Risk Management & Modelling

www.pwc.cz/rmm
Dear Risk professional,

Thank you for your interest in the PwC Risk Management & Modelling team’s products and services. In this catalogue, we present our main areas of focus (as defined by regulation) and support that we can deliver to our clients.

The focus of our team is on financial institutions, predominantly banks and insurance companies; however, we are ready to support investment firms or large corporates as well.

The catalog is organised into 4 chapters:

- **Services** – There are different ways to help you improve your current risk management practises. The individual techniques are described in this chapter - they apply to all topics equally.

- **Core topics** – The universe of regulation is continuously growing. The topics covered by the team are described in the chapter together with the key regulation. Each topic is owned by a Subject Matter Expert monitoring market practise, new regulation, and supervising delivery to our clients.

- **Tools** – Automation in risk management through the use of modern technologies is our key differentiator. Explore our set of innovative Tools that will help you digitise your risk-related processes.

- **Team** – Subject Matter Experts representing and developing the team’s expertise in the respective topic.

Thanks for your time and interest in reading our catalog.

Please don’t hesitate to contact us, if we could be of help to you and your institution.

Rostislav Černý
Partner

Ondřej Glatz

Jiří Mach

Risk Management & Modelling
# Table of Contents

<table>
<thead>
<tr>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Services</strong></td>
<td><strong>Core Topics</strong></td>
<td><strong>Tools</strong></td>
<td><strong>Team</strong></td>
</tr>
<tr>
<td>Pages 4 – 7</td>
<td>Pages 8 – 52</td>
<td>Pages 53 – 54</td>
<td>Pages 55 – 59</td>
</tr>
</tbody>
</table>
01

Services
To achieve higher performance standards, banks and other financial institutions are forced to continuously implement a growing number of complex models. These models are mostly created with advanced-analytics techniques. According to the regulatory requirements, models must be under strict control. Regulators and auditors expect institutions to have a robust model risk management framework to identify, eliminate, and minimise risks. Poorly designed models can have significant financial consequences and damage a bank's reputation and market position. An effective model validation framework must be built to provide not only evaluation and constructive feedback on a particular model but also to help maximise the model's performance.

The validation process can be challenging; to help our clients, PwC validation experts remain attuned to the ever-changing regulatory landscape to deliver high-performing solutions that reflect the latest requirements. Our team offers a high level of expertise, experience, and modern technology services to achieve desirable results and align with the best market practices.

Model development has turned into a core quantitative activity. Many institutions have a dedicated department whose purpose is to ensure models are conceptually sound and implemented as expected.

Our risk modelling experts are able to cover the clients' needs in most of the quantitative risk management areas. We have strong experience in particular in credit risk model development (scoring models, IRB models, loan loss provisioning), stress testing (CCAR/DFAST, EBA, ...), and complex derivatives pricing.

Our team's knowledge is based on the hands-on experience of Subject Matter Experts with CV records from financial institutions. Knowledge of regulation, often the driver for risk-related projects, is thus accompanied by knowledge of products and processes.

We can support you by performing quality checks on the project's outputs, soundness of implementation of regulatory requirements, or by providing consultation regarding observed market practice.
New financial regulations can affect various departments and processes across the institution, which makes its implementation a complex task. Non-compliance can lead to fines imposed by regulators, litigation, loss of reputation on the market and other unfavourable consequences for the entity.

Our team can support you in end-to-end implementation starting from preparation of an operational gap analysis and proposal of a local implementation plan and budget. This is followed by execution of financial impact assessments, development of local methodology, creation of target operating models of processes, implementation of new IT solutions allowing for the new regulatory requirements and their UAT to be reflected.

Projects are vital for implementing ideas and transforming them into respective outputs. The benefits of a well-organised and controlled project are that the required outputs are delivered in a specified time and within an approved budget. In FSRR, the management of projects is our daily agenda. We combine our project management experience with expert knowledge of the topic to deliver the best experience for the client.

We can support your projects by appointing a project manager with expertise in the topic addressed by your project. Our contribution is also in the transfer of knowledge.
Due Diligence

Conducting a comprehensive due diligence is an integral part of any business combination transactions. When financial institutions are involved in a transaction, along with typical topics such as financial, legal, tax, IT, HR, etc., there are at least two additional important areas to be covered by specialists: risk and capital.

We offer a team of risk management experts with specialised knowledge in the areas of credit risk modelling & management, capital requirement calculations and related standards and regulations. Using our experience from audit engagements, we are able to assist the buy-side in analysing the target's loan portfolio quality, gap assessment of the provisioning models, review of the risk-weighted asset calculations (both SA and IRB), or in assessing the ICAAP and other risk-related policies.

Audit

Providing support to our PwC colleagues from Audit is one of the most common activities of our team. We are experienced in performance of audit procedures, as we often act as the auditors' experts, e.g. in the area of loan loss provisioning. We communicate with the core audit teams, as well as with the clients.

Given our knowledge and experience, we are efficient in seeking the potential issues and analysing them. We can offer both qualitative and quantitative analyses, with respect to the relevant standards and the needs of individual clients. We are able to provide our own back testing or challenger models if needed. We are also experienced in documenting the audit results and findings, as the outcome of our work contributes to the final audit reports.

Education

Transferring knowledge is at the core of the added value our team brings its clients. We utilise various platforms to ensure coherent knowledge sharing. Our subject matter experts regularly deliver workshops on specific topics requested by the client. We are also prepared to provide ad-hoc support via focused calls. Furthermore, to create a long-term and replicable impact, we can develop custom-made e-learning to fit the needs of the client. We will closely cooperate with our colleagues from PwC Academy, a branch of PwC and a training organisation recognised worldwide, to achieve excellence not only in the content of the e-learning but also in the effectiveness of the knowledge transfer.
Core Topics

1 Digitalisation 9
2 Risk Appetite Framework 10
3 Risk Culture 11
4 Integration of Climate and Environmental Risks 12
  4.1 ESG Quantitative Modelling 14
  4.2 Green and Sustainability Issuance 15
5 Model Risk Management 17
6 Internal Ratings-Based approach 18
7 Underwriting Cost Optimisation 19
  7.1 Scoring and Big Data Integration 21
8 Predictive Models 23
9 Capital Management 25
  9.1 Synthetic Securitization 27
  9.2 Economic Capital 29
  9.3 Regulatory Stress Testing 30
9.4 Internal Stress Testing 31
10 Risk Based Pricing 33
11 Recovery Planning 35
12 Resolution Planning 36
13 Antifraud Process 37
14 Retail Collections Optimisation 40
15 Liquidity Risk Management 41
  15.1 Funds Transfer Pricing 42
16 Market Risk Management 43
  16.1 Interest Rate Risk in the Banking Book 44
17 Commercial Credit Lending Process 45
18 Risk Data Aggregation and Reporting 47
19 Asset Quality Review Preparation 48
20 Asset Quality Review Audit 51
21 Loan Loss Provisioning 52
Papers are things of the past. The future is in having everything digital and seamless. A seamless experience is what today’s customers demand when dealing with loans or any financial products. The experience should be smooth, short and, if possible, enjoyable. However, we need to always have in mind that loan application is primarily a risk process. Our team helps loan providers to catch up with this trend and deliver value for their clients while we keep in mind to make the process sustainable and product profitable.

Fintech companies have disrupted the market by introducing various technologies in interactions with the client. We create a roadmap on how to transition from pen and paper to being fully paperless in all parts of the loan origination process.

We advice on benefits and limits of using features such as
- Online client onboarding
- E-KYC
- Face recognition or fingerprints
- OCR technologies
- Online help
- E-signature or face signature

Our team has knowledge of complex advisory to all risk related components for a new digital bank setup. For example how to set up Minimum Viable Product (MVP) for a digital bank, where we accelerate deployment to the market, so you can offer your services as soon as possible.

Particularly in the credit risk area, we have experience with helping to set up the initial underwriting, antifraud or collection strategies as well as fine-tuning the existing ones, connecting new external or internal data sources or integrating your processes with the parent bank.
A sound Risk Appetite Framework aligns Business Strategy, Risk Appetite, and Risk Management Strategy for the sustainable long-term growth of the bank. It defines the maximum amount of risk the bank is able to bear (risk capacity) and the amount of risk the bank is willing to accept (risk appetite) to achieve its business objectives.

The Risk Appetite Framework defines the overall approach through which the risk appetite is established, communicated, and monitored. The framework is designed to capture and consider all material risks to the bank and the bank’s reputation vis-à-vis policyholders, depositors, investors, and customers.

**Risk Appetite Framework**

The framework sets the roles and responsibilities of stakeholders, ownership of risks amongst 1st and 2nd Lines of Defense, embedding mechanisms for sound risk culture. It determines the general framework in which Internal Capital Adequacy Assessment Process and Internal Liquidity Adequacy Assessment Process are conducted. At the same time, the results and outputs of the ICAAP and ILAAP are also channeled back into the framework. The framework defines the process of cascading and embedding Risk Appetite Statement throughout the bank.

The framework interconnects remuneration policies, individual risk management policies (credit/market/liquidity risk), policy on the creation of limits, and other procedures are aimed at securing the appropriate balance between risk and rewards.

**Relevant regulations**

- Basel II, III, IV
- CRR/CRR 2, CRD 5
- Upcoming CRR 3, CRD 6
- EBA/GL/2021/05 Guidelines on internal governance under Directive 2013/36/EU
- BCBS Guidelines Corporate governance principles for banks (2015)
- FSB Principles for An Effective Risk Appetite Framework (2013)
Risk Cultures vary across financial institutions. However, certain common fundamental elements determine a sound Risk Culture within the institution, such as:

- Effective risk governance
- Effective risk appetite framework
- Compensation practices that promote appropriate risk taking behaviour

PwC’s globally recognised methodology for assessment of Risk Culture recognises six focus areas - Leadership, Governance and Organization, Communication, People Management, Incentivization and Accountability.

The initiative is focused on assessing Risk Culture attributes in each focus area via specialised tools, ensuring consistent deployment of the methodology. There are four techniques for observing the attributes – a Risk Culture Survey for all employees, desktop research aimed at policies and procedures, interviews with the key stakeholders, focus groups on dedicated risks.

