ABU DHABI GLOBAL MARKET ACADEMY

ADGM Academy

RESEARCH CENTRE

LEVERAGING ARTIFICIAL INTELLIGENCE TO ENHANCE THE SME ECOSYSTEM IN THE UAE

EXECUTIVE SUMMARY

ABU DHABI GLOBAL MARKET ACADEMY (ADGMA) RESEARCH CENTRE

DR. NIHEL CHABRAK

IN COLLABORATION WITH

ASIAN INSTITUTE OF DIGITAL FINANCE (AIDF), NATIONAL UNIVERSITY OF SINGAPORE

NUS-AIDF DEEP CREDIT ANALYTICS TEAM

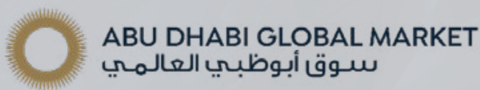
2022

NUS National University of Singapore | Asian Institute of Digital Finance

The ADGM Academy Research Centre collaborated with the Asian Institute of Digital Finance (AIDF) from the National University of Singapore to produce a white paper on how big data and artificial intelligence can be leveraged to develop a more informative credit model to support the UAE SME ecosystem and drive improved decision making when lending to SMEs.

The research was supported by a Working Group consisting of senior representatives from across the UAE ecosystem. The ADGM Academy Research Centre acknowledge and thank the following organisations for their support, guidance and input throughout this project:

- Abu Dhabi Department of Economic Development (DED)
- Emirates Development Bank (EDB)
- ADGM Financial Services Regulatory Authority (ADGM FSRA)
- HUB71



SMES GLOBALLY AND IN THE UAE

SMEs Globally

SMEs represent the backbone of most of the world's economies. As a result, they are getting thoughtful attention from planners, economists, governments, and multilateral agencies for their impact on national economies and the continuous market dynamics they are likely to produce in creating jobs, contributing to productivity, fostering innovation, generating tax revenues and achieving the Sustainable Development Goals (SDGs) by delivering more inclusive economic growth, environmental sustainability, promoting sustainable industrialisation, reducing income inequalities, and alleviating poverty.

Worldwide SMEs represent more than 90% of all companies, generate between 60% and 70% of employment and are responsible for 50% of the Gross Domestic Product (GDP). In 2020 there were over 322 million formal SMEs globally, employing more than 705 million people. However, SMEs face continued challenges in securing financing to grow their business.

SMEs in the UAE

A healthy and growing SME sector is the key to the UAE's ambition to diversify its economy. The SMEs sector in the UAE represents:

SME definition in the UAE

The definition as given by the UAE Cabinet of Ministers Executive Regulation number 35, varies based on the type of business, number of employees and annual returns.

Category	Number of Employees			Annual Returns (AED)		
	Trade	Manufacturing	Services	Trade	Manufacturing	Services
Small	6-50	10-100	6-50	<Dh50m	<Dh50m	<Dh20m
Medium	51-200	101-250	51-200	<Dh250m	<Dh250m	<Dh200m

The UAE's initiatives to support SMEs

The UAE has long held ambitions to be among the most innovative countries in the world, supported by digitisation, owing to advanced and creative talent, legislation, government efficiency, availability of capital and infrastructure.

The UAE started its digital transformation journey in 1982 and today is leading the region in government service automation. It continues investing in digital transformation to improve the quality of government service, customer happiness and develop science and technology-based innovations.

As an prerequisite of a diversified, innovative, and resilient economy, SMEs get particular focus from the UAE Government, providing SMEs with the necessary legal frameworks, policies, and support. Among the main initiatives:

- Federal Law No. 2 of 2014 on Small and Medium Enterprises to protect, promote and regulate SMEs
- The UAE SME Council to develop strategic plans and policies for SMEs
- A National SME Programme under the umbrella of the Ministry of Economy
- Minister of State for entrepreneurship and SMEs
- Federal Decree-Law No. 9 of 2016 on Bankruptcy
- The creation of specialised free zones
- An attractive taxation system
- A Federal Supplier Register to support SMEs' participation in public procurement
- Foreign ownership of companies and golden visas for entrepreneurs
- Career breaks and early retirement plans for Emiratis in federal government positions to start a business
- An AED1 Bn Graduate Fund for fresh graduates to start a business
- Operation 300bn, the UAE's ten-year industrial strategy to increase the industrial sector's contribution to the GDP with significant initiatives to support 13,500 industrial SMEs in priority sectors
- Encourage the development and adoption of the Fourth Industrial Revolution (4IR) applications and advanced technologies
- Create 25,000 jobs while reducing the environmental footprint of the industrial sector

SMES FINANCE CHALLENGE – THE CREDIT GAP

In the initial stage of companies, entrepreneurs need considerable capital to advance their ventures. However, evaluating their risk and success in their early years is challenging.

