KEY TOPIC GROUP FINAL REPORT

ADVANCED ANALYTICS FOR RISK MANAGEMENT

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PRODUCED BY THE MONTREAL GROUP AND ITS MEMBERS
AUTHORED BY GABRIEL YOUSSEF AND VASANThA NARASIMHAN
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ABSTRACT

This whitepaper is prepared by The Montreal Group and authored by Gabriel Youssef and Vasantha Narasimhan of GY Consulting. It incorporates inputs gathered from the “Advanced Analytics for Risk Management” working group, comprised of members from BDC, BNDES, Bpifrance, CDB, CCG, Finnvera, NAFINSA and SIDF.

The paper provides insights into the ecosystem that shapes and governs the technology transformation of TMG member banks. Specifically, it tackles the impact of the digital wave on MSME (micro, small and medium enterprise) financing and risk management, through advanced analytics.

Based on first-hand information, obtained from TMG member banks on the current and future role of risk management, as well as on the benefits of adopting advanced analytics to further the accuracy and speed of risk predictions for strategic decisions; an implementation road map, that is actionable for everyday and crisis situations, is provided.

ABOUT THE MONTREAL GROUP

Micro, small and medium-sized enterprises (MSMEs) face ongoing challenges. In response, governments have developed schemes to help remedy market deficiencies where private sector sources are unable or unwilling to operate, by creating public development banks.

The Montreal Group is a forum of such State-Owned Banks that have a strong focus in supporting MSMEs. The forum was created in 2012 to foster peer group exchanges, identify best practices and innovative solutions on issues/products of common interest. Accompanying the MSMEs is at the heart of any exchange.

As of June 2020, members of The Montreal Group are:

- Business Development Bank of Canada (BDC) CANADA
- Banco Nacional de Desenvolvimento Econômico e Social (BNDES) BRAZIL
- Bpifrance FRANCE
- Caisse Centrale de Garantie (CCG) MOROCCO
- China Development Bank (CDB) CHINA
- Finnvera FINLAND
- Nacional Financiera (Nafinsa) MEXICO
- Saudi Industrial Development Fund (SIDF) SAUDI ARABIA
- SOWALFIN BELGIUM

Head office is located in Montreal, Canada.

www.themontrealgroup.org
The activities of The Montreal Group (TMG) are organized around specific topics selected by Board Members. For the period 2019-2020, the Advanced Analytics for Risk Management Key Topic Group was formed by the following members who agreed to produce this White Paper:

**Sherrilyn Lequin**  
Assistant Vice President, Risk Assessment and Models

**Faisal Al-Sadaan**  
Senior Risk Manager

**Aurora Moreno**  
Chief Risk Officer

**Charlie Berger**  
Ongoing Monitoring, Finance Department

**Ilpo Jokinen**  
Senior Risk Officer

**Mustapha Ait Laamoud**  
Head of Risk Management and Compliance

**Diogo Gobira**  
Market Risk Manager

**Rui Guo**  
Deputy Director SME Division Project Appraisal Department III

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The Montreal Group was founded in 2012 to promote international cooperation, mutual learning, and exchange of technical expertise among MSME-focused Development banks.

The Group’s name is derived from the city in which it was founded, Montreal, Canada.
Report
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1. The Ecosystem for Development Banks

1.1 Introduction to the Ecosystem

The digital wave

Digital disruption is the new normal that is changing what we do, and how we do it in many fronts of our lives. While we are aware of many changes such as robots building cars alongside with humans, delivering parcels, and/or designing computers\(^1\), this report aims to focus on the impact of the digital wave and its strong currents on MSME (micro, small and medium enterprise)\(^2\) financing, specifically, with respect to managing risks through advanced analytics.

McKinsey and Company\(^3\) has identified five critical trends in the ecosystem that are currently impacting risk management models in banking which, based on recent reports from IFC\(^4\) and others, are also beginning to impact MSME banking:

- Customer expectations demanding online, and real-time mobile experience have put pressure on chief risk officers to provide timely, high quality service;
- Tighter regulatory controls resulting in increased supervision and enforcement action require greater risk-function effectiveness;
- Technology changes requiring heightened importance of strong data management and advanced analytics necessitate banks to stay competitive through robust customer differentiation and risk decision capabilities;
- New entrants driving business model disruptions require banks to seek advanced risk management capabilities to compete or collaborate with fintech companies; and,
- Need for accessing financial technology, talents, and highly qualified staff or partners to modernize risk management has resulted in higher costs and weak ROIs on risk and compliance activities.

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\(^1\) Deloitte, Crunch time V, Finance 2025, \url{https://www2.deloitte.com/ca/en/pages/finance-transformation/articles/crunch-time-series-cfos.html}

\(^2\) In this report we use the terms MSME and SME interchangeably


The impacts of the digital wave and how MSME banks are responding to them, and what would differentiate the leaders from the laggards will be described in this paper with a focus on advanced analytics in risk management.

**The needs of MSMEs**

The MSMEs around the world need finance to build their businesses. According to the World Bank, they are struggling to find the necessary finance even though they comprise the economic backbone of every economy in the world.5 In many markets, financial institutions discriminate against MSMEs on the basis of their higher risk profile and lower profitability. This occurs in developed markets and more acutely in developing ones, where the MSMEs are situated in weaker legal and business environments. Development banks and financial institutions are sometimes prone to showcasing infrastructure or large corporate projects at the expense of smaller projects by MSMEs. This bias for larger projects contradicts the mandate of development banks and financial institutions because SMEs and micro-enterprises are an important source for creating jobs, spawning innovation, and implementing integral projects, with significant impact on the local economy. It is, therefore, imperative for development banks to make a special effort towards micro-lending and MSMEs, especially if the local environment discriminates against them. 6

A major barrier to MSMEs gaining access to finance is the inability of the lender, e.g., a bank, to assess the credit risk of the enterprise. Four main obstacles prevail: limited and fragmented financial data, insufficient risk models, lengthy and time-consuming processes, and other issues such as a disconnect in the bank between the sales arm and the credit arm. In short, MSMEs face a severe constraint in access to finance resulting in major financing gaps in the order of 2.6 trillion US dollars because of their credit invisibility, and the inadequacy of banks in processing their credit risk in an accurate and timely fashion. As stated by the Asian Development Bank’s survey results, “even as technology is introducing new ways to assess and manage risk, the fundamental causes of unmet demand for trade finance amongst MSMEs are unaddressed.” 7, 8 A survey undertaken by the International Finance Corporation (IFC) indicated that information asymmetry, lack of collateral, weak creditor rights, legal and regulatory environment are the key obstacles to financing MSMEs.

Given the importance of access to credit and trade financing, it would be extremely important for financial institutions that serve MSMEs to use modern technologies to make credit

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5 World Bank, Addressing the SME finance problem: https://tinyurl.com/y7zs95qm
6 The ten challenges facing development finance institutions www.gbrw.com/announcements/the-10-challenges-facing-development-finance-institutions
8 Flowcast, Big data, smart credit closing the SME finance gap through artificial intelligence and machine learning, https://www.linkedin.com/pulse/download-flowcast-whitepaper-big-data-smart-credit-closing-ken-so/
applications and assessments a real-time process accessible from many online platforms including mobile platforms.

**The levers of change**

There are many levers of change that a financial institution could use to close the gap between what MSMEs expect and desire from the banks and what is being offered or made available to them today. The current gap between MSME needs and the product/services offered by banks is exacerbated by the fact that while retail banking has advanced in several areas to become more customer centric through the use of technologies, similar product offerings from development banks are still in the design or launch phases. MSMEs do not understand why products and services from banking institutions servicing their financing needs are not similar to retail banking and are in the process of exploring options to move with alternative finance players on the market, who promise a smoother, real-time experience.9 A study by EY states emphatically “Digital is at the heart of the next wave of SME banking services. SMEs use digital platforms for their businesses and have every right to expect to have their financial services on these platforms too.”10

The various pain points of MSMEs across their lifecycle is well described in literature.11 Exhibit 1 shows the key pain points across the life cycle of MSMEs. It is an observation that since alternative finance players are targeting the SME pain points to relieve them of both financial and business needs, banks should make a move in the same direction. The changes that could make a significant difference in the quality and type of service offerings available to MSMEs from banks would include the development of:

- Quick approval for credit and loan applications including access to real time cash;
- Digital, personal, and real-time services;
- Online platforms with banks in the centre assisting/advising business activities e.g., faster loan services, visual capture of the MSMEs’ financial situation, bill payments, purchasing, accounting, inventory management, etc.;
- Better pricing for less risky MSMEs with maturity; and,
- Help with exports and foreign exchange.

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Exhibit 1: Examples of pain points for MSMEs

Needs of MSMEs change and so do risks across lifecycle

Set-Up
- How to register?
- Where can I get funds?
- How do I set up business process?
- How do I start e-commerce?
- Etc.

Start-Up
- How do I set up books and maintain records?
- How do I make arrangements with suppliers?
- Can my expenses, payments and receivables be monitored?
- Where can I get legal and tax advice?
- Where should I get talent?
- How do I acquire customers?
- Etc.

Growth
- Where do I get working capital?
- How can I manage my payroll?
- What help can I get on hiring managers or training them?
- How do I manage contracts?
- Can I get alerts on my cashflows to optimize them?
- Etc.

Maturity
- Which other markets should I expand to?
- Is there help with B2B or B2C markets?
- Who will fund more at better rates?
- Can I get help with export/trade?
- Where can I get good exchange rates?
- Etc.

Banks could deploy the following levers to address the MSME pain points:

- Availability of internal and alternative data on the digital footprints left by MSMEs;
- Automation and digitization of processes;
- Increase in the intelligence base of banks with data scientists, artificial intelligence, machine learning, advanced analytics and predictive models;
- Augmented intelligence of staff through skill-up training;
- Increase in infrastructure capacity, and digital interactive interfaces with customers;
- Decision-making enabled at frontlines through continuous flow of processes from front office to back office and edge analytics;\(^{12}\)
- Partnership with fintechs and others where needed;\(^ {13}\) and,
- A strong risk management system that is linked to business goals and customer goals.

\(^{12}\) An approach to data collection and analysis in which an automated analytical computation is performed on data at a sensor, network switch or other device instead of waiting for the data to be sent back to a centralized data store.

\(^{13}\) IDC, Connected intelligence in the world’s best banks, sponsored by TIBCO, https://www.tibco.com/resources/analyst-report/connected-intelligence-banking
The levers of change to be deployed by banks servicing MSMEs are described by McKinsey in a more elaborate manner and are shown in **Exhibit 2**.\(^\text{14}\)

**Exhibit 2: Levers of change to be deployed by MSME banks**

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The AA initiative enters with support from the C-suite senior executives and is linked to strategy and the risk appetite. The seven levers of change can be deployed depending on the extent of readiness of the bank for the AA initiative. For example, if automation relevant to the initiative has already been undertaken, then one will begin with the data lever. The seven levers will have to act in sync at the end of the implementation.

The process and workflow automation lever is deployed to map the processes, following the customer journey across various business units, in order to re-engineer and streamline the process flow and to automate those processes that would yield the greatest gains in efficiency with automation e.g., underwriting.

With respect to data, the first step is to ensure the availability and access to large volumes of data from internal and external sources. In addition, data has to be consistent, of high quality and should fit the purpose for which it is used. Overall, data management should be linked to strong data governance.

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Infrastructure is more difficult to deploy for traditional banks because of legacy systems or disconnected siloed systems. Creating a modernized platform with data lakes and/or the cloud to enable seamless access from various devices such as mobile devices and computers requires integration of systems and a flexible data environment.

On the deployment of AA technologies there are many levels of technologies, techniques, and analytics that could be used. The idea is to see which risks are being targeted and to work on those that will yield synchronized results and high gains. For example, one could use a model of predictive analytics with machine learning to detect fraud or to identify customers with high credit risk. Depending on the desired goal of high value to the organization, the appropriate data, machine learning and deep learning techniques including AI could be employed. Use cases of the benefits of scaling up new methods of credit risk assessment are beginning to surface. For example, one could look, beyond traditional balance sheets and collaterals, at data from supply chain finance that enables a different approach to risk assessment. By examining the performance history of an MSME in the supply chain and the ‘stickiness’ of relationships in a supply chain, it would be possible to assess the credit risk of the incumbent.

The talent and culture lever indicates that the human aspect of digital value is extremely important. Significant planning is needed to have the right talents across the organization. Different levels of integration of technology competence and business expertise are required because risk management is intricately linked to strategy and competitive advantage.

Partnership is a practical solution to banks struggling to either find the right infrastructure, AA tools, data, or talents. In fact, the Deutsche bank has attributed much of its success in the digital risk environment to partnerships.

The AA user interface via dashboards and visualizations, is the ultimate exposition of all the work that goes behind the outputs and models of AA. It supports quick answers to questions pertaining to various aspects of risk e.g., credit risk, portfolio risk, market risk, churn, fraud, AML, regulatory risk etc. The decision-maker, i.e., user will be able to get the necessary answers from the target system via a user-friendly visual interface.

It is evident that the future of risk management would require deploying the different levers. Major changes are required to traditional banking e.g., consorted agreement between risk management and business strategy, customer centricity, collaboration with units inside and outside the organization, streamlined automation of processes, alternative data with strong data governance, synchronized platform architecture, advanced analytics, and acquisition of talent through hiring or partnerships. Given the massive changes required, one should refrain from a “boiling the ocean” strategy and instead start with a strategic plan on how to prioritize changes that flow across the organization to achieve significant impacts in key areas.
New entrants to the MSME financing landscape

Increase in customer expectations and availability of better service models enabled by technology are creating opportunities for high returns in MSME financing. Many fintechs and big technology companies are entering the arena. Their product offerings include traditional banking products and many other business services, such as invoice management, payroll support, tax preparation, and inventory management. A single platform of services tailored to meet fundamental needs of MSMEs is an attractive proposition in a landscape where traditional banks have offered minimal services to MSMEs.

Digital SME lenders have begun to reach an important level in several markets, because of the ability to provide easy to access services that include banking and beyond, e.g., CreditEase, Dianrong, Tradeshift, China Rapid Finance, Baidu, Tencent, and Alibaba in China, LoanZen, Capital Float, AmazonBusiness.in, Alibaba.com’s SMILE platform, Industrybuying.com, Power2SME, Tolexo, Bizongo, Moglix, TradeIndia. Com and ofBusiness.com in India, Kabbage, OnDeck, CAN Capital, Square Capital, ApplePie Capital, and PayPal in the US and Funding Circle, Worldpay, and Iwoca in UK. Because these new entrants are not encumbered by legacy processes, they are willing to offer cloud-based services and use data streams from a variety of digital sources. Their deployment of linked advanced technologies enables them to provide solutions that not only address the needs of the MSME customers but also reduce risks for them as lenders. The advanced technologies include a digital end-to-end solution, with easy to use, simple online and mobile customer interfaces at the front end feeding into digital middle and back-end systems and processes with automated risk analytics, which in turn are linked to advanced capabilities in decision-making, client management and collection practices.

In their description of how the fintechs are disrupting the SME banking landscape, EY from its UK office has provided many examples as shown in Exhibit 3.

Four types of business models of new entrants to the MSME finance landscape are described in the report of the International Finance Corporation: the MSME marketplace lenders, who are non-bank digital lenders providing loans to MSMEs through intermediary platforms that connect MSME borrowers to investors; tech, e-commerce, and payment giants that have their origins in online marketplaces across the globe, offering loans and other financial services to their captive SME customers; supply chain platforms supporting SME financing during financial transactions between buyers and sellers trading and collaborating along the supply chain; and,

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15 McKinsey, Using ecosystems for SME Banking
17 EY, the future of SME banking: Minds made for redefining financial services, December 2018,
mobile-data based lenders offering small mobile loans based on credit scores derived from mobile calling patterns, mobile transactions, mobile e-money usage, etc.

**Exhibit 3: Examples of alternative finance providers disrupting SME banking sector**

<table>
<thead>
<tr>
<th>AREA OF EXPERTISE AND SERVICE</th>
<th>NAMES OF FINTECHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SME Lending</td>
<td>OnDeck, Funding Circle, MarketInvoice, Modula, Ezbob, iwoca, Kabbage</td>
</tr>
<tr>
<td>Working Capital</td>
<td>C2FO, Taulia, Aztec Group, Traxpay, Assetz Capital, CAN Capital, Ezbob, Funding Circle, Growth Street, MercadoLibre and Invapay</td>
</tr>
<tr>
<td>Accounting</td>
<td>Xero, Holvi, Tide and Sage Pay</td>
</tr>
<tr>
<td>Robotics and AI</td>
<td>Softomotive, Persado, Automation Anywhere, Blue Prism, WorkFusion, Clinc and Rainbird</td>
</tr>
<tr>
<td>Cashflow Management</td>
<td>Budget Insight, Cashforce, Float, Flowcast, Strands, and Rimilia</td>
</tr>
<tr>
<td>Invoicing</td>
<td>Zervant, Invoice2go, Tradeshift, Viewpost, TrustWeaver, Taulia, and Intuit Quickbooks</td>
</tr>
<tr>
<td>KYC verification</td>
<td>ShoCard, Trunomi, Onfido, Validis, Factern, EyeVerify, BioID and Kyckr</td>
</tr>
<tr>
<td>On-demand tax</td>
<td>Avalara and Davo</td>
</tr>
<tr>
<td>Centralized inventory and order management across multiple sales channels</td>
<td>TradeGecko and Stitch Labs</td>
</tr>
</tbody>
</table>

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Exhibit 4 provides business models of new entrants to the SME Market across the globe. It expands on similar examples provided by McKinsey and others in literature.