The assessment is both qualitative and quantitative. Unified, widely recognised terminology for maturity level evaluation is not available. Still, there is consensus that there are five levels of maturity. In PwC methodology, there are five maturity levels - Basic, Developing, Defined, Managed, Optimised.

For attributes assessed as “Defined” and below, the qualitative assessment is used to define improvement opportunities and formulate recommendations.

**Sound Risk Culture**

- Consistently supports appropriate risk awareness, behaviors, and judgments about risk-taking within a robust risk governance framework
- Bolsters effective risk management, promotes sound risk-taking, and ensures that emerging risks or risk-taking activities beyond the institution’s risk appetite are recognised, assessed, escalated, and addressed on time

**Relevant regulations**

- FSB Guidance on Supervisory Interaction with Financial Institutions on Risk Culture (2014)
- FSB Principles for An Effective Risk Appetite Framework (2013)
- EBA/GL/2021/05 Guidelines on internal governance under Directive 2013/36/EU
- BCBS Guidelines Corporate governance principles for banks (2015)
Moving to a greener and more sustainable economy is good for job creation, good for people, and good for the planet. Today we are making sure that the financial system works towards this goal. Our proposals will allow investors and individual citizens to make a positive choice so that their money is used more responsibly and supports sustainability.

(First Vice-President of the European Commission Frans Timmermans, during presentation of the EU Action Plan for Sustainable Finance)

**Background**

Binding climate protection regulations are slowly being imposed on the financial sector under the EU Action Plan. Its targets, based on the Paris agreement and UN sustainable development goals, are seeking to decarbonise the EU economies by 2050, and reduce GHG emissions by 55% by 2030 compared to 1990 levels. To be compliant with these rules, the institution should formulate its sustainable business strategy, governance, risk management and sustainability targets. That way, they can seize opportunities for sustainable development, set themselves apart from the competition, and make sure their business model is ready to react to climate change challenges.

**Preparing for the climate challenges**

Integrating climate and environmental risks into bank’s governance, business strategy and risk management should include:

- Reviewing the current status of the sustainability activities, and mapping them to climate-related and environmental (C&E) risks, opportunities and trends on the market
- Incorporating best practices into the company’s ESG area, namely into:
  - Governance: the integration of C&E risks into roles and responsibilities of the management, risk reports, risk appetite statement, and C&E data needs and plans
- Business strategy: setting strategy, business environment monitoring and key performance indicators
- Risk management: the integration of C&E risks into credit risk sector lending policies, underwriting procedures, continuity of its operations, and conduct of an (ad-hoc) C&E-related stress testing or sensitivity analysis
- Identifying the main strengths and weaknesses in the company’s C&E disclosures
- Creation and promotion of green products and services by formulating:
  - responsible financing policy
  - developing sectoral heat-maps
  - creating tools for relationship managers that can help them talk to their clients about their C&E approach and goals

**Relevant regulations**

- European Green Deal
- ICMA Sustainable Finance principles (Green Bond Principles, Social Bond Principles, Sustainability Bond Guidelines, Sustainability-Linked Bond Principles)
- Principles for Responsible Banking (Framework by UNEP-FI)
Challenging questions in the integration of climate and environmental risks

When thinking about and integrating C&E risks into bank’s processes, financial institutions must tackle the following questions:

- How to incorporate C&E risks into business processes such as financing decisions, investment advisory processes, and disclosure requirements?
- How is the governance of C&E risks incorporated into the bank’s roles and responsibilities?
- Does the company have C&E goals? How do they promote those goals across the organisation?
- Does the company have, or does it plan to introduce decarbonisation plans and pathways for specific industries and clients?
- How do they measure their carbon footprint, and that of their suppliers and clients? Do they disclose such information on a regular basis?

- How do C&E risks and opportunities impact the business strategy and governance of the bank, and risk management & client relationship management more specifically?
- Is risk management working on incorporating C&E risks into its governance and processes? Are credit risk, market risk, liquidity risk and operational risk units aware of and ready to integrate the climate-related and environmental risks into their daily management processes?
- Does the company perform C&E-related stress testing or scenario analyses?
- How to use the bank’s approach to C&E risks in issuing debt and capitalising on the demand for green debt?
ESG (Environmental, Social and Governance) risks have fallen under increased regulatory scrutiny putting pressure on banks’ modeling teams to include these new risks within their credit risk models - both transactional and portfolio. Current requirements are limited to managing these risks: (i) during the loan origination process, via (ii) special purpose stress-testing tools and (iii) through specialised disclosures, but in the future, these risks will have to be included within Basel and IFRS frameworks. Furthermore, banks that do not prepare for these tasks in advance, could be subject to increased capital requirements under Pillar 2 within Basel III and, more formally, within Basel IV. Notwithstanding regulatory pressures, ESG modelling also represents a significant business opportunity (green and brown), if the framework is adapted well to the bank’s business model.

**ESG modelling poses significant modeling challenges as:**

- Many of these risks have not yet materialised, and thus traditional model calibration is not possible
- Physical and transitional risks behave differently and have different transmission channels
- Dynamic balance-sheet assumptions require more sophisticated calculation methods otherwise calculation times are very long
- Lack of data and infrastructure for data collection is particularly problematic

In PwC, we are prepared to help with these issues comprehensively in order to enable the bank to appropriately assess risks associated with ESG issues and demonstrate its ability to do so to all stakeholders.

### Relevant regulations

- Sustainable finance disclosure regulation (SFDR)
- EU Taxonomy
- CRR 2, CRD 5
- EBA/ITS/2022/01 Final draft implementing technical standards on prudential disclosures on ESG risks in accordance with Article 449a CRR
- EBA/GL/2020/06 - Guidelines on loan origination and monitoring
- Upcoming CRR 3/CRD 6
- ECB Guide on climate-related and environmental risks
If some companies and industries fail to adapt to the transition to a low-carbon economy, they will fail to exist.

(Mark Carney, Governor of Bank of England; François Villeroy de Galhau, Governor of Banque de France)

Demand for green debt has been soaring since market inception, with over $1.6tn issued to date, of which over $500bn was issued in 2021 alone, and 2022 expected to see the first annual trillion, according to Climate Bonds Initiative (see chart on next page). Likewise, pricing advantages are expected to show endurance during a changing economic landscape, driven largely by heavy demand outstripping the supply as asset managers look to address climate risk in their portfolios.

Harnessing the bond investors' preference for green and sustainable investment opportunities, green issuance is another tool to further solidify the sustainability strategy of banks in the eyes of investors, rating agencies and clients. By setting up a framework aimed at defining sustainable project categories with either environmental and/or social aspects, financial institutions get financing for their customers' sustainable activities, and they show a commitment towards their sustainability targets.

Relevant regulations

- EU Taxonomy (Regulation 2020/852)
- ICMA Sustainable Finance principles (Green Bond Principles, Social Bond Principles, Sustainability Bond Guidelines, Sustainability-Linked Bond Principles)
- European Green Deal
### Green Issuance Options

When deciding on getting financing for their ESG projects, financial institutions must consider several aspects:

- How will they set up the Sustainable finance framework, with links to the overall sustainability strategy of the company?
- What projects they want to finance/refinance with their Green issuance, and according to which classification system will they report their green/sustainability compliance (e.g., ICMA principles, EU taxonomy, their own green definitions)
- Whether they need a second party opinion on:
  - The whole company, and/or
  - The sustainable finance framework, and/or
  - Some specific areas (such as green portfolio reporting, their ESG strategy, etc.)
- Through what channels will they promote and underwrite the issue (selection of bookrunners, lead managers, lead arranger, etc.), including setting up the roadshow and investor calls
- Which investor types / specific investors do they want to target (Green / Dark green investors, mainstream investors, what proportion of each type, etc.)

- What incentive structures (if any) do they want to embed into the offering, such as financial and/or structural characteristics depending on whether the issuer achieves predefined Sustainability/ESG objectives?
- Who and how often will verify the issuer’s sustainability claims and promises made in the offering?
- How and in what frequency will they disclose and report their sustainability targets and green portfolio performance?

### The time for action is now

What lies ahead of humanity in order to limit global warming (well) below 2°C compared to pre-industrial levels is a (very) challenging task. It will require cooperation from all economic stakeholders around the world. What is positive is that, according to the latest report by the Intergovernmental Panel on Climate Change, we still have a chance to achieve this target, but we will have to significantly reduce carbon dioxide emissions in the next five to ten years. In order to secure a liveable future, financing sustainable projects is one piece of the puzzle.

### Green Bond Issuance

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USD Trillion</td>
<td>0.16</td>
<td>0.18</td>
<td>0.25</td>
<td>0.30</td>
<td>0.52</td>
<td>1.00</td>
<td>1.40</td>
<td>2.70</td>
<td>5.00</td>
</tr>
</tbody>
</table>
Banking organisations should be attentive to the possible adverse consequences (including financial loss) of decisions based on models that are incorrect or misused, and should address those consequences through active model risk management. (Supervisory Guidance on Model Risk Management, SR Letter 11-7, FED)

Model risk is associated with the use of models during their entire lifecycle. It arises from various sources. It can originate from incorrect identification, erroneous model implementation in a system; unreliable or incomplete data; uncertainties about statistical and mathematical methods in place; inaccurate calibrations; model misuse; incorrect interpretation of model results; inappropriate assumptions stemming from the use of upstream and downstream models; incomplete or inaccurate model inventory and so on.

To manage and remediate associated risks, a financial institution needs to establish and implement the formal set of standards, policies, and processes known as model risk management. Hence, model risk management is the control framework that supports the business and decision process around the use of all models in an institution. The framework should be built on controls along the phases of the model lifecycle.

Model lifecycle phases:
- Model development
- Model evaluation
- Model monitoring
- Model maintenance

Formalised requirements on model risk management are part of industry practice and part of the regulation. Authorities such as the European Central Bank, US Federal Reserve System, or Canadian Office of the Superintendent of Financial Institutions require supervisees to set up proper governance around model risk.