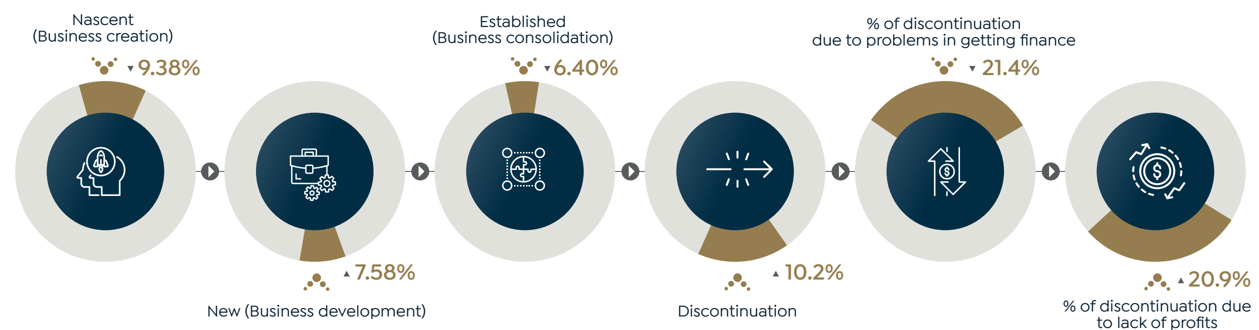
In 2021, the percentage of the adult population in the UAE (18 - 64 years of age) that started a businesses is higher than the percentage of those who consolidated businesses. The percentage of those who exited a business was higher than those who started a business.

Moreover, more than half of discontinued enterprises have exited the market. The main reasons for abandoning their business after the effects of the pandemic are 1) challenges in obtaining financing and 2) the lack of profits.

SMES ENCOUNTER STRUCTURAL BARRIERS
TO ACCESSING NECCESSARY FINANCING

UAE's 2021 results on entrepreneurial activity through the phases of business

BUSINESS ACTIVITY IN THE UAE (% OF UAE'S POPULATION AGED 18–64 INVOLVED IN EACH STAGE)



Access to finance is the second most cited obstacle facing SMEs in growing their businesses worldwide. 65 million firms, or 40% of SMEs in developing countries, have an unmet financing need of USD 5.2 trillion every year, representing 1.4x the current level of global SME lending, which is equivalent to 19% of the Gross Domestic Product (GDP) of countries covered in this analysis. Latin America, the Caribbean, the Middle East, and North Africa have the highest proportion of the financial gap compared to potential demand, measured at 87% and 88%, respectively.

Although debt financing appears to be ill-suited for newer, innovative, and fast-growing companies with a higher risk-return profile, bank credit remains SMEs' primary source of external funding to manage their working capital requirements, capital acquisitions, capacity expansion and launch of new products and services in the market. In 2021, 65% of European SMEs indicated that they prefer bank loans to finance their future growth ambitions, and another 16% reported loans from other sources. Across the globe banks are still the most trusted type of financial services provider in the eyes of SMEs. Yet, 20% of SMEs in high-income countries, 28% in middle-income countries, and 44% in low-income countries need a loan but refrain from applying for credit.

Informal funding, professional business angels, government subsidies, venture capital and equity funding are considered sufficient in the UAE. In terms of access, however, it is easier to attract investors once the start-up phase has been completed than to obtain debt funding.

IN THE UAE, ATTRACTING INVESTORS IS EASIER THAN
OBTAINING DEBT FUNDING FOR NEW BUSINESSES

The state of the finance framework could be explained by relatively limited financing options and credit lines, and the size and availability of loans. In 2017, only 10% to 12% of UAE banks' corporate lending book was extended to SMEs. With an AED 106 Bn supply of finance to SMEs, the estimated unmet credit demand for SMEs in UAE is AED 296 Bn. The average financing gap in 2020 was estimated to be between AED310 Bn and 330 Bn.

Opening a bank account and the KYC issue

One of the significant challenges impeding business-related transactions and accessing debt finance is opening a bank account, which may take up to three months in some instances. Onboarding small businesses by banks is generally challenging due to anti-money laundering and combatting the financing of terrorism regulations, which make the KYC process time consuming and cumbersome.