An in-depth look at how banks in UK are responding to the new entrants is summarized in the “future of SME Banking” by EY. While traditional banks look at the UK SME market from different perspectives, e.g., creating a separate position for SME banking, combining with business banking, including SMEs with both personal and business banking, etc., they are united in the challenge to leverage digital and redevelop their products. Examples are Lloyds Bank, HSBC, RBS, Barclays, and Santander. The major banks are aware of the dynamic forces at play and are trying to reposition their propositions to the SME market through improved products and services, creation of digital banks, and similar strategies. The following are examples of the response of UK banks using digital as a lever:
• Lloyds became the first provider to integrate with a third party (Yolt) under Open Banking this year;

• HSBC increased their SME Fund in 2018 to £12bn this year;

• RBS has announced that they will be launching a standalone Digital SME bank (Mettle), and at the same time, it is funding the Alternative Remedies Package;\(^{20}\)

• Barclays has taken a stake in MarketInvoice and launched SME funds for groups such as UK housebuilders, and Northern Powerhouse; and,

• Santander is building an open digital financial services platform for SMEs.

Other examples of beyond banking services provided by banks include automatic and prompt invoice issuance by Wells Fargo, digitizing expenses with OCR image processing by Standard Chartered bank, reminders and repayment solutions for debtors by RBS, and payroll services by Bank of America.\(^{19}\)

**Summary to introduction**

As a summary to this introduction, it would be fair to state that with technological advances, and competition from new entrants, MSMEs have sensed the need for better financial services and products that are suited to their needs. New entrants offering streamlined banking and beyond services are likely to become attractive alternatives to banks.

While the expanding role of new MSME lenders indicates the need for banks to make smart moves in MSME financing and risk management, many of the experts in the area emphasize that banks still have a competitive advantage over the new players. The ultimate winning strategy for banks would be to improve their risk management strategy to include digitization, use of advanced analytics, and integration of the risk function with total strategy and all aspects of banking from the front end to the back end.

The major banks are aware that their ability to survive the dynamic forces at play is dependent on the strategy they choose to meet competition with improved risk management, better customer experience, and seamless flow of decision making to make them agile and at the same time dependable, responsible organizations. McKinsey reports that banks such as BBVA, HSBC, Santander, and Sberbank have allocated $100 million and more in technology and partner acquisitions to increase their market share, sophisticated technologies, and people.\(^{21}\)

Several use cases of moves by major banks to offer better services via technology adoption and use of AA are found in literature and will be discussed in a separate section later.

\(^{20}\) The Alternative Remedies Package was introduced in 2017 to boost competition through regulatory intervention.

1.2 Report Structure

Objectives

The objectives of this report are to provide:

- A holistic view of risk management and the role of technology;
- Information on advanced models of risk management using Advanced Analytics (AA), i.e., Artificial Intelligence (AI) and Machine Learning (ML) in banks outside The Montreal Group member banks;
- A comparative analysis of member banks with banks outside the Montreal Group on various aspects of digital maturity; and,
- Insightful recommendations on Implementation of AA.

Methodology

Our methodology is based on three lines of evidence:

- Secondary source research including inputs from online resources, seminars, expert research reports and fintech whitepapers;
- Survey responses of member banks of the Montreal Group compared with global surveys conducted by consulting firms like McKinsey, EY, Deloitte and others; and,
- Interviews and group calls with the members of the Montreal Group.

Content Flow

The report is structured as follows:

- Chapter 2 deals with impact of technological transformation on risk management’s role in financial organizations, specifically on the evolution of the role from one of avoidance to one of being a strategic enabler of growth and long-term sustainability, the implications of digitization of the risk function, the role of risk management in technological transformation, and mitigation of various types of financial and non-financial risks that are part of and emerging in the new ecosystem.
- Chapter 3 is a core chapter dealing with advanced analytics and the associated technologies helping banks to transform their risk management function. The chapter provides definitions for advanced analytics (AA), its components namely, descriptive, diagnostic, predictive and prescriptive analytics, the relationship of AA to artificial intelligence (AI), machine learning (ML), deep learning (DL), and natural language processing (NLP). It identifies the key drivers behind AA for risk management and describes several applications of AA to risk management in financial organizations in the areas of credit risk, fraud prevention and compliance monitoring, cybersecurity risk and
market risk. It clearly indicates that with increase in digitization, a financial institution is also subject to new emerging risks such as data risk, model risk, identify theft, reputational and culture risks.

• Chapter 4 focuses on a comparison of the responses provided by members of The Montreal Group (TMG) to a survey entitled “Advanced Analytics for Risk Management.” The survey was followed by one-on-one interviews with TMG members to obtain more context to their survey responses. The chapter compares the answers provided by TMG members to answers provided to similar questions in the risk management surveys conducted by EY, IIF, McKinsey and others since 2018. Whereas no direct comparison was intended, the chapter enables an indirect positioning of where the members of TMG stand with respect to various aspects of their journey towards AA for risk management. The areas covered include: competitive threats from the ecosystem; drivers behind technology transformation; risk management’s influence on long-term sustainability and growth; risk priorities over the next three years; processes that will leverage technology to improve risk management; areas where technologies will have a material impact on managing risks; types of AI used or being considered; the challenges that affect or are likely to affect the progress of implementation; and, the areas of risk that face talent shortage.

The chapter moves on to define and elaborate on the concept of digital maturity. Based on inputs from TMG members, it places them in the digital maturity hierarchy for the year 2020 (now) and 2023. There are four levels in the digital maturity hierarchy: beginning, i.e., considering how digital technology can transform the business, building internal support and developing the business case; transitioning, i.e., exploring the application of new technologies and starting to digitize some elements of the business; maturing, i.e., optimizing middle- and back-office processes via new technologies as part of a coherent digital investment plan; and, being a digital leader with integrated front-, middle- and back-office operations, supported by data that flows across functions and geographies.

• Chapter 5 provides an implementation road map with seven milestones. The key considerations for each milestone are described. The pitfalls to avoid during the implementation journey are also provided. Finally, in view of the inputs from TMG members and the extensive literature review and benchmarking exercises, ten recommendations are articulated to assist in realization of the vision of an enhanced RM in the future in TMG member organizations. The approach is flexible, and each member can adapt the recommendations to their current position in digital maturity, their mandate, forces from the ecosystem, amount of resources available, timelines or urgency, and above all the strategic thrust of their leaders at the top.
2. Risk Management Now and in the Future

2.1 Technological Transformation and its Impacts on Risk Management

Evolution of the role of risk management

Digitization of risk expands the traditional role of risk management because it is not restricted to risk avoidance. The new role of risk management involves working with business functions across the organization in a digital transformation to enable the firm to make strategic decisions regarding identification of emerging risks and pursuing growth opportunities presented by the ecosystem.

In its expanded role, risk management has to be linked with the organization’s strategic decisions aimed at sustainability and long-term growth. This could be accomplished by linking strategy and risk appetite, identifying emerging risks beyond the near term, assessing and validating the business model, influencing the risk culture of the organization, and focusing on risk adjusted performance.

In addition to long-term growth, risk management has a key role in enabling short-and medium-term growth. With the help of digitization, access to clean and relevant data, advanced analytics, and appropriate risk models, risk management could provide a more efficient, timely, and effective approach to accurate risk decisions. The function has to adopt a collaborative approach with other business units in technology transformation, validate risks included in business plans, protect reputational risks, deploy and validate controls in new products, and drive capital allocation to optimize performance.\textsuperscript{22}

Risk management in its fully evolved form has the ability to link strategy to the appropriate level of risk appetite based on an assessment of a variety of factors including the eco-system. Traditionally, risk management in most banks have been well-equipped to manage cyclical risks such as credit risk. Generally, the long-term economics have been stable, requiring only minor tweaks in underwriting policies through the cycle. However, today, as fintechs compete with banks, the latter may not be able to generate the fee income that brings a sufficient return on capital for the business. This threat to the bottom line of banks will require newer business strategies and models. Risk management in an evolved state in a bank for MSMEs would influence strategy and business models and focus the organization on risk adjusted

performance. In addition, it would be forward looking and vigilant to new emerging risks while also influencing the risk culture of the organization.

With respect to supporting approaches to enable the bank to grow, risk management could help attract customers by starting the risk approval process with the customer in mind. By technologically equipping the back-office function it could provide faster, more accurate decisions on credit approvals. It could be at the front end of product design and development and validate controls in new products. By enabling an appropriate culture and risk behaviour in the organization, it can regulate conduct risk and protect the bank’s brand and reputation. The types of influences and support that the risk function could exert will depend to a large extent on its stature in the C-suite, where it will be linked to the executives making decisions on business strategy and models, and at the same time its collaborative links with all business units in the organization including IT and technology transformation groups.

2.2 Implications of Digital Risk Management

To understand the implications of digital risk management, it is good to have a definition of digital risk. McKinsey defines digital risk as a “term encompassing all digital enablers that improve risk effectiveness and efficiency—especially process automation, decision automation, digitized monitoring and early warning. The approach uses work-flow automation, optical-character recognition, advanced analytics (including machine learning and artificial intelligence), and new data sources, as well as the application of robotics to processes and interfaces. Essentially, digital risk implies a concerted adjustment of processes, data, analytics and IT, and the overall organizational setup, including talent and culture.”\(^{23}\)

Digital risk management is a complex journey involving many parts of the organization. It is not just a few pilot projects run by a small part of the organization that is not tied to an overall strategy or outcome. How an organization accomplishes the transformation to a fully digitized risk function will vary depending on the region and the bank’s ability to implement the transition. Exhibit 5, adapted from Oliver Waynman,\(^{24}\) provides some of the key areas that have to be considered during the transformation such as:

- Placing the risk function in close relationship to senior management and endowing it with digital capabilities, e.g., relevant data from all units, deep data analytics and methodologies involving artificial intelligence, machine learning and AA;
- Redesigning processes across the spectrum from front-to-back office so that the customer experience is enhanced by digitization initiatives such as easy access, smooth


interfaces, quick and fast credit decisions, a platform with beyond banking facilities, etc. This step requires consideration of data and IT costs;

- Upgrading core banking systems, finding appropriate strategies to deal with legacy systems, using platforms, and adding APIs with or without 3rd party providers;
- Installing regulatory and supervisory controls to monitor regulatory compliance and reporting and forestall emerging risks;
- Collaborating with external parties, e.g., alternative data providers, cloud technology owners, fintech, etc., and achieving a broad internal buy-in;
- Acquiring new talent, upskilling existing members, and enabling a healthy work environment with attractive remuneration-benefits package;
- Cooperating across all business units especially in model considerations, new product development, and validation of controls; and,
- Promoting the ultimate goal of a risk organization closely linked with governance in a collaborative culture that encourages seamless integration of risk in business decisions.

**Exhibit 5: Considerations for digital risk transformation**

The digital transformation journey begins in different ways within each financial organization. Some begin with optimizing the traditional risk function e.g., via automation. In some others the risk function is more progressive, e.g., it has an advanced risk data and IT architecture, and is focused on obtaining talent, and skills in advanced analytics to gain extra insights into risks as well as achieve operational efficiencies. Most organizations with progressive risk function
require in their risk officers a mix of traditional risk and analytical skills combined with strong ability in managing technology operations. In the ultimate transformation to a fully digitized risk function of the future, one can envisage not only internal partnerships of the risk function with other business units, including IT, but more partnerships with external parties e.g., cloud vendors, fintechs, technology companies, alternative data sources etc. The emphasis at this stage will be one of identifying risks emerging in the horizon, managing vendors, providing new interfaces, testing and approving sophisticated algorithms, etc.

Forrester, based on their survey and research, emphasize that banks with impressive track records in the digital journey are few and invest in a holistic approach. Their white paper indicates that “many banks are still exploring the potential of digital technologies in pockets of their organization or striving to digitize the customer life cycle from end to end. Only the leaders are investing in transformation with the aim of delivering compelling digital customer experiences and building strong digital capabilities for the future.”

The role of risk management in technological transformation

Given the expanded role of risk management in the organization, it is important for chief risk officers to have a hands-on approach in technological transformation. Risk management has to have an important seat at the transformation table and be involved in all aspects of the digital transformation discussions from strategy to implementation. According to EY’s survey, risk management groups in banks have taken a passive role in technology transformation. There is room for improvement with respect to stronger inputs to the organization’s IT and digital strategy as well as alignment of bank strategy with risk management’s operating plan. However, exceptions are noted in some banks with advanced digital maturity. These banks that are leaders in the risk digitization process have embraced cultural change, collaboration with the front office and back office, and embedment of risk at the heart of all processes including multichannel processes and automated decisions.

Types of risks to consider

Financial organizations such as the MSME banks face two key types of risks namely, financial risks and non-financial risks. Research conducted by McKinsey and EY indicate several types of risks that are being considered by senior executives and risk officers in banks. They include: financial risks such as credit risk, model risk, liquidity risk and market risk; non-financial risks such as, conduct risk, reputational risk, operational risk, cybersecurity risk, data related risk,


new technologies risk at a macro level, risks from technology architecture or IT obsolescence at a micro level, competitive risks from new entrants and players in the SME financing landscape, geopolitical risk, social unrest risk from the region, regulatory risk, talent shortage risk and SME industry disruption due to regulatory arbitrage.

The risk management function in addressing these different types of risks has to first set priorities for the risks encountered now as well as the emerging risks, and then devise a strategy to leverage technology in managing the high priority risks. It is in this context that the risk management function becomes linked with many aspects of long-term sustainability and growth performance of banks as well as with near term approaches to growth and customer retention. It is evident from all in-depth research with financial executives that banks have a strong need to develop new risk management capabilities. They will need to define their appetite for risk taking and be vigilant in detecting new potential risks as well as the strengths/weaknesses of controls that are aimed at mitigating them. The described involvement in risk appetite setting, identifying emerging risks and validating controls in turn will lead to a well-informed decision on the appropriate approach to risk management as well as the necessary technological transformation.

The next chapter deals with key concepts surrounding AA and how banks use them in various types of risks to improve performance, reduce losses, and mitigate the impacts of risks.
3. Risk Management and the Role of Advanced Analytics in Financial Institutions

3.1 Definitions

In their pursuit of excellence and best business practices for risk management, the successful banks demonstrating leadership emphasize data availability, integrity, and quality while leveraging artificial intelligence and machine learning to learn from the data. In order to accomplish a massive transition from traditional to modernized risk management, described in the last chapter, banks have to introduce and lead digitization, automation and advanced analytics using artificial intelligence, specifically, machine learning, deep learning, natural language processing and other technologies. In addition to introducing new technologies and techniques, it is important for banks to enable the link between strategy and risk management, introduce change in process flow, upgrade skills of staff, include high quality data scientists and data engineering talent, and begin their risk management journey across various business units starting from the customer at the front end to decisions at the back end. It is in this context that one has to understand the definitions for the terms: advanced analytics, artificial intelligence, machine learning, and natural language processing.

Advanced analytics (AA)

Historically, data analytics has been a key aspect of banking decisions, e.g., credit scoring, capital investments, market risk predictions, etc. With the advent of technology, big data analytics has become an important component of decisions in the banking and finance sector. In the last decade, with availability of big data, the use of advanced and predictive data analytics is being pursued seriously to help provide deeper insights.

Advanced Analytics (AA) is a term used for the use of analytics which require advanced techniques to push the frontiers in understanding data from past, present and future perspectives. The desire to increase insights about the past, present and future stimulate continuous advances in the field of data analytics. Banks can now use many advanced analytic tools to learn from their huge repositories of data on clients, markets, and products to predict profitable prospects, detect transactions of high risk, protect themselves from money laundering or fraud, create accurate credit models for small businesses (SMEs), alert clients of
an impending liquidity shortfall, and predict client cash flows, sales volumes, and inventory levels.  

Artificial intelligence (AI) and machine learning techniques that form the core of AA, are transforming, and will revolutionise, how banks approach financial risk management through advanced analytics. All processes related to understanding and controlling risk are candidates for deeper and better insights using AI-driven solutions using machine learning, deep learning, natural language processing and related technologies discussed below. The aspects of risk covered range from credit scoring, credit approval decisions, market risk assessment including portfolio and position risk, customer and insider fraud detection, regulatory compliance and model risk reduction.

In order to adopt advanced analytics, banks have to understand the components that make up the technology. The main components of advanced analytics can be broken down to four categories:

- **Descriptive analytics**: focuses on **what has happened** by converting raw data into information. For example, shows charts for decrease in suspicious activity or increase in number of defaults from one year to another;

- **Diagnostic analytics**: focuses on **why something happened**. This involves more diverse data inputs and running a few models to hypothesize why something could have happened. An example would be to see if the recent increase in defaults is due to a weakness in specific industries impacted by trade regulations;

- **Predictive analytics**: focuses on **what will happen**. It involves using past patterns to predict future actions or scenarios. For example, predicting default risks or market risk based on a number of relevant variables under different scenarios; and,

- **Prescriptive analytics**: focuses on **what needs to happen**, i.e., a **course of action** to be pursued given the occurrence of a specific situation. This involves gathering results from descriptive, diagnostic and predictive analytics to determine what, why and how a situation is likely to occur and having rules to meet the situation. For example, decision rules based on how to respond to specific economic and consumer trends.