PwC assists financial institutions across the globe with implementing a model risk management framework. We are helping to establish group-wide minimum standards for inventory, development, validation to align and harmonise the current processes with market practice and regulatory requirements.

Relevant regulations
- CRR/CRR 2, upcoming CRR 3
- ECB Guide to internal models
- Delegated Regulation on RTS on assessment methodology for IRB approach under CRR
- EBA/GL/2018/03 - Guidelines on SREP (and upcoming revised version - EBA/CP/2021/26)
- PRA Supervisory statement: Model risk management principles for stress testing (SS3/18)

Tools
- Model Risk Manager
Deepening banks’ experience with credit risk modelling, increasing portfolio size and availability of historical portfolio data might lead to a decision by a bank to move from a standardised approach to more sophisticated credit risk internal rating-based (IRB) models for the purpose of regulatory capital calculation. Transition to more complex IRB models introduces additional costs due to increased demand for more qualified and experienced staff, strict requirements on data quality and other conditions set out by regulation. On the other hand, the IRB approach should lead to a level of capital requirements that is sensitive to the riskiness of the portfolio, improve management of credit risk and should deliver model-based risk parameters applicable also in areas of the banks’ activities outside of the regulatory scope. In the European setting, modelling itself is considerably dependent on the implementation of Basel rules in the form of CRR 575/2013 and further supported by EBA guidelines and regulatory technical standards.

Typically, the IRB modelling involves the following steps:

1. Data Processing, Data Quality Checks, Construction of Reference Datasets
2. Development of Ranking Mechanism for LGD and EAD parameters or Scoring for PD
3. Calibration to Long Run Average
4. Margin of Conservatism
5. Downturn (LGD and EAD)

Naturally, the transition to the Foundational or Advanced IRB approach does not end with the development of the model. The model must be initially and periodically validated and, if needed, recalibrated or redeveloped when its performance is not satisfactory or not compliant with any newly imposed regulatory requirements.
Being flexible and innovative is the only way to survive in today’s financial world.

1 Underwriting process review
In retail, risk costs and acquisition costs can significantly impact overall product profitability. The relative impact of the acquisition when the loan amount is relatively small. While it is true that getting more data about the client means better risk prediction for your decision engine so you are able to achieve lower risk costs, it is also true that, with some level of data, every new data gives lower added value and may cost more to acquire. Our goal should be to minimise total costs.

Total costs = risk costs + cost of acquisition.

We will look at underwriting process from three perspectives:
- Risk costs of various population segments
- Acquisition costs related to the underwriting processes (i.e., cost of big data, costs of manual verifications)
- Time to make a decision on various population segments
2 Operations cost optimisation
Traditionally, mainly in the retail lending business, the operations of financial institutions contained a high percentage of manual processes such as additional verifications or credit experts. Such processes are slow and expensive.

With new technologies and data available, lending companies are able to challenge costs spent on the operational force and create automatic decisions with comparable predictive powers. Automatic processes are not just cheaper, but also quicker, which brings additional value to customers. PwC can help you to bring this change to your company.

3 Underwriting process end-to-end design
If your company is a start-up and does not have automatic underwriting yet in place or you are thinking about changing your current underwriting solution, there are various options on the market. We are proficient in the effective design of modern underwriting process from scratch supported either by the decision engine of your choice or by our partner decision engine Taran DM.

Taran DM, is a full scope real-time decision manager based on a modern open-source technology stack without vendor lock-in. It provides a unique ecosystem for integrating your data sources, development of your scoring strategy and orchestrating your scoring request.
Underwriting processes age quickly. Most of them could be simplified and recalibrated to achieve better results.

1 **Scorecard modelling**

The scorecard review and validation process is a mandatory activity that is performed every one or two years to ensure that the scorecard is still predicting precisely when deployed.

**We cover the full scorecard development, Scorecard review and validation**

During scorecard development, we assess the potential predictor candidates and choose the best selection using either logistic regression, XG boost or other relevant modelling methodology. Our modelling team is proficient with modelling software such as Python or SAS.

The review and validation process works in the following steps:

- Review scorecard monitoring and finding out the focus points, which variables, historical performance
- Recalculate scorecard using own code and compare with score values calculated by the decision engine
- Merge with relevant performance data for the relevant scorecard
- Calculate all relevant validation statistics as defined in the review and validation policy/manual
- Prepare a summary report with all key findings and submit the report to the risk committee
- Keep the scorecard as the predictive power and all key statistics are within defined values
- Develop a new scorecard
- Cancel the scorecard as there is no need for this scorecard due to a very small segment volume and apply a more general scorecard instead

![Credit customer lifecycle diagram](image-url)
2 Big data integration
Data from the application form in which the client tells us about himself gives us only a limited understanding of them. If the client gives us consent, we are able to look into their activities and experiences. Such data will give us a more complete picture about them and so we are able to better target the product we offer to them, better set up the pricing and especially better predict the client’s credit and fraud risk.

Commonly used data are from:
- Credit bureaus
- Telco operators
- Transactional data
- Digi data
- Geolocation data
- Social media
- External blacklists

The availability of data depends on legislation and advancement of the market. We have helped businesses to integrate and utilise big data even on markets, where such data were never previously used. As an example could be usage of telco data in the retail scoring.

3 Telco data
Telco data are among the most predictive and useful data that lending companies may use to better understand new clients. The reason behind this is that clients are paying phone bills regularly, and a wide range of telco services offer variety, which clients usually choose based on their affordability. An examination of the client’s behaviour proves to be a great means of understanding the client’s credit risk level and also the client’s propensity to buy.

Telco companies typically have a very wide range of good quality data. Often too wide. And it can be a long process trying to sort out those, which are good for risk prediction. PwC has experience with defining valid telco predictors and implementing them into the scorecards and segmentation models. We also have practice with third party data cost and benefits analysis in order to be able to properly decide upon their usage.
Introduction

Predictive analytics uses methods of mathematical statistics, data mining, and artificial intelligence to predict likely future outcomes with the aid of historical data. In the financial sector, predictive models help institutions optimise their business strategies, automate processes and reduce costs. Nowadays, a plethora of predictive models is used in banking practices ranging from traditional statistical approaches (e.g., linear or logistic regression, principal component analysis, hierarchical clustering) to machine learning methods (e.g., random forests, neural networks, genetic algorithms). Typically, various approaches are tested and compared, eventually combined to arrive at the best performing solution.

Focus areas

1 Credit scoring models

Methods used for credit scoring have increased in sophistication in recent years. Although traditional statistical techniques like logistic regression are always the reference point of all benchmark studies, innovative methods based on machine learning algorithms are increasingly often used in banking practices.

2 Automated credit decisioning & online lending

Many credit institutions aim to use a fully digital credit decision-making system for online lending. Such a system requires sophisticated integration of data sources, scoring strategy and orchestration of scoring requests. Its key component is a reliable predictive model that allows real-time scoring of applicants and instantaneous decision-making. Full automation of the whole process imposes much stricter requirements on the efficiency and accuracy of the underlying model, as there is no space for any correction by people.
3 Expected credit loss models for provisioning
With the adoption of IFRS9 and CECL accounting standards, new spaces for sophisticated modelling approaches were wide open. The estimation of expected credit losses should be based on the best-estimate principle and should include forward-looking information that is typically linked with macroeconomic forecasts. Since IFRS9 was released, we have been serving our clients with IFRS9 model development and validation and gained experience with a variety of modelling approaches.

4 Expected and unexpected loss estimation for capital requirements
In the regulatory world (F-IRB, A-IRB), statistical approaches that are rather traditional are preferred for estimating expected loss parameters (PD – probability of default, LGD – loss given default, EAD – exposure at default). Nevertheless, due to inhomogeneities in the banks’ portfolios and also in the incurred losses, banking experts repeatedly tackle significant modelling challenges. Note that even for banks using a standardised approach, detailed and accurate predictive analysis can serve as a supportive argument for transitioning to a foundation or advanced approach with a positive impact on overall credit risk management.

5 Stress testing
Predictive analytics plays an essential role in stress testing where banks are supposed to predict the quantitative impact of stressed conditions on their portfolios. The scenarios' impact is monitored via credit risk, market risk, operational risk and "other income" sheets. On one hand, stress testing models need to satisfy strict regulatory requirements and the banks often take the path of least resistance. On the other hand, the correct embedding of relevant endo- and exogenous factors can provide banks with trustworthy and indispensable insight into their future business in a changing world. This is particularly important in connection with the increasing demand to include ESG risk factors in the stress-testing exercises.

Relevant regulations
- IFRS 9
- CRR/CRR2/CRD5
- EBA-GL-2017-16 Guidelines on PD estimation, LGD estimation and treatment of defaulted assets

Tools
- Credit Decision Engine
- Credit Risk Modeling Suite
Introduction
The capital requirements for the bank consist of three main elements - minimum capital requirements (Pillar 1), an additional capital requirement (Pillar 2), and buffer requirements. Both minimum and additional capital requirements are binding (TSCR), and the bank should maintain the applicable TSCR, at all times in an adverse scenario.

The large banks are expected to implement the normative perspective complemented by the economic perspective:

- **Normative perspective** – multi-year assessment of the bank’s ability to fulfill all of its capital-related regulatory and supervisory requirements
- **Economic perspective** – the bank is expected to identify and quantify all material risks that may cause economic losses and deplete internal capital

On top of the amounts regulators and supervisors demand, the bank is expected to assess and maintain capital that it considers adequate to cover the nature and level of the risks it is or might be exposed (ICAAP).

The regulatory changes (Basel IV, CRR 3, BRRD 2) in capital quality, capital eligibility and composition, and RWA calculation significantly impact capital needs and capital ratio calculations. The bank shall consider the impact of regulation changes and analyze the possible impact on its overall risk profile, future regulatory own funds, or the TREA.

Relevant regulations
- Basel III and Basel IV
- CRR 2 and upcoming CRR 3
- EBA Guidelines and ECB Guides
Capital management process

Measures to maintain sufficient capital (under a baseline/adverse scenario) are essential areas in capital management.

