AI),

credit risk and GRC – where we've been focusing our research, and where we expect more important developments in future.

This year has also been a watershed in terms of how we operate at Chartis. At the end of 2019 we developed the 'pillar' structure that will underpin most of what we do in future, helping vendors and end users navigate our research more easily. We also plan to expand our quadrant and rankings reports into other vital areas for our clients, not least on the buy-side, with analyses of transaction cost analysis and portfolio management.

As always, these and other planned initiatives represent the latest steps in our strategy of defining, researching and understanding the ever-changing RiskTech market in all its complexity – research for which RiskTech100® remains the cornerstone. While this year has been a challenge operationally – for Chartis and our clients – we believe that we have emerged stronger as a result, while the RiskTech100® rankings serve as a testament to the importance and resilience of many players in RiskTech markets.

With that in mind, it only remains for me to congratulate the vendors that feature in RiskTech100® 2021. On behalf of the whole Chartis team, we look forward to working with them and others in what promises to be another crucial year in RiskTech.

Enjoy the report!

Mark Feeley, Global Brand Director

2. Overview

The companies in RiskTech100® are drawn from a range of risk technology specialisms, and meet the needs of financial and non-financial organizations. They share a number of qualities that rank them among the top 100 RiskTech providers in the world.

Note that the RiskTech100® report only includes companies that sell their own risk management software products and solutions.

We determine the RiskTech100® rankings based on the classifications shown in Figure 1, and focus on solutions, industry segments and success factors.

Figure 1: RiskTech100® 2021 taxonomy



Source: Chartis Research

RiskTech100® 2021: Highlights

FIS, Moody's Analytics, MSCI, Oracle and SAS remained in the top five spots. Numerix rose 3 places to enter the top 10.

There were 13 new entrants to the rankings this year:

- Dow Jones (ranked 29)
- OneTrust (47)
- Trepp (48)
- PwC (65)
- Mitratach (68)
- AML Partners (72)
- CARE Risk Solutions (86)
- ActiveViam (89)
- NetGuardians (93)
- Aptitude Software (95)
- Mirai (97)
- SecondFloor (98)
- ComplyAdvantage (99)

6 companies rose in the rankings by 5 places or more:

- Fenergo moved up 9 places, from 42 to 33
- Beacon Platform moved up 9 places, from 47 to 38
- SS&C moved up 7 places, from 27 to 20
- Prometeia moved up 7 places, from 34 to 27
- Loxon moved up 6 places, from 70 to 64
- ACI Worldwide moved up 5 places, from 58 to 53

RiskTech vendors

Mergers, acquisitions and partnerships continue apace among vendors in the risk and compliance technology market. Opposite is a representative list (selected by Chartis) of deals announced in the past 12 months:

Highlights of RiskTech100® 2021

 **13** new entrants

 **26** Rising Stars

 **6** notable rises

- Broadridge acquired digital platform FundsLibrary; and ClearStructure Financial Technology, a provider of portfolio management solutions for private debt markets.
- Chicago Board Options Exchange (Cboe) Global Markets acquired Hanweck, a provider of real-time risk analytics; and FT Options, a portfolio management platform.
- Confluence Technologies bought StatPro, a cloud-based firm offering software as a service (SaaS)-delivered portfolio analytics.
- FIS acquired a majority interest in Virtus Partners, which provides solutions for asset managers, banks, hedge funds and investors.
- IBM acquired Spanugo, a cloud cybersecurity start-up; and Brazilian robotic process automation (RPA) provider WDG Soluções Em Sistemas E Automação De Processos LTDA.
- IHS Markit acquired Catena Technologies, a global regulatory trade reporting firm.
- Moody's Corporation acquired Regulatory DataCorp (RDC), a provider of anti-money laundering (AML) and Know Your Customer (KYC) data and due-diligence services.
- MSCI acquired a minority stake in Burgiss Group, a specialist private asset data provider.
- NICE Actimize acquired Guardian Analytics, a leading provider of cloud-based AI financial crime risk management solutions.
- Refinitiv acquired The Red Flag Group, a global integrity and compliance risk firm; and Scivantage, a wealth management solution provider.
- Wolters Kluwer acquired risk management software provider CGE Risk Management Solutions.

3. Big Bets, blockchain and beyond: analyzing the Chartis View of RiskTech

In the past 10 years or so, the risk technology landscape has been transformed. Successive regulations and accountancy standards, many issued in the wake of the 2008 financial crisis, have forced financial institutions (FIs) to examine and redesign their technology operations in new ways. And as digitalization and data have swept across the financial services industry, the sophistication of analytics is bringing about its own revolution, as FIs across the industry find more appropriate uses for analytical tools and techniques. In some areas of RiskTech – notably credit risk and GRC – digitalization and the transformation of analytics have caused deep structural changes to operations, processes and systems, changes that will have profound implications for FIs and vendors alike.

And then there is COVID-19. Much like the financial crisis before it, this latest global upheaval is likely to have lasting (albeit uncertain) effects on RiskTech systems and processes, notably – and not coincidentally – in the areas of credit risk and GRC. Crucially, though, rather than creating new problems and issues in financial sectors, the pandemic may simply be highlighting and amplifying concerns that were already there.

Examining the landscape

The chief remit of any research house is to identify market trends and predict how they will develop and shape the landscape as technology and business models evolve and adapt. In the 15 years that Chartis has been analyzing RiskTech markets, it has always trained a steady, objective gaze on evolving technologies and their application. As a result of the changing technology landscape, especially one altered by COVID-19, we are continually finding new areas to explore and analyze, with often complex nuances that must be carefully examined and evaluated.

In our *Big Bets 2020* report, we highlighted several core RiskTech themes that build on ongoing Chartis research – notably the operationalization of AI and other tools and processes, the credit revolution, and the structural changes in key RiskTech areas such as GRC. In the following three articles, we outline the Chartis View in these strands of research, summarizing the

developments we have identified, and emphasizing our actionable advice and analysis for market participants.

Dismantling the Chartis RiskTech lens: digitalization, hype, and the Rule of 10

Any research and analysis, of course, is always viewed through the lens of the overarching forces shaping the landscape. In the case of our RiskTech research of the past few years, these can be summarized as ‘digitalization’, ‘hype’, and the ‘Rule of 10’ (not forgetting the unexpected but often transformational role of crises like COVID-19). In this article we consider these factors in more detail, drawing on examples of our own research – into cyber and blockchain – to consider how, for the most part, our analysis has been borne out by market events. Finally, we list some of the areas we will focus on in future, to ensure we maintain a leading independent voice in RiskTech research.

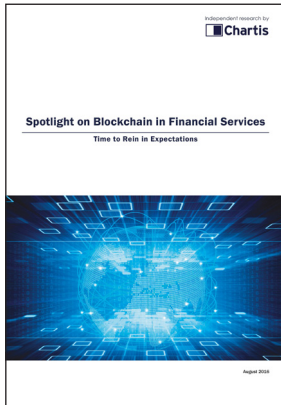
Expectations and reality: the case of cyber

In recent years the one certainty in industry has been digitalization. Digitalization – and the wider availability and improved quality of data – is now at the heart of most modern business. This in turn has made cyber, and cyber risk, a fundamental concern for most business operations.

Because cyber risk is now vital to most organizations, there has been much discussion about the importance of tackling it, and developing suitable technology to do so. Since we published our first cyber report in 2016 (*Safety in numbers: Toward a new methodology for quantifying cyber risk*), there has certainly been a lot going on. The amount of cyber-risk modeling has increased, new cyber-risk entities have been created in the vendor space, and there has been much activity in areas such as cyber risk quantification (CRQ).

Given this attention and activity, it would have been reasonable to predict that cyber-risk technologies might have matured by now, with standardized and well-understood technology tools and systems. But cyber-risk technology remains a fragmented market, with a variety of

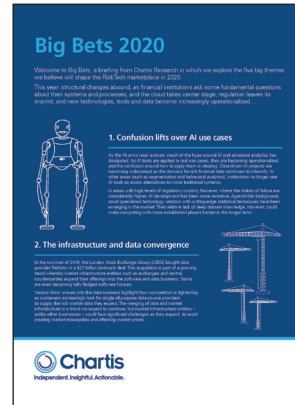
The Chartis View: key references



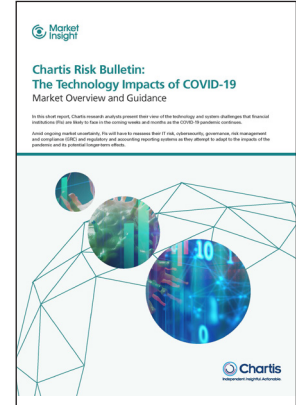
Spotlight on Blockchain in Financial Services
August 2016



Spotlight: Quantifying Cyber Risk in Financial Institutions
February 2017



Big Bets 2020
January 2020



Chartis Risk Bulletin: The Technology Impacts of COVID-19
April 2020

methodologies and approaches¹, and considerable confusion among end users about how these relate to one other. Despite attempts (including some by Chartis) to taxonomize the space with a framework in which to analyze solutions and approaches, the overarching confusion among users is still deeper than many (including us) had expected.

Understanding the basics: hype and the Rule of 10

As our research has revealed, the evolution and maturity of any technology – including cyber-risk solutions – relies on its users fully understanding the methodological and conceptual factors that underpin it. This is a tough ask. In short, it is far easier to buy systems and software than to understand them completely. So the journey of a particular technology approach toward maturity and widespread standardization can take some time.