OPENING A BANK ACCOUNT MAY TAKE UP TO 3 MONTHS IN SOME INSTANCES

To bridge the underbanked and SME finance gap, Emirates Development Bank (EDB) launched a digital account for local transactions that can be opened within 48 hours. Two years ago, Hub 71 piloted an initiative with Mashreq Bank to open accounts for start-ups within a few days. Further improvements could be made by establishing a pre-approved directory of investors, creating light bank accounts with limited features, leveraging the risk level identified by licencing entities and integrating them to obtain start-up documents seamlessly. Creating an e-KYC platform to inform banks of red flags and share parts of the process could be a significant step in improving SME finance in the UAE.

Challenges perceived on demand side

17% of SMEs surveyed by the UAE Central Bank mentioned they applied for bank credit in 2020, and only half could secure the finances needed. 75% of funds were secured from conventional banks ahead of Islamic banks (18%) and Development Funds, and other sources (such as family and friends) (7%). SMEs mentioned being constrained when applying for bank financing due to: (1) the low lending sums involved making them feel less important to lenders, (2) the resulting high cost of processing their credit applications, and (3) the high risk of default and lack of credible credit history. Other significant hurdles mentioned by SMEs for not applying for bank credits include lacking a credit score from Al Etihad Credit Bureau, not having audited financial statements, not being on the Emirates Movable Collateral Registry, having weak business performance, being risk averse or believing the credit application would be rejected, cumbersome and confusing lending regulations and the lengthy application process.

17% OF SMES APPLIED FOR BANK CREDIT IN 2020, OF WHICH 50% SECURED THE FINANCES NEEDED

Challenges perceived on supply side

IN 2020, BANKS CONTINUED TIGHTENING THEIR LENDING STANDARD FOR SMES

In 2020, banks continued tightening their lending standards for several reasons: (1) weak book-keeping and financial management, which recalls the importance of raising SMEs' financial literacy, including how to prepare audited financial statements (2) the absence of a federal credit guarantee scheme, (3) absence of a dedicated regulatory framework for SME lending, (4) limited alternatives (e.g., venture capital), (5) and absence of a federal small business administration.

The root causes:

A. Macroeconomic factors such as the general economic and financial environment, fiscal policies, and financial regulations requiring banks to keep detailed information on clients and loan origination.

B. SMEs cannot get sufficient external funds, although they have profitable investment projects.

CAUSES:

- Limitations in terms of the size of loans or availability of credit lines, the terms and conditions of bank financing (levels of interest rates due to a higher risk premium, collateral requirements, required guarantees, information requirements, procedures, and the time needed for loan approval and loan covenants)
- Market imperfections, such as information asymmetries or weak creditor protection, make the creditworthiness of SMEs' assessment, monitoring their actions, and enforcing repayment more difficult.

C. Lending is not extended because of the SMEs' pessimistic outlook concerning their sales, profitability and business plan.

CAUSES:

- SMEs are not creditworthy or do not have the appropriate financial knowledge, strategic vision, resources and sometimes even the willingness or awareness to attract sources successfully.

In addition, the significant decline in sales and profits due to the pandemic also constrains banks from lending to SMEs.

In the UAE, many initiatives aim to overcome these challenges by providing SMEs with required funding: Emirates Development Bank (EDB), The Khalifa Fund for Enterprise Development (KFED), Dubai SME, the Strategic Development Fund (SDF), and the investment arm of the Tawazun Economic Council, among others. In addition, during the pandemic, the Central Bank of the UAE extended benefits to SMEs through the TESS programme (Targeted Economic Support Scheme) to help lenders mitigate the effects of the Covid-19 pandemic and support the country's economic recovery. It also issued a new regulatory framework for loan-based crowdfunding and the Small to Medium Sized Enterprises Market Conduct Regulation to promote best practices among licensed financial institutions when engaging with SMEs.

In Abu Dhabi, ADGM launched a framework to regulate operators of Private Financing Platforms (PFPs) serving equity investment, debt financing and trade receivables funding needs of start-ups, private enterprises, and SMEs.

CASE STUDY – INTELLIGENT CREDIT ANALYTICS SHARING SYSTEM (ICASS): A TECHNOLOGY-ENABLED DIGITAL CREDIT BUREAU 3.0

To strengthen coordinated national efforts in the UAE to support bridging the SME finance gap, we present a case study on an innovative solution to reduce information asymmetries between debtors and creditors implemented at the Asian Institute of Digital Finance (AIDF) at the National University of Singapore.