The key relationships between the various components of advanced analytics, namely descriptive, diagnostic, predictive and prescriptive analytics that are utilized in risk

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27 Data Robot, *6 AI Solutions Every Commercial Bank Needs*
29 Finextra, *Advanced Analytics in Banking World*, October 2019
management in banks are shown in Exhibit 6. It is noted that from moving through the vector, hindsight becomes insight and then changes to foresight and optimization.

Exhibit 6: Components of AA: From descriptive to prescriptive analytics

Artificial intelligence (AI)

Artificial intelligence refers to computing systems that have the ability to reason about things and make classifications and decisions that would normally require human intelligence. In the context of risk management, AI would imply that machines can demonstrate a risk management-related intelligence that is even superior to human intelligence in this field. This is a broad definition of AI.

It is difficult to distinguish between AI and some of the core techniques of AI such as machine learning. Aziz and Dowling make a distinction between the two and say machine learning is a core technique of AI involving learning from data, but that AI often involves additional techniques and requirements. According to their line of reasoning, a full AI solution would be automated in terms of data identification, data testing, and making decisions based on the data

testing. In practice, AI might involve additional techniques in addition to machine learning, such as including hard-coded logic rules.

In the context of risk management, it is more relevant to refer to AI using specific techniques, most notable being machine learning (ML), deep learning (DL) and natural language processing (NLP). These techniques are based on learning algorithms that self-improve by gathering and analyzing mountains of data.

The relationship between AI, machine learning (ML), deep learning (DL), and natural language processing are shown in Exhibit 7. The definitions of ML, DL, and NLP are elaborated in the subsequent paragraphs.

**Exhibit 7: AI, ML, DL and NLP**

![Diagram of AI, ML, DL and NLP](image)

**Machine learning and deep learning (ML and DL)**

Machine learning (ML) is a technique that allows computers to learn from data on their own without rules that are explicitly programmed. The machine learns the rules from the data and refines the model over time. ML can use different types of data e.g., structured, semi-structured, unstructured and so on. While the machine sets the rules based on patterns it observes, it is noted that ML is a method of analyzing data correlations and anomalies that could be augmented with human involvement. The outputs are then provided for human
decisions. ML allows machines to process much more data than a person could; hence, it can detect patterns to draw new insights.

Deep learning (DL) is a subset of ML in which a deep hierarchy of interconnected neural network layers help to arrive at common features found in massive amounts of data. The purpose behind DL is to more accurately model complex relationships between variables in order to mimic human decision-making. In this sense DL comes close to actual AI, however, it still lacks some of the data identification and automation features necessary for true AI.

Emerj in its research in UK found that, there seems to be a lot of traction in the UK with regards to using ML to predict risk in the financial sector. Banks in the UK, such as the Bank of Ireland and the Lloyd Banking Group, are engaging in ML projects for such applications.32

**Natural language processing (NLP)**

NLP is the ability of a machine to process and use human languages as an input for certain activities. In banking, it is widely used for chatbots and sentiment analysis. The latter uses analytical techniques that relate sentiment words to risk in finance. Words from news, social media, emails, etc., can be processed using computational linguistics to identify risk in attitudes of companies or people.

### 3.2 The Drivers behind AA for Risk Management

With increased computing power and new analytical techniques, banks can now extract deeper and more valuable insights from large volumes of data available internally, from conventional external sources such as credit bureaus as well as unconventional sources such as data from utilities, supply chains, loyalty cards, government statistics, and geospatial data. As an accelerator to increased interest in analytic techniques, automation of processes employed by many banks has compressed the time needed to extract fit-for-purpose data for analytics. For risk departments, which have many years of experience in data analytics, these trends provide opportunities to improve risk management through better methods for identifying, measuring, and mitigating risk. Through analytics of various types, risk management is in a position to help leaders shape the strategic agenda of the bank.33

Risk managers today are being asked to do more with less in an uncertain environment of macroeconomic headwinds and regulatory changes.24 It appears that in order to be viable, the

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leading organizations have to make bold moves to embrace effective use of technologies to their advantage. Using AA for risk management provides compelling opportunities for customer growth and retention, greater productivity through automation of front-, middle- and back-office functions, greater insights in a shorter timeframe for better decisions, and potentially achieving a competitive advantage in a digital world. In short, the drivers behind AA for risk management are primarily competitive and strategic advantage triggered by an ecosystem that is increasingly digital and customer centric. The organizations that will achieve the maximum gains will include those with:

- Senior management championing technology transformation to result in a strong risk management capability tied to strategy in all parts of the organization;
- An understanding of the competitive landscape, emerging risks, and the value of digital risk tools and analytical techniques;
- Access to big data that is relevant and of high quality, from internal and external sources;
- A comprehensive analysis of the efficiency gains across risk processes and the technologies to adopt over time;
- Defined targets for technology transformation in risk processes;
- A well-designed strategic plan and infrastructure to analyze fit-for-purpose data using modern computational technologies and techniques to arrive at better decisions in risk management in a shorter timeframe;
- A culture and capacity to operate in a digitized environment with high capacity intelligent staff;
- A talent hiring and management plan including appropriate training; and,
- Consistency of the digital risk plan with global and local regulatory expectations.

The attainment of the desired state of risk management with a significant role in the long-term sustainability as well as growth of the organization will also rest on the ability of the organization to direct resources to endeavours with high yield because the return on the expenses will take some time to manifest.

Organizations are at various stages of maturity when it comes to analytics. Many are already deploying technologies such as predictive analytics and text analytics. A smaller group of companies aim to be leaders and are pushing the frontiers by experimenting and adopting technologies such as ML, DL, NLP and AI either to build models or include the viable technologies in their analytics platforms. Although early adopters are using these technologies
now, other organizations are just starting to explore them.\textsuperscript{34} Many organizations now realize that to be competitive they need to be proactive in their analytics strategy. This includes AA, which involves utilizing and deploying advanced technologies and AI as part of an ever-expanding analytics horizon.

### 3.3 Description of AA Applications for Risk Management

This section will provide examples of AA applications in various aspects of risk management. Chapter 2 indicated that the risk management function includes both financial risks and non-financial risks. We will now look at some applications of AA to areas of financial and non-financial risks such as credit risk, fraud including conduct risk, reputational risk, compliance risk, cybersecurity risk, and market risk. A number of industry giants such as JPMorgan Chase, BBVA (Banco Bilbao Vizcaya Argentaria) HSBC and OCBC (Oversea-Chinese Banking Corporation) have already started to use back-end risk management with AI to automate processes, aid employees, and solve critical issues in the underwriting process. The ensuing subsections provide examples of AA applications in management of various types of risks.

**Credit risk processes and fraud**

In this subsection we combine credit risk processes and fraud because many banks do combine these in their digitization efforts. This is because criminals have learned how to exploit situations in which fraud might look like an issue of credit risk. While fraud prevention technology and professionals might be alerted by a suspicious transaction, it is too late for them because for a while it appears as a credit issue. By the time it appears to be a fraud issue, criminals have retreated back into their protective shadows, essentially immune to arrest and prosecution. This is why more and more programs are targeting fraud, insider fraud and credit risk process activities together.\textsuperscript{35}

The enhancement of the credit risk processes, and fraud monitoring functions involves different activities. Some of the activities which could be leveraged by technology transformation are shown in Exhibit 8.

The first activity to enhance the credit risk function will involve a synchronization of the credit-risk strategy with the bank’s risk appetite statement and overall risk-return profile for MSME finance. As emphasized in Chapter 2, the risk management function has to embed itself in the overall strategy and risk appetite setting of the organization. To enable this, it is necessary to view the entire portfolio of loans as well as the pipeline of requests, identify sources of variation in risk, establish appropriate trade-offs, and map roles and responsibilities for the

\textsuperscript{34} TDWI, Best Practices Report, Moving toward ai, machine learning and natural language processing

\textsuperscript{35} PYMNTS.com, When fraud risk is credit risk in disguise, \url{https://www.pymnts.com/fraud-prevention/2019/credit-risk-digital-technology/}
management of risk. The next step would require an understanding of the organization’s competitive position and customer requirements by assessing current performance and the performance of likely new market entrants.

Credit delivery is often delayed by manual processes for data collection, underwriting, and documentation, as well as data issues affecting risk performance. Slow cycle times for credit approval is a key pain point for MSMEs because they require funds quickly. Digital credit risk management uses automation, connectivity, digital delivery and decision making to alleviate these pain points. Value is created in three ways: by protecting revenue, improving risk assessments, and reducing operational costs.

To protect revenue in consumer credit, digital risk strengthens customer retention. Due to improvements in customer experience resulting from quicker credit decisions, and the use of dynamic risk-adjusted pricing and limit setting, it avoids the risk of customer churn and migration.

AA and ML tools can increase the accuracy of credit risk models used for credit approvals and portfolio monitoring. The models when validated reduce the frequency of judgment-based errors caused by bias. The integration of new data sources enables better insights for credit decisions, while real-time data processing, reporting, and monitoring further improve overall risk-management capabilities. Operational costs are also reduced as credit processes are digitized. The ensuing paragraphs elaborate on how AA could be used for underwriting, early credit warning and collections, fraud and compliance monitoring. Exhibit 8 shows that the link established between risk management and the organization’s strategy would guide technology transformation in the right zones such as underwriting, credit scoring, early credit warning, collections, fraud monitoring and compliance activities.

**Exhibit 8: Credit risk process and fraud activities that could be leveraged using AA**
Underwriting

AA could be used to make better underwriting decisions by using DL algorithms to process enormous amounts of data in order to accurately quantify the risk of default through predictive analytics. With automated ML, it is possible to leverage the organization’s experience in each industry. Using financial statement data and past loan experience, the key financial metrics that are strongly predictive of default risk can be identified for each industry. In addition, with automated ML, unique models for each industry segment can be designed. Such models, because of reuse, result in tremendous operational efficiency in the specific industry segment. In addition to efficiencies in underwriting, the models provide for faster and better credit decisions and more accurate pricing for risk. As the cost of underwriting falls and credit default models get better, banks can offer better terms than their competitors to the best customers and increase their market share. Examples of banks undertaking use of historical data to identify models to predict default in each industry is shown in Exhibit 9. While some banks like J.P. Morgan have done this on their own using internal modelling others have used fintechs for predictive analytics to speed up underwriting, credit scoring, and pricing.

Exhibit 9: Examples of AA used for underwriting

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>AREA/ACTIVITY</th>
<th>TECHNOLOGY</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellen Capital, US</td>
<td>Risk management,</td>
<td>Cloud based predictive</td>
<td>• Uses historical default data to build granular models to predict default</td>
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<tr>
<td></td>
<td>underwriting(^{36})</td>
<td>modelling capability</td>
<td>in each industry in which they operate, lowering portfolio default rates</td>
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<td></td>
<td></td>
<td>(DataRobot)</td>
<td>significantly.</td>
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<td></td>
<td></td>
<td></td>
<td>• The models make credit decisions and risk-based pricing better and</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>underwriting as well as credit approval faster.</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>• Use of cloud-based solution reduces cost.</td>
</tr>
<tr>
<td>M-Pesa Equity Bank, Kenya</td>
<td>Underwriting(^{37})</td>
<td>Artificial intelligence,</td>
<td>• Takes portfolio data of cured loans (or other instruments) and classifies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Underwrite.ai</td>
<td>the cured loans as either good or bad based upon factors such as status</td>
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<td></td>
<td></td>
<td></td>
<td>(Paid Off, Charged Off, Defaulted, Late, Collections) or profitability.</td>
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<td>• Trains models based upon a wide array of algorithm types which then</td>
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<td>compete against each other for the greatest accuracy in predicting the</td>
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<td>outcome of loans.</td>
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<td></td>
<td></td>
<td>• Feeds in new application data and determines the probability that a given</td>
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<td></td>
<td></td>
<td>application will have a good outcome.</td>
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</table>


\(^{37}\) Underwrite ai, Case studies, [https://www.underwrite.ai/](https://www.underwrite.ai/)
Credit scoring and pricing

Based on a definition provided by IBM, predictive analytics “brings together advanced analytics capabilities spanning ad-hoc statistical analysis, predictive modeling, data mining, text analytics, optimization, real-time scoring and machine learning.”

Historically, banks have used credit scoring techniques for measuring the risk levels associated with lending as well as for assessing the likelihood that a customer will default on their payment. The pricing of the interest rate also depends on the credit score. With AA, banks can predict credit risks with far more accuracy. A predictive analytics application using ML could calculate default using the applicant’s credit score, credit history, and overall financial history. These tools help organizations discover patterns in data and go beyond describing what has happened in the past to predicting what is likely to happen next. In addition, an AA driven credit-risk scoring model can help a financial institution recognize incorrect payment amounts in real-time. This may bolster the institution’s ability to identify fraudulent payments before they can be fully processed. Exhibit 10 provides examples of AA deployed for credit scoring.

Exhibit 10: Examples of AA used for credit scoring and related activities

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>AREA/ACTIVITY</th>
<th>TECHNOLOGY</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>
| Piraeus Bank Group, Greece | Credit risk | SAS platform for automated credit scoring | • The solution provides a single platform for statistical analysis and data mining, data collection and management, reporting and model development.  
• Streamlines and automates risk data collection and management. |

38 Vladimir Fledack, 5 use cases of machine learning in the banking industry, https://techburst.io/5-use-cases-of-machine-learning-in-the-banking-industry-a4cfbedda722


### ORGANIZATION | AREA/ACTIVITY | TECHNOLOGY | APPLICATION
---|---|---|---
JPMorgan Chase | Small business loans and approvals[^41] | On Deck Capital technology platform | • Automates and integrates data management, reporting, model development and validation.  
• Reduces credit losses and boosts overall business performance by making better, data-driven credit decisions on both the origination and servicing sides of business.  
• Performs application and behavior scoring for virtually all lending products – including commercial loans, cards, and installment loans.  
• Optimizes model development and produces reports with greater speed and accuracy.  
• Provides cost and time savings with more accurate decision-critical intelligence.  
• Maintains appropriate levels of credit risk to grow in an ailing economy.

MYbank, China (SME Forum Award) | SME credit and loans processing system[^42] | “310 model” for SMEs, which has enabled financial institutions in China to leverage proprietary risk management technologies so they can provide collateral-free business loans to SMEs. | • Enables technology to process loans quickly.  
• Real-time or next day funding.  
• Enables access to capital for SMEs.  
• SMEs can apply for a loan simply by using their mobile phone.  
• Enables borrowers to complete their online loan applications in three minutes, obtain approval in one second and with zero human.

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**Early credit warning and collections**

Early warning of credit deterioration is the key to avoiding losses. If a bank can detect deterioration in the financial condition of a borrower early enough, then it is possible to exercise a few options. ML enables this capability of sighting credit deterioration at an early stage. For SMEs, ML can use transactional analysis, for example, inflows/sources of cash, outflows/ uses of cash, and history of past defaults to develop a model that provides an alert.

[^41]: Pankaj Jain, and Madhuri Prabhakar, Banks and online lenders — the new power couple, August 2019, https://medium.com/@scienaptic/banks-and-online-lenders-the-new-power-couple-is-coopeting-b70609c4bb42
when the probability of default goes up. Credit analysts can then determine whether risk mitigation strategies such as credit default swaps, exposure reduction, etc., might be prudent.

McKinsey provides a case study of a European bank using AA to address segmentation of customers by level of default risk and planning strategies for collection. The team developed advanced models for estimating the probability that a customer would default, and for segmenting delinquent customers based on their payment and spending patterns. The models incorporated detailed analysis of the delinquent-loan portfolio based on statistical regressions. The team then helped the bank develop customized loan portfolio based on statistical regressions. The team then helped the bank develop customized collection strategies for each customer segment. For example, the bank now offers different restructuring solutions, uses different collection channels, and creates different call-center scripts for each segment.

It is noted that collections could be improved by making the right offer at the right time using the right channel based on ML algorithms which provide decisions.

As shown in Exhibit 11, the Bank of America has teamed up with DataRobot to use AA, specifically predictive analytics, for insights on loan defaults. The predictive analytics powered by AI and ML models could forewarn the risk managers in the bank about the weakness of the customer and thus provide time for them to prepare the remediation efforts. In addition, this application has other benefits such as assessing the risk of a new customer based on historical patterns of credit default of existing and previous customers.

Exhibit 11: Example of AA used for early warning default risk and collection

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>AREA/ACTIVITY</th>
<th>TECHNOLOGY</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank of America</td>
<td>Default risk⁴⁴</td>
<td>DataRobot</td>
<td>• The AI platforms are trained using historical loan repayment records and other data like social media data to coax out patterns that might lead to a customer defaulting on credit payments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The bank's loan managers might use the DataRobot platform to gain insights on risk of loan defaults for new customers by means of a dashboard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Loan managers can then use the dashboard to review the applications that have a high risk of default thereby speeding up the loan approval process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Loan managers might use DataRobot's predictive analytics platform to predict the risk of default for new borrowers by analyzing historical data about existing borrowers' default rates.</td>
</tr>
<tr>
<td>ORGANIZATION</td>
<td>AREA/ACTIVITY</td>
<td>TECHNOLOGY</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• By integrating these predictive models into their loan-approval, the bank could potentially expand their loan portfolios while simultaneously managing the risk involved.</td>
</tr>
</tbody>
</table>

**Fraud and compliance monitoring**

Fraud monitoring includes identification and review of high-risk payments before they are executed. This is accomplished through ML models often developed with inputs from fraud investigators. The fraud sometimes originates from internal staff, from those who steal cards or identities, and at times from money laundering entities. Fraud detection systems analyze clients’ behavior, location, and buying habits and trigger a security alert when something seems out of order and contradicts the established patterns of behaviour and spending.45

Banks are investing in AI-based fraud detection systems because it is believed that an AI approach, based on identifying outliers in a dataset, makes fraud detection faster and more cost-effective for banks.46 The automation involved in these systems allow for processing massive amounts of data in a short time using AI. In addition, evidence suggests that these systems are far more accurate than traditional methods and save time by reducing the number of false positives.