About a decade, in fact. Cyber-risk technology will take about 10 years in total to mature – and there is no reason why it should move any faster. Miscalculations about its maturity have largely emerged because of ongoing discussions about its crucial importance, which have created a false imperative that cannot be borne out by reality. In short – because of hype.

Experience tells us that the ‘Rule of 10’ is likely to be an iron law of technology development: significant technologies take about a decade

to settle in, regardless of what they are or how important they are deemed to be. Developers make mistakes; they continue to use old terminology and old mechanics; and progress and learning are slow.

A solution looking for a problem: puncturing the blockchain bubble

Of course, there’s always an exception that proves the rule – and in the context of our research this would be blockchain. In *Spotlight on Blockchain in Financial Services*, a largely skeptical analysis of the technology published by Chartis in August 2016, we considered the mix of technical issues inherent in blockchain, and remarked on its functional similarity to reconciliation solutions. Over time, as technological maturity has helped to push down the cost of reconciliation, the relative rigidity of blockchain approaches has made them less obvious alternatives. In a similar trajectory to the relative success of cell and satellite phones, reconciliation technologies have matured to the point that they are now so cheap and straightforward that, increasingly, blockchain doesn’t seem worth the effort.

Blockchain and distributed ledger technology (DLT) demonstrate that a technology is only likely to mature beyond the theoretical if robust use cases have been developed for it. Despite being around for some time, blockchain and DLT have yet to reach maturity and standardization in the financial services industry (although many argue that they

¹ Factor Analysis of Information Risk (FAIR), for example, or statistically driven frameworks that focus on producing event probabilities using risk-attribution-related models.

are being used more effectively in other areas). The reason is simple: rather than a revolutionary technology, blockchain is more like an overly complex solution in search of a problem.

governance and industry standards should guide any firm's crisis response: how they act now could ultimately affect the reputation and resilience of the business.

Focusing the lens: COVID-19 and the crisis factor

By the spring of 2020, the coronavirus pandemic had driven most of the world into lockdown, markets into freefall, and unemployment into record high figures. Crises have a habit of shaping the RiskTech landscape, as we saw with the financial crisis of more than a decade ago. While it might seem that COVID-19 has transformed the world (at least in the short to medium term), from a RiskTech perspective, and particularly when we talk about the increasing digitalization of modern economies, COVID-19 is simply magnifying and distorting dynamics that were already there.

One effect of the pandemic has been to sharpen the focus on specific areas of the RiskTech space – notably credit risk and GRC. As with any crisis, the effectiveness of FI's response to the pandemic will depend on two factors: governance and technology. And as Chartis pointed out earlier this year (in *Chartis Risk Bulletin: The Technology Impacts of COVID-19*), while the far-reaching consequences of the crisis are uncertain, how well companies cope will depend to a large extent on their technology infrastructures. Good

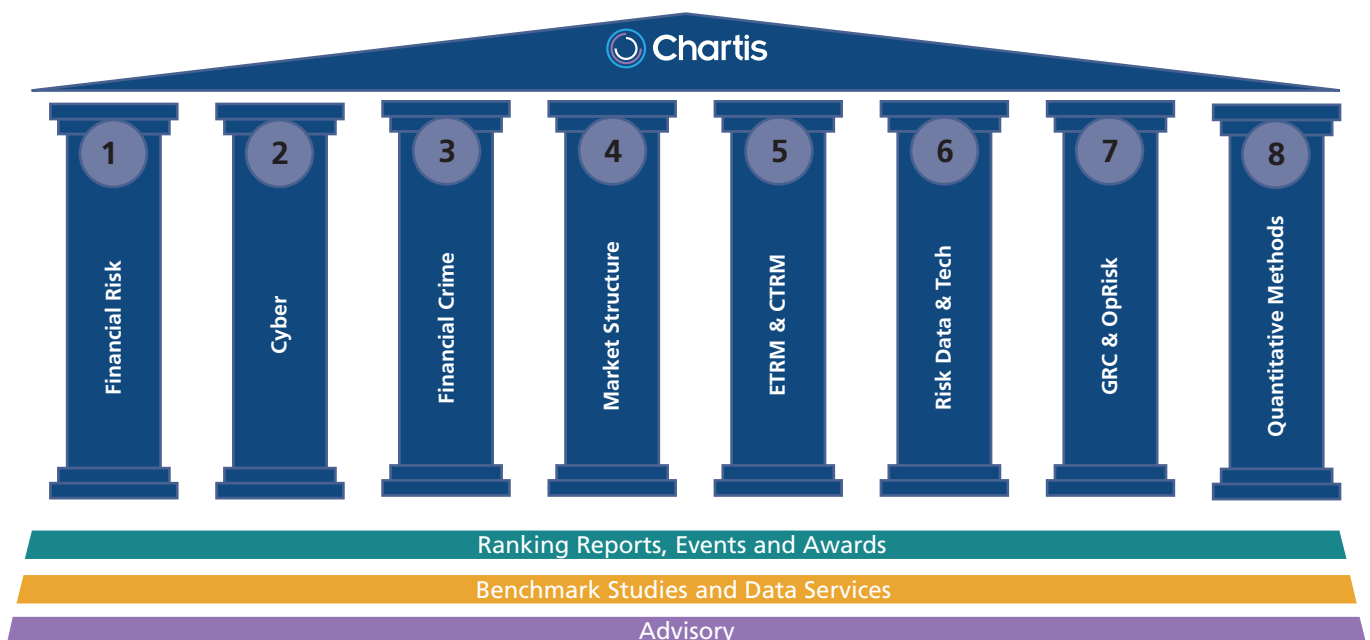
The long view

If Chartis' research has revealed anything over the years, it is that the context in which RiskTech evolves is defined by core themes that include crisis, digitization, hype and conceptual maturity. As the landscape evolves, different segments of the financial services sector will continue to converge as mathematical frameworks, computational processes and best practices are exchanged. Even post-COVID-19, these dynamics are unlikely to change, and they will continue to shape and steer future developments in specific RiskTech sectors.

And this will be the lens through which Chartis will continue to view the landscape and its ongoing evolution. As outlined in our regular research updates, we will structure our research across eight key pillars (see Figure 2) – financial risk, cyber, financial crime, market structure, energy/commodity risk management, risk data, GRC and quantitative methods – conducting our broader analysis as we assess technology: through the hype and on into maturity.

For more information, contact us on info@chartis-research.com.

Figure 2: Chartis Research – our research pillars



Source: Chartis Research

4. Artificial intelligence: beyond the hype into a new reality

The Chartis View: Statistical tools such as AI and ML are now used widely across the finance sector. But rather than becoming our bosses, or replacing us entirely, they have found more prosaic – but no less impactful – employ in a variety of business niches. Nevertheless, a more pragmatic approach to AI will require a new way of thinking – and speaking – about it.

A radical rethink

Until fairly recently, AI tools were seen as exotic, mysterious and all-powerful technologies destined to revolutionize industry and sweep all before them – ‘black boxes’ that can be plugged into any system to miraculously transform it and save users a lot of time, effort and money. In fact, elements of AI and machine learning (ML) have been embedded in financial services for a while, and nowadays are used mostly as ‘cogs’ in bigger, established processes and systems.

Nevertheless, the prevailing view of AI in financial services has resulted in many misapplications of the technology. In recent years, though, users have been encouraged to rethink exactly what AI is, and how to use it effectively. In its research, Chartis has been dismantling some of the persistent beliefs about AI, to encourage more pragmatic thinking about the technology. And its main themes and conclusions – AI maturity varies by industry and geography, AI tools are used most often in data management, and are most effective when used in tandem with more traditional

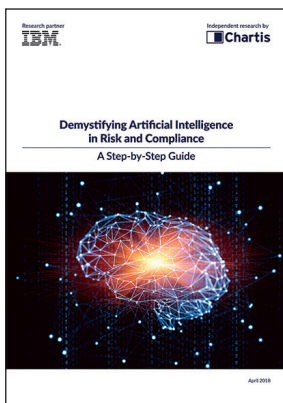
techniques – have largely been borne out in the market.

Recognition and reconciliation

AI systems are not robots, and they do not ‘think’ like humans. Rather, they are statistical processes ideally suited to extracting complex patterns across vast amounts of data. The results generated by an AI or ML routine depend on data inputs; they don’t occur because the AI ‘thinks’ a certain way. If a particular type of person constitutes the profile of 97% of the employees in an organization, an ML-based analysis as part of a recruiting process – in essence a regression-type statistical model – will produce a profile similar to those of people hired in the past. If, on the other hand, a firm has been acquiring certain types of asset in the past, an ML routine can identify efficiently and quickly what future asset acquisitions should be, based on a logic of replicating historical patterns it recognizes.

And that’s the key. Anthropomorphism only goes so far: AI and ML tools are replication, correlation

The Chartis View: key references



Demystifying AI in Risk and Compliance
April 2018



AI in Financial Services, 2019: Demand-Side Analysis
February 2019



AI in Financial Services, 2019: Market and Vendor Landscape
March 2019



The State of AI in Risk Management
October 2019

and pattern-recognition engines that cannot necessarily predict a future that is in any significant way different from the past. What they excel at is spotting and extracting complex patterns that humans may not see – or those that humans can spot, but get bored in the process of doing so. Humans can extract specific terms and words from a 500-page pro forma legal document, for example, but it takes a long time, with diminishing returns in terms of attention span and engagement. AI tools, on the other hand, can do this very efficiently.