The bank needs to specify arrangements on:

- The internal capital adequacy assessment (ICAAP) methodology and its periodic reviews
- The scenarios for stress testing exercise
- The monitoring method of capital adequacy
- The process of calculating the capital adequacy ratio
- The monitoring of regulatory changes in capital, capital eligibility and composition, and RWA calculation
- The capital planning, recovery & resolution planning process

Potential business benefit impact

Capital management has become a critical factor in value creation for banks - the issue is using rational methods (management of the business and correlated risks) from the viewpoint of capital consumption and producing profit on a forward-looking basis.

The bank can benefit from capital management improvement in the following areas:

- Risk-adjusted performance metrics (RAROC)
- Effective capital allocation and optimization of regulatory capital structure (types and composition of capital, synthetic securitization as a way to boost regulatory capital - see next topic)
- Risk-based pricing (and product design)
- Active capital management (diversification benefit, quantified “bank specific” capital requirement, strategic capital planning, etc.)
- Demonstrate strong risk management capabilities to regulators, rating agencies, and other stakeholders
9.1 Synthetic Securitization (1/2)

Synthetic Securitisation: Strengthening Bank Capital Ratios at Favourable Costs

Banks are utilising innovative ways of transferring credit risk to third parties, thus releasing capital at favourable costs. This way banks can achieve two objectives: (i) support business growth, and (ii) reduce risks. Structuring and advising banks on end-to-end implementation of such synthetic risk transfer can help them in widening their risk management capabilities and bring them a useful capital management tool.

Deep dive

The transfer of credit risk related to the loan portfolio takes place by the use of a risk-hedging instrument – an unfunded financial guarantee. An outside investor assumes a large part of the credit risk of some portfolio of loans of the originating bank, thus significantly decreasing unexpected losses. According to CRR, if a so-called Significant Risk Transfer occurs, this results in a decrease in risk-weighted assets and thus higher capital ratios (CET1, Tier 1 and Total capital ratios). When executing using best market practice, the costs of capital released are much lower than the usual equity costs required on capital markets.

Three options to achieve higher capital ratios

1. Reduction of the loan book
   - €80 → €56
   - Assumptions: 70% risk weight, 12% Pillar I minimum CET1 requirement
   - Decrease in loan book resulting in both RWA and asset notional decrease
   - With constant capital, the capital ratio improves

2. Capital increase
   - €100 → €70 → €10.5
   - Increase by €2.1 in the amount of capital results in an increase of capital ratios, keeping portfolio and RWAs constant

3. Risk transfer transaction to reduce RWA intensity
   - €100 → €56
   - Decrease in total RWA by transferring risk
   - Loan portfolio kept constant on bank’s balance sheet
   - Capital ratios increase

Relevant regulations

- CRR Art. 244, 245
- EBA Report 2020/32 on significant risk transfer
- ECB Public guidance on the recognition of SRT
Key transaction highlights

1 Financial guarantee
- The transfer of credit risk occurs by the use of a hedging instrument – unfunded financial guarantee
- The reference portfolio remains on the originator’s balance sheet and the business relationship between the originator and its clients is kept intact

2 Benefits of the transaction
- Lower costs of capital released than traditional equity costs, even after taking into account all transaction and maintenance costs
- No involvement of rating agencies required – Supervisory formula used for the calculations
- Reference portfolio protection against adverse economic scenario
- Support for new business generation – part of the saved costs of capital can be passed on to the business lines for new business generation

3 Reference portfolio
- The reference portfolio remains on the originator’s balance sheet and will not be sold on to a third party
- As the loan portfolio remains with the originator, business relationship between the originator and its clients is kept intact
- All interest income and fees and commissions remain at the originator

4 Loss guarantee
- Under the financial guarantee, the originator is reimbursed for a range of losses from the reference portfolio
- Potential losses from the reference portfolio are divided into tranches, whereas the originator retains first loss (junior) tranche and only losses above this level are passed on to the investor (mezzanine tranche)

5 Significant risk transfer
- Significant Risk Transfer (SRT) acc. to CRR Article 244 is fulfilled by the transfer of the mezzanine securitisation positions to the investor
- Regulator has to recognise the SRT after a comprehensive review
- Significant risk-weighted assets (RWA) reduction is achieved by replacing the reference portfolio’s RWA with the RWA of the retained tranches
Economic capital is a term coined by the Basel committee with reference to Pillar 2 requirements, where each institution should estimate the amount of risk it faces (usually described by some “quintile”) and hold sufficient equity against it.

Compared to the regulatory capital models, there are no prescribed requirements or formulas, and each institution is free to adopt any available technology.

Although many risk practitioners point to the fact that for the most part economic capital requirements are lower than regulatory ones, and therefore they lack justification to invest in the topic as no capital savings can be derived; a key benefit of implementing economic capital is its specificity to the business model of the bank.

For credit risk, in case of IRB institutions, many regulatory assumptions can be relaxed:
- No single-name concentration (fully granular portfolios)
- Infinitely large portfolio
- Predefined term-structure
- Predefined asset correlation structure
- No correlation between PD and LGD
- Use of down-turn LGD in all scenarios

… which all influence not only the credibility of the regulatory capital requirements towards its stakeholders, but also its usefulness for risk-management, pricing purposes and portfolio steering.

In case of STA institutions, a need for an internal capital model is even more pronounced as the standardised method is not risk-sensitive at all, as it basically treats all clients within one exposure class as similar, leading to it being unstable for any internal use.

Credit risk capital models are usually built using either the Vasicek model (also used in the IRB framework: probability of loss on loan portfolio) or using correlated binomial models. The key difference to the stress-testing models is an emphasis on the repeatability and reproducibility of the calculation and lack of interest in a specific scenario.

Apart from the credit risk, market risk and operational risk capital models, economic capital models also assign equity requirements for business risk, strategic risk and IRRBB.

The key benefit of the economic capital model is that it can be drilled down to the level of a client or transaction with a risk-consistent approach, which means that each transaction is assigned a capital requirement, which corresponds to its contribution to the tail risk the institution faces. This way, it can be used to measure and report the real risk that is on the bank’s books. It can be used to identify problematic clients or sectors and price them accordingly. Economic capital can also encompass ESG risks, where it can act as a simple and powerful means to implement it through the bank, even in pricing, without introducing unnecessary new risk/price category.
One of the responsibilities of the national supervisory authority is to ensure the orderly functioning and integrity of financial markets and the stability of the financial system. A stress test exercise is the primary supervisory tool for such an analysis. The aim of a test is to assess the resilience of financial institutions to adverse market developments and to contribute to the overall assessment of systemic risk in the financial system.

The stress test is based on the baseline and severe scenarios, mandatory for all banking institutions. Transitional mechanisms are developed by individual banks depending on the complexity of their products and the portfolio structure.

**Stress test deliverables**

Stress tests are delivered via qualitative and quantitative information provided by each bank to the regulator. The qualitative information offers insight into transmission mechanisms, including reasoning of possible deviations versus prescribed scenarios and/or limitations set by the scenarios.

Quantitative information focuses on the delivery of a stressed Income Statement and Balance Sheet of the financial institution. The stress test is performed on the 3 year horizon and focuses on the institution's prudential requirements (capital adequacy). The scenarios' impact are monitored via credit risk, market risk, operational risk and "other income" sheets. The challenging part is simulating Net Interest Income as the core input into the capital adequacy calculation. The institution can use its existing engine for the NII calculation if it meets the constraints and mechanics set up by the stress test.

In 2021, the regulatory stress test was enhanced by the “Economic, Social and Governance” aspects as these are the new emerging risks. The ESG should not create a new category of risks (credit/market/operational), but rather they should be embedded in traditional risks.
Apart from the regular regulatory stress-testing exercises, institutions are required under Pillar 2 to perform internal-stress tests at least once a year for all risk types of risk: credit, market, operational and liquidity. Additionally, many institutions decided to go beyond these minimum requirements and regularly use stress-testing methods to explore possible situations where it could endanger the going-on principle. They also capture business risk, strategic risk, interest-rate risk in the banking book, and funding risk.

Many of these situations are in the form of the materialisation of concentrations in the portfolio, either sectoral or single-name, in some cases also by the wrong-way risk (a situation where collateral value is negatively correlated with a borrower’s credit worthiness).

Compared to the regulatory stress tests, with a “one size fits all” approach, internal stress tests are able to focus on those areas that specifically match the institution’s risk profile, while not requiring unnecessary regulatory conservatism (e.g., zero net profit assumption); therefore, they are generally much more useful for the top management. Their only negative is that they are not very comparable across the market.

Normal outputs revolve around possible PL impacts for the institution and capital/liquidity requirements.

Standard market practice revolves around three approaches, all being very powerful tools, having unique traits. They are distinguished mainly by the way a scenario was generated:

1. **Sensitivity analysis**
   Outputs of sensitivity analyses show the degree of an institution’s vulnerability to specific risks and possible PL impacts. The standard scenarios explore specific problems like sovereign distress, mortgage crisis, sectoral ESG transition risk, represented by tangible and simple key risk indicators: decrease in sovereign credit rating by 2, 4 or 6 notches; decrease in real-estate prices by 10%, 20% or 30% while increasing unemployment by 50%, 200% and 500%; increase in carbon price by 500%, 1000%, 2000%. These scenarios do not need to have their occurrence probabilities attached to them; they should be severe, but plausible.

2. **Stress-testing**
   Stress-testing exercises are broader in the sense that they work based on (usually narrative-rich) scenarios and are overarching across all portfolios, with scenario narratives being defined separately per each risk type, although they could be loosely connected. We note that scenarios should have some ‘probability of occurrence’ attached to them.

3. **Integrated stress-testing**
   Integrated stress tests represent the highest level of modelling efforts as they are built on fully fledged scenarios across all risk types. Generating those scenarios is usually a very challenging task, since it requires consistent predicting of all key risk indicators. Such scenarios are usually obtained from external sources, or via internal macro/micro-economic models.