Federated learning and coopetition

The extension of credit is primarily based on the overall creditworthiness of the firm, and the lender generally views the expected future cash flows of the firm as the primary source of repayment. Different lending technologies are used to assess and monitor the firm's creditworthiness, considering the information asymmetry between lenders and borrowers. They combine diverse sources of information about the borrower, screening and underwriting procedures, structure of the loan contracts, monitoring strategies and mechanisms. As they have less publicly available information, SMEs are more opaque than large firms. As a result, banks have more problems assessing their creditworthiness, decisions take longer and involve higher costs, and requirements for collateral are common.

AS SMES HAVE LESS PUBLICLY AVAILABLE INFORMATION, BANKS HAVE GREATER DIFFICULTY ASSESING CREDITWORTHINESS. CREDIT DECISIONS TAKE LONGER, INVOLVE HIGHER COSTS AND REQUIRE COLLATERAL.

Good practices:

A. Governments use public Credit Guarantees (PCG) to channel credit toward SMEs. For example, in the UAE, EDB Credit Guarantee Scheme (CGS) was launched in partnership with nine commercial banks to provide a guarantee of up to 50% or AED 7.5M. This has led to mobilise up to AED 452M YTD in 2022 for SMEs.

B. Online platforms for reverse factoring transactions to facilitate supply-chain finance for SMEs. In 2020, Emirates Development Bank (EDB) launched the UAE's National Supply Chain Finance (SCF) platform, giving UAE businesses improved access to working capital.

C. Reforms of secured transaction systems create security interests over movable assets.

D. Credit rating for SMEs

E. Start-up banking and partnership with venture capital firms to launch new financing solutions and provide strategic advice and technical support. For example, in the UAE, EDB has launched the micro-lending platform to grant loans up to AED 2M (unsecured) and AED 5M (secured), for which decisions are communicated within five business days.

F. Digital banking (Wio Bank, Zand digital bank and Al Maryah Community Bank, the first digital and community banks in the UAE) and centralised e-KYC platforms

Privacy-preserved data sharing among creditors can develop more reliable credit models through federated learning. The models can better measure borrowers' creditworthiness at a lower cost and thus help reverse lenders' low-risk appetite to engage with SMEs. Such data sharing, in effect, operates on the principles of coopetition, where lenders cooperate to create a shared infrastructure while competing. The proposed federated learning platform targets interpretable credit risk models that combine artificial intelligence, machine learning and big data aiming to reduce information asymmetries between debtors and creditors for all participating lending institutions but still allows them to build an individual competitive edge. The shared infrastructure lowers information acquisition costs to lenders and passes down the savings to borrowers via competition.

INFORMATION ACQUISITION COST IS LOWERED, ALLOWING INCREASED BENEFITS TO BORROWERS VIA COMPETITION

Credit Bureau 3.0: Digital platform for informed SMEs' credit-related decisions

A TECHNOLOGY-ENABLED DIGITAL SME CREDIT ANALYTICS PLATFORM POOLING ANONYMIZED DATA FROM A CONSORTIUM OF LENDERS

The case study's central idea is to create a technology-enabled digital SME credit analytics platform that pools data from multiple lenders who form a consortium. Each member's local data site generates and transmits highly aggregated functional values (a single value representing a credit portfolio corresponding to a parameter value so that inversion back to the input values becomes impossible) to the centralised calibration node. Given the black-box nature of methodologies such as neural networks, the federated Learning platform avoids this and other black-box machine learning tools. Instead, it is designed to support interpretable credit models. It trains a model iteratively over multiple distributed data sites to calibrate the consortium members' credit risk models to produce optimised coefficients without explicitly exchanging their underlying data. Then, each member can use the trained credit model(s) for internal risk management and cost-benefit analysis.

Why does it matter for financial institutions?

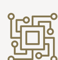
Because of intensified competition and narrowing margins in other banking segments, the SME debt finance gap represents a lucrative business opportunity for financial institutions. Moreover, leveraging digitisation and exploiting economies of scale and scope make an increased engagement with the SME segment a strategic choice to gain a competitive edge.

What is the main challenge?

Each bank has limited data on SMEs' default events in their lending portfolios. This affects their ability to accurately calibrate their credit models, leading to a low-risk appetite to engage with SMEs.

What is the solution?