We are now starting to experience what we might term a ‘quantitative reconciliation’ in AI. Rather than accepting AI solutions as something that ‘just work’, without much explanation or knowledge of why that should be so, FIs are gaining a better understanding of their quantitative foundations. And the view of AI as a catch-all ‘magic bullet’ is increasingly seen as problematic.

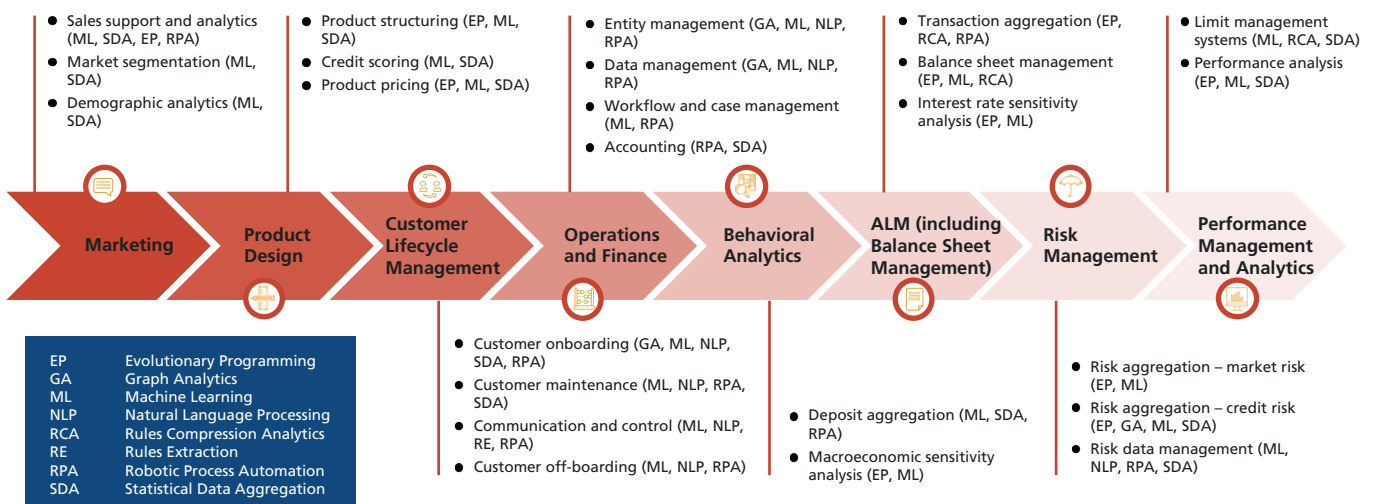
Also contrary to popular belief, AI tools are not being applied uniformly across different market segments in the finance industry. They have enjoyed most success in areas such as retail banking (see Figure 3) and alt-data analysis, rather than in the capital markets sector, which is often a test-bed for new technologies. The application of AI tools also varies considerably by use case: AI is relatively widespread in the area of data management, for example, where specific tools (such as ML, natural language processing [NLP], and graph analytics [GA]) have proved particularly well-suited to certain applications.

Toward a more pragmatic reality

More recently, awareness of the prosaic nature of AI tools as pattern-recognition and correlation engines has spread, and as the number of AI implementations has grown, use cases and applications of the technology have become more ‘realistic’. Contrary to some speculation, nobody yet has an AI boss – nor are they likely to for some considerable time. Instead, AI can be used in a multitude of relatively low-level digital applications: tracking locations, monitoring email and websites visited, and extracting text. One application, for example, is to use AI tools to track employees’ movement in offices by monitoring their access cards. Based on historical behavior, the system can flag if someone wanders away from where they should be. What’s more, with AI this process can be extended across thousands of employees. Few humans would be capable of this level of attention to detail, but for an AI or ML solution it is a relatively easy task.

In the finance industry, the number of areas in which pattern-recognition and correlation engines can be used is vast. Successful applications are straightforward and statistical. And increasingly FIs are appreciating and understanding the boundaries of the technology, and its true value, which exists largely in augmenting human beings, rather than replacing them wholesale.

Figure 3: AI tools are in broad use across the retail banking value chain



Source: Chartis Research

Rethinking AI: a proper explanation...

Reflecting the more pragmatic approach to understanding and using AI that is pervading the finance industry is the move toward 'explainable' AI. Recent thinking has been that AI tools can and should explain themselves. But this thinking is influenced by the common and mistaken attribution of human emotions, feelings and actions to what are in essence mathematical, statistical routines.

Humans can attempt to explain themselves by employing a complex semantic process to articulate their actions and the reasons behind them. Neural networks, by contrast, merely do what they do. To fully appreciate what this actually entails requires a deep understanding of the underlying mathematical and stochastic structures. The key to AI use and explainability is understanding the data, understanding the inputs and outputs, and having a firm grip of the statistical processes at work. (Of course, to make the most of data analysis, institutions must also have access to the right sources of data and the right expertise to manage it.)

...requires the correct terminology

This is all very well. But as Chartis has argued for some time, in its work to 'demystify' AI, the drive toward a more pragmatic approach must be couched in the correct terminology. The language of AI needs to adapt alongside the technology. 'Learning' in a human context, for example, has a quite distinct and widely understood meaning. Using the word 'learning' in an AI context, however, can cause misunderstandings about what process is actually being employed. A term like 'iterative correction', by contrast, is unlikely to cause as much confusion.

Fortunately, in some areas of the finance industry (capital markets, notably), this need for a change in terminology is starting to filter through, as quants develop a better understanding of how AI and ML models really work. In other areas, however, progress like this is still some way off. And as long as terminological ambiguity persists, evolution toward a more sophisticated understanding of AI is still likely to be relatively slow.

The right uses

At their heart, AI and ML tools are about statistics. We shouldn't get over-excited about them – but equally, we shouldn't be too depressed about them either. The discussion is no longer about whether robots will take over the world, or even make our lives easier. The reality is clearer and more prosaic: AI is here, it's ubiquitous, it focuses on data management, and it's relatively straightforward to use in the right applications. Attempt to use it in implementations that are too complex and it will fail; set it up for vanilla text extraction, and it will thrive.

5. Credit in a time of crisis: the new structural reality of Credit Risk 2.0

The Chartis View: As credit, the lifeblood of modern economies, undergoes a transformation, deep structural and operational issues are being exposed – and amplified by COVID-19. As banks continue to spend big on credit solutions, and credit risk concerns spread across the finance landscape, for technology vendors this is a time for action and adaptation.

A vital area

Credit provision is the lifeblood of the entire financial system, a central pillar of modern economies and a measure of their sophistication. Even taking into account the effect of central bank initiatives on credit mechanisms in recent years, the provision of credit is what distinguishes and differentiates highly sophisticated markets like the US (and to a lesser extent the UK and some European countries) from everywhere else. And for banks credit is fundamental – the main reason they exist.

The credit risk landscape is a diversified space composed of many sub-areas and niches, each with its own issues and concerns. Since Spring 2018 Chartis has been researching and analyzing what it terms ‘Credit Risk 2.0’, a new interpretation of the credit risk landscape that covers areas including technology solutions, credit data, credit valuation adjustment (CVA) and the transformation of credit in financial markets. We regard credit risk as a vital area for research and analysis for three main reasons:

- Credit risk, credit operations and credit risk models are undergoing profound structural change.
- Difficult questions are being posed about many of credit’s central tenets and pillars, and new complex problems are emerging in the space.
- Banks are spending considerable amounts of money on credit-risk systems and solutions (see Figure 4).

A structural transformation...

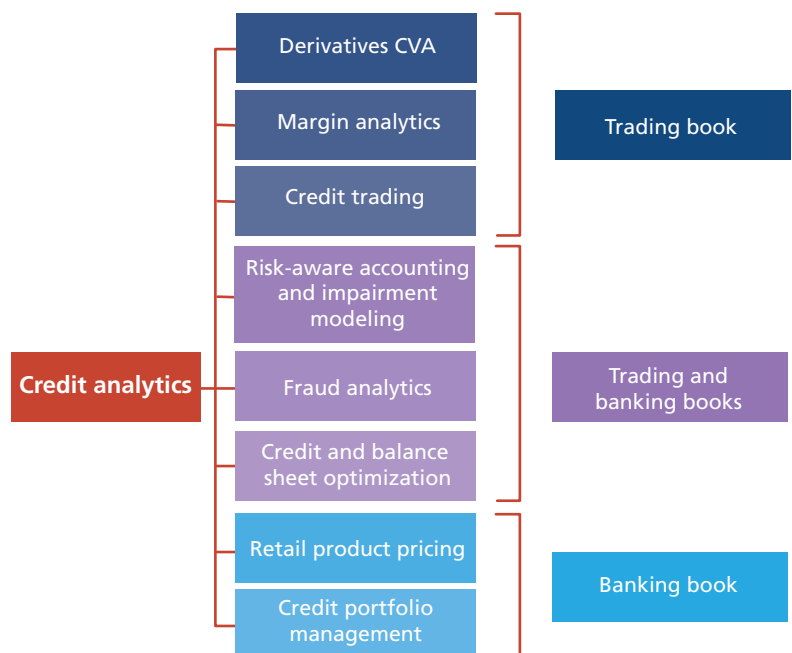
The wholesale transformation of credit markets in the past few years has been triggered largely by regulations and disclosure standards – notably Basel 4, International Financial Reporting Standard (IFRS) 9 and Current Expected Credit Losses (CECL). The effect of these initiatives has been to

stimulate new ways of thinking about credit and how banks structure and organize it. As a result of the Basel regulations in particular, banks have been pushed to shift some credit risk onto buy-side firms – insurance companies in Europe and asset managers and hedge funds in North America.