**Relevant regulations**
- Overview of Pillar 2 supervisory review practices and approaches
- Stress-testing principles
- Final report on Guidelines on institutions stress testing (EBA-GL-2018-04)
The sophistication of the stress-testing models revolves not only around how scenarios are generated or how the risk drivers are defined in the Scenario Generation module, but also by the stress-testing models that are employed. They could be specific for that exercise, be general tools or use IFRS models that are already available in a bank. These models are used to capture transmission mechanisms from the Key Risk Indicator to a particular risk metrics that are used for the calculation of possible loss. The calculation level of these models can be client, sector or portfolio specific. Lower granular calculations provide more precise calculations, but there is a requirement for homogeneity in the modelling sample, so in many cases it’s driven by the narrative itself. The “PD model level” is often considered the minimum calculation level.

Not to be confused with the calculation level, the last thing which should be considered is the application level: being portfolio based (top-down) or transaction/client based (bottom-up). Bottom-up application levels are highly recommended, as sufficiently granular application levels ensure that available collateral is not averaged across all clients, even to those, where they are not applicable.
Traditionally, the pricing topic has been a domain of business departments, seen as largely driven by market forces, where the bargaining power of an individual institution was often disputed. Within their responsibilities, business lines came up with intuitive and, in many cases, simple pricing models that somewhat reflected the riskiness of their clients, but such schemes were often disconnected from the rest of the banks’ risk management, which potentially led to pricing inconsistencies and to a decrease in profit via mispricing, both in terms of the credit risk not correctly pricing, but also in not accepting clients that could still be profitable.

On the other hand, the ability to come up with risk-consistent pricing models has been, in the past, hindered by the lack of (i) risk data and (ii) risk-pricing knowledge in the institutions, but now with more or less developed ICAAP and IRB frameworks, the data gaps are closed, but low awareness and risk-pricing knowledge remain the main inhibiting factor for implementations.

Pricing effectiveness can be measured on different granularities. Once it's measured on the bank level, the most common metric is ROE, which has three drawbacks:

- It cannot be drilled down, so institutions often lack knowledge of what transactions or business lines contribute to ROE and by how much. Many transactions or even segments can have long-term negative ROEs without being even noticed by the top management. And even for profitable transactions, the capital associated with them could be so high such that the cost of capital outweighs interest income and fees, leading to ROEs much lower than Cost of Equity, being effectively loss making from shareholders’ view.
- ROE can be influenced by the macroeconomic factors outside the control of the management (COVID crisis, financial crisis, sovereign debt crisis or by positive events by long-term relaxed monetary policy stance) and, therefore, it is hard to judge what the real contribution of the management was to the net profit. From the shareholders’ and often also regulatory perspective, this is not a desired feature as management could get rewarded for the good years in the economy, and punished for crisis years through their KPIs, even though it managed to go through the downturn periods much better than peers, effectively contributing to the shareholders’ value.

These drawbacks can be overcome by three of the following metrics...

- RORAC - Return on risk-adjusted capital (Point-in-time metric)
- RAROC - Risk adjusted return on capital (Though-the-cycle metric)
- EVA - Economic value added (Though-the-cycle metric)

... which can be measured on all granularities: transaction, client, segment, business-line, bank as well as ex-ante (used for pricing) and ex-post (used for reporting and analyses and setting of effective KPIs, where the KPI objective has especially been proven by banks to be very efficient in managing Net Profit).

Relevant regulations

- Guidelines on loan origination and monitoring
- Credit risk regulation (CRR)
- Credit risk directive (CRD)
- IFRS 9
While the first two metrics are relative, the second one is measured in units (of currencies) and can be compared to the Net Profit, and its main benefit is that it is fully additive, meaning that the sum of all EVAs on all clients is the bank’s total EVA. EVA can help to spot important sectors, clients or transactions from the Net Profit point of view, while RAROC and RORAC can be comparable across any loan sizes and portfolios.

The main idea behind these metrics is to take Cost of capital and Though-the-cycle cost of risk into account. In best-in-class implementations, the average RAROC across multiple years will equal ROE.

It is proven by industry practice that implementing risk-adjusted-pricing techniques for pricing and/or setting KPIs brings significant benefits to the

- Risk-cost awareness (stops Après moi, le déluge thinking)
- Capital awareness (stops capital wastage)
- Reduces volatility of Net profit (by pricing though-the-cycle)
- Removes arbitrariness from the evaluation process
- Helps to promote fair, just and transparent pricing and shines the light on possible price manipulation and/or outliers

The need for risk-based pricing is embedded deep in the IFRS9 staging rules, which are at the moment being ignored by most banks, thus creating development liabilities for the future. We think that ignoring these requirements substantially weakens IFRS performance in terms of its ability to timely and adequately capture credit risk in (stage 2) loan impairments.

Needless to say, the implementation of these metrics in IRB (or equivalent) banks is easier, but by no means is IRB status required. The main challenge of the implementation actually lies in the alignment of the base of the finance, controlling and risk data.

The standard comprehensive implementation comes in three phases (not all have to be done):

- Institutions should start with the implementation in the ex-post world (reporting to the top management and business-lines). As problematic and crucial follow-up segments are identified, and an action plan is prepared (retention or change in strategy/pricing).
- Once the institution internalises numbers and can work and interpret the reports, the ex-ante (pricing) aspect is implemented, where all metrics should be embedded within credit decision-making standards for underwriting.
- Lastly, the KPI aspect should be implemented for both senior management and business lines, to set correct incentives for the long term.
Recovery Plan is a key element of the crisis management framework. The Plan shall set out the arrangements and measures a bank would adopt to restore long-term financial viability in case of severe distress. The regulatory Technical Standards and EBA Guidelines provide details on the key part and information that must be included in Recovery Plan to be drafted by banks as requested by the Bank Recovery and Resolution Directive (BRRD).

The compliance of recovery plans with the regulatory requirements is crucial for all key elements of The Recovery Plan – governance, recovery plan indicators, stress scenarios, strategic analysis including recovery options and preparatory measures, communication and disclosure plan.

We are ready to fully support you to understand and apply all the requirements thanks to our vast knowledge of the regulation, experience in Recovery Plan projects and implementation (also in view of COVID-19 pandemic) including direct interaction with the regulators.

**Our Services**

We cover all aspects of the Recovery Plan revision and preparation process from the review of the current state and gap analysis, through the plan development to the support during the submission to the regulator:

- **Preparation** – complete preparation of the Recovery Plan covering the review of the current state, quantitative analysis and document drafting
- **Revision** – quality assurance, gap analysis vs compliance with EBA guidelines, RTS and local regulatory requirements
- **Update** – methodological support in the recovery plan update process as a response to the supervisor’s feedback, including gap analysis and quantitative analysis
- **Seminars & Workshops** – open and in-house seminars and workshops on recovery plans, best practice sharing

**How do we proceed with Recovery Plan?**

The process of Recovery Plan preparation / update / revision consists of several parts. Throughout the whole process, we actively communicate with you and agree on the next steps.

**Relevant regulations**

- RTS on the content of recovery plans – Commission Delegated Regulation (EU) 2016/1075
- EBA/GL/2014/06 Guidelines on the range of scenarios to be used in recovery plans
- EBA/GL/2015/07 Guidelines on failing or likely to fail

**Recovery Plan pipeline**

- **Gap analysis**
  - review of current state of Recovery Plan
  - gap analysis vs. compliance with EBA guidelines, EBA RTS and regulatory requirements
- **Strategic analysis**
  - business model analysis
  - analysis of critical functions
- **Recovery Plan indicators**
  - choice of indicators for Recovery Plan in line with EBA guidelines
- **Stress scenarios**
  - preparation of stress scenarios in line with EBA guidelines:
    - system-wide stress
    - idiosyncratic stress
    - combined stress
- **Calibration of indicators**
  - simulation of selected indicators under stress scenarios
  - thresholds setting for Recovery Plan activation
- **Recovery measures and option**
  - proposal of recovery measures and option
  - assessment of total recovery capacity
- **Preparatory measures**
  - analysis of preparatory measures
- **Governance description**
  - methodological support in the area of governance, decision making process, communication and disclosure plan

**Silvia Majlingová**

Table of Contents | Services | Core Topics | Tools | Team

Risk Management & Modelling | 35
Stability and trust are integral parts of local, regional and global financial systems. However, in today’s increasingly interconnected world, failing financial institutions can threaten the stability of financial systems. Costly public bailouts of ‘too-big-to-fail’ banks during the 2008 financial crisis highlighted the need to address the moral hazard posed by systemically important financial institutions.

Resolution planning, or “living will” of financial institutions, helps regulators and banks ensure important areas are resolution-proof, should an idiosyncratic shock lead to insolvency.

### Failing or likely to fail:
**Resolution**

The resolution plan shows what an institution would do if it fails, and addresses the financial, legal and operational obstacles to resolution. This enables the regulator to make an assessment of the potential effects on financial stability and then determine whether the plan is acceptable.

A sound resolution plan should enable regulators to understand a bank’s ownership structure and exposures to, and connections with, other affiliated and unaffiliated entities, markets and payment infrastructures. The plan should also include an understanding of the legal structure as it will help regulators identify structural and operational issues relevant to the separation of significant entities.

It is also important to understand the scale of each economic function and the potential impact of closing any of the economic functions. This will provide details of which legal entity or entities each function sits within, and how to deal with them in case of crisis.

### Single Resolution Board
(SRB, the EU Resolution watchdog) and National Resolution Authorities focus on the following 7 dimensions of the resolvability process:

1. Governance
2. Loss absorption and recapitalisation capacity
3. Liquidity and funding in resolution
4. Operational continuity in resolution and access to financial market infrastructure
5. Information systems and data requirements
6. Separability and restructuring
7. Communication

### Relevant regulations
- Bank Recovery and Resolution Directive, BRRD II
- Single Resolution Mechanism Regulation, EU and national Deposit insurance frameworks
- EBA/GL/2022/01 – Resolvability Guidelines
Well set up an anti-fraud process that protects the business from fraud groups and individuals, and, at the same time, doesn’t disrupt good client experience and doesn’t cost too much.