The investment in fraud detection is also supported by the regulatory bodies supervising banks because banks are held responsible for reporting incidents of fraud or money laundering. The AI systems for AML take a longitudinal view of payment pathways and identify those that are strongly indicative of money laundering, which then triggers powerful investigative tools to stop the money laundering activities.

As shown in Exhibit 12, to monitor and prevent fraud, some banks like Citibank and HSBC are using ready-to-use algorithms from technology vendors and adapting them to their organization’s situation and data; however, others like J.P. Morgan Chase are developing their own ML tools.

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Exhibit 12: Examples of AA used for fraud prevention, anti-money laundering and compliance

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>AREA/ACTIVITY</th>
<th>TECHNOLOGY</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citibank, USA</td>
<td>Mitigate Fraud</td>
<td>FeedzAI uses ML</td>
<td>• Data science application helps to identify and demolish fraudulent attempts in various avenues of financial activities, including online and mobile banking.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>algorithms to</td>
<td>• Manages risk by monitoring transactions and raising red flags when necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>analyze huge</td>
<td>• AI technology watches for suspicious payment-related behavioral shifts among clients before payments are processed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>volumes of Big Data</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>in real-time and</td>
<td></td>
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<td></td>
<td></td>
<td>alerts the financial</td>
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<tr>
<td></td>
<td></td>
<td>institutions of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>alleged fraud cases</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>at once.</td>
<td></td>
</tr>
<tr>
<td>HSBC, USA</td>
<td>Fraud, Regtech,</td>
<td>Ayasdi, AI and</td>
<td>• In fraud detection, AI technology can identify complex fraud patterns and cut down on the number of false positives by consolidating large volumes of data, such as geolocation, tagging, IP addresses, usage patterns, etc.</td>
</tr>
<tr>
<td></td>
<td>AML</td>
<td>automation</td>
<td>• In AML, AI can reduce the number of false alerts by taking more data into account. It can use this data to identify complex criminal activity occurring across different products, lines of business, and customers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• In insider trading and corruption, AI can analyze multiple sources of information including emails, phone calls, messaging, expense reports, etc. to identify suspicious activity.</td>
</tr>
<tr>
<td>JP Morgan Chase</td>
<td>Conduct risk and</td>
<td>Big data analytics</td>
<td>• Analytics enables the bank to process vast amounts of data to identify individual behaviour that could reveal risks or openings to make money.</td>
</tr>
<tr>
<td></td>
<td>fraud</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cybersecurity risk

Cybersecurity is gaining importance with more digitization in the financial sector. In fact, the technological transformations occurring because of the digital wave are also increasing the probability of cyber attacks. Several articles written recently emphasize that there is a need to take a risk-based approach to reduce the chances of cyber attacks. In the near future, it is

47 Here’s how HSBC is using artificial intelligence to take money launderers to the cleaners, https://netfinance.wbresearch.com/hsbc-artificial-intelligence-strategy-to-beat-money-launderers-ty-u
48 Deutsche Bank, Big Data, How it can become a differentiator, https://cib.db.com/docs_new/GTB_Big_Data_Whitepaper_(DB0324)_v2.pdf
expected that cybersecurity will be part of the risk management function; hence, we have included a few examples to illustrate how some banks are using AA to protect themselves from cyber attacks.

To understand the risk-based approach to cybersecurity it is necessary to define cybersecurity from a new perspective. Cyber risk should be considered “only” as another kind of operational risk. This is because cyber risk has the potential for business losses of all kinds—financial, reputational, operational, productivity related, and regulatory related—in the digital domain. In this context, cyber risk becomes integrated with all units and the vulnerabilities are to be mapped throughout the enterprise value chain. Cybersecurity thus becomes a part of overall business strategy and risk management.

As organizations seek to digitize, many face significant cybersecurity challenges. Often, there is intense conflict between the need to digitize and the cybersecurity team’s responsibility to protect the organization, its employees, and its customers within existing cyber operating models and practices. In order to remove the barriers to digitization, organizations must improve risk management, apply quantitative risk analytics, and build cybersecurity throughout the value chain. For this to happen, there is a need to support the next generation technology platforms, which include innovations like agile development, robotics, and cloud-based operating models.\textsuperscript{51} Exhibit 13 provides examples of the use of AA for cybersecurity.

**Exhibit 13: Examples of AA used for cybersecurity**

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>AREA/ACTIVITY</th>
<th>TECHNOLOGY</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>
| Canada’s Scotiabank, Italian banking group Intesa Sanpaolo | Cybersecurity\textsuperscript{52} 53 | Shape Security AI powered system. Augmenting fraud analytics abilities by leveraging data available in Shape’s dashboard | • Eliminates malicious login traffic, ensuring site availability.  
• Acquires fine-grained control over financial aggregators, i.e., Plaid, Mint and Yodlee.  
• Protects customer accounts from fraud.  
• Provides intelligent segmentation.  
• Optimizes the data-sifting process to produce the fewest number of false positives.  
• Advanced alert system auto-categorizes alert priorities.  
• Advanced transaction monitoring uses ML to spot suspicious anomalies. |

\textsuperscript{51} McKinsey, Cybersecurity: Linchpin of the digital enterprise  
\textsuperscript{53} How big banks fight online fraud, [https://blog.shapescurrency.com/2018/04/19/how-big-banks-fight-online-fraud/](https://blog.shapescurrency.com/2018/04/19/how-big-banks-fight-online-fraud/)
### Market risk

Investment firms have implemented trading algorithms based on sentiment and insights from social media and other public data sources for years. The algorithms can now be enhanced with more data from a variety of sources and ML models. AA can now be deployed to process large volumes of data and create algorithms used for managing trading rules to assist trading decisions.

Hong Kong-based Aidya uses algorithms to conduct trades autonomously, and some companies, like Japan-based Nomura Securities, rely on AI robo-traders for high-frequency trading, to boost profits. Kensho’s intelligence-grade database provides traders with information on market trends around the globe, ForwardLane provides quantitative modeling using AI powered by IBM’s Watson, and Wealthfront uses AI to track account activity and assist investment decisions. Banks like Deutche Bank have invested in platforms for risk data and advanced analytics to learn from historical trading data. ML models are deployed to identify abnormal patterns in market behaviour and trading including insider fraud activities. Exhibit 14 lists examples of banks using AA for lowering market risk.

**Exhibit 14: Examples of AA used for market risk**

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>AREA/ACTIVITY</th>
<th>TECHNOLOGY</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deutsche Bank</td>
<td>P&amp;L Risk, Market Risk, Volcker rule regulatory risk, AML</td>
<td>Platform for risk data and advanced analytics</td>
<td>• Big Data technologies enabling the Bank to store over 10 years of proprietary trading data and ensure easy accessibility.</td>
</tr>
</tbody>
</table>


55 The Volcker Rule is a federal regulation that generally prohibits banks from conducting certain investment activities with their own accounts and limits their dealings with hedge funds and private equity funds, also called covered funds.
Barclays, London

Barclays uses agent-based modeling and ML to run millions of market scenarios (Simudyne technology)

- Matching algorithm, which enables the business to gain greater visibility on its performance versus the goal, an AI process using graphing rules.
- Profiling of data to identify abnormal information through rule-based algorithms, or “teaching” a machine what is abnormal and normal so it can quickly flag errors and minimise false positives, which is mainly applied in activity monitoring and anti-money laundering processes.
- Reporting from the data source itself, without having to create dedicated reporting systems.


Kensho provides machine intelligence and data analytics using a combination of cloud computing and natural language processing (NLP)

- Kensho’s natural language processing finds relationships between financial trading data, such as stock prices, portfolio performance, company financials, news, social media, and press releases.
- Banks with access to Kensho’s AI-powered database in the days following Brexit used the information to quickly predict an extended drop in the British pound.

3.4 Summary of AA Applications for Risk Management

It is evident from the examples provided that application of AA to risk management has several advantages. The banks are using AA in many aspects of credit risk management such as underwriting, credit scoring, early warning of default, etc. In addition, there appears to be a good fit between AA applications to management of fraud, compliance with regulations, and

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AML. Recently, cybersecurity is becoming more risk-based than conventional methods. In addition, trade monitoring and guidance in investments are also assisted by AA models.

With the changing of the risk landscape due to the digital wave, the new entrants in the finance sector, availability of data and the capacity to use advanced analytics with AI, ML, DL, and NLP as components, it appears that the quality and speed of decisions in risk management among the leader banks are moving up to meet the bar of customer expectations. The opportunities for risk management in protecting revenue, improving risk assessments, and reducing operational costs are enormous. For example, McKinsey Global Institute research suggests that, together, AI and AA in banking could generate as much as $1 trillion globally in annual economic value.

However, the fundamental changes that are positive are also increasing the probability of new and emerging risks. AI and AA can trigger a host of unwanted, and sometimes serious, outcomes. For example, the data could be contaminated or inconsistent leading to serious risks in predictive analytics. Similarly, some models could be poorly constructed and lead to loss. Because of increase in automation, outsourced services, and partnering with other parties, there could be more opportunities for privacy violations, erratic automated processes, and biased model outcomes.

The risk management function has expanded to include a variety of non-financial risks e.g., infrastructure failures, data risk, model risk, market risk due to poor modelling and flawed analytics, identity fraud due to vulnerabilities in partner systems, data privacy violations, and cyber attacks due to insufficiently secured data on the cloud.

The next chapter will look at how The Montreal Group compares with other banks tested by other surveys conducted by EY and other consultant groups on various aspects of AA-related themes.


4. Benchmarking

4.1 Key Benchmarks of Risk Analytics

This chapter provides a comparison of the responses provided by members of The Montreal Group to a survey titled “Advanced Analytics for Risk Management.” The aim of the survey was to prepare each member for an in-depth interview to understand the position of their organization in application of new technologies like AI and ML to risk management. In this context, an electronic survey with questions on the topics listed below was sent to each member. When the responses were received, each member provided further inputs to the context of their responses in a bilateral telephone interview. It was explained to the members that the questions covered similar areas as the global surveys administered to financial institutions by EY, McKinsey, Deloitte and others to enable a comparison of The Montreal Group’s responses to those of the global surveys. The topics covered by the survey and followed up in the interviews included:

- Competitive threats from the ecosystem;
- Drivers behind the technology transformation;
- Risk management's influence on long-term sustainable performance;
- Risk management's influence on approaches enabling growth;
- Risk priorities for emerging risks over the next three years;
- The processes that will leverage technology to improve risk management in your organization;
- Technologies with significant impact on the risk management function;
- Types of AI used or considering for use;
- The challenges that affect or are likely to affect implementation of new technologies for risk management; and,
- Areas of risk with talent shortage.

Competitive threats from the ecosystem

The Montreal Group

The ecosystem for members of TMG provides different parameters under which each member operates. The following examples illustrate that the mandate and lending model of TMG

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62 It is noted that a direct one on one comparison is not the intent of this chapter; however, by covering similar topics and providing similar options it was possible to make an indirect comparison.
member banks had a singular influence on the competitive threats, the drive for technology transformation as well as the focus of their risk management (RM) function:

- In some regions, the regulatory pressures may be higher than others, for example, in Europe, the regulatory pressure from the European Central Bank makes it very tough for the RM function, which has to focus on avoiding heavy fines and protect brand reputation.

- In some regions, government strategy may dictate lending to a specific segment e.g., micro enterprises. The development bank may then have to guarantee up to 80% of the loans to microbusinesses. In such situations, the government initiative types will exert strain on RM and its ability to predict risks and behaviors.

- Some TMG members may offer only a guarantee to financing products of other banks or on loans granted by banks to SMEs i.e., use an indirect lending model. In such cases, the traditional banks offering new and enhanced digital services will require a similar digital transformation in TMG member bank.

- Some members may operate under hybrid models; in such cases, they may lend directly to SMEs as well as offer guarantees to other banks. In such cases RM has to bolster its capabilities to meet competitive threats as well as gear up to the level of the other banks in technology transformation.

- Some direct lending institutions are much more under pressure from fintechs and other new entrants.

- Some are completely protected by the government and only face minimal competition from another government department.

The Montreal Group members were asked to rate the extent to which specific competitive threats from the ecosystem were faced by their organization. Of the listed threats, the following received the highest rating in terms of being critical to their organization:

> Critical competitors were traditional banking competitors, traditional players in another financial, new online only players and consumer technology players.

The answers of The Montreal Group are shown in Exhibit 15. Combining the percentage of the very critical and critical responses, it is noted that traditional banking competitors and
traditional players in another financial have the highest percentage of responses (50%) followed by new online-only players and consumer technology players (38%).

Exhibit 15: Criticality of competitive threats from the ecosystem (%)

It is noted that the level of competition varies by region, the level of control on the banks from government regulators, and the type of lending model in place, i.e., direct, indirect or hybrid lending.

Other banks

The EY/IIF survey on bank risk management of 2018 covered a similar topic and they found the responses differed slightly by region but overall, they were consistent as per the quote below.63

There is a relatively consistent view on which competitors will be most significant over the next decade. Online-only providers are viewed as the most potent, closely followed by the largest consumer technology companies. As one risk executive put it, “Digital disruption and digital technologies, including fintechs, are emerging threats strategically — those will affect operational efficiency and carve up the value chain.” In some regions, traditional competitors in banking or broader financial services remain significant threats competitively. By contrast, despite ongoing media commentary to the contrary, banks are less concerned about comparison shopping websites and diversified brick-and-mortar or online retailers.63

63 Eighth annual global EY/IIF bank risk management survey: Restore, rationalize and reinvent, 2018


**Comparison of responses**

Given that The Montreal Group (TMG) members are from different regions of the World, and that the members are development banks dealing with MSMEs, one can expect some variations from the survey responses to the specific EY survey being compared.

During the interviews, several members clearly explained that, given their mandate, they were not really concerned with competition although there was a need to ramp up technology transformation to meet customer expectations and the digital wave of the ecosystem. Many of them operated under an indirect model and, therefore, were co-financing with another bank, which often had new solutions and products based on technology transformation. In some cases, where members used a direct or hybrid lending model, the key thrust for change came from consumer technology players, traditional banking companies, traditional players from another field and online only players.

Similar to the banks in the EY survey, TMG members did not see much of a threat from online retailers or the retailers with business outlets (brick and mortar online retailers). This is an interesting observation because in our literature review, we have seen powerful disruption emanating from online retailers like Alibaba, Amazon, and Tencent.  

**Reasons behind the technology transformation**

*The Montreal Group*

TMG members provided the top five reasons behind their organizations’ plans to invest in technology over the coming years. Based on the percentage distribution of responses, the following were selected as the key reasons behind the technology transformations.

- Generate cost savings and operating efficiencies
- Mitigate growing cybersecurity threats
- Drive digital transformation program
- Gain access to new business models
- Improve risk management.

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64 Alibaba versus Amazon, How the e-commerce giants stack up in the fight to go global
https://www.cbinsights.com/research/amazon-alibaba-international-expansion/

65 International Finance Corporation, Alternative data transforming SME finance, 2017,
The responses of TMG members are shown in Exhibit 16.

Exhibit 16: Top five reasons behind organization’s plan to invest in technology

Some interesting observations were made during TMG member interviews:

- The drive for digital transformation in direct lending models came from the need to remain competitive in the whole customer-experience journey, while building market share and maintaining it.

- If operating under a full indirect model i.e., the interaction is with other banks not customers, then technology transformation is mainly focused on back office functions of RM.

- Managing the threat of financial crime emanated primarily from heavy fines imposed by the regulator.
**Other banks**

Similar questions were asked by the Global Banking Outlook Survey, 2018. The responses of the other banks, as one may observe from the text below, indicated strengthen competitive positioning and build market share, and expand ability to acquire, engage and retain customers as primary reasons followed by generate cost savings and operating efficiencies, mitigate growing cybersecurity threats and drive digital transformation program.

**Comparison of responses**

TMG members are development banks. Their technology drive, therefore, seems to emanate from reasons of cost savings and operational efficiencies, mitigation of cybersecurity threats, and the need to drive a digital transformation program. These reasons are also selected as important by the other banks but only behind the reasons to strengthen competitive positioning and build market share, and expand ability to acquire, engage and retain customers. TMG members also selected improve risk management and gain access to new business models as important reasons behind their investment in technology.

**RM’s influence on long-term sustainable performance**

**The Montreal Group**

TMG members were asked to rate the extent of influence that RM had on the long-term sustainable performance of their organization. As shown in the text box below, based on the

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66 Global banking outlook survey 2018.
percentage distributions of the ratings given, RM was found to have a high level of influence in three areas.

- High influence in linking strategy and risk appetite
- High influence in shaping risk culture and behaviours
- High influence in focusing the organization on risk-adjusted performance.

The responses of TMG members are shown in Exhibit 17. It is noted that 75% of members rated RM’s influence in linking strategy and risk appetite and 63% rated RM’s influence in shaping risk culture and behaviours as high.

**Exhibit 17: RM’s influence on long-term sustainable performance (%)**

Other banks

Similar questions were asked by the IIF survey. The responses of the other banks on the areas of high influence of RM are shown in the text below.