In addition, in any economic cycle throughout history, as the cycle of growth nears its end, credit challenges (such as the threat of boom-and-bust as cash flows dry up and defaults increase) start to mount. Concerns about the state of credit have been simmering in the market for some years, but against a background of continued strong growth they have been largely ignored. But as the growth cycle draws to a close, the introduction of new regulatory and disclosure standards has increased banks’ focus on credit and credit processes.

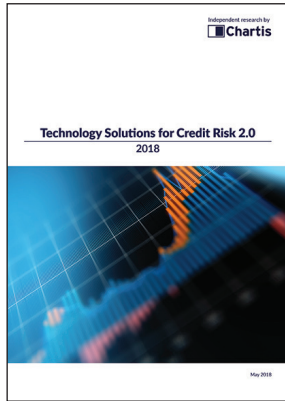
Several issues have been revealed – many processes have become disorganized, over-automated, or highly centralized and standardized.

Figure 4: Banks are investing in a broad range of credit analytics

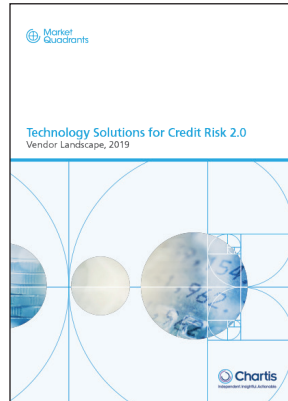


Source: Chartis Research

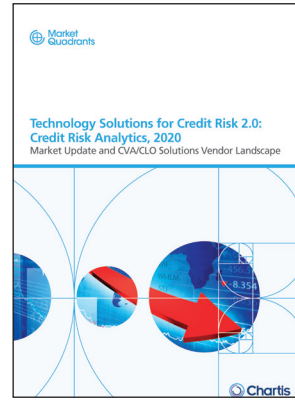
The Chartis View: key references



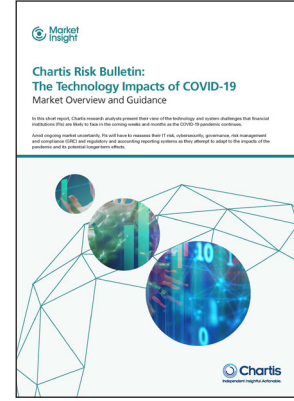
Technology Solutions for Credit Risk 2.0
May 2018



Technology Solutions for Credit Risk 2.0: Vendor Landscape, 2019
December 2019



Technology Solutions for Credit Risk 2.0: Credit Risk Analytics, 2020
April 2020



Chartis Risk Bulletin: The Technology Impacts of COVID-19
April 2020

Standardized operations enable banks to apply the same process to all customers regardless of who they are, where they live, or what they do. But maintaining these processes with large numbers of staff can be expensive, and assuming that all customers' credit dynamics are the same, regardless of which industry or location they happen to be in, means that customers receive the same treatment based on standardized and fairly straightforward algorithms. In that context, if a process fails even slightly, huge losses can result.

...amplified by COVID-19

Then COVID-19 happened. The pandemic has introduced a completely unexpected – and potentially explosive – variable into the equation, modifying the structural shift already gripping the credit landscape, and accelerating the credit deterioration. This realignment has also meant a refocusing of attention away from purely regulatory and reporting issues to more operational ones.

Crucially, however, the shift to an operational focus was already happening pre-COVID; the pandemic has merely accelerated it, bringing an existing problem into sharper focus. Clearly concerned, regulators and central banks are keeping their interventions largely positive, aware that banks are the best available channels through which to distribute vital funds to small and medium-sized companies.

The consequences of crisis

Of course, many of the consequences of current developments are unknowable at this time. The effects of COVID-19 are linked in large part to how governments react – how much lockdown they impose, what level of reopening and restoration of 'normal' services they allow, and the type of fiscal policies they inject into the system. During a period of post-COVID-19 transition, regulators will have to cooperate with banks to enable them to make the shift as smoothly as possible. We are likely to see a great deal of credit 'relocation', as companies in industries that were relatively stable before the pandemic (such as transport, travel and hospitality) find themselves struggling, and more marginal ones (some in the energy sector, for example) bow out completely. Credit in emerging markets will also face a turbulent time.

A crash course in credit

There have been wider consequences too, notably on the buy-side. In the past, few buy-side firms were overly concerned about the ramifications of credit risk. Even if they bought credit-risky instruments they tended to assume they were relatively stable, and that they could synthesize third-party results and analysis to create a point of view they could invest against. The traditional approach was to employ buy-side-oriented mechanics and thinking without being overly concerned with the granular details.

Now, however, firms are having to take a crash course in credit. As demand for far more granular detail about crucial market dynamics grows, a

host of firms are starting to offer more detailed and sophisticated analytics and data, becoming in the process extremely valuable in the new environment. With such potential for growth, ultimately it's likely that many of these firms will become a central feature of the new credit space.

What's more, as COVID-19 hit, some hedge and private equity funds were actually more willing than banks (and quicker) to lend money to some of the most affected firms, including airlines. (Assuming the price was right, of course.) If nothing else, this highlights the value of allowing different types of institution – such as hedge funds and insurance companies – to address credit, because they bring different perspectives. Insurance companies, for example, are willing to consider credit for very long periods of time. And some classes of hedge and sovereign fund may be willing to be more flexible – and certainly more opportunistic – in a crisis.

The future of Credit Risk 2.0: what will change?

So far, thanks in large part to central bank interventions, the market has been preserved in something of a bubble. In some senses, a complex system has been tested by the current crisis. And while it has not necessarily been found wanting, clearly many credit-related challenges are likely to surface in the next two to three years.

The resulting change to the credit landscape is likely to be vast. The new emphasis on operations will inevitably lead to a realignment and shift in the type of analytics financial firms use, and credit analytics and models will have to adapt. Chartis believes that the exact mix of systems will change as a result of the COVID-19 crisis, with a greater focus on process and early warning and analysis.

The use of alt-data, at every level of credit, will become a central process pillar. And as alt-data and alternative analytical models (such as ML tools) are used more in an operational context, new challenges will arise.

The operational implications

Some banks have addressed the operational overhead highlighted by COVID-19 by approaching outsourcers for short-term support. Looking ahead, however, it's clear that they will have to significantly rethink many parts of their operational

chains, improving certain elements, and automating appropriately where necessary.

Growing numbers of institutions have started to invest in behavioral models to get a better understanding of their clients. Many, however, have overly simplistic, standardized processes that do not necessarily account for the complexities of individual and market situations, and which lack sufficient granularity. Banks will have to replace their standardization with a more sophisticated – yet industrialized – process that allows some flexibility and ensures the speedy delivery of crucial business data. Looking ahead, banks' singular challenge will be to balance two contradictory elements: become more granular in their operations and analysis, but with a process that is industrialized and systematized enough to make money.

Of course, this would be a challenge in the best of times, but in current circumstances it is made harder, not least because systems and processes will have to be changed 'in flight'. For FIs, connecting firms across the market will require diverse, granular data sets and the application of credit-risk models. So in the next several years, we are likely to see a significant dynamic at play in the areas of credit operations and credit analytics, driven by FIs' operational, disclosure and regulatory requirements, and heightened by the COVID-19 crisis.

For vendors, solution churn

For technology and solution vendors this will mean much change too. A rapidly growing and complex vendor landscape is evolving, containing firms that cover a variety of data areas. We are likely to see significant churn in the solutions market, as new data and analytics systems and solutions emerge, and older operational systems face a challenge from new managed-service platforms. Vendors must be ready to adapt. And while the market at the moment is composed of a fairly diverse set of companies, most of which are growing, ultimately we will see consolidation in the credit risk space – and vendors must be prepared.

6. GRC, old and new: a digital divergence

The Chartis View: Shaking off its ‘tick-box’ role as digitalization spreads, modern GRC technology – and its various sub-segments – has become a core discipline for most financial businesses. As governance, operations and business continuity become critical in a post-COVID world, solution vendors will have to diversify and specialize to succeed.

Evolving into diversity

GRC as a technology concept originated in the area of organizational audit, before expanding into the operational risk aspects of a business. A large and significant component of GRC is process-oriented, focusing on how firms manage their governance and a variety of ‘non-quantitative’ operational and reputational risks.

As GRC has evolved over the past 15 to 20 years, its organizational importance in the finance industry has waxed and waned. In many businesses GRC systems have been implemented largely to demonstrate an awareness of the issues. GRC is a diverse area of risk, and while most firms recognize its theoretical importance, its specific role, and its relationship to other business processes and systems, has often been unclear. Over time, several other operational areas, united by a focus on process rules and controls, have moved under the GRC umbrella. A modern definition of GRC will include many sub-segments such as model risk management (MRM), third-party risk management (3PRM), IT resilience and CRQ; and these sub-segments are increasingly becoming standalone functional areas. Despite this

evolution and expansion, however, until relatively recently GRC has remained largely a ‘tick-box’ concern.