Using coopetition principles, privacy-preserved data about borrowers' creditworthiness are shared by consortium members and pooled in a digital infrastructure that calibrates the benchmark model shared by all members and enhanced models for individual financial institutions with their alternative data.



Which technology enables this solution?

A.I., M.L. and B.D. enable Federated Learning of interpretable credit risk models.

With the federated learning approach, lending institutions can share the lending experience without transmitting granular and privacy-sensitive data about individual customers. While the underlying data remains private to each lender, lending institutions' specific internal SME credit models are improved with more accurate credit risk information about SMEs produced by the digital infrastructure. This is done without the intervention of any public or private entity to gather and pool the data, hence the concept of Credit Bureau 3.0. The principles of coopetition allow treating the improved credit model as a common good shared by all member institutions, who still compete via their differences in risk appetite, services, and operational efficiency.

COOPETITION WILL ENABLE CONSORTIUM MEMBERS TO IMPROVE THEIR CREDIT MODELS AND TREAT IT AS A COMMON GOOD WHILE MAINTAINING THEIR COMPETITIVE ADVANTAGE

Alternative data: the enhanced credit risk model – Credit Bureau 3.0

Alternative data reflect the increasing corporate digital footprint and include information such as media sentiments, utility usage, social media chatter, mobile GPS locations, and public records. Alternative data provide additional insights above and beyond the information in conventional data usually gathered by lending institutions and credit bureaus. In principle, they should help further reduce information asymmetry. That is why many lending institutions (but not all) incorporate alternative data into their credit model. In fact, some lending institutions may have the resources to gather alternative data and view them as a way of gaining a competitive edge over others who may not. The iCASS platform accommodates institution-specific alternative data to create an enhanced credit risk model, in addition to the benchmark model that relies on the standard data fields agreed to by all consortium members, hence the concept of Credit Bureau 3.0, a coordinated decentralised operation.

CREDIT BUREAU 3.0 ACTS AS A COORDINATED DECENTRALIZED OPERATION THAT UPGRADES BENCHMARK CREDIT MODELS WHILE ACCOMMODATING THE USE OF INSTITUTION-SPECIFIC ALTERNATIVE DATA TO CREATE ENHANCED CREDIT MODELS

The model

The credit risk model is a function linking the probability of a realised outcome (the dependent variable) to predictive attributes (independent variables).

The dependent variable can take values of 0, 1 or 2 to capture survival, default, and other corporate exits, such as discontinuation of banking services between the borrower and the lender. The independent variables include (1) common macroeconomic risk factors (such as a change in short-term interest rates) faced by borrowers, (2) borrower-specific characteristics (such as leverage, liquidity, profitability metrics, and the like) over a particular period, and (3) lender-specific alternative data gathered from, say, digital footprints.

The Calibration

The calibration is the process which produces optimised coefficients for the model to link the probability of a realised outcome (i.e., 0, 1, and 2) to a borrower's many attributes:

1. Proposed coefficients for all lenders are initially set in the Calibration Central physically located at a members-agreed facility.
2. A locally installed API at each consortium member site computing highly aggregated functional value, using individual borrower attributes and default information corresponding to the proposed model coefficients from the Calibration Central.
3. single value for the entire credit portfolio that does not carry any obligor-specific information is transmitted back to Calibration Central, which maintains data privacy.
4. Calibration Central aggregates each lender's value and determines the following best-proposed coefficients for all lenders. The process is repeated until attaining optimisation.
5. Lending institutions use the trained benchmark credit model (or the enhanced individual credit risk models for members with lender-specific alternative data) to generate default probabilities for borrowers in their credit portfolios.

Credit model performance improvement: iCASS illustration

This study was implemented in the Asian Institute of Digital Finance (AIDF) at the National University of Singapore to emulate the lack of data on SMEs' default events and the benefits of iCASS. Imagine four hypothetical financial institutions (Banks A to D). Banks A to D do not witness many defaults. Therefore, they are perfect candidates to engage through iCASS to benefit from the shared-information solution and to improve their default prediction model. iCASS operates as if there is a hypothetical bank (the Grand Bank) that lends to all companies. Under this assumption, it holds all the data individually stored by Banks A to D. Before using iCASS, it is evident that model parameters calibrated to Grand Bank's data, which witnesses all default cases, are more accurate than those for Banks A to D individually. The performance is measured using a dynamic goodness of fit, i.e., R^2, and an accuracy ratio which respectively shows how successfully the model performs over time at the credit portfolio level and ranks individual borrowers cross-sectionally.