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Comparison of responses

It is interesting to note that both TMG members and the respondents of the global survey conducted by IIF noted that RM has a high influence on linking strategy and risk appetite. TMG members in the interviews indicated that:

- RM puts together the risk appetite strategy and is directly involved with the strategy organization. From this involvement stems a risk appetite statement, which influences the risk culture and consequently behaviours.

TMG members are in sync with the findings of the IIF survey which states the following.

“Banks point to the central importance of the risk appetite framework and board-approved risk tolerances in helping drive performance, as well as manage risk. For example, two-thirds of banks say risk management can influence capital allocation to optimize returns within the context of risk appetite, and risk appetite is a key tool for risk to influence firm strategy.”

In terms of RM’s influence on shaping risk culture and behaviours, a greater percentage of TMG members (63%) found the influence to be high compared to the respondents of the IIF survey (34%). The interviews provided some interesting observations:

- Sanctions are very penalizing if some regulated public banks do not abide by the rules, and so this needs to be reflected in risk culture and behaviours. In some banks, all employees have to undergo mandatory training to adopt and integrate new behaviours to avoid jeopardizing the bank’s reputation.
Other members of TMG explained that their organizations were in the process of developing a risk culture based on RM’s influence, and it was important because there was some resistance from staff, who were used to a different culture.

It is also interesting to note that only 25% of TMG members considered RM’s influence on forward looking, emerging risks to be high compared to 53% of respondents to the IIF survey. One of the reasons could be that since many TMG members are only in the beginning to transitional stages of digital maturity, they do not face many of the emerging risks such as data risk, talent shortage risk, fraud risk, etc., as high as some of the members of the IIF survey who are higher in the digital maturity hierarchy, using alternative data, working in the cloud, and forming external partners. The IIF survey emphasizes emerging risks in the light of changes being made to processes as shown in the text box below.

Risk management has to consider broad internal and external changes to determine whether new risks are being created as business models adapt, and whether the firm is managing the quantum of risk associated with major change brought about by digital transformation.67

**RM’s influence on approaches enabling growth**

*The Montreal Group*

TMG members were asked to rate the extent to which RM influenced their organization’s approach to enabling growth through specific activities. The activities that were rated high by a greater percentage of the respondents are shown in the text box below.

- A greater percentage of TMG members considered RM’s influence to be high on activities that provide faster, more accurate risk decisions, and those that are at the front end of product design and development.
- This was followed by RM’s influence on protecting firm’s brand and reputation, optimizing performance through driving capital allocation, and starting the risk approval processes with the customer in mind.
The answers of The Montreal Group are shown in Exhibit 18.

**Exhibit 18: Influence of RM on activities enabling growth (%)**

**TMG**

- Partner with other business units in enabling...: 81%, 38%, 50%
- Validate risks considered in business plans: 25%, 40%, 63%, 13%
- Validate controls in new products: 38%, 75%, 25%
- Start the risk approval process with the customer in...: 25%, 38%, 38%
- Drive capital allocation to optimize performance: 25%, 38%, 38%
- Protect firm’s brand and reputation: 63%, 38%
- Be at the front end of product design and development: 38%, 13%, 50%
- Provide faster, more accurate risk decisions: 38%, 13%, 50%

**Other banks**

The other banks answered similar questions in the IIF survey. The text box below provides the activities that were selected by a higher percentage of the respondents with respect to RM’s role in enabling growth.
Comparison of responses

It is noted that in the banks surveyed by IIF,\(^67\) the highest percentage of respondents acknowledged the role of RM in enabling growth by providing faster, more accurate risk decisions. Similarly, of the various activities enabling growth, a higher percentage of TMG members rated RM’s influence on activities providing faster, more accurate risk decisions to be high. The interviews with TMG members had interesting observations:

- Due to shifts in priorities and availability of tools and techniques, credit analysis and disbursement processes are being accelerated so that Micro-SMES can get faster access to loans.

Two activities influenced by RM in enabling growth were selected by 81% of respondents from other banks surveyed by IIF, namely partnering with business in enabling transformation as well as validating risks considered in business plans. These activities were not rated high by a majority of TMG members. Many TMG members cannot partner as per regulations. As for validating business plan risks, models are just beginning to emerge in TMG organizations.

Some TMG members were also more customer focused on their RM and gave high ratings to two activities, namely being at the forefront of product design and development (50%) and starting the risk approval processes with the customer in mind (38%).

Once again, these differences relate to the mandate of the development banks in TMG as well as their government-controlled environment, which is influenced more by special rules and regulations, rather than competition, as well the stage of digital maturity of the organizations. Since many members of TMG are not actively using external partners and have just begun to work on business strategy, RM in these organizations could be more involved with protecting the bank’s reputation and driving capital allocated to optimize performance.

Priorities for risks and emerging risks over the next three years

The Montreal Group

TMG members were asked to rate the organization’s priority level for emerging risks over the next three years. The risks that were considered high with respect to organizational priority are shown in the text box below.

- Cybersecurity risk, operational risk, data related risk, SME’s industry disruption due to regulatory arbitrage, credit risk, regulatory risk and risk from technology architecture are considered high priority risks.
The answers of The Montreal Group are shown in Exhibit 19.

**Exhibit 19: Organizational priorities for emerging risks (%)**

The key observations from the interviews of TMG members are:

- Data is the foundation for digital activities, hence, making sure it is reliable is a key priority. TMG members are exploring new sources of data and some are already acquiring data from third parties to complement the data from banks. Data risk also includes information security risk which is a serious risk in terms of fines and reputation.

- Risks from technology architecture is high because, in some member banks, merger of many agencies has resulted in the merger of many platforms. Some have big projects underway to renew operational financing systems. Cloud computing is considered by some members, but it is not easy to implement because of regulations.

- SME industry disruption risk is important to some members, for example, a taxation law on foreign labour could disrupt some of the SME industries.

**Other banks**

A majority of respondents (81%) from the IIF survey selected cybersecurity as a high priority risk. The next areas selected as high priority risks were integrity of data (79%) and industry disruption due to new technologies (79%). Credit risk was considered a high priority by 46% of the respondents.
Comparison of responses

It appears that cybersecurity risk is considered a high priority by a majority of both TMG members and respondents to the IIF survey.67

A higher percentage of TMG members also consider operational risks as high priority (63%) compared to other banks (41%) surveyed by the IIF survey. The reason for this difference is not known.

A higher percentage of TMG members consider the risk from technology architecture to be a high priority (50%) compared to the respondents of the IIF survey (39%). This is because many of them are merging data platforms and do not have a uniform platform or data lake. TMG members also consider data-related risk, SME’s industry disruption due to regulatory arbitrage, credit risk, and regulatory risk as high risks (50%). Another important observation is that industry disruption due to technologies is considered a high priority risk by only 25% of TMG members compared to 79% of the other banks.

Despite differences, it is safe to comment that cybersecurity risks and data risks are high priority risks for the financial institutions regardless of whether they are development banks (TMG members) or a mix of commercial and retail banks surveyed by IIF.

The processes that will leverage technology to improve RM

The Montreal Group

The members of TMG were asked to select processes in their organization that would leverage technology to improve RM in 2020 and 2023. The results are explained in the text box below. Exhibit 20 provides a detailed view of the responses from TMG members.
A high proportion TMG members (75%) selected know your customer activities (KYC), risk analytics, and integrated stress testing as processes that will leverage technology in 2020. The respondents have considered modelling, fraud surveillance and tracking new regulations to aid change management as key processes leveraging technology in 2023.

Exhibit 20: Processes that will leverage technology in 2020 and 2023 to improve RM (%)

Observations from the interviews of TMG members indicate that some TMG members are transitioning in digital maturity, i.e., are testing a number of processes such as KYC, risk analytics, integrated testing capabilities, modelling etc. However, in 2023 more digital maturity is expected in modelling as well as fraud surveillance and monitoring. In some banks, financial crime is the responsibility of another function outside RM. However, TMG members saw value in looking at leveraging technology for financial crime.
**Other banks**

The processes that will leverage technology has been asked in several surveys with different lists. The results vary depending on the digital maturity of the participating banks. The results from the EY, IIF survey\(^7\)_1 are shown in the text box below.

### Comparison of responses

It is interesting that TMG members consider fraud surveillance and modelling as key processes to leverage technology in 2023. The respondents of the EY/IIF survey and many other surveys\(^\)\(^7\)_1 have indicated fraud surveillance and modelling as key processes earmarked for leveraging technology in the 2018-2021 timeframe. This difference may be due to the extent of digital maturity of TMG respondents compared to those of the other banks surveyed. It is also interesting to observe that whereas financial crime is selected as a key process for 2020 and 2023 by 25% and 38%, respectively, of TMG members, it is acknowledged as a key process by 68% of respondents to the EY/IIF survey. Our interviews indicated that the responsibility for financial crime is situated outside the RM function in some banks. However, there may be a greater push to leverage technology for this area in the future.

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71 Ninth annual EY/IIF global bank risk management survey: Accelerating digital transformation.
According to McKinsey, bank risk management is constantly changing.\(^\text{72}\)

Bank risk management will likely look dramatically different by 2025, when it has become a core part of banks’ strategic planning, a close collaborator with business heads, and a center of excellence in analytics and de-biased decision making. Its ability to manage multiple risk types while preparing for new regulations and complying with current ones is expected to make it even more invaluable to financial institutions, and its role in creating fulfilling customer experiences will most probably transform it into a key contributor to banks’ bottom lines.

Technologies with significant impact on the RM function

*The Montreal Group*

Members of TMG were given a list of technologies and asked to select those technologies that would have a significant impact on the RM function of their organization. The findings are reported in the text box below.

A high percentage of TMG members (88%) stated that big data and analytics technology will have the most significant impact on their RM function in 2020. This was followed by, machine learning and cryptography/cybersecurity (63%). With respect to 2023, a majority of TMG members (75%) selected cloud technology, followed by blockchain distributed ledger (50%).

The answers of The Montreal Group are shown in Exhibit 21. It is noted that for a higher proportion of TMG members (63-88%) big data and analytics technology, ML and cybersecurity will have a significant impact on RM functions. From our interviews, we gathered that members were looking at internal data integration in data lakes and some were purchasing data from external parties. This is a good move because to use ML, it would be necessary to have big data. It is also interesting to see that TMG members expect cloud technology to have a

significant impact by 2023 because right now many of them find it difficult to move to the cloud because of restrictions on their operations.

**Exhibit 21: Technologies with significant impact on the RM function in 2020 and 2023 (%)**

![Bar chart showing technologies with significant impact on the RM function in 2020 and 2023.]

**Other banks**

Several surveys have addressed the topic of technologies that will have a significant impact on the risk function.\(^{73,74}\) The percentage of respondents to the EY survey\(^ {74}\) selecting technologies that will have an impact on the RM function in their organization are provided in the text box below.

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\(^{74}\) EY, Global banking outlook 2018, Pivoting toward an innovation-led strategy
Comparison of responses

It appears from the responses to the 2018 survey, that the other banks may be a little ahead on the digital maturity curve. In 2018, other banks considered cloud technology as having a significant impact on RM in the next three years. i.e., 2018-2021. On the other hand, TMG members see cloud technology as a significant technology for RM by 2023.

It appears from our interviews, that TMG members will catch up with the other banks in the adoption of artificial intelligence, cryptography/cybersecurity technology and ML by 2023. A few member banks have been collecting all financial and accounting information from businesses and have created models with this Big Data that can predict how the business will perform and the risks it will take.

Technologies like identification software based on biometrics are not selected my many TMG members because they are still in early or transitional stages of maturity. In addition, some of TMG members have no customer contact and are guarantee providers to other banks (indirect lending models) and are, therefore, not exposed to customer onboarding, access, and identification issues. However, some TMG members involved in know your customer activities could become more interested in the identification software based on biometrics for 2023.

Types of AI used or being used for RM

The Montreal Group

Members of TMG were asked to select types of AI used or being considered by their organization for enhancing the RM function. The key responses are provided in the text box below.
Assisted decision making with an analytical model providing insight from data was selected by 88% of members. This was followed by DL- or ML-based models and fully automated, data driven decision making using analytical models (63%), which is a bold move.

The answers of The Montreal Group are shown in **Exhibit 22**.

**Exhibit 22: Types of AI used or being considered for use (%)**

*Other banks*

A survey with similar questions to compare is the Finextra-Quantexa survey. In mid-2019 Finextra and Quantexa conducted a questionnaire survey of senior business and technology managers from 31 countries, representing 63 financial institutions, about their current state of AI adoption and their future plans and challenges. The responses in ascending order of percentage of respondents to the survey are shown in the text box below.

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Comparison of responses

The comparison is striking because when viewing from the highest to the lowest percentage of respondents who said they used or were considering using a type of AI, the results from both surveys are identical. Assisted decision making with an analytical model providing insights from data had the highest percentage of respondents using or considering use of it in both surveys. This was followed by DL or ML models, and fully automated, data driven decision making using analytical models. As stated in the report of the Finextra-Quantexa survey the financial institutions are moving on in technology adoption (see text box below).

The difference now is that techniques have moved beyond the simpler models of logistic and linear regression and narrow goals associated with predictive analytics. The machine learning discipline is now more computer science than pure statistics, often incorporates the use of more advanced algorithms, and can be used to address a wider range of problems.

The challenges that affect/likely to affect implementation of technologies

The Montreal Group

Members of TMG were asked to rate the challenges that affect or are likely to affect implementation of new technologies for the RM function. The key challenges that were rated high in terms of severity are shown in the text box below.
A higher proportion of TMG members rated four challenges as high-level challenges:

- Shortage of IT resources/talent
- Costs
- Cybersecurity concerns
- Current infrastructure does not support new technologies.

The responses of TMG members are shown in Exhibit 23. It is also noted that 25% of respondents did not see any challenge stemming from management of regulatory and technological requirements across different jurisdictions within the bank, uncertain regulatory environment, and uncertainty over build or buy strategy. It is interesting that the regulatory challenges are not being considered high enough, except by a few members, this could be because some of the banks have lesser regulatory issues than other.

The following observations from the interviews of TMG members add some light:

- Some are outsourcing areas requiring IT talents.
- Costs and capacity are placed in the same category in some banks, and the challenge stems from having too many projects with limited capacity.
- Regulatory management is a big challenge in some member banks but not in all. Sometimes, the member bank has to negotiate with the central bank to change some of the rules for developmental banks as they are not competing in the market, they are not for profit, and often are only providing guarantees.
- Some members are new to Big Data. Because they are new to it, they face high obstacles in assessing and testing digital technologies. Some others are working towards creating data lakes.
Exhibit 23: Extent of challenges to implementation of new technology for RM (%)

**TMG**

- Uncertainty over build or buy strategy: 25% (Low), 15% (Medium), 50% (High)
- Fragmented ownership of digital initiatives/platform across the bank: 38% (Low), 63% (High)
- Resistance among staff: 13% (Low), 50% (Medium), 25% (High), 13% (Low)
- Management of regulatory and technological requirements across different jurisdictions within the bank: 25% (Low), 50% (Medium), 13% (High), 13% (Low)
- Digital technologies not sufficiently tried and tested: 50% (Low), 38% (Medium), 13% (High)
- Uncertain regulatory environment: 25% (Low), 25% (Medium), 38% (High), 13% (Low)
- Current infrastructure does not support new technologies: 13% (Low), 13% (Medium), 50% (High), 25% (Low)
- Cybersecurity concerns: 13% (Low), 63% (High), 25% (Low)
- Costs: 13% (Low), 50% (Medium), 38% (High)
- Shortage of IT resources/talent: 25% (Low), 25% (Medium), 50% (High)

**Other banks**

Although other surveys have looked at challenges faced by chief risk officers during technology transformation of the risk function, we selected the list from the Eighth annual global EY/IIF bank risk management survey titled “Restore, rationalize and reinvent,” of 2018. The responses of the banks surveyed on key challenges faced or likely to be faced by the RM function in the face of technology transformation are shown in the text box below.
Comparison of responses

TMG members are in sync with other banks in considering shortage of IT resources/talent, costs, cybersecurity concerns and the inability of the current infrastructure to support new technologies as high challenges. However, as stated earlier, the uncertain regulatory environment is relatively a lower challenge for a majority of TMG members compared to the other banks that responded to the EY/IIF survey. This may be due to a larger proportion of banks from regions like Europe in the EY/IIF survey.

Areas of risk with talent shortage

The Montreal Group

TMG members rated talent shortages in various areas of financial and non-financial risks. The responses of the members indicating key areas of risk facing talent shortage are shown in the text box below.

A greater percentage (83-100%) of TMG members indicated talent shortage in areas such as technology risk, model risk, and advanced data analytical skills, 75% indicated shortage of talents in cyber risk management, testing skills and communication.

The answers of The Montreal Group are shown in Exhibit 24: Areas of risk with talent shortage.

Exhibit 24: Areas of risk with talent shortage (%)

Other banks

Many of the surveys cited in this report have broached the topic of talent shortage. We selected the results of the “Eighth annual global EY/IIF bank risk management survey: Restore, rationalize and reinvent, 2018” for this topic to be the comparator.
The key results varied by regions and are shown in the text box below.