Digitalization drives GRC to the center

More recently, spending by FIs on most areas of GRC has been driven largely by business factors, such as boosting efficiency, improving the utilization of IT assets, and a desire to meet service-level agreements reached with third parties. In the past five to seven years, aggressive digitalization has spread across virtually all businesses, and offers firms the possibility of significantly more control capability. FIs can now collect and access previously unavailable data and apply a variety of new controls, deflecting or preventing certain behaviors (managing conflicts of interest, for example, or failing to act in the customer’s interest) in real time, rather than after the fact. Risks can also be quantified, because it’s now possible to independently monitor every element of an electronic workflow – who is doing what, when, and for how long – as well as gaps,

The Chartis View: key references



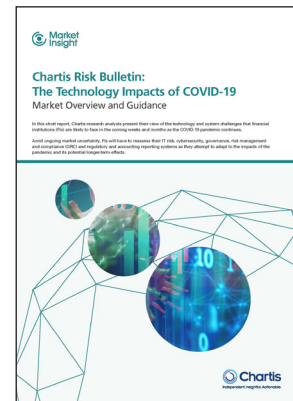
Enterprise GRC Solutions: Market Update 2017
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Enterprise GRC Solutions, 2019: Market Update and Vendor Landscape
November 2019



More Than Just Policy: Effective MRM in a New Age
March 2020



Chartis Risk Bulletin: The Technology Impacts of COVID-19
April 2020

risks and key performance indicators (KPIs). For GRC as a discipline, this has meant a steady move toward a far more central role in the business. This has also been true for each of its sub-segments – notably MRM.

Digitalization has its downside too. It can usher in problems, such as increased risk of hacking, and uncertainties around external firms and their connected entities. And there is no escaping COVID-19. The pandemic has given FIs a painful reminder of the vital importance of robust business continuity planning as part of effective GRC systems. Many are reassessing their approach to GRC, with a view to upgrading and honing their systems.

A range of developments: the burgeoning role of MRM, 3PRM and IT risk

Of the individual GRC sub-segments, **MRM** has become considerably more important. A series of regulations from the US Fed, the European Banking Authority (EBA) and the Financial Conduct Authority (FCA) have addressed a variety of issues around MRM, and further regulation is likely. Buy-side firms are also increasingly being pushed to examine their models.

And as banks sharpen their focus on IT as an overall capability, the importance of IT and **IT risk** has increased hugely. Once regarded as simply another type of workflow, it now occupies a central area in the business. Concerns about IT risk and resilience have grown as systems bear the pressure of more remote working, and for most FIs these are now crucial considerations.

Similar trends can be observed in the area of **third-party risk**. FIs are becoming increasingly concerned about who they connect to, who their suppliers and counterparties are, and the risks posed by connecting with them. Until recently IT and counterparty relationships had been something of an afterthought for regulators. Now, however, they are starting to ask tougher questions about who firms are working with, what form their infrastructure takes, and how sure they can be that they have fulfilled all their privacy and regulatory obligations.

Finally, quantifying non-market risks (such as operational risk and conduct risk) has become much easier in the new digital environment. A broader set of functional tools – such as ML and

nonparametric statistical methods – have become widely available, as has the data needed to enable them. There is now no business rationale for not carrying out these activities. Together, these developments have also helped to make GRC more central to firms' business and operational concerns.

Vendor dynamics: balancing 'old' and 'new'

For technology vendors attempting to respond to these dynamics, awareness and understanding are vital: of the complexities and wider implications of GRC systems, and of their peers in the vendor landscape. Vendors must transform as the landscape changes. This will involve emphasizing their analytical capability, sharpening their ability to work with IT systems and myriad networks, and gaining a thorough understanding of the underlying infrastructure.

Needless to say, this presents opportunities and challenges. For one, vendors will have to integrate with a diverse range of technologies, forcing them to focus on the nuances of technology in a new way. They will also need a clearer picture of the wider landscape in which they operate, remaining constantly aware of their shifting technology environment while transforming 'in flight'.

Solution providers will approach the market from different angles: some will build complete frameworks, while others will focus on specific content areas – and this will increase the diversity of vendors in the space. A variety of new players have already started to emerge, including 'classical' workflow and document management firms and players with more general-purpose, across-the-board GRC solutions. Alongside these providers are very specific and narrow players that operate in different contexts. As general platform providers establish partnerships with various component firms, specialization will increase across the landscape, producing a mix of end-to-end and specialist players.

In tandem with this, 'older', more 'traditional' GRC players will, we believe, become a subset of the newer, overarching GRC concept, either by consolidating into larger entities, or scaling down and paring their focus to avoid wide thematic variance. And while the core market segment consolidates, in the broader GRC space there will be more fragmentation and activity, with a repositioning of more longer-serving firms.

In fact, the functional variety across the GRC landscape is so considerable that in conceptual terms it would be virtually impossible for any single vendor to span everything – to be effective across cyber risk and IT risk, for example, as well as MRM and 3PRM. Within the broader expanse of GRC, some smaller FIs may require highly specific solutions, and may opt for a technology partner with a lightweight offering, collaborating at a distance.

Overall, the broader GRC space contains many niches in which to operate, and for the growing variety of players within it, a balance between platform content and the right partnerships will be critical.

7. RiskTech100® 2021 rankings

2021 Rank	2020 Rank	Company	HQ	Overall score	Functionality	Core technology	Strategy	Customer satisfaction	Market presence	Innovation
1	1	FIS	US	77.27%	94.2%	80.9%	72.0%	62.5%	86.0%	68.0%
2	4	Moody's Analytics	US	72.50%	85.0%	69.0%	76.0%	64.5%	73.0%	67.5%
3	3	Oracle	US	72.38%	84.8%	85.0%	67.0%	58.5%	71.0%	68.0%
4	2	MSCI	US	72.25%	79.0%	71.0%	75.0%	65.0%	75.5%	68.0%
5	5	SAS	US	71.50%	85.0%	80.0%	64.0%	59.0%	75.0%	66.0%
6	6	FICO	US	69.17%	79.0%	65.0%	66.0%	65.0%	66.0%	74.0%
7	8	Wolters Kluwer	Netherlands	68.80%	83.5%	68.5%	60.0%	66.8%	73.0%	61.0%
8	7	Murex	France	68.17%	76.5%	72.0%	66.5%	61.5%	67.0%	65.5%
9	12	Numerix	US	66.67%	67.0%	61.0%	72.0%	68.0%	67.0%	65.0%
10	9	NICE Actimize	US	66.50%	70.0%	65.0%	69.0%	56.0%	72.0%	67.0%
11	10	IHS Markit	UK	66.08%	73.0%	67.0%	68.0%	61.5%	62.5%	64.5%
12	11	Finastra	UK	65.50%	77.0%	69.0%	62.0%	50.0%	77.0%	58.0%
13	14	Bloomberg	US	65.42%	70.0%	63.0%	67.0%	61.0%	67.0%	64.5%
14	13	ION Trading	Ireland	65.33%	81.0%	70.0%	66.0%	40.0%	73.0%	62.0%
15	15	IBM	US	65.00%	69.0%	79.0%	65.0%	52.0%	61.0%	64.0%
16	20	MetricStream	US	63.83%	64.0%	60.0%	66.5%	66.0%	70.0%	56.5%
17	16	LexisNexis Risk Solutions	US	63.58%	70.0%	65.0%	60.0%	60.0%	63.5%	63.0%
18	18	Qontigo ¹	Germany	63.08%	68.5%	63.0%	65.0%	62.0%	56.0%	64.0%
19	19	AxiomSL	US	63.00%	65.0%	64.0%	64.0%	67.0%	59.0%	59.0%
20	27	SS&C	US	62.97%	71.8%	58.0%	68.5%	57.0%	65.5%	57.0%
21	17	Refinitiv	UK	62.92%	76.5%	65.0%	55.0%	55.0%	70.0%	56.0%
22	22	Numerical Technologies	Japan	62.88%	76.5%	68.5%	52.5%	66.3%	51.5%	62.0%
23	21	FactSet	US	62.50%	71.0%	58.0%	64.0%	51.5%	63.0%	67.5%
24	23	CME Group ²	US	62.00%	69.0%	60.0%	62.0%	60.0%	57.0%	64.0%
25	25	GBG	UK	61.83%	65.0%	61.0%	68.0%	56.0%	56.5%	64.5%