1. **Know your enemy**
   By knowing your enemy, you can better target fraud preventive actions and contribute greatly to the mitigation of potential losses. While any company that faces substantial fraud is well aware of its vulnerability, we often see cases where a company does not understand the types of fraudsters they are facing. Either the company has never been attacked through large-scale frauds, or the frauds committed against the business are so small the negative numbers that are generated are considered “business as usual”. Either way, knowing the enemy can contribute to loss mitigation by better targeting the fraud preventive actions.

2. **Antifraud ecosystem**
   **Due to the cleverness of fraudsters, it is not possible to entirely rule out any kind of fraud attack, but with proper processes, we can ensure that:**
   - Majority of frauds are prevented thanks to the prevention mechanisms used during the application process as well thanks to the deterrence effects as a result of a sound antifraud system
   - Fraudulent cases are detected quickly enough that they do minimal damage
   - Identified fraud instances are investigated with enough evidence that remedial action is taken, so fraudsters would be punished, and others deterred

   An overall good antifraud process should not be too disturbing for good clients and be, as much as possible, a matter of background checks and controls.
   In some cases, fraud risk may be the main differentiator between profitable and non-profitable products. In other cases, the mitigation of fraud risk improves financial results and minimises PR issues.
Fraud prevention
Best way to deal with frauds is to prevent them from happening.

Our focus lies in three key pillars:

1. **Application process**
   We ideally want to ensure that fraudsters are recognized and their application is rejected. It can be done either via blacklists or via known suspicious behavior during application process.

2. **Technology**
   Today we are able to collect biometrics as face recognition or fingerprints. With recent rapid developments in area, face recognition are difficult to fool, and provides great preventive tool for KYC. Under many legislations we are able to implement electronic signature, which enables fully digital process with better disputability than classical pen and paper.

3. **Awareness and deterrence**
   Trainings, warning signs and consistent care about antifraud measures create environment, where all employees will cooperate in the mission of fraud prevention and would design innovations with fraud risk in mind and minimize process loopholes, which could be potentially exploited. In the same way it will deter both internal and external fraudsters from fraud attempts.

PwC has expertise and past experience in all the listed areas and offers advisory with fraud prevention design.
4 Fraud detection

1. Triggers
2. Mystery shopping
3. Helpline and complaints handling

Despite all the preventive measures, some frauds can happen. In such a case it is necessary to detect them as soon as possible.

Triggers are sets of rules, which are applied over whole portfolio. We run it typically over aggregated entity such as sales agent, POS, branch or telesales operator. Whenever the rule is triggered, the entity is selected for further investigation.

Investigation process is relatively expensive, so we need to make sure, that detected triggers detects only cases with high probability of fraud.

PwC experts together with client can setup automatic triggers which would regularly scan the portfolio looking for suspicious cases to trigger. We typically concentrate on flowing areas:

- **Default triggers** – we search entities which are having statistically improbable deviation from standardly observed default rates. Such default concentrations worth further investigation.

- **Early warning signals** – Concentrations of contracts which are not yet defaulted but shows suspicious activities such as quickly increased sales volumes, high share of rejections or poor connect rate during welcome call.

- **Urgent cases** – Typically run over individual contract to which there was recorded some fraud complaint or stolen identity suspicion.

- **Price and product cheating mechanisms** – algorithms designed to discover sales agent’s misbehavior around collection of downpayment.

- **Fraud score** – asides all above, we can create and calibrate a score, which would rate all entities based on the level of suspicious activity. This score would order cases based on some priority which they might be investigated.
Collections are one of the most important functions in credit risk management. Collections may reverse the negative financial impact of delinquent clients when the collections team works efficiently.

**Collections process optimisation**
Collections represent a combination of people, collections strategies and data analytics and systems used to drive, optimise, and manage the whole complex collections process from the pre-collections stage through the early collections stage, late collections state until NPL management and the debt sale process.
Possible approach to well working collections can be done in following steps:

- Collections process design done from scratch or analyse the data of current process funnel to understand space for optimisation
- Think about the most appropriate collections tools for each collections stage
- Review and measure current segmentation strategy and propose changes to make collections more effective
- Optimise call centre assignments, calling frequency and calling times
- Design proper penalty scheme for the best income yield

**Collections focus areas – Our approach**

1. **Collections strategy and data analytics**
   - Optimise collections efficiency through data analytics, optimised collections strategies and applying collections scorecards into the collections process and case segmentations
   - Define key collections metrics for effective management

2. **People**
   - Effectively use manpower available in collections department based on skills and the collections strategy
   - Design and review of collections org chart regarding the efficient management of operators and keeping high standards of training and quality control

3. **Systems**
   - Advisory in optimal predictive autodialler calling mechanism
   - Time-effective and cost-effective use of SMS, calling, voice bots, IVR, messaging services

- Account assignment strategy for external debt collections agencies and legal proceedings
- NPL management and debt sale valuation and advisory in debt sale process
Liquidity management is a core activity performed by the financial institution on a daily basis. The sound liquidity management framework is in the center of the attention of different stakeholders – depositors, shareholders, and regulators. The 2008 crisis brought liquidity management to centre stage for regulators and lawmakers.

The liquidity risk management is further divided into:

1. Setup of appropriate organisational structure supporting the principles of sound liquidity management (3 Lines of Defense concept)
2. Accurate definition of roles and responsibilities throughout the risk management cycle (risk identification, assessment, mitigation, monitoring and reporting)
3. Severe but plausible stress testing – sensitivity testing, scenario based testing
4. Intraday Liquidity management
5. Effective Contingency Liquidity suited to the scale, complexity and nature of the institution’s business
6. Alignment of Liquidity risk appetite (as defined in the Risk Appetite Statement) and Business Plan

Among others sound liquidity management framework supports:

- Senior Management effort to reach Business Plan objectives within approved risk appetite
- The ability of efficient liquidity management via reduction of costs
- Process of selecting the most advantageous funding or placement of options
- Institution comfort during a period of stress

Liquidity risk management policy follows principles listed in points 1–6. It can also state approaches to modelling of non-maturing deposits, loans prepayments, early withdrawal of term deposits, loan drawdown or other material B/S items. ALM manages liquidity risk in its 1st Line of Defense role. Market risk performs the role of 2nd LoD. The Treasury has the role of securing access to financial markets – handling orders from ALM.

Relevant regulations

- Basel III
- CRR/CRR 2
- EBA Guidelines on LCR disclosure to complement the disclosure
- EBA Guidelines funding plans

**ILAAP**: Linking the principles

The ILAAP is a core process ensuring that liquidity risk management principles are regularly monitored, assessed and enhanced.

*ILAAP = Internal Liquidity Adequacy Assessment Process*
15.1 Funds Transfer Pricing

An effective FTP
- Provides input into the product pricing process
- Contributes to the desired long-term sustainable and profitable Balance sheet
- Secures a margin of a business unit throughout the lifetime of the transaction, transfer the FX, interest rate and liquidity risk to the central unit (Treasury/ALM)
- Enables profitability measurement on a deal level
- Transfers the cost of liquidity to liquidity consumers, in other words FTP rewards providers of liquidity by defining a transfer price for the funds invested (assets) and acquired (liabilities)
- Provides essential input for risk-adjusted profitability measurement (RAROC, RORAC)

FTP curves
- Currency-specific
- Used to derive FTP for products, on the level of particular transactions
- FTP curve consists of several components
- Market observable (for example mandatory reserves at the central bank)
- Bank-specific – related to the business objectives of the Bank, complexity and scale of the Bank's business, clients portfolio (for example Contingency Liquidity Buffer)

FTP framework
- Description of FTP methodology including construction of FTP Curves
- FTP formulas on the level of products
- Principles of splitting revenues from the transactions (business unit vs. central unit)
- Roles and responsibilities of stakeholders
- Implementation – FTP rates communication, recalculation frequency

Relevant regulations
- Basel III
- FSI Liquidity transfer pricing: a guide to better practice (2011)

A Bank should incorporate liquidity costs, benefits and risks in its product pricing, performance measurement for all significant business activities. (Principles of sound liquidity management, 2008)

Funds transfer pricing (a mechanism that allocates liquidity costs, benefits and risks) is part of the effective risk management framework of an institution. As such, the mechanism should be consistent with the framework of governance, risk tolerance and the decision-making process. (CEBS/EBA Guidelines on Liquidity Cost Benefit Allocation, 2010)
Market risk is defined as the risk of losses in on and offbalance-sheet positions arising from movements in market prices.

The market risk arises from the volatility of market rates and the sensitivity of the market risk positions to them. The market risk can materialise into both profit and loss for the financial institution.

(Basel Committee on Banking supervision)

Market Risk Management includes management of Interest Rate Risk, Equity Risk, Exchange Rate Risk and Commodity Risk. In managing the risk, it is necessary to distinguish between Banking Book and Trading Book.

The last Basel Committee reform focused also on capital requirements for market risk arising from the Trading Book. The market risk as such is present in all of the three Basel Pillars.

The Market Risk Management is defined by the organisational framework of the financial institution (Three Lines of Defense model) establishing the Market risk management department/division.

Market risk management framework should focus on identifying, measuring, mitigation, monitoring and reporting of market risks.

A sound framework defines:
- Organisational structure, roles and responsibilities of functions
- Measurement and analysis methods (techniques, assumptions, etc.)
- Monitoring method – Value at Risk, sensitivities calculation
- Stress Testing scenarios
- Policy on Key limits, ensuring alignment with the Risk Appetite Statement

Sound Market Risk Management Framework is an assumption for effective management of the market risks and supports:
- Early identification of risks and in-time treatment of risk (decreasing the cost of risk mitigation).
- Decision-making process based on relevant, and accurate information.
- In-time reporting of matters that would seriously affect the financial institution.
- Risk profile is within the risk capacity of the financial institution and in line with the shareholders will for risk to be accepted.
- Institution comfort during a period of stress.