<table>
<thead>
<tr>
<th>Africa-Middle East</th>
<th>Asia-Pacific</th>
<th>Europe</th>
<th>Latin America</th>
<th>North America</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AA skills</td>
<td>1. AA skills</td>
<td>1. AA skills</td>
<td>1. AA skills</td>
<td>1. Model risk</td>
</tr>
</tbody>
</table>

In another survey entitled the GARP/SAS survey, there is an interesting observation of how the skill sets in the RM function will change over time. The text box below provides a quote from the survey report.76

“Being able to understand the models and communicate how they will perform in different circumstances becomes highly valued. That suggests heightened demand for quantitative skills spanning risk, statistics and programming. He believes such training will increasingly be incorporated in advanced degree programs... Over time, we’ll probably see fewer people in risk, but they’ll have a combination of both the domain and quantitative skills that will come to dominate the risk function.”

**Comparison of responses**

From responses of TMG members and those of other banks in the EY/IIF survey63, it appears that talent shortages were reported relatively more in areas of RM such as AA skills and model-risk knowledge. In addition, TMG members have rated technology risk and cyber risk management as areas facing shortage. These were not key to the other banks in the EY/IIF survey. It is interesting that 75% of TMG members mentioned communication skills, which also appears as an area of shortage with other banks in the Asia-Pacific and Latin America regions. Lastly, conduct risk appears relatively more important to Africa-Middle East, Asia-Pacific, and Europe compared to Latin-America and North America in the EY/IIF survey. In comparison, 50% of TMG members reported shortage of talents in this area. As TMG members mature and have risk models ready to be automated using AI, different types of talent shortages are to be expected compared to what is envisioned now.

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4.2 Digital Maturity

Digital maturity is defined in many ways; however, in essence it means the level of experience the organization has gained with respect to modernizing its operations in order to adjust to the digital wave and the ecosystem changes that have already taken place and are likely to continue:

- Accenture has described digital maturity as the state in which banks can give business customers the banking experience they want, by shifting to their next-stage operating model, one that is mature enough to suit the digital economy and at the same time manage risks.77

- Another study by Tata and Chartis on AI and AA has looked at maturity from a different perspective, which ties maturity to “the diffusion and deployment of AI projects throughout the institution,” measured by the extent of standardization of processes and projects as well as the integration of the quantitative team with data scientists team in AI techniques and approaches with clarity in methods.78

- Deloitte in another publication has used the digital maturity scale to indicate the extent to which an organization has been transformed by digital technologies and capabilities that improve processes, engage talent across the organization, and drive new value-generating business models.79

For the purpose of our TMG survey, we aligned with the definition provided by the “Global Banking Outlook Survey” of EY.74 As shown in Exhibit 25, there are five stages in digital maturity as defined by EY in their survey:

1. Beginning — considering how digital technology can transform the business, building internal support and developing the business case;

2. Transitioning — exploring the application of new technologies and starting to digitize some elements of the business;

3. Maturing — optimizing middle- and back-office processes via new technologies as part of a coherent digital investment plan; and,

4. Digital leader — integrated front-, middle- and back-office operations, supported by data that flows across functions and geographies.

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77 Accenture, Better everything: A faster path to creating a next-stage credit operating model, https://www.accenture.com/ca-en/insights/banking/commercial-banks-better-credit-operating-model
Survey results of banks across the globe indicated that 62% would achieve digital maturity by 2020. This is not necessarily what may be true today. A recent survey by Tata Consultancy Services indicated that about 46.5% of banks were in a state of maturity ranging from somewhat mature to highly mature. In 2019, according to McKinsey and other researchers including Forrester, a good proportion of the banks are still trying AA in pockets of their organization or striving to digitize across the customer journey, from end to end, and only few have reached digital maturity or leadership. Secondly, digital maturity is relative given that some banks may be comparing themselves to traditional banks and others may be comparing themselves to the new online players and fintechs.

**Digital maturity of TMG members in 2020 versus 2023**

In order to compare the digital maturity of TMG members, a similar question was asked during the interview. Based on self assessment, in 2020, six members are in various stages of beginning (33%), transitioning (50%), and on the path to maturing (17%) as shown in Exhibit 26. As observed in the last chapter on benchmarking, it is expected that TMG members would have caught up with other banks by 2023; at least 67% of TMG members are expecting to be in the maturing and leader positions in three years.
Exhibit 26: TMG members on digital maturity

The digital maturity positioning of TMG members is important with respect to where the levers of change are deployed (Exhibit 2) as well as for deciding on the tasks to be completed under each milestone during implementation. This is because some TMG members have already completed some aspects of the digitization journey. The roadmap for the risk digitization journey is explained in the next chapter.
5. Implementation of Advanced Analytics

5.1 A Road Map for TMG Members’ Digital Reinvention Journey

Milestones and considerations

A roadmap for TMG members with seven milestones is provided in Exhibit 27. TMG members will have to consider all the seven milestones provided in the Exhibit in order to assess where they should begin their reinvention journey, depending on the project or program they would like to implement:

1. The first milestone ensures that target projects for AA are selected using criteria that allow them to be winners in terms of both enhancing RM efficiency or effectiveness while at the same time achieving strategic goals. The criteria and tips for project selection are elaborated in a subsequent subsection.

2. The second milestone requires that an end-to-end approach be taken by following the customer journey from the front-office to the back-office. A mapping of processes that need to be streamlined and automated, a list of data requirements, as well as techniques of AI, ML, DL, or NLP necessary for modelling and AA are enumerated with a clear notation of the business units involved. This milestone provides a blueprint leading to the AA initiative to be implemented.

3. The third milestone emphasizes the need for cross-functional teams. In many TMG organizations, digitization happens in pockets within business units and are often pilot projects involving IT teams that have the leadership. What is needed is a balanced team with talents including data science, IT, statistics, RM, and strategy. The human value in digitization is emphasized in this milestone.
4. The fourth milestone focuses on a cohesive and flexible infrastructure for digitization efforts. Some TMG members have indicated that due to mergers of various entities there are several infrastructure problems. Some banks are also restricted in moving to the cloud architecture because of government policy. Under these scenarios, achieving a proper infrastructure will need evaluation of a few options that are described in a subsection later.

5. The fifth milestone focuses on AA, which is the crux of this project report. In order to develop models and analytic algorithms, all the preceding four milestones should be reached. At this stage of readiness, an organization is equipped with appropriate technologies and techniques using AI, ML, DL, NLP and others. It can thus build and refine models and algorithms to enhance the risk function in the selected areas.

6. The sixth milestone indicates that testing and refining models are necessary to enhance the reconciliation of the AA model to the requirements of the risk function being subject to digitization e.g., credit risk, regtech, financial crime, fraud monitoring, market risk, cybersecurity, conduct risk, operational risk or other risks. This milestone is often run in parallel with existing algorithms and methods to ensure that AA has significant advantages such as reduced number of false positives, lower bias, lower risks, higher returns, and happier customers. There is a need to incorporate explainability as part of the modelling exercise.
7. The seventh milestone is a reminder that AA should be run in a continuous monitoring paradigm. This paradigm captures user feedback and has a built-in flow that follows the decision cycle in an observe, orient, decide, act, (OODA) loop.

**Milestone 1 considerations**

Considerations for milestone 1 require that RM works closely with the leadership function in the organization. A survey by McKinsey indicates that senior executive involvement is important for successful execution of AA transformation projects.

Some TMG members have indicated that RM in their organization works with strategy to set the risk appetite. This is a good starting point. The next thing to do is to embed risk in all strategic initiatives of importance. From a collection of initiatives, RM should pick a few initiatives for AA implementation that have pressing needs for development. It is important to select projects/initiatives that are achievable and will have impacts that would demonstrate the advantages of AA. Demonstrating success in the early stages of AA implementation is crucial to building confidence among staff members of various units in the digitization of risk. A few tips for success based on literature review are:

- Brainstorm and identify a number of projects that tie in with the organization’s strategic priorities and the ability of AA to achieve results. The examples provided in this report on various types of risk-related use cases in Chapter 3 (including Exhibits 9-14) should be a good starting point.

- Determine the most productive and doable digitization activities through a bottom-up assessment of risk processes and estimate the total impact.

- Make agile a cornerstone, while it is important that one learns to walk before running, there should be no fear of failure. Successful organizations adopt speed and execution over perfection. That requires agility in delivering products and quickly learning from them, as well as the willingness to take appropriate risks.

**Milestone 2 considerations**

Considerations for milestone 2 require a process map using the customer journey as a guide, as well as identification of data, AA tools and techniques required for each specific AA implementation project selected in milestone 1. This milestone develops the blueprint for all activities leading to each initiative from the list of AA initiatives selected for implementation.

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Mapping the customer journey

A customer journey refers to a chain of steps a customer takes to complete a given task, including the channels and touchpoints with which they interact as well as the needs and questions they have at each stage. The process map overlaid on the customer journey would help to undertake process re-engineering by simplifying certain paths, removing redundant tasks, parallel processing, front loading certain activities, etc. Banks have reported gains from re-engineering based on process mapping interlinked with the customer journey.

McKinsey has identified a few important generic customer journeys to be mapped: signing up for a new account; setting up the account and getting it running; adding a new product or account; using the account; receiving and managing statements; making changes to accounts; and resolving problems. Journeys differ by product or service line and the segment of the customer e.g., SME, large corporation, etc. In McKinsey’s experience, targeting about 15–20 top journeys can unlock significant value in the shortest possible time.83

Process automation

Next, this milestone would aim to automate processes controlled by risk along the process map overlaid on the customer journey pathway for each transformation project. It is reported in literature that organizations and projects have a better success rate if key stakeholders are involved at the outset. For example, in a workshop setting, teams can identify options to streamline connections, and identify the data and digital enablers necessary for the automation process.84 Examples of tasks that easily lend themselves to robotic process automation include collateral data entry, credit extension fulfillment, contracts generation, underwriting, etc. The smart and streamlined workflows will have the benefits of cost savings, avoidance of redundant processes, shorter cycle times for approvals, and better experience for customers. With streamlined and automated processes, the risk officers can now focus more on the activities related to the core of their function, which in turn would increase employee satisfaction through RM’s involvement in risk decisions rather than just the processes.

Most often automation has to be linked with AA to infuse intelligence to the automated process, which also means that the risk engine using automation and AA will need fit-for-purpose data. This is why the next two components, namely data and AA technologies described in the following paragraphs are integral to milestone 2.

Data requirements

This milestone would list the data requirements necessary for each transformation project. It is normal to expect that RM would like to collect fit-for-purpose data from a variety of sources e.g., from functions inside the bank and outside, including non-traditional sources. With the introduction of more data from varied sources, this milestone should consider steps for enhanced data governance that will improve the quality and consistency of the data. It is also important to consider data risk as a key element with which RM has to deal with; in this context, data risk would become a part of the risk appetite statement and the control framework.

Some important aspects of data are also discussed under infrastructure.

Infrastructure requirements

Given that milestone 2 is engaged in drawing a blueprint for the digitization process overlaid on the customer journey, there will be a preliminary component dealing with infrastructure considerations such as platforms, data lakes, cloud migration etc., which are elaborated under milestone 4. In other words, milestone 2 and milestone 4 are linked.

AA requirements

Milestone 2 would also chart the types of advanced analytics tools and techniques that would be necessary to further improve the accuracy and consistency of the models developed, which are elaborated under milestone 5. In other words, milestone 2 is a lynch pin for the subsequent milestones 4 and 5 while it would directly lead to milestone 3 on talent and capacity.

Other considerations for the blueprint

In addition to providing a blueprint of automation priorities, data requirements, infrastructure features, and AA technologies and technical requirements, the blueprint will provide an idea of the post-development stage. It would incorporate in the development plan various test points of running old and new processes in parallel for a while to gain confidence in advanced analytic methods.

This blueprint will outline how the tested solutions would be embedded in a bank’s website, its mobile apps, and banking platform, while deploying a flexible risk data architecture. It would also describe how users inside the bank would have options to consult the AA dashboards backed up by risk analyses to help them act on risk-driven strategic advice that is faster, more forward-looking, and includes deeper insights.14

Milestone 3 considerations

This milestone aims to emphasize the value of humans in the digitization process. The evolution of the risk function, described in Chapter 2, will require a team of digitally qualified personnel with competencies in both risk and the business, operating within a culture that values innovation and experimentation. The talents seen as most critical in a digitized risk function include data scientists, modeling experts, IT professionals, and risk officers with good exposure
to AA and modern technologies. Successful organizations are reviewing ways to bring together the right combination of skills to assist and sustain the transformation process. This often means having flexible organization boundaries in which team members come together from different business units. Multidisciplinary, cross-functional collaboration is often mentioned as a necessary component of transformation efforts in digital banking, specifically digitization of risk. It allows efficient access to critical expertise and enables a healthy balance in transformation through the inclusion and involvement of key roles. Team members can voice the ideas of their respective group or discipline, e.g., product development, design, data science and IT, and could collaboratively identify key outcomes to achieve as well as pitfalls to avoid. Because team members work side-by-side with other roles and disciplines, they can influence each other’s perspective, and move towards a common goal in digitization by integrating diverse aspects of the organization and the risk embedded in different functions. The following considerations are necessary for this milestone:

- Integrate the digital technology group with other technology functions like conventional IT and statistics to ensure that the transformation teams are supporting common strategic objectives and that they are investing in the systems, processes, and talents that can achieve the goals.

- Involve the product owner who has knowledge of the operations and customer perspectives to help with designing the appropriate inputs and outputs, flag areas of potential failure, and highlight cultural and behavioral changes that may be necessary for success.

- Include a designer who can view the transformation from a user perspective so that there is greater acceptance of the new output. With diverse skills, designers enable a balance between human and technology elements.

- Have an AI and automation solution architect for assessing technologies and making recommendations based on cost, functionality, and the existing enterprise IT architecture. The solution architect can also identify needed data and analytics, as well as evaluate new opportunities to enhance the infrastructure.

- Ensure that there is an operations lead that would help to merge the new automation and digital version of the new process with the existing operations. This lead would also ensure that the innovation is working well in daily operations, and that the modifications necessary to the item being tested are fed back to the transformation team from the operations.
• Develop a talent plan\textsuperscript{85} that builds on both existing internal talent and external sources while adapting the culture to appeal to next-generation digital workers as well as conventional IT workers, who have valuable knowledge of the organization’s systems.

• Create attractive policies and packages for acquiring new talent and have a well-balanced human-resource management to motivate and retain the integrated team.

\textbf{Milestone 4 considerations}

This milestone deals with a key challenge faced by many banks, including members of TMG, in dealing with an infrastructure that does not easily lend itself to AA implementation. The modern-risk infrastructure is conceived to support several other building blocks of digitization for example innovative data storage solutions such as data lakes, new interfaces, easier access to external ecosystems, and so on. Approximately 45 percent of respondents to a McKinsey’s survey see innovative technologies as a key to digitization of risk and enhancement of RM.\textsuperscript{14} “No code” and “low code” solutions will endow risk executives and officers with more control and reduce the number of end-user computing tools. Nearly 60 percent of the respondents expect innovative data storage structures to have a significant impact on RM. We will discuss the new technology infrastructure and data storage options under this milestone.

\textbf{New technology versus legacy systems}

Technology is a core element of any organization trying to implement the next-generation operating model. Organizations often have difficulty in making decisions with respect to introducing new technologies when legacy systems exist.

To address the issues, leaders in banking are moving to modular architecture. This means that an assessment is made to select those systems that need to be modernized to improve speed and flexibility for better results tied to strategic outcomes. This understanding will help to answer some questions related to important decisions, for example:

• Is it possible to create a new platform or a data lake or move the operations to the cloud to speed up processes, reduce maintenance and achieve goals of better RM, growth, and customer satisfaction?

• Should the new technology be run in parallel with the existing technology or should the existing one be replaced by the new?

The modular approach can accelerate development and prioritize the use of common components, which in turn can boost efficiency and consistency. In addition, a more flexible architecture enables banks to partner with companies in the external ecosystem, which may have superior capabilities in providing different types of technological and business support.

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\textsuperscript{85} Deloitte, Banking analytics: The three-minute guide
Besides a modular approach to technology architecture, leaders are investing heavily in DevOps. The latter combines software development and information-technology operations to enable a shorter systems development life cycle and provide continuous delivery of high-quality outputs by combining people, process, and technology changes. For example, DevOps can help automate software testing, security, and delivery processes as well as infrastructure changes.\textsuperscript{86}

\textit{The legacy dilemma}

Many banks are operating on core platforms that have been customized and are complex to maintain. Until recently, the potential hardships that financial organizations could face in modernizing their core system have been a major hurdle in replacing legacy systems. Specifically, in the short term, such decisions entailed huge investments of time, effort, and money. In addition, decision makers were concerned about the operational risk involved and the likelihood of disruption in day-to-day operations. This is why many banks have carried on with legacy core systems as long as they can run the core operations. However, this status-quo situation does not appear tenable anymore for many organizations because of expiring service contracts, customized patchworks on the system, and scarcity of resources in older technologies such as COBOL and mainframe systems.

Now, there is a convergence of factors for change such as higher customer expectations for fast and streamlined services, alternative finance providers in the ecosystem, advancements in modernized offerings, and a feeble support for existing systems, which are very expensive to upgrade. With a variety of technology solutions at their disposal, banks now have several options to transform their core capabilities. To determine which option is best suited for them, banks need to establish their modernization profile based on criteria such as the suitability of their existing platform, their risk appetite, the need and drivers behind their technology transformation, their strategic timeline to transform, the resources available, and the complexity of their data strategy.\textsuperscript{87}

Deloitte has provided case studies for four options to consider beyond the “do nothing” option:

- Re-Platform: This requires code migration with minor upgrades to the existing platform and minimal change to application functionality or technologies. This option does not provide opportunities for major risk digitization and AA.