2021 Rank	2020 Rank	Company	HQ	Overall score	Functionality	Core technology	Strategy	Customer satisfaction	Market presence	Innovation
26	28	BlackRock Solutions	US	61.50%	73.0%	52.0%	67.0%	52.0%	64.0%	61.0%
27	34	Prometeia	Italy	61.42%	66.0%	59.0%	59.0%	71.5%	51.0%	62.0%
28	26	Confluence ³	US	61.38%	63.3%	56.0%	64.0%	63.0%	57.0%	65.0%
29	–	Dow Jones	US	61.33%	66.0%	67.0%	55.0%	60.0%	60.0%	60.0%
30	29	Nasdaq	US	61.21%	56.0%	63.0%	65.0%	58.5%	60.0%	64.8%
31	30	Fiserv	US	60.92%	71.5%	63.0%	52.0%	62.0%	66.0%	51.0%
32	24	BAE Systems Applied Intelligence	UK	60.92%	69.0%	63.0%	54.0%	54.5%	60.0%	65.0%
33	42	Fenergo	Ireland	60.58%	64.0%	60.0%	61.0%	56.0%	62.5%	60.0%
34	37	Calypso	US	60.42%	69.0%	64.0%	60.0%	53.0%	58.0%	58.5%
35	39	Intellect Design	India	59.71%	68.0%	62.0%	59.0%	60.5%	50.3%	58.5%
36	36	Raise Partner	France	59.71%	67.0%	63.0%	61.3%	60.0%	45.0%	62.0%
37	41	Cboe ⁴	US	59.67%	57.0%	63.0%	62.0%	61.0%	55.5%	59.5%
38	47	Beacon Platform	US	59.58%	61.5%	63.5%	54.0%	63.0%	54.5%	61.0%
39	38	ICE	US	59.54%	66.8%	57.0%	63.0%	55.5%	54.0%	61.0%
40	40	Workiva	US	59.50%	53.0%	50.0%	59.0%	75.0%	59.0%	61.0%
41	32	Vermeq	Netherlands	59.42%	63.0%	57.0%	60.0%	60.0%	62.5%	54.0%
42	45	LSEG	UK	59.33%	68.5%	58.0%	64.0%	55.5%	50.0%	60.0%
43	31	Accuity	US	59.00%	60.0%	57.0%	53.0%	64.0%	64.0%	56.0%
44	35	BearingPoint	Netherlands	58.92%	63.0%	57.0%	58.0%	69.5%	50.0%	56.0%
45	44	Imagine Software	US	58.75%	64.0%	60.0%	51.0%	63.5%	56.0%	58.0%
46	43	Quantexa	UK	58.67%	57.0%	67.0%	58.0%	58.0%	45.0%	67.0%
47	–	OneTrust	US	58.35%	67.0%	50.0%	60.5%	57.6%	67.0%	48.0%
48	–	Trepp	US	58.25%	58.0%	53.0%	64.0%	61.0%	53.0%	60.5%
49	51	Quantifi	US	57.92%	66.0%	64.0%	47.0%	58.5%	51.0%	61.0%
50	53	QRM	US	57.67%	64.0%	50.0%	55.0%	53.0%	66.0%	58.0%
51	49	Pelican	US/India	57.42%	58.0%	62.0%	57.0%	55.5%	46.0%	66.0%
52	56	Conning	US	57.25%	65.0%	57.0%	57.0%	52.0%	54.0%	58.5%

2021 Rank	2020 Rank	Company	HQ	Overall score	Functionality	Core technology	Strategy	Customer satisfaction	Market presence	Innovation
53	58	ACI Worldwide	US	57.09%	58.1%	59.0%	57.0%	49.5%	64.0%	55.0%
54	52	Abrigo ⁵	US	57.00%	61.0%	55.0%	54.0%	59.0%	60.0%	53.0%
55	46	Symphony AyasdiAI ⁶	US	57.00%	58.0%	60.0%	64.0%	51.0%	45.0%	64.0%
56	54	RSA	US	56.83%	60.5%	53.5%	52.5%	54.0%	63.5%	57.0%
57	61	InfrasoftTech	India	56.67%	60.0%	55.0%	51.0%	60.0%	64.0%	50.0%
58	57	State Street GX	US	56.58%	62.0%	60.0%	47.5%	58.0%	59.0%	53.0%
59	50	FINCAD	Canada	56.50%	67.0%	61.0%	35.0%	61.0%	49.0%	66.0%
60	59	Broadridge	US	56.42%	63.5%	55.5%	60.0%	58.5%	56.5%	44.5%
61	55	SmartStream	UK	56.33%	48.0%	59.0%	53.0%	56.0%	68.0%	54.0%
62	60	Kamakura	US	56.25%	67.0%	56.0%	57.0%	61.0%	42.0%	54.5%
63	62	RiskVal	US	55.92%	59.0%	59.0%	52.0%	60.0%	49.0%	56.5%
64	70	Loxon	Hungary	55.92%	64.0%	66.0%	46.0%	70.5%	46.0%	43.0%
65	-	PwC	UK	55.75%	69.5%	66.0%	54.0%	50.0%	44.0%	51.0%
66	67	3i Infotech	India	55.67%	61.0%	52.0%	51.0%	60.0%	65.5%	44.5%
67	63	GTreasury	US	55.67%	57.0%	58.0%	45.0%	60.0%	53.0%	61.0%
68	-	Mitratech	US	55.35%	67.0%	50.0%	54.5%	50.6%	67.0%	43.0%
69	72	SAP	Germany	55.33%	68.0%	68.0%	52.5%	49.0%	43.5%	51.0%
70	66	Appian	US	55.17%	49.0%	63.0%	63.0%	48.0%	46.0%	62.0%
71	68	BlackSwan Technologies	US	55.17%	56.0%	60.0%	57.0%	55.0%	40.0%	63.0%
72	-	AML Partners	US	54.71%	56.3%	58.0%	60.0%	55.0%	40.0%	59.0%
73	74	Appway	Switzerland	54.71%	52.3%	54.0%	59.0%	56.0%	50.0%	57.0%
74	69	SAI Global	Australia	54.68%	65.0%	50.0%	53.5%	49.6%	67.0%	43.0%
75	65	Pegasystems Inc.	US	54.67%	51.0%	66.0%	56.0%	48.0%	50.0%	57.0%
76	71	EastNets	UAE	54.50%	61.0%	51.0%	54.0%	57.0%	55.0%	49.0%
77	78	Vichara	US	54.33%	59.0%	60.0%	52.0%	61.0%	44.0%	50.0%
78	80	Clari ⁵⁷	India	54.25%	62.0%	59.0%	48.0%	56.5%	46.0%	54.0%
79	75	ZMFS	US	54.17%	56.0%	53.0%	49.5%	55.5%	54.0%	57.0%

2021 Rank	2020 Rank	Company	HQ	Overall score	Functionality	Core technology	Strategy	Customer satisfaction	Market presence	Innovation
80	82	RiskSpan	US	54.13%	53.8%	58.5%	53.5%	62.0%	45.0%	52.0%
81	77	FERNBACH	Luxembourg	54.08%	67.5%	58.0%	45.0%	54.0%	45.0%	55.0%
82	79	Jack Henry & Associates	US	53.38%	61.3%	51.0%	49.0%	50.0%	61.0%	48.0%
83	81	MathWorks	US	53.33%	47.0%	58.0%	50.0%	58.0%	52.0%	55.0%
84	76	Arachnys	UK	53.00%	56.0%	60.0%	47.0%	58.0%	37.0%	60.0%
85	87	MORS Software	Finland	52.58%	67.0%	63.0%	43.0%	62.0%	30.0%	50.5%
86	–	CARE Risk Solutions	India	51.92%	52.0%	56.0%	51.5%	60.0%	41.0%	51.0%
87	84	PolyPaths	US	51.83%	63.0%	52.0%	36.0%	63.0%	49.0%	48.0%
88	89	iMeta	UK	51.75%	56.0%	51.0%	52.0%	73.5%	33.0%	45.0%
89	–	ActiveViam	UK	51.75%	54.0%	59.0%	48.0%	59.0%	42.0%	48.5%
90	92	SimCorp	Denmark	51.67%	51.0%	48.0%	48.0%	52.0%	57.0%	54.0%
91	90	Thetica Systems	US	51.58%	55.0%	57.0%	49.0%	60.0%	41.0%	47.5%
92	93	Featurespace	UK	51.25%	43.0%	49.0%	54.0%	60.0%	37.0%	64.5%
93	–	NetGuardians	Switzerland	50.92%	58.0%	54.0%	51.0%	63.5%	34.0%	45.0%
94	94	zeb	Germany	50.58%	70.0%	61.0%	41.0%	51.5%	32.0%	48.0%
95	–	Aptitude Software	UK	49.75%	68.0%	57.0%	43.0%	51.5%	32.0%	47.0%
96	99	Manipal Technologies	India	48.75%	48.5%	50.5%	45.5%	53.0%	42.5%	52.5%
97	–	Mirai	Spain	48.58%	66.0%	58.0%	41.0%	50.5%	29.0%	47.0%
98	–	SecondFloor	Netherlands	48.33%	51.0%	50.0%	52.0%	47.0%	38.0%	52.0%
99	–	ComplyAdvantage	UK	46.83%	42.0%	40.0%	46.0%	60.0%	33.0%	60.0%
100	100	KYC Global Technologies	US	46.67%	39.0%	43.0%	50.0%	49.0%	53.0%	46.0%

¹ Qontigo includes Axioma.

² CME Group includes TriOptima.

³ Confluence acquired StatPro.

⁴ Cboe acquired Hanweck.

⁵ Abrigo includes Sageworks.

⁶ Symphony purchased Ayasdi and renamed it SymphonyAyasdiAI.

⁷ Clari5 is the new name for CustomerXPs.