Relevant regulations
- CRR/CRR 2/CRD 5
- Upcoming CRR 3
- BCBS Fundamental Review of the Trading Book /Minimum capital requirements for market risk/ (2019)
Introduction

IRRBB refers to the risk, both current and forward-looking, to the capital and earnings of the bank arising from interest rates shifts. It stems from two types of mismatches that are at the core of the business of most banks. First, banks are exposed to IRRBB due to the maturity mismatch (i.e. long-term assets are funded by short-term liabilities). The second cause of IRRBB is the rate mismatch (i.e. fix rate loans are funded by variable rate deposits). Banks need to identify the IRRBB in their products & activities and take appropriate steps to ensure the risk is adequately measured, monitored, and controlled. The treatment of IRRBB is an integral part of the broader risk management framework of the bank via ICAAP.

Measurement

Measurement of IRRBB is based on two pillars; change in Economic Value of Equity (ΔEVE) and change in net interest income (ΔNII). When interest rates change, the cash flows of the bank are affected. Cash flows are slotted into time buckets; regulation defines a minimum granularity of the buckets. Different time horizons and assumptions are applied to EVE (B/S run-off) and NII (1-3YR horizon, constant B/S).

For EVE, the Basel standard prescribes 6 interest rate shock scenarios, the results of which need to be disclosed. Behavioral options, such as loan prepayments, deposit early withdrawal, or non-maturity deposits, have to also be included.

Mitigation

The most common tool to minimise the mismatch described above is hedging. The bank needs to identify appropriate debt and derivative instruments and strategies to mitigate the risk, such as interest rate swap. Due to the different measurement methods, hedging of NII opens the position as measured by EVE and vice-versa.

Relevant regulations

- BCBS Interest rate risk in the banking book (2016)
- CRD 4/CRD 5
- EBA/GL/2018/02 - Guidelines on the management of interest rate risk arising from non-trading book activities
- Upcoming regulation (under development): RTS on IRRBB supervisory outlier tests, RTSon IRRBB standardised approach, EBA Guidelines on IRRBB and CSRBB
Institutions and creditors should have sufficient, accurate and up-to-date information and data necessary to assess the borrower’s creditworthiness and risk profile before concluding a loan agreement.

(EBA/GL/2020/06 Guidelines on loan origination and monitoring)

Goals for the credit risk department

Loan origination in the commercial (SME and corporate) segment is a comprehensive procedure, consisting of various steps and diverse participants from several departments. The goal of a bank is not to eliminate credit risk, but based on all available information, measure and manage credit risk with the aim to maximise risk adjusted return. A bank must take an optimal mix of the portfolio view in managing risk on one side and on the detailed assessment of individual transactions on the other.

The quality of a bank’s credit portfolio affects the amount of credit risk a bank is facing. In other words, this portfolio quality is indicated by the reliability of repayments of every individual client and of the whole portfolio as well. The basic instrument for measurement is the probability of default (PD), meaning that the client will not be able (partially or in full) to meet its obligations. Additionally, such parameters as the loss given default (LGD) and exposure at default (EAD) might help to estimate the client’s credit risk.

Loss-given-default defines the loss that a bank realises when the client defaults. LGD is supplemented with the recovery rate (RR), thus we assume that, in the case of default, the bank is able to recover part of its receivables. Recovery rate is influenced by numerous factors that might vary. Also, the assessment of the credit risk is impacted by the estimation of exposure at default, considering that EAD could be higher than the current exposure.

Regular portfolio review with focus on check of exposures classification play an important role in credit risk management. Correct exposure classification to performing/non-performing should be an integral part of monitoring in the lending process. In PwC, we have broad experience with AQR and portfolio reviews using the ECB methodology.
Milestones in credit lending process

The following practical issues are directly associated with the commercial credit lending process. Classic credit analysis generally involves an analysis of financial statements (balance sheet, income sheet, cash flow statement, all with historical overview), financial ratios analysis, and the analysis of many other qualitative issues (strategy, business plan, transaction setup, competitiveness, quality of management, market or industry situation). Part of this is also the analysis of the ability (capacity) of the borrower to repay its debt (usually expressed in covenant DSCR – debt-service coverage ratio), assessed based on cash flow models and financial statements (creditworthiness assessment). Another essential part for commercial lending is the analysis of collateral and guarantees, which covers more than a simplified comparison measurement of LTV covenant (loan-to-value). The lending process also includes the important component of monitoring and evaluating groups of connected borrowers; this matters, for example, for exposure limits control or as part of fraud prevention.

The result of quantitative and the quantitative analysis is usually summarised in the scoring model. Based on the scoring results, clients are grouped in one of the rating categories. Doing this, banks achieve division of clients into several groups with certain default probability.

Exceptional grip ready to the exceptional cases

Special attention should be paid to the specific types of commercial loans; as with each particular loan type all the parts of the process mentioned above might vary. A classical investment loan has a different cash flow model than project financing or RE development financing (for example different regulatory requirements for speculative immovable property financing according to Article 4(1)(79) of Regulation (EU) No 575/2013 (CRR)). So, the approach to their assessments should be appropriately adjusted and taken into account.

Relevant regulations

- IFRS 9
- Basel III
- CRR/CRR 2/CRD 5
- EBA/GL/2020/06 – Guidelines on loan origination and monitoring

Tools

- Credit Decision Engine
Data aggregation is the process of gathering and combining raw data entry from different sources in a defined format used as input into risk management (risk monitoring and reporting). Data governance creates a framework for data aggregation by defining risk data architecture and IT infrastructure to ensure compliance with reporting requirements, processes, and policies.

Data aggregation and data reporting

For accurate data report creation, it is essential to follow policies and standards describing the required data governance framework. The data should be aligned with the reporting principles and be accurate, complete, and adequate. There are different purposes for which consolidated data outputs are used: to analyse resources, create systematic investigations or design studies, estimate potential risks, provide early warnings. Moreover, financial institutions are required to distribute mandatory data reports (FinRep, CoRep, etc.).

Data requirements definition

Dataset or data request should be defined based on the regulatory requirements. Data should be defined, realised, and delivered during the overall data definition process. The following three areas can describe critical elements of the data requirements definition process:

1. Definition of data requirements – Definition is based on accessing and finding a relevant data source through the different data warehouses. The data definition process goal is to create a data glossary to ensure that data are accessible and in line with the requested framework.

2. Setting functional and non-functional requirements – Functional requirements can be described as the solution design that needs to be created for the relevant data requirement. Non-functional data requirement is a broader term describing all relevant information (e.g., data access, frequency, governance procedures, etc.).

3. Ensuring data quality – Testing the data quality per defined scenarios. Further remediation actions, including supervisory review, can occur with dependence on the outcome.

Data requirement definition is a part of the data aggregation process, yet this process is interrelated with data governance and management. The quality of risk management reports relies on solid risk data aggregation capabilities.

Relevant regulations

- BCBS Principles for effective risk data aggregation and risk reporting (2013)

Improving banks’ ability to aggregate risk data will improve their resolvability. For recovery, a robust data framework will help banks and supervisors anticipate problems ahead. It will also improve the prospects of finding alternative options to restore financial strength and viability when the firm comes under severe stress.

(BCBS Principles for effective risk data aggregation and risk reporting, 2013)

(BCBS Principles for effective risk data aggregation and risk reporting, 2013)
The Asset Quality Review (AQR) is a supervisory mechanism created by the European Central Bank (ECB) for reviewing the quality of a bank’s assets, including the adequacy of assets, collateral valuation and expected credit losses.

The AQR is a comprehensive assessment that covers a variety of areas such as a review of internal policies, extraction of client data, performing a credit file review, or modelling of collective provisions. While the AQR usually has tight deadlines, it is essential that a bank prepare itself in advance because each area requires significant involvement of bank staff to prepare the requested documents in the required quality and within a given timeline.

A bank should primarily focus on the AQR work blocks summarised in the chart below, which require significant bank involvement. The chart also shows interdependencies between the individual AQR work blocks. The next sections describe a “best practice” preparation approach for each considered work block.

### Processes, policies and accounting review (PP&A)

PP&A review is focussed on ensuring that the bank has a robust set of clearly defined policies and processes for correctly interpreting accounting rules or other applicable industry standards. The review covers thematic areas related to key accounting decisions, e.g., classification of financial instruments, provisioning methods, impairment staging criteria, NPE definitions, forbearance and restructuring, collateral valuation, and disposal processes, etc.

AQR preparation process consists of

1. **Explanation of the PP&A requirements and templates.**
2. **Collections of internal policies and procedures as defined in the AQR methodology.**
3. **Review of the collected documentation, communication of findings and definition of remedial actions.**

A proper preparation process will result in the availability and completeness of the documentation.

### Loan Tape creation and Data Integrity Validation

AQR methodology requires the creation of a “loan tape” which is a dataset that includes basic account information about clients and exposures. To achieve the transparency of bank balance sheets, it must be ensured that the provided data is correct, meets defined requirements and is of sufficient quality.
Hence, a set of tests is performed on the data which is called Data Integrity Validation (DIV). Since the required format and terminology differ from the bank’s internal one, banks usually struggle with providing all requested information. PwC developed the following approach to assist banks with these tasks:

1. **Explanation of the loan tape data requests, structure, and format.** Sharing best practices for loan tape creation and common DIV errors. Optionally, assistance with the extraction of data from a bank’s source system(s).

2. **Performance of DIV checks in several DIV iterations using the DIV Tool.**

3. **Explanation of DIV findings and their potential impact on the AQR assessment.**

4. **Definition of remedial actions reflecting the identified DIV findings.**

As a result, banks are prepared to deliver loan tapes of high quality and mitigate any potential gaps identified by DIV.

### Sampling

The sampling process is an intermediate step between the creation of a loan tape and the credit file review and results in a set of debtors (sample) which is subject to the credit file review. In the sampling process, debtors are segmented into risk classes and exposure classes based on the portfolio’s characteristics, hence sample sizes may differ between banks and portfolio types.

During the AQR preparation, the sampling is performed using the internally developed Sampling tool in order to:

- Assess overall sample sizes per portfolio;
- Assess concentration of debtors in particular risk and exposure classes and understand the underlying drivers; and
- Create a sample of debtors that will be subject to credit file review.

One of the challenges for a bank during the AQR audit is to prepare the requested credit files of selected debtors (in a very short period of time). The estimation of the sample size should be properly projected into a project plan so as not to underestimate the required staff capacities.