\textsuperscript{86} McKinsey, \textit{How to start building your next-generation operating model},

\textsuperscript{87} Deloitte, \textit{Digital transformation hits core banking},
• Re-factor: Modernize the core banking platform codebase to current technologies (from COBOL to Java for example) without changing the baseline. Re-factoring potentially enables the existing core platform to migrate to the cloud; however, unless migrating to the cloud is part of the digitization road map, this will not help with AA for RM.

• Augment: Deploy a parallel core that meets AA needs not provided by the legacy core. The new core can run for a number of target product offerings and could be used as a precursor for migrating from the legacy core. This option combines the advantage of offering innovative solutions for banks looking to transform RM and processes quickly while maintaining the existing core and its offerings.

• Replace: Replace the existing core platform with new, modern solutions. This option accelerates the launch of new products and AA for RM for banks that can afford to incur the initial investment and are able to justify the risk of replacement. It would also be the option for a bank which needs to replace the existing platform because it has reached its end stage and is not viable anymore.

The decision of whether to re-platform, re-factor, augment or replace the core is complex. An in-depth analysis of the current infrastructure is required as also the risk appetite, strategic directions for transformation, and organizational capabilities. If a bank chooses the “augment” or “replace” the core system option, the next important consideration is migrating the data to the new system.

Data sources, storage and management

The wealth of data at a bank’s disposal represents a unique advantage. It can offer insights into customers’ current and future needs and their challenges. Importantly, this data can feed the analytics which can improve RM, enable faster and better risk decisions, and lead to appropriate pricing and more personalised services for customers. Busting the silos of data and creating more dynamic access will enable banks to align with the ecosystem.

Banks have an increasing volume of data although there may be some exceptions in some TMG member banks. The issue of paucity in data and how to overcome this issue will be addressed in the ensuing paragraphs. Risk data originates in transactions, customer data, credit reports, ledgers, news feeds, cyberspace, and other sources. In addition to volume, some banks with automation have a high velocity of data because data is captured and generated at a rapid pace. Lastly, there is also a vast potential for variety in data including traditional structured data and unstructured data. The risk function needs to have a robust approach to collect, use, and manage data to ensure appropriate quality of analysis in support of risk decisions.

88 Accenture, Redefine banking with artificial intelligence
Wavestone has undertaken research on small and medium-sized banks and identified their weakness in having sufficient data to adopt AI. In this context, they have stated that while banking giants such as Citibank are increasingly using ML and big data to adopt AI based programs, small and medium-sized banks struggle with the amount of data needed to deploy similar programs. They are in agreement with the findings of the World Economic Forum (WEF), which says that small and medium-sized banks should be agile and use collaborative AI-driven tools, built on shared datasets. In the view of WEF, if small and mid-sized banks move to create common utilities and frameworks for their data, AI can be used to develop better models for prediction of consumer behaviour and risks. This move for sharing and partnership will keep the larger banks from adding to their competitive advantage from the use of AI which is facilitated by their advantage in scale.

As stated by McKinsey, risk can no longer rely solely on traditional risk data such as loan exposures and usage limits, but must identify and harness all the fit-for-purpose data that is available about the customer from a variety of digital footprints. Risk identification, measurement, monitoring, and prediction often employs data from external sources:

- In emerging markets, telecommunications providers have data about payments received or sent via a mobile phone, and this data can serve as a good proxy for a customer’s revenue flow and ability to pay. In addition, customers pay bills, make purchases, and send and receive remittances with mobile devices, and this data could be used to assess risk.
- Mobile users also make calls, send text messages, and access information using their mobile devices. The number of calls placed, or online behavioural characteristics could be predictors of their payment ability and default risk.
- Utilities collect information about usage and payment patterns of their customers. This data can serve as an excellent proxy for the customer’s ability to repay, particularly because utility bills are regularly sent to the customer with specific cut-off dates to pay, and, hence, resemble loan payment intervals of banks.
- Wholesale suppliers maintain payment histories for their small-business customers. With the customer’s consent, such data can be used to assess ability to repay and

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92 The paragraph answers the question from a TMG member on what to do in case of data paucity.
sometimes to estimate revenue. The data can reveal the cyclicality of the business over a year, and the payment patterns could serve as a proxy for credit reports for SMEs.

- Retailers can also be a rich source of data as cash register devices and retailer loyalty programs are now penetrating emerging markets. SME owners can be identified, and the data used to estimate behavioural patterns, risk taking behaviour, and propensity to pay, which in turn can be used to estimate the probability of default.

- In the emerging nations, government agencies collect vast data sets about their residents to help them in their decision making and to administer public policy, including social programs. If allowed, development banks could use some of that data for risk scoring. However, this would depend on the privacy laws that are attached to the data.

Deloitte refers to the challenge inherent in using data from external sources. For example, data on emerging strategic and reputational risks could be in highly unstructured forms, such as social media and news reports, as well as structured forms, such as economic data, earnings reports, and public filings. However, with advanced capabilities, it is possible to drill through such data and identify patterns using ML, DL, and NLP techniques. The fact that the cost for use of AA is lower now than before is an incentive for banks to use data from such diverse sources. With greater volumes of data about the customer, it is possible to make fast, accurate and unbiased decisions.

One of the tips from McKinsey’s research is that the need for data should not burden customers. Instead, data should be gathered from other sources that are available e.g., utilities, fintechs, e-commerce giants, online retailers, suppliers and others. These ecosystem players can help risk modeling to introduce new, timelier, and more precise customer risk segmentation, and provide attributes such as payment patterns, purchasing history, and even online search and behaviour.

Banks are also experimenting with alternative sources of data for trading and operational risk, fraud, cyber risk, and reputational risk; for example, banks use sentiment scores obtained through use of NLP on social media, location patterns, and behavioral anomalies. In order to assess and identify the attributes that are truly relevant for RM, banks engage in capture, analysis, and testing data over relevant time frames. This means banks will need to capture (and often purchase) a considerable volume and variety of data to learn which attributes are suitable for predictive analytics. Some TMG members are already doing this. Members who are facing lack of sufficient data can facilitate their access to data by joining interest groups and roundtables, as well as by partnering and sharing learnings with other participants.  

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94 The paragraph answers the question from a TMG member on what to do in case of data paucity.
Given that customer data is available from external sources as well as from internal sources, with some exceptions, there is a strong need for appropriate governance rules to protect the privacy of customers. The General Data Protection Regulation (GDPR), for instance, has been passed in the European Union to strengthen online privacy rights and harmonize data-protection rules. Banks, and the risk function in particular, must make sure they maintain appropriate data standards and policies, as well as robust remediation programs. This is important from the standpoint of reputation and conduct risk which are important for TMG members.

Data quality and consistency could be key issues for many TMG members. Complex organizational structures, ill-defined or overlapping responsibilities between silos, and overly complex data architecture could cause difficulties in merging and having a clean flow of data. To overcome these issues, many banks have established governance strategies across the various business units. For example, the following measures are in place: accountability models enforce natural points of ownership; dictionaries and common taxonomies ensure that the purpose for which the data is collected is known; and, quality measures enable transparency in data deficiencies and remediation. These governance measures have to be strengthened with specific reference to RM.

A sound data management strategy is thus a serious counterpart of efforts to modernize the core infrastructure of a bank. The data whether migrated to a data lake, data warehouse in the cloud or a cloud feature that allows handling of both the data lake and the data warehouse should take place smoothly. The data migration consideration as to where it will be stored and managed is important in light of any discussion around core modernization or digital transformation. This aspect of relationship between data type and migration with core modernization decision is extremely complex when there are many data channels, lines of business, and data owners with varying levels of data quality. Irrespective of the modernization option that is selected, for example, “augment” or “replace” the core, banks must understand their current state and map how their data assets will flow within their organization (Milestone 2). Managing data effectively is not only necessary from the perspective of operational efficiency and accuracy but is a must to equip banks to launch AA capabilities.

**Milestone 5 considerations**

This milestone focuses on how to implement the tools and techniques of advanced analytics using components of AI such as ML, DL, NLP, etc. Earlier chapters, specifically, Chapter 3, have dealt with the use of AA in banks for a variety of RM applications. To avoid repetition, we will deal mainly with highlights and tips for implementation.

AA can handle many decision models as illustrated with examples in Chapters 3, including descriptive, diagnostic, predictive, and prescriptive models. A wide variety of algorithms
including ML algorithms, such as random forest, XGBoost, and deep learning, can now be applied with the right volume and type of data, tools, techniques, and talent.\textsuperscript{95}

ML takes three main forms:

- Supervised learning is undertaken with data that can be used for training with known outputs. The algorithm is taught to recognize similar outputs in the future. A target or dependent variable is defined, and the algorithm chooses from a set of predictor or independent variables that best predict the outcome. Typical analytic methods employed include linear and logistic regression, classification and regression trees (CART), and random forest. These algorithms are typically used for predictions e.g., predicting a fraud event in a credit life cycle or market risk. Because the right answer is already known, the algorithm can be taught to improve its prediction capability. The Deutsche Bank has used supervised learning for teaching ML algorithms.\textsuperscript{96}

- Reinforced learning is when an algorithm is asked to determine the optimal action to select by providing it with a reward function. Through a series of actual or simulated interactions with the environment, the algorithm learns the reward function of its actions within particular states of the environment. Examples of “learners” that could be used include the use of Monte-Carlo simulations to assess the credit risk of structured specialized lending contracts. Monte Carlo simulation engine would run the data through a vast range of scenarios to produce the clearest view of the probable outcomes one could face, even with limited data.

- Unsupervised learning is used to extract insights. It examines the data and suggests ways to cluster them, which can then be augmented with additional knowledge and inputs from risk officers and analysts. Since it has no predefined target outcome, it would undertake a variety of clustering. Such clustering can be used, for example, in early credit warning systems as well as in detection of anti-money laundering (AML).

The type of ML, DL or behavioural models (NLP) to use will depend on the questions that are being answered for the project selected under Milestone 2. Regarding timelines, according to Tata consultancy services,\textsuperscript{78} the areas with increasing complexity take more time. The areas with increasing complexity and, therefore, likely to take more time for completion (placed in ascending order) are:

- Alternative data (e.g., credit risk analytics to support and augment SME credit analytics);
- Stress testing and scenario management;

\textsuperscript{95}McKinsey, Rajdeep Dash, Andreas Kremer, Luis Nario, and Derek Waldron, “Risk analytics enters its prime,” June 2017, \url{https://bobmorris.biz/tag/risk-analytics-enters-its-prime}

\textsuperscript{96}How Deutsche Bank industrialized AI and machine learning, September 2019 \url{https://conferences.oreilly.com/strata/strata-ny-2019/public/schedule/detail/79559}
• Graph analytics\(^{97}\) and NLP;
• Credit portfolio management;
• Non-linear modeling for complex credit products or programs for credit portfolio management; and,
• Development of common quantitative framework.

The key considerations for implementation of this milestone include:

• Integrating AI and AA for RM as part of the risk framework.
• Maintaining data management and governance (Milestone 4) as strong areas to enable use of AA.
• Ensuring access to availability of sufficient knowledge and talent to understand data from a variety of sources, and analytic models that could be deployed to obtain insights for better risk decisions (Milestones 3 and 4).
• Undertaking rigorous analysis of AA tools and techniques, the quality and consistency of data, and the \textit{validity and explainability} of all computational methods and algorithms.\(^{98}\)
• Understanding the three stages of explainability namely \textbf{pre-modelling, modelling and post-modelling explainability} by understanding the data to be used in developing the models, developing inherently explainable models, and extracting explanations to pre-developed models, respectively.\(^{99}\)
• Applying appropriate methodologies such as: exploratory data analysis as well as data set description and standardization for \textbf{pre-modelling explainability}; explainable model family inclusion, joint prediction and explanation, and hybrid designs for \textbf{modelling explainability}; and, backward propagation, proxy models etc. for \textbf{post-model explainability}.\(^{99}\)
• Conducting traditional pricing, modeling and risk analytics in parallel with AA approaches to validate, test and achieve effective models.
• Undertaking reconciliation between traditional pricing, modeling and risk analytics, and new AI-oriented statistical approaches.

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\(^{97}\) Graph analytics are analytic tools used to determine strength and direction of relationships between objects in a graph. The focus of graph analytics is on pairwise relationship between two objects at a time and structural characteristics of the graph as a whole.


\(^{99}\) Explainability for TMG member that requested it.
Some tips for selection of automated ML model tools, based on features suggested by Data Robot, are to look for tools which would:

- Identify the best model for a particular situation through assessment of several models based on performance using multiple criteria and appropriate metrics available to match the particular purpose for the model under consideration.
- Remain transparent regarding each model’s use of data, for example, not just which data is most important, but when and for what purpose.
- Explain individual predictions, including the influence of specific variables and their values.
- Provide diagnostics to understand each model's accuracy and consistency using a variety of standard metrics.
- Use tools to make trade-offs between speed and accuracy, positive versus negative predictive value, and the need for more models to support the findings.
- Create the documentation required for model validation and model risk management.
- Reduce the cost and burden of deploying models into the bank’s core production environment by providing options that are not invasive such as code generation, API deployment and Hadoop.
- Enable model performance and detect drift or performance degradation over time, alerting modelers to the need for retraining or creation of challenger models.
- Build retraining models on new data and redeploy models into production that are simple, fast, and of low risk.

**Milestone 6 considerations**

This milestone emphasizes the need to test and refine AA algorithms and models once they are developed.

Generally, teams build confidence by testing and operating tested processes that have passed the pilot phase. Often, banks that test the accuracy of outputs are already ahead in analytics and use statistical techniques like regression. In such cases, AA is expected to result in better accuracy as in the case of credit scoring and market price forecasting. Another attribute of AA that could be compared would be its superiority in segmenting customers into high and low risk as well as in predicting default. From a practical standpoint, testing of accuracy is a complex

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101 Apache Hadoop is a collection of open-source software utilities that facilitate using a network of many computers to solve problems involving massive amounts of data and computation. It provides a software framework for distributed storage and processing of big data using the MapReduce programming model.
issue because the results would depend on the attributes of the dataset, the structure and variety of the test data as well as the type of processing undertaken. Different programs use different validation techniques. For example, in Random Forest, a cut-off date is established for the data to be used in training the model, e.g., data 6-9 months prior to the start of model building. The “train set” data used for the model building process is always the data prior to the cut-off date. The algorithm builds several trees and these trees form the ensemble that results in a Random Forest ML model.

Once the model is built, it is tested on the out-of-time data, i.e., the data that was set aside and was 6-9 months old when the model building commenced. Because the out-of-time data includes new time periods that are ‘unseen’ by the model, this is the best data on which to determine the model’s expected accuracy. Models are also tested for performance in a real-world setting. In addition, testing involves a shadowing process to let the models run for a period of time and measure the on-going performance.

To improve results and finetune the new model, best business practices recommend that the new model, using novel techniques, should be run in parallel with existing traditional models. This approach allows bank management, regulatory supervisors and others to build confidence in new techniques that are being promoted. It is advantageous for risk teams to expose all interested parties to test results and provide a strong, evidence-based launch.

Another strategy that works is to put the existing process in a digital form and slowly amend the digital form to produce better results. This way, the decision makers will be introduced to the digital system with outputs similar to the existing system, thus allowing them to make their decisions in the same environment as before. Subsequently, in a well-staggered and controlled approach, new data and approaches can be added to enhance the digital system and revector it.

**Milestone 7 considerations**

This milestone indicates that it is important to run AA projects in a continuous improvement paradigm. When it comes to performance improvement, it is important to follow an agile culture of experimentation and innovation in which being wrong is acceptable. Accordingly, it is important to realize, at the launch of an AA initiative, that the first hypothesis on which the AA model was built needs to be adapted as experience is gained. The late and brilliant COL(Ret) John Boyd provided the framework of Observe, Orient, Decide, Act (OODA loop) in which the enemy gets a vote. When followed, the OODA loop serves as a good template for continuous improvement as it follows the decision cycle of observe, orient, decide, and act. The performance improvement of AA models, when used in real-world settings, are subject to

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102 Brady Reed, Need performance improvement? Get in the ooda loop! [https://www.govloop.com/community/blog/need-performance-improvement-get-in-the-ooda-loop/]
change of attitudes, culture, customer interactions, industry environment, politics, and other variables. Since many of the AA models are built with assumptions for each scenario, it is important to be ready to change the model if the bases for the assumptions have shifted.

According to McKinsey, the success of a decision is closely related to accurate and quick processing of situations and information. The decision process is thus a dynamic series of interconnected loops.103 Best-in-class organizations make data-focused decisions, build user feedback into solutions, and rapidly iterate products that are successful. Digitized data points enable shorter time frames for feedback cycles. By using AA, organizations can run loops that are faster and better. There are significant advantages to test, iterate and monitor the AA initiatives. For example, one can check for data quality, incorporate new data points as and when they become available, and build modified models to suit the new data sets.

In addition to following a continuous improvement paradigm, it is important, in the initial stage of risk digitization (as also later), to render the output usable and appealing to the users. While the best algorithms can be effective, they cannot impress decision makers in boardrooms unless they are communicated clearly at a strategic level. Many data scientists may not have the communication skills. An impressive interface for the model and its results in an attractive dashboard for AA is a must for the adoption of AA. It has been observed by specialists that by framing the right questions, stress-testing the options, and communicating the trade-offs with an elegant, interactive visual model, it is possible to convey a strong message to decision makers that investment in AA is significantly important to upgrade the effectiveness of the organization.