The results confirm how data pooling can enhance the performance of a credit model for a particular bank, in this instance, Bank A. Acting individually and using its data without alternative data, Bank A's dynamic R^2 is 64.00%, and its accuracy ratio is 71.62%. The federally calibrated model applied to Bank A's portfolio improves the dynamic R^2 and the accuracy ratio by 0.44 and 1.81 percentage points, respectively. Looking at the performance of the enhanced model, incorporating alternative data in the form of media sentiment for Bank A only using its data, we can see that the enhanced model improves the performance by close to 2.25 percentage points for the accuracy ratio and the dynamic R^2 increases by 1.02 percentage points. The model performance further improves by data pooling over four banks through the iCASS platform. As a result, Bank A experiences an accuracy ratio improvement of a further 1.10 percentage points to 74.97%, with the dynamic R^2 also improving by close to 0.19 percentage points to 65.21%. The enhanced model offered by iCASS has generated an overall improvement of the dynamic R^2 and the accuracy ratio for Bank A credit risk model of 1.20 and 3.35 percentage points, respectively.

Practical implementation challenges

Network latency and intermittent transmission disruptions are the main technical challenges related to the practical implementation of this solution.

Solutions

Sequential Monte Carlo (SMC) technique provides an optimisation tool robust to network latency and tolerant of localised data site failures. An approximation scheme using the SMC sample kicks in if transmission disruptions occur. The approximation quality improves over multiple rounds of iterations.

The enhanced model incorporating alternative data

Alternative data tend to be inhomogeneous across lending institutions. Measurement methodologies of similar metrics likely differ from one institution to another, making the incorporation of these data into an enhanced credit model challenging. The iCASS platform robustly includes alternative data into credit models by generating lender-specific models that are identical in terms of the standard data fields but differ for lenders on their alternative data fields. In effect, there is a hidden grand model whose coefficients on the alternative data fields are only meaningful and visible to the concerned institutions. In contrast, the corresponding variables are set to zero for other institutions. The aggregation, transmission, optimisation, and re-distribution follow the same process described above. This way, lending institutions using alternative data can improve their credit model through calibration without sharing the data with competitors.

CALL TO ACTION

The case study illustrates how sharing lending experiences improves credit risk model performance for all lenders in the industry. Data sharing technology enables lenders to form a consortium to manage their credit risk and lower costs through better risk assessments of loans to SMEs. Through such a consortium, the improved benchmark credit model becomes a common good among its members. However, the enhanced credit model(s) remain a competitive edge to those institutions that have access to alternative data, enabling lending institutions, while benefiting from the shared infrastructure, to continue competing in loan pricing, niche strategy and service package. The consortium, therefore, becomes a realisation of coopetition and, in effect, acts like a Credit Bureau 3.0, a coordinated decentralised operation.

We call conventional/digital banks, finance companies, lending platforms, and FinTech companies that possess credit-relevant data in the UAE to form a consortium, Credit Bureau 3.0, to explore the benefits of developing an intelligent credit analytics-sharing system supported by a technology-enabled digital platform for a privacy-preserved data-sharing solution using coopetition.

Please download the full paper from the ADGM Academy Research Centre Knowledge Library:

https://www.adgmacademy.com/publications/

ABOUT ADGM ACADEMY

ADGM Academy is part of Abu Dhabi Global Market (ADGM), an International Financial Centre (IFC) located in the capital city of the United Arab Emirates. The Academy has been established with the vision of becoming one of the leading academies in the region, providing world-class financial research and training services.

Delivering world-class financial education and literacy, ADGM Academy will help to position Abu Dhabi as a leading global financial centre. This will be achieved through globally recognised educational and experiential programmes on a range of topics and qualifications in banking, finance, leadership, entrepreneurship, technical and soft skills.

ABOUT RESEARCH CENTRE

The ADGM Academy Research Centre brings together an ecosystem of academics, financial industry practitioners, government and technology experts to unlock the shared potential to improve the financial environment in MENA and beyond.

The financial industry continues to transform at a rapid pace with new technologies, disruptors, threats and opportunities appearing all the time. Independent research is crucial to be able to understand and utilise this transformation for the benefit of your business, your customers and society in general.

The Research Centre provides that understanding through insights developed in collaboration with the academic community.

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ADGM Academy Abu Dhabi Global Market
Level 20, Al Maqam Tower
ADGM Square, Al Maryah Island
PO Box 111999 – Abu Dhabi, UAE

T : +971 2 333 8500