### Credit File Review (CFR)

The CFR focuses on the assessment of misclassification and under/over-provisioning of sampled debtors.

The CFR approach is performed in the following steps:

1. **CFR data preparation** – understanding of the CFR templates and related data requests. Alignment of which documents should be included in the credit file of a debtor. Reconciliation of the data in the credit files against the data in the loan tape and assessment of the data quality.

2. **Classification review** – assessment of whether exposure is correctly classified by a bank from different perspectives (evidence of impairment, NPE classification, regulatory exposure classifications, AQR asset segmentation and related party classification). Based on this assessment a new classification might be determined.

3. **Review of provisions** – individual provisions are recalculated for the non-performing debtors which involve using the “going concern” / “gone concern” AQR approach.

Particular attention should be dedicated to potential differences and data gaps between the loan tape, templates, and credit files, as well as to significant differences in provision levels of a bank.
and those calculated using the AQR approach.

**Collective provisioning**

During the collective provisioning analysis (CPA), the level of provisions of a bank is assessed against the so-called Challenger Model – a standardised statistical model that estimates expected credit losses based on the provided data inputs.

**Steps performed**

1. Explanation of the CPA data requests, structure, and format. Sharing best practice for accurate calculation of the CPA data inputs (e.g., contractual repayment schemes; debt collection data; sales log of repossessed assets, etc.).
2. Analysis of data quality and consistency to ensure that collected data are of sufficient quality.
3. Creation of the Challenger Model using the CPA Tool which processes the reviewed CPA data inputs and loan tape data.
4. Interpretation of the Challenger Model results which quantify the impact of each parameter on the final results. This output can be further used to identify "weak spots" and potential gaps in the CPA data inputs as well as in a bank’s provisioning models.

The above-mentioned tasks help the bank to identify required sources for CPA data inputs and might identify potential weak spots in the prepared data. This will enable the bank to investigate any deteriorations and, if necessary, set up a mitigation process.
The objective of the Asset Quality Review (AQR) is to ensure the proper valuation of a bank’s assets and that a bank has sufficient capital to absorb losses on existing delinquent assets.

The AQR exercise is the most comprehensive methodology available globally for reviewing the asset quality of a banking institution and covers all areas from accounting policies to loan classification, impairment, collateral valuation, repossessed assets valuation to capital impacts (see the chart below). Subjectivity is minimised.

Rules are followed.

Such an exercise is much wider than any internal or external audit. Most banks have not experienced this type of review and the pressure that goes along with it with tight deadlines and hundreds of files to be provided to an external reviewer.

To successfully complete the AQR audit, the AQR auditor needs to have:

- Good understanding of the methodology and have hands-on experience with delivering AQR audits
- Automated solutions and tools for repetitive tasks within the AQR process, such as filling out the standardised AQR templates
- Effective communication channels with a bank to share a large number of files and monitor the status progress
- A sound multi-level quality assurance process
- A robust project management structure

**Workflow of the AQR work blocks with determination of level of bank involvement**

- **Processes, policies and accounting review**
  - Loan tape creation and Data Integrity Validation
  - Sampling
  - Credit File Review (CFR)
  - Collateral valuation
  - Projection of findings of CFR

- **Collective provisioning analysis**

- **Fair value exposures review**

- **Quality assurance and project management**
  - Minimal bank involvement
  - Limited bank involvement
  - Medium bank involvement
  - Significant bank involvement

**Determination of AQR-adjusted CET1% and definition of remedial actions**
A loan loss provision is an income statement expense set aside to allow for uncollected loans and loan payments. In order to ensure that banks are presenting an accurate assessment of their overall financial health, they will account for potential loan defaults. In this context, the loan loss provision represents the expected credit losses.

The level of provisioning is influenced by a variety of factors, which include the supervisory requirements. In Europe, the requirements on loan loss provisions are set by the International Financial Reporting Standard 9 – Financial Instruments (IFRS 9) issued in July 2014 by the International Accounting Standards Board (IASB). In the US, the similar role plays Accounting Standards Update (ASU) No. 2016-13, Topic 326, Financial Instruments – Credit Losses (CECL) issued in June 2016 by the Financial Accounting Standards Board (FASB). Under both IFRS 9 and CECL, banks are required to recognise expected credit losses taking into account past events, current conditions and forecast information. The main difference between IFRS9 and CECL is that under IFRS 9, the credit deterioration affects the amount of allocated expected credit loss.

In order to ensure the overall adequacy of Loan Loss Provision levels and compliance with the relevant standards, suitable models need to be developed, validated, implemented and monitored. Furthermore, the IFRS 9 and CECL models and their outcomes will be periodically reviewed by external auditors. Any discovered deficiencies will be addressed by making model adjustments, recalibrations or redevelopment.

**Relevant regulations**
- IFRS 9
- CECL (FASB standard)

**Tools**
- IFRisk 9 Calculator
- CECL Calculator
03 Tools
Tools

- Model Risk Manager
- Credit Decision Engine
- Credit Risk Modelling Suite
- IFRisk 9 Calculator
- CECL Calculator
- Model Validator

more info at www.pwc.cz/rmm
04

Team
**Jiří Mach**  
**Senior Manager**  

**Experience summary**  
Jiří is a Senior Manager in the Risk Management & Modelling team based in Prague. Prior to joining PwC, Jiří worked for another Big 4 and had over 18 years of rich risk management experience in consulting and financial services industry including role of Director of Trading & ALM of the bank, CEO and BoD role in Central Bank regulated financial institution.

**Contact**  
jiri.mach@pwc.com

**Areas of expertise**
- Risk Appetite Framework
- Risk Culture
- Regulatory Stress Testing
- Liquidity Risk Management
- Funds Transfer Pricing
- Market Risk Management
- Interest Rate Risk in the Banking Book

---

**Ondřej Glatz**  
**Senior Manager**  

**Experience summary**  
Ondřej leads the risk modelling agenda of the Risk Management & Modelling team in PwC CEE. He has more than 10 years of experience in quantitative modelling from both PwC and a multinational bank. He delivered multiple IFRS 9 and IRB projects across the world taking part in both model development as well as modelling related client trainings. He is also responsible for development of PwC IFRS 9 calculation software.

**Contact**  
ondrej.x.glatz@pwc.com

**Areas of expertise**
- Loan Loss Provisioning
- Predictive Models
- Internal Ratings-Based approach
Experience summary

Jaroslav is a manager in the Risk Management & Modelling team and has worked in the Advisory department of PwC Czech Republic for 6 years. He specialises in bank credit risk management and has broad experience with the Asset Quality Review projects and IFRS 9 impairment models. Further, he also has strong project management skills as he was responsible for delivering complex international projects in eastern Europe and east and central Asia. Jaroslav also specialises in data analytical projects, data visualisation and automatisation of BI processes. He is skilled with Power BI, Tableau and other data visualisation software.

Areas of expertise

- Commercial Credit Lending Process
- Risk Data Aggregation and Reporting
- Asset Quality Review Preparation
- Asset Quality Review Audit

Contact

jaroslav.n.nedved@pwc.com

---

Experience summary

In PwC, David leads credit risk model validations and risk management for PwC Risk Management & Modelling team in Prague. He is skilled in credit risk model development, validation, audit and methodology design under various regulations including ECB Guidelines, Basel II and IFRS9. David also has experience in leading end to end development of complex model risk solutions. He is currently a product owner for the CEE PwC model inventory solution Model Risk Manager.

Areas of expertise

- Model Risk Management
- Loan Loss Provisioning

Contact

david.dolejsi@pwc.com
Experience summary

Silvia is a Senior Regulatory Expert in PwC Consulting in Czech Republic. Silvia is an experienced banking professional in Risk management, Banking regulations and Internal Audit domains. Silvia has more than 25 years of experience and knowledge in risk management and prudential regulations. Prior to joining PwC, she was leading the team of internal auditors (focusing on risk and regulation) in Ceska Sporitelna (Erste Group) and Komercni banka (Societe Generale Group) and leading Liquidity and Risk management, ALM, and Treasury departments in CSOB bank (KBC Group) in Czech Republic and Slovakia.

Areas of expertise

- Risk Appetite Framework
- Capital Management
- Regulatory Stress Testing
- Recovery Planning
- Liquidity Risk Management
- Resolution Planning
- Market Risk Management
- Interest Rate Risk in the Banking Book

Contact

silvia.majlingova@pwc.com

Experience summary

Peter has over 14 years of experience in risk management from management positions in a large banking group as well as a co-founder in a peer-to-peer lending start-up. His areas of expertise are credit risk management, capital management, recovery & resolution planning and incorporating climate and environmental risks into banks' standard risk management processes.

Areas of expertise

- Integration of Climate and Environmental Risks
- Green and Sustainability Issuance
- Synthetic Securitization
- Resolution Planning
- Capital Management

Contact

peter.tuchyna@pwc.com
**Experience summary**

Jan has more than 10 years of experience in Credit risk management and underwriting from a major European banking group. He was responsible for development of Basel II and III across the group, Credit risk regulatory compliance, CVA methodology and calculations as well as deployment of RAROC/EVA calculation. In underwriting, he was responsible for managing the largest clients in the EMEA territory (sovereigns, banks, NBFIs, SOEs).

**Areas of expertise**

- ESG Quantitative Modelling
- Capital Management
- Internal Stress Testing
- Regulatory Stress Testing
- Risk Based Pricing
- Economic Capital
- Integration of Climate and Environmental Risks

**Contact**

jan.muchna@pwc.com

---

**Experience summary**

Coming to the business with a quantitative background, Martin has been working for 15 years in the financial sector across the world - China, Philippines, US, Czechia and also consulting experience with Russia, India, Indonesia and Vietnam. Past 9 years he has been taking various senior management roles in Asian branches of Home Credit group, a leading consumer finance company. His main focus is retail&SME lending business. Mainly credit and fraud risk management and loan origination process.

**Areas of expertise**

- Digitalisation
- Underwriting Cost Optimisation
- Scoring and Big Data Integration
- Antifraud Process
- Retail Collections Optimisation
- Risk Based Pricing

**Contact**

martin.chvoj@pwc.com