**Pitfalls to avoid**

The AA journey is fraught with pitfalls. Experts in implementing AA for banking institutions suggest that AA should not be treated as a novelty because the hype will cause inappropriate applications of AA in RM. Instead it should be closely tied to strategy and receive constant and consistent encouragement from executives. The key pitfalls in AA transformation project implementation are described in Exhibit 28.

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The first pitfall to avoid is inconsistent support from leadership, lack of strong links to strategy, and unstructured goals. In many organizations, leadership falters after initiation, hence, the culture for digitized risk is not built with steady focus from the top to penetrate all parts of the organization. In addition, weak, unstructured goals prevail for AA in RM. According to McKinsey, this happens when the executive team does not have: a real grasp of what AI/AA can do for achieving important strategic goals; a clear vision of the AA program; well-defined roles for traditional analytics versus AA; sufficient knowledge of a spectrum of AA use cases of strategic value; and, a roadmap for AA initiatives to be executed in the medium- and long-term. A case is cited by McKinsey when top management did not understand AA and its relevance, struggled to identify and define problems of strategic value for the analytics team to solve, and consequently did not invest in building the right skills within the organization. As a result, the AA pilots failed to get traction and generate more interest and support. Another reason cited by Tibco in their analysis of pitfalls is that when AA projects are selected, some organizations fail to include short-term wins in the AA roadmap and this leads to disappointment because the rest of the organization does not see the value of implementing AA. In other instances there is no alignment between the business case for AA and a compelling business strategy.

The second pitfall to avoid is insufficiency of data and sometimes explosion of data from too many sources e.g., new channels, new types of interactions, and third-party data providers. In

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this context, there is the danger of low-quality data seeping in, as well as data that is inconsistent between the different sources. Lack of data governance is often the cause of many data problems. Most often there is not sufficient consideration of what data is needed for the specific AA initiative on hand. According to McKinsey, the IT teams sometimes spend enormous amounts of time, effort and money on large data cleansing efforts trying to scrub all the data instead of focusing on fit-for-purpose data. In addition, the quality and consistency of data available is not governed and the entire idea of having the right data of high quality for the purpose on hand seems like a mission that is impossible to accomplish. Organizations often fall into this pit unarmed because of lack of data science training and know-how and absence of formal data governance.

The third pitfall is intricately linked to the second pitfall. Most often current infrastructures in banks are siloed and do not allow for data access across business units, much less from external partners. In many banks, systems of records are isolated from systems of engagement. They also differ in terms of quality and usability. Emerj, a leader in AI research, that advises many clients on infrastructure indicates that often organizations fail to ensure that data is harmonized so that fields of data are uniform across systems and can be matched. When ML systems are trained, they need to access data from all parts of the bank; in addition, the data has to be consistent. Practitioners helping with infrastructure modernization note that when a bank tries to find a way to modernize the infrastructure, it could make some wrong and costly decisions such as thinking that legacy IT systems have to be integrated first. Another common mistake is to build a data lake without carefully assessing the best way to build and structure it. Often, the types of data that would flow to fill the lake are not envisioned. Also, many organizations design the data lake as a single entity without partitions for different types of use cases and this structure could lead to modelling inefficiencies.

The fourth pitfall is related to many types of common errors made with respect to introduction and implementation of AA technologies and techniques. Generally, organizations, resist AA models and initiatives because they are used to traditional analytics and believe that moving away from established ways of doing things could cause chaos and disruption to core operations. Lack of knowledge in AI and data science among analysts and decision makers results in an unwillingness to supplant old analytics with new methods involving AI and ML. Once an organization circumvents resistance to AA, it should remain alert for further dangers e.g., lack of curation of new models, algorithms, and techniques leading to “suspect models” that business units are unwilling to adopt. In modelling, black-box models, which lack pre-

105 System of Record is the primary system or data repository of an organization. A System of Engagement is the system that is used to collect data. It’s software that people interface with directly in the form of a task-specific, usable tool for capturing data.
106 Emerj, Beginning with AI, A business leader’s guide, https://podbay.fm/podcast/670771965
modelling, modelling, and post-modelling explainability, are also bound to derail the prospect of adoption of ML and DL models. This pitfall is often related to the next pitfall, namely, lack of talent and culture for transformation.

The last pitfall is related to talent and culture. The main reason for the lack of a strong culture for digital transformation in the organization stems from inconsistent support for AA initiatives from the organization’s executives and leadership. The common mistake often made with respect to culture and talent is in not recognizing the internal data culture of the organization and the extent to which the organization is ready to embrace the digital culture. In addition, very few executives have information on the types of analytics talent in their organizations. Hence, technology transformation decisions are often made without consideration of human aspects. Project teams often fail to have a balanced combination of people with the right analytical skills, technology know-how, and business experience, specifically RM if the project has to do with risk digitization. Many organizations develop analytics capabilities in isolation from business units and some of them in small sporadic pockets of a few business units. They also lack “translators” who can convert or translate the strategic goal to be achieved in terms that would enable data scientists, data engineers, and other tech experts to build an AA solution. The translators are able to express the strategic goals of business leaders in a language that the technology transformation team can understand.84

The next section provides a set of key recommendations that would lead to successful AA implementation and thus achieve the vision of a future risk organization.

5.2 Realizing your Vision of RM for the Future

From the surveys collected from TMG members, one-on-one interviews and group sessions, we have been able to discuss various aspects of AA for RM. Specifically, we have observed and discussed:

- The digital wave imminent in the ecosystem that makes it important for transformation of RM to embrace not only new and advanced technologies but also to link RM to strategic considerations of the C-suite. Creation of the new risk culture thus entails the embedding of risk in a systematic manner across all business units and functions to reach strategic goals.

- The need for RM to adopt an inclusive perspective that strengthens internal, cross-functional collaboration with data scientists, IT professionals, and business managers and also encourages external partnerships, when necessary.

- The importance of the central role of data governance, as data is key to all AA programs and there prevails a driving need to secure access to appropriate data and a cohesive, flexible infrastructure.

- The efficiencies that accrue from mapping processes to the customer’s journey in pursuit of streamlining process flow and automation.
• The value of hiring and retaining the right mix of talents as well as the need to keep the customer in mind for all risk-related initiatives.

In addition, we identified critical problems such as the paucity of data, inflexible infrastructure, and the lack of explainability of many ML models. On the basis of comprehensive literature review findings, survey benchmarking and discussions with TMG members we have provided recommendations in the next subsection.

Recommendations

The following recommendations emanate from the survey inputs, discussions and the literature review knowing that there are many pitfalls to avoid in implementing AA for RM:

1. Set the vision of the future for RM and articulate the need to change the role of RM in view of its impact on the strategic initiatives of the organization.
   a. Drive and uphold a culture to support digitization of risk and ensure that the culture becomes embedded in various functions within the organization beyond simply a few projects.
   b. Ensure that there are both realistic and feasible short-, medium- and long-term goals for the AA initiatives with increasing potential support from the leadership team when goals are met.

2. Make digitization of risk an intertwined part of key strategic endeavours. Create an end-to-end plan for use cases, moving from important but less complex use cases to important but more complex use cases.
   a. At start, select sure winner projects with potential to produce compelling results that achieve strategic goals.
   b. Secure continuous and energized involvement of the leadership team at the head of the organization and link risk appetite to the organization’s strategy.
   c. Avoid running stray pilots in little pockets of the organization.
   d. For all AA projects, aim at cutting across business units for involvement and inputs, while following the customer journey.

3. Map the customer journey and overlay key processes across the map to secure streamlined processes and opportunities for automation through robotic process automation.

4. Have a proper data governance program in place to identify key data needed for each AA endeavour of importance.
   a. Endeavour to bust the data silos and create a uniform data stream from a variety of internal and external sources.
b. While consistency and quality of data is a must, do not indulge in cleaning masses of data without a purpose, i.e., clean the data that is needed.

c. When there is paucity of data, look for partners in utilities, telecom companies, e-commerce giants, credit bureaus, government agencies, suppliers, fintechs and others.

5. Tie your data governance to a modernized infrastructure that is appropriate.
   a. Consider modernizing your infrastructure either through augmentation or replacement. In either case, the legacy problem could be resolved.
   b. Create a cohesive, flexible infrastructure that enables experimentation in an agile environment allowing for collaboration.
   c. Integrate data from many systems of the bank, and source data flows from within as well as from third party partners.
   d. While it is important to consider a data lake, do not ignore partitioning the data lake for different purposes and different types of analyses. A plan on the types of data that would flow into the partitioned lake is important.

6. For the AA initiative implementation to succeed, follow an agile culture where experimentation is key, and it is important to be resilient and quick to achieve results.
   a. As stated in recommendation 2, start with initial projects that are sure and easy wins with impressive results that back strategy.
   b. Select a modelling approach that is suitable for the task at hand. In the case of ML models focus on explainability, testing, and validation.
   c. Walk before you run, i.e., try the simple explainable models before trying the complex ones; however, be agile and experiment boldly.
   d. Run the new analytics in parallel with the old analytics until the users see the impact of AA and are comfortable.
   e. Follow the continuous monitoring paradigm and be agile to change data or assumptions as needed.
   f. Continuously rebuild, refactor and redeploy models based on new knowledge and influx of information on changed situations.

7. Secure the involvement of an energized and motivated cross-functional team with sufficient mix of data scientists, IT specialists, statisticians, and business experts.
   a. Make sure that there is a person with business experience and sufficient knowledge of AI and AA that can convert/translate the ultimate goal of the AA initiative into AA tasks for each type of talent in the team.
b. Work with HR in attracting and retaining qualified personnel through a flexible work environment and attractive package of remuneration and benefits with scalable incentives for performance.

8. Promote external orientation and assessment of opportunities in the ecosystem so that partners in data, technology, and AA expertise become available, if needed.

9. Communicate the results of AA implementation through a visual and usable dashboard that answers key questions of decision makers.
   a. Ensure that the dashboard is really outstanding in usability, functionality, and visualization.
   b. Institute appropriate impact/performance measurement and metrics to communicate the value of AA initiatives to the leadership team in the boardroom and the operational managers in the organization.

10. Create momentum and maintain it from one initiative to another so that one does not face the “pilots only” syndrome in which organizations fail to work on a continuous stream of use cases of importance to the organization.

The above 10 recommendations should help your way to RM of the future for your organization in a timeframe that you think is feasible, given resources and support from the senior leaders of the organization. If all endeavours by TMG members go forward in the manner suggested in this report, which outlines their concerted view, the future of RM in TMG would be remarkably similar to that enunciated by McKinsey and cited earlier in Chapter 4:

“Bank risk management will likely look dramatically different by 2025, when it has become a core part of banks’ strategic planning, a close collaborator with business heads, and a center of excellence in analytics and de-biased decision making. Its ability to manage multiple risk types while preparing for new regulations and complying with current ones is expected to make it even more invaluable to financial institutions, and its role in creating fulfilling customer experiences will most probably transform it into a key contributor to banks’ bottom lines.”^72
6. Appendix 1

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The Business Development Bank of Canada (BDC; French: Banque de Développement du Canada) is a federal development bank structured as a Crown corporation wholly owned by the Government of Canada. Its mandate is to help create and develop Canadian businesses through financing, growth and transition capital, venture capital and advisory services, with a focus on small and medium-sized enterprises.

The bank was founded in 1944, and its corporate headquarters is located in Montreal. BDC has more than 123 business centres across Canada and 60,000 clients. BDC’s debt obligations, secured by the Government of Canada, are issued to public and private sector institutions.
The Brazilian Development Bank (BNDES) is the main financing agent for development in Brazil. Since its foundation, in 1952, the BNDES has played a fundamental role in stimulating the expansion of industry and infrastructure in the country. Over the course of the Bank’s history, its operations have evolved in accordance with the Brazilian socio-economic challenges, currently including support for exports, technological innovation, sustainable socio-environmental development and the modernization of public administration.

The Bank offers several financial support mechanisms to Brazilian companies of all sizes as well as public administration entities, enabling investments in all economic sectors. In any supported undertaking, from the analysis phase up to the monitoring, the BNDES emphasizes three factors it considers strategic: innovation, local development and socio-environmental development.

With its extensive knowledge, stemming from its vast experience allied with the technical capacity of its workforce, the BNDES is an important partner for investors to be able to understand and access opportunities offered by the Brazilian economy.

Banque publique d'investissement (Bpifrance)

Banque Publique d'investissement (literally, [French] Public Investment Bank, also known as Bpifrance, BPI Groupe S.A.) is a French Investment bank. It was a joint venture of two public entities: Caisse des dépôts et consignations and "EPIC BPI-Groupe". (ex- "EPIC OSEO"). In 2016, Bpifrance becomes the first sovereign fund in the world since 2010 for the number of transactions in supporting technology companies.

In 2017, Bpifrance Assurance Export is the new French agency for managing public guarantees for exports. Bpifrance leverages financing for entrepreneurs via its ecosystem, namely with banking partners, investors, regions and other relevant institutions. Their focus is around the following five themes: Innovation, Funding, Guarantees, Own funds (fonds propres) and International, Advisory.
**Finnvera**

**Finnvera** is a specialised financing company owned by the State of Finland. It provides its clients with loans, guarantees, venture capital investments and export credit guarantees. Finnvera is the official Export Credit Agency (ECA) of Finland.

Finnvera provides financing for the start, growth and internationalisation of enterprises and guarantees against risks arising from exports. Finnvera strengthens the operating potential and competitiveness of Finnish enterprises by offering loans, domestic guarantees, venture capital investments, export credit guarantees and other services associated with the financing of exports. The risks included in financing are shared between Finnvera and other providers of financing.

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**Nacional Financiera, S.N.C. (Nafinsa)**

**Nacional Financiera** is a Development Banking Institution that operates in accordance with the rules of its own Organic Law, the Law of Credit Institutions, and the rules issued by the National Banking Securities (NBSC). The objectives of Nafinsa are to promote the overall development and modernization of the industrial sector with a regional approach; stimulate the development of financial markets and act as financial agent of the Federal Government in the negotiation, contracting and management of credits from abroad.

Nafinsa carries out its operations in accordance with financing criteria applicable to development banks, channeling its funds mainly through commercial banks and non-banking financial intermediaries. The principal sources of Nafinsa's resources are loans from international development institutions such as the International Bank for Reconstruction and Development (IBRD) and the Inter-American Development Bank (IDB), lines of credit from foreign banks and the placement of securities in the international and domestic markets.
Caisse Centrale de Garantie du Maroc (CCG)

The Caisse Centrale de Garantie (centrale guarantee fund) is a Moroccan public financial institution affiliated to a credit institution. Their head office is located in Rabat. Its mission is to help boost modernization of businesses. The CCG also supports social development through, among others, loan guarantees to social housing.

The CCG’s key strategic business areas include:
- Guarantee of investment loans, financial restructuring and venture capital;
- Co-financing with investment banks and innovation programs and;
- Guarantee of loans to social housing.

NB: To note that CCG joined The Montreal Group once this report was already finalized, explaining the absence of their contribution.

China Development Bank (CDB)

China Development Bank (CDB) provides medium- to long-term financing facilities that assist in the development of a robust economy and a healthy, prosperous community. It aligns its business focus with national economic strategy and allocates resources to break through bottlenecks in China’s economic and social development. CDB carries out its mission by:
- Financing: supporting the development of national infrastructure, basic industry, key emerging sectors, and national priority projects;
- Promoting coordinated regional development and urbanization by financing low-income housing, small business, agricultural/rural investment, education, healthcare, and environment initiatives, and
- Facilitating China’s cross-border investment and global business cooperation.

CDB is committed to market-based practices that stimulate solid performance, innovation and sustainable growth.
Saudi Industrial Development Fund (SIDF)

The Saudi Industrial Development Fund (SIDF) contributes effectively to the realization of the goals, policies and programs of the Kingdom’s industrial development, by providing the finance and advisory services needed to support the growth and development of the local industrialization.

SIDF endeavors to realize the following strategic objectives:

- Yielding a rewarding return on industrial investment;
- Realizing a local and appropriate value added to the national economy;
- Import substitution, by replacing foreign imports with domestic production;
- Enhancing non-oil exports;
- Integrating the industrial sector with the other economy sectors;
- Increasing employment opportunities for Saudis by encouraging nationalization in the industrial sector;
- Optimal local raw material exploitation management;
- Attracting foreign capital, technology transfer and localization;
- Promoting the culture of industrial safety and loss prevention in the industrial plants;
- Promoting the awareness of environmental conservation in the industrial sector.

SOWALFIN

The Wallon Finance and Guarantee Company for Small and Medium-sized Enterprises (SOWALFIN) is a public interest limited company set up by the Walloon Government in 2002 to support and facilitate access to finance to MSMEs and Self-employed entrepreneurs located in Wallonia, Belgium. Its non-financial services are paired up with several financing solutions to enable entrepreneurs to carry out their project by holistically meeting their needs.

To do so, their focus is on a three working axis:

- Positioning SOWALFIN as the public financial window where SMEs go to in their search for financing
- Developing new financial products for MSMEs, and
- Reducing the administrative formalities of the companies to allow the to focus on their “core business”.

The constitution of their company reflects the desire for coherence and coordination of Wallonia’s financial tools for SMEs.
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DISCLAIMER

The content of this White Paper is to be considered solely as a guide and should not be quoted as, or considered to be, a legal authority. It may become obsolete in whole or in part at any time without notice.

www.themontrealgroup.org
secretariat@themontrealgroup.org