8. Category winners

Category award	2021 winner
Overall winner	FIS
Chartis categories	
Functionality	FIS
Core technology	Oracle
Strategy	Moody's Analytics
Customer satisfaction	Workiva
Market presence	FIS
Innovation	FICO
Industry categories	
Banking	Moody's Analytics
Buy-side	MSCI
Corporations	SAP
Insurance	FIS
Trading and capital markets	FIS
Solution categories	
Actuarial modeling and insurance risk	FIS
Artificial intelligence applications	FICO
Asset and liability management (ALM)	QRM
Audit	MetricStream
Balance sheet risk management	Prometeia
Buy-side fund administration	SS&C
Capital optimization	QRM
Client lifecycle management (CLM)	Fenergo
Climate risk	Moody's Analytics
Commodity trading risk management (CTRM)	ION Trading
Communications monitoring	NICE Actimize

Category award	2021 winner
Credit risk for the banking book	Moody's Analytics
Current Expected Credit Losses (CECL)	Moody's Analytics
Cyber risk management	IBM
Cyber risk quantification	FICO
Data integrity and control	Oracle
Data privacy	OneTrust
Energy trading – applications	ION Trading
Energy trading – data	Enverus
Enterprise stress testing	Moody's Analytics
Environmental, social and governance	MSCI
Evaluated pricing and data – credit	Trepp
Evaluated pricing and data – fixed income	Bloomberg
Evaluated pricing and data – multi-asset	ICE
Evaluated pricing and data – OTC derivatives	Refinitiv
Financial crime – anti-money laundering (AML)	Oracle
Financial crime – data	LexisNexis Risk Solutions
Financial crime – enterprise fraud	FICO
Front office risk management	FIS
FX risk and trading	ICE
Governance, risk management and compliance (GRC)	MetricStream
International Financial Reporting Standard (IFRS) 9	SAS
IFRS 17 – accounting systems	PwC
IFRS 17 – data management and reporting	Oracle
Integrated trading and risk management	Murex
IT risk	RSA
KnowYour Customer (KYC)	Fenergo
Liquidity risk	Wolters Kluwer
Market risk – buy-side	BlackRock Solutions

Category award	2021 winner
Market risk – sell-side	Murex
Model risk management	SAS
Model validation	Moody's Analytics
Operational risk regulatory analytics	The Analytics Boutique
OpsTech – buy-side reconciliation	Electra
OpsTech– credit operations	Finastra
OpsTech – fees and commissions	Cognizant
OpsTech – fixed-income support services	Broadridge
OpsTech – legal operations	Mitratech
OpsTech – onboarding	Fenergo
OpsTech – securitization services	Moody's Analytics
OpsTech – sell-side reconciliation	SmartStream
OpsTech – tax processing	Wolters Kluwer
OpsTech – wealth management lifecycle operations	Appway
Portfolio and factor modeling	Qontigo
Pricing and analytics – credit for collateralized loan obligations (CLOs)	Moody's Analytics
Pricing and analytics – credit for commercial mortgage-backed securities (CMBS)	Vichara
Pricing and analytics – credit for the banking book	Moody's Analytics
Pricing and analytics – fixed income	Bloomberg
Pricing and analytics – OTC derivatives	Numerix
Real-time risk	Cboe
Regulatory intelligence	Thomson Reuters
Regulatory reporting	Wolters Kluwer
Risk and finance integration	SAS
Risk as a service (RaaS)	RiskSpan
Risk data aggregation and reporting	Oracle
Risk technology infrastructure	NVIDIA

Category award	2021 winner
Supervisory technology (SupTech)	Calypso
Third-party risk	OneTrust
Trade surveillance	Nasdaq
Transaction cost analysis (TCA)	FIS
Treasury platforms	ION Trading
xVA	Numerix

9. 2021 Rising Stars

This category recognizes a selection of emerging vendors that, in the opinion of our analysts, are companies to watch.

★ 7Park Data

Since 2012, New York City-based 7Park Data has been developing ML- and AI-powered algorithms, applying them to unstructured datasets to develop analytics-ready data and performance indicators.

★ Bahwan CyberTek

A provider of predictive analytics and digital supply-chain management solutions in several sectors across the globe, including oil and gas, government and finance. Its focus on joint innovation has also seen it partner with a number of leading global technology organizations.

★ Camms

Camms supplies integrated SaaS solutions to organizations, to aid in their risk management, skills development and strategy enhancement.

★ CARE Risk Solutions

With a wide global presence and more than 80 implementations, CARE Risk Solutions focuses on developing products powered by AI and ML to help FIs manage their governance and financial and operational risk.

★ Cassini

Founded in 2014, Cassini serves the asset management, hedge fund and investment banking communities. Its software services are designed to enhance front-office trade decisions with visibility and analytics of post-trade costs, as well as post-trade optimization and estimation tools for treasury and operations.

★ Cognizant

Cognizant is an American multinational corporation providing digital products and services to help organizations glean insight from data to shape their own products and services.

★ Compendor

Compendor offers a combination of decision tools and certified regulatory and business experts to help firms prove their compliance and reduce business risk.

★ Credit Benchmark

Credit Benchmark combines internal credit risk views from more than 40 leading global FIs. These are then anonymized, aggregated and published as consensus ratings and aggregate analytics, to provide risk and investment professionals with an independent view of credit risk.

★ Diligencia

A specialist information services provider focusing on company data in emerging markets. Established in 2008, Diligencia uses technology and human insight to extract unstructured data on companies in territories where public domain information is not readily available.

★ Electra

A large buy-side aggregator of investment accounting data, Electra provides solutions and services designed to improve the efficiency of post-trade processing, data collection and transformation, trade matching and settlement, and client fee billing.

★ Emerge ML

Emerge ML has been developing its proprietary ML prediction software for the past 15 years, producing predictive analytics designed to help firms improve their processes and reduce wastage and inefficiencies.

★ Galvanize

Galvanize's HighBond is an end-to-end platform that connects security, risk management, compliance and audit solutions to provide visibility into risk, helping firms demonstrate compliance and develop their audit, risk and compliance programs.

★ KANERAI

A provider of scalable structured finance trading and investment analytics and enterprise data solutions. KANERAI's customized offerings are backed by robust high-performance computing

technology, enabling it to process, integrate and analyze vast amounts of data.

★ **Kyckr**

Kyckr provides real-time access to legally authoritative global company data via a single platform, offering a suite of tools to help firms develop their KYC processes for AML regulations.

★ **Legerity**

Legerity provides an accounting rules platform to firms in the insurance, banking and telco sectors. Processing large volumes of complicated data rapidly in the cloud, it helps firms develop and enhance their back-end processes.

★ **Protecht**

With backgrounds in finance, accounting and audit, Protecht's founders combined training, advisory services and software development to build a sophisticated and efficient enterprise risk management system covering the full risk management lifecycle.

★ **Regtify**

Regtify's RegTech solutions for risk management, capital adequacy and regulatory reporting aim to streamline complex regulatory reporting processes, helping FIs boost the efficiency of their regulatory compliance and risk- and data-management processes.

★ **RiskSense**

RiskSense uses intelligence-driven risk analytics to help firms reduce their cyber risk. The cloud-based RiskSense platform uses a foundation of risk-based scoring, analytics and technology-accelerated penetration testing to identify security weaknesses and remediation plans.

★ **RNA Analytics**

A provider of actuarial models, modeling software and consulting services to insurers. Its solution provides risk and regulatory metrics and supports the modeling of insurance portfolios across a spectrum of risk-based regulatory regimes (such as Solvency II and IFRS).

★ **Silent Eight**

Silent Eight provides audit trail and reporting functionality designed to help banks protect

against financial crime, by optimizing their due-diligence processes and providing transparency into decision making.

★ **Supply Wisdom**

Supply Wisdom provides continuous third-party risk intelligence, real-time risk monitoring, in-depth risk assessments and health scorecards to global enterprises, to help minimize the risks of disruption and maintain business continuity.

★ **Surya**

Founded in 1999, Surya is a provider of software and implementation services to the global financial services industry. It aims to help banks, hedge funds and corporations mitigate risk and comply with regulatory requirements.

★ **The Analytics Boutique**

Covering the operational risk and stress-testing space, The Analytics Boutique provides software solutions designed to enable transparent analytical processes, minimize model errors, and enhance the automation of firms' analytical processes and data flows.

★ **The Technancial Company**

Delivering real-time risk management and trade surveillance tools, The Technancial Company's JANUS platform supports more than 80 risk rules and more than 60 clearing houses' margin algorithms. Its products can be used pre-trade, post-order (at-trade) and post-trade to manage market, credit and operational risks in demanding environments.

★ **VALITANA**

VALITANA has developed a software platform and system that gathers and synthesizes data from the finance industry's leading data providers, enabling users to perform valuations of collateralized loan obligation (CLO) debt and equity securities as part of their investment and trading process.

★ **Yields.io**

Founded in 2017, Yields.io's Chiron MRM platform now helps users standardize their testing and generate regulation-compliant documentation. It does this by automating repetitive analyses, creating reproducible model documentation and validation reports, and monitoring the evolution of model quality over time.

10. Appendix A: Research methodology

Chartis's RiskTech100® report is the most comprehensive study of its kind, and is a core element of our annual research cycle. The rankings in the report reflect our analysts' expert opinions, along with research into market trends, participants, expenditure patterns and best practices. We validated the analysis through several phases of independent verification (see Table 1).

Note that so we can continue to accurately assess the market and its key players, we are developing and refining our methodology as the risk technology market evolves. Any changes will be reflected in subsequent reports.

Table 1: RiskTech100® research methodology

<ul style="list-style-type: none"> Performed a comprehensive market sweep of leading market participants in 40 risk categories.
<ul style="list-style-type: none"> Completed 1,500 surveys and interviews with risk technology buyers and end users.
<ul style="list-style-type: none"> Collected data on organizations' expenditure priorities and vendor preferences.
<ul style="list-style-type: none"> Collated 400 completed questionnaires, briefing documents and product specifications from risk technology vendors.
<ul style="list-style-type: none"> Conducted and attended 200 interviews, product demonstrations and strategy briefings with risk technology vendors.
<ul style="list-style-type: none"> Conducted 150 interviews with risk technology buyers to validate our survey findings.
<ul style="list-style-type: none"> Conducted more than 50 interviews with independent consultants and system integrators specializing in risk technology.
<ul style="list-style-type: none"> Applied RiskTech100® assessment criteria to filter the top 150 vendors.
<ul style="list-style-type: none"> Reviewed data with 30 independent consultants and 110 risk technology buyers.
<ul style="list-style-type: none"> Interviewed 60 ex-employees of the top 50 risk technology vendors to validate our findings.
<ul style="list-style-type: none"> Undertook final data validation with 100 vendors, receiving 80 completed questionnaires and carrying out more than 100 vendor briefings.
<ul style="list-style-type: none"> Completed 100+ independent reference checks to validate vendor claims and client satisfaction levels.
<ul style="list-style-type: none"> Developed the final top 100 rankings, identified the category winners and finalized the report.

Source: Chartis Research

11. Appendix B: How to read the RiskTech100® rankings

The RiskTech100® assessment criteria comprise six categories:

- Functionality.
- Core technology.
- Strategy.
- Customer satisfaction.
- Market presence.
- Innovation.

Within each category we have included a number of sub-categories to encompass the range and scope of current risk technology solutions (see Table 2).

Table 2: RiskTech100® assessment criteria

Functionality	<ul style="list-style-type: none"> • Depth of functionality. The level of sophistication and detailed features in the software product. Aspects assessed include: innovative functionality, practical relevance of features, user-friendliness, flexibility and embedded intellectual property. High scores are given to those firms that achieved an appropriate balance between sophistication and user-friendliness. In addition, functionality that links risk to performance is given a positive score. • Breadth of functionality. The spectrum of risks covered as part of an enterprise risk management solution. The risk spectrum under consideration includes treasury risk management, trading risk, market risk, credit risk, operational risk, energy risk, business/strategic risk, actuarial risk, asset-liability risk, financial crime and compliance. Functionality within and integration between front-office (customer-facing) and middle/back-office (compliance, supervisory and governance) risk management systems are also considered. High scores are given to those firms achieving (or approaching) integrated risk management – breaking the silos between different risk management functions.
Core technology	<p>Chartis evaluates a vendor’s overall technology stack by benchmarking it against latest best practice. Key considerations this year have been the use of cloud and Big Data technologies, as well as the agility and openness of the overall technology architecture.</p> <ul style="list-style-type: none"> • Data management. The ability of enterprise risk management systems to interact with other systems and handle large volumes of data. 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. • Risk analytics. The computational power of the core system, the ability to analyze large amounts of data in a timely manner (e.g., real-time analytics), and the ability to improve analytical performance are all important factors. • Reporting and visualization. The ability to surface risk information in a timely manner. The quality and flexibility of visualization tools, and their ease of use, are important for all risk and compliance management systems.

Source: Chartis Research

Table 2: RiskTech100® assessment criteria (continued)

Strategy	<ul style="list-style-type: none"> • Vision and leadership. Market understanding, a scalable business model, product strategy, technology strategy and go-to-market strategy are critical success factors. Both organic and inorganic growth strategies are considered, as well as strategic alliances and partnerships. • Ability to execute. The size and quality of the sales force, the sales distribution channels, the global footprint, partnerships, differentiated messaging and positioning are all important factors. Specific consideration is given to the quality of implementation and support functions, post-sales support and training. • Financial performance. Revenue growth, profitability, sustainability, financial backing and the percentage of recurring revenues. The ratio of license to consulting revenues is key to business scalability.
Customer satisfaction	<ul style="list-style-type: none"> • Value for money. The price to functionality ratio, and the total cost of ownership versus license price. • After-sales service and support. Important factors include the ease of software implementation, the level of support and the quality of training. • Product updates. Important considerations for end users include how often vendors issue updates, and how well they keep pace with best practice and regulatory changes.
Market presence	<ul style="list-style-type: none"> • Market penetration. The number of customers in chosen markets, and the rate of growth relative to sector growth rate. • Market potential. Brand awareness, reputation, thought leadership, and the vendor's ability to use its current market position to expand horizontally (with new offerings) or vertically (into new sectors). • Momentum. Performance in the past 12 months, including financial performance, new product releases, quantity and quality of contract wins and market expansion moves.
Innovation	<ul style="list-style-type: none"> • New product development. New ideas, functionality and technologies to improve risk management for target customers. Chartis assesses new product development not in absolute terms, but in relation to a vendor's closest competitors. • Exploitation. Developing new products is only the first step in generating success. Speed to market, positioning of new products and translation to incremental revenues are critical success factors. • New business models. Innovation is not limited to the product dimension. Some risk technology vendors are also actively working toward new business models for generating profitable growth.

Source: Chartis Research

12. How to use research and services from Chartis

In addition to our industry reports, Chartis offers customized information and consulting services. Our in-depth knowledge of the risk technology market and best practice allows us to provide high-quality and cost-effective advice to our clients. If you found this report informative and useful, you may be interested in the following services from Chartis.

Advisory services

Advisory services and tailored research provide a powerful way for Chartis clients to leverage our independent thinking to create and enhance their market positioning in critical areas.

Our offering is grounded in our market-leading research, which focuses on the industry and regulatory issues and drivers, critical risk technologies and leading market practices impacting our sector. We use our deep insight and expertise to provide our clients with targeted market and industry analysis, tailoring content to assess the impact and potential of relevant regulatory and business issues, and highlighting potential solutions and approaches.

Chartis' advisory services include:

Market dynamics

The markets that our clients – vendors, institutions and consultants – address are changing at an ever-increasing pace. Understanding the market dynamics is a critical component of success, and Chartis uses its deep industry and technical knowledge to provide customized analysis of the specific issues and concerns our clients are facing.

Market positioning

In today's highly competitive market, it is no longer enough to simply have a leading product or solution. Buyers must be able to appreciate the differentiating capabilities of your brand and solutions, and understand your ability to help them solve their issues.

Working with our clients, we generate compelling, independent co-branded research, targeting critical business issues. This helps our clients to position their solutions effectively, 'own' key issues, and stand out from the crowd.

Collaborating closely with our clients, we develop pragmatic, resonant thought-leadership papers with immediate industry relevance and impact.

Our offering includes:

- **Co-branded research** on key market topics to provide a unique and compelling point of view that addresses a key industry driver and highlights the relevant issues. Reports can be tailored to varying levels of depth and can be powered by quantitative survey fieldwork, qualitative industry interviews, our deep domain expertise, or a blend of all three.
- **Chairing roundtables and/or facilitating events and workshops**, to support clients in hosting compelling events that put them at the heart of the discussion.
- **Targeted marketing through our sister brands**, leveraging the power of our parent group – Infopro Digital – to reach across leading brands such as Risk.net, WatersTechnology, FX Week and Central Banking.

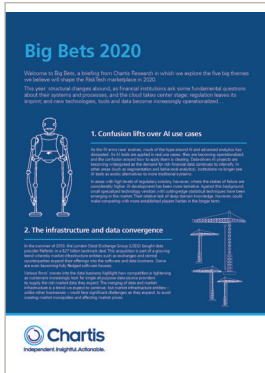
Competitor analysis

Our unique focus on risk technology gives us unrivalled knowledge of the institutions and vendors in the sector, as well as those looking to enter it. Through our industry experts, Chartis clients can tap our insights to gain a much deeper understanding of their competitors and the strategies they should pursue to better position themselves for success.

Regulatory impact analysis

The analysis and assessment of regulatory change and implementation is one of Chartis' core strengths. We can apply our insights to assess the impact of change on the market – both as it applies to vendors and the institutions they serve, or on a client's specific product and customer base. We can also provide insights to guide product strategy and associated go-to-market activities, which we can execute for internal use to drive our clients' strategy, or as a co-branded positioning paper to raise market awareness and 'noise' around a particular issue.

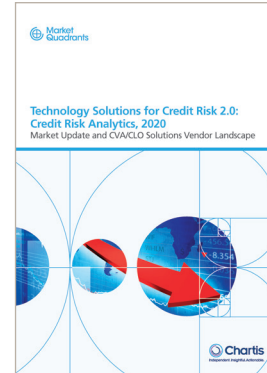
13. Further reading



Big Bets 2020



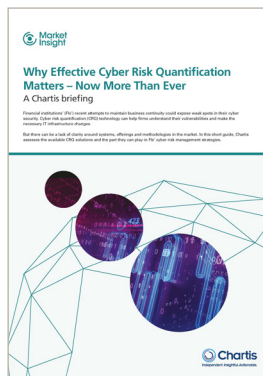
Artificial Intelligence in Financial Services, 2019: Demand-Side Analysis



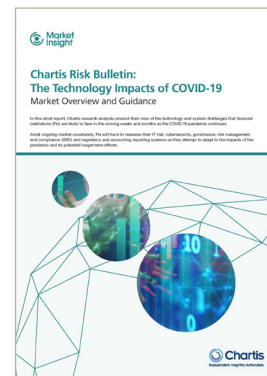
Technology Solutions for Credit Risk 2.0: Credit Risk Analytics, 2020



Enterprise GRC Solutions, 2019: Market Update and Vendor Landscape



Why Effective Cyber Risk Quantification Matters – Now More Than Ever



Chartis Risk Bulletin: The Technology Impacts of COVID-19

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