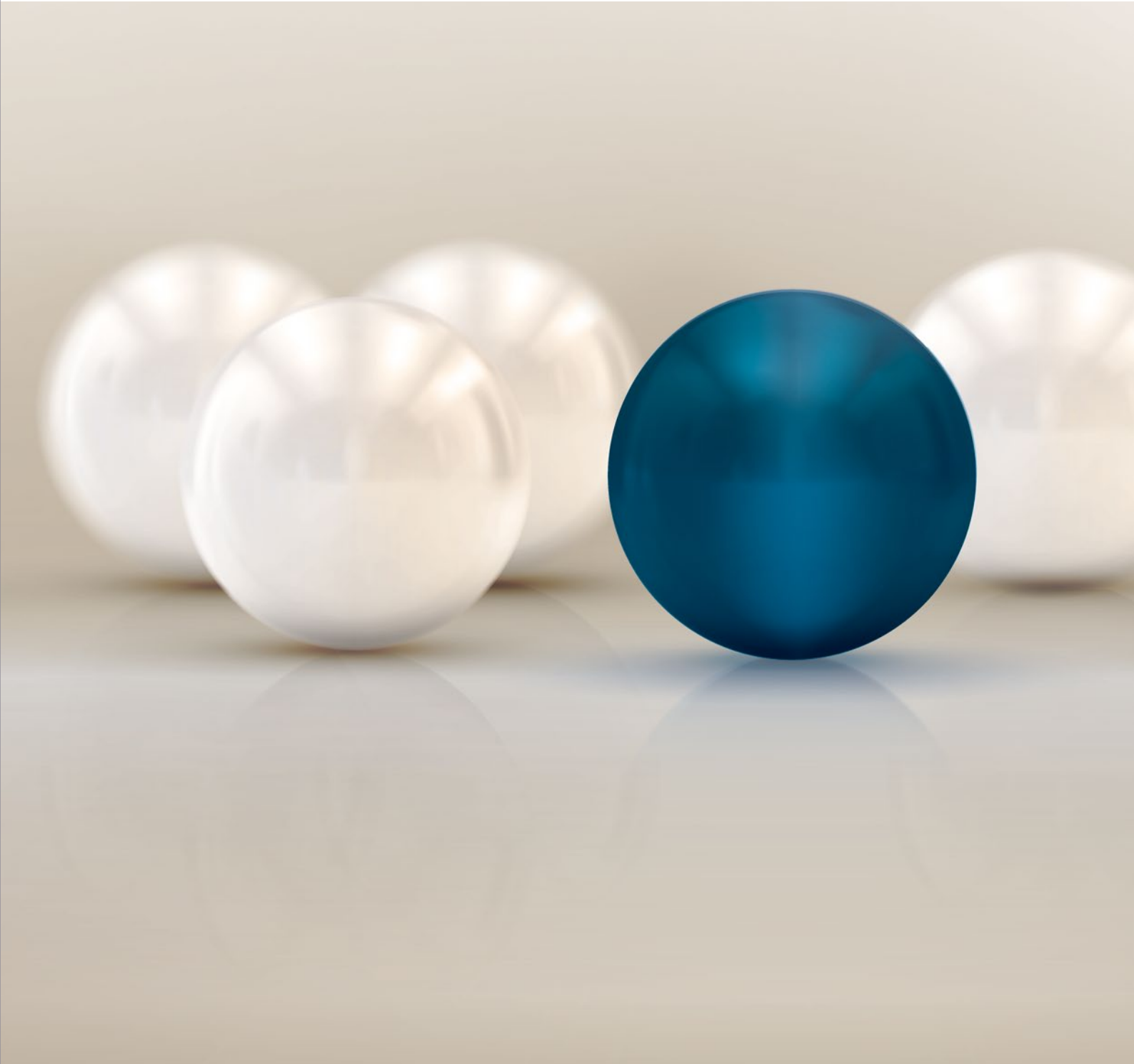


# CredaRate

EXPERTS FOR INTERNAL RATING SYSTEMS



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The name **CredaRate** is an acronym combining the concepts of **credit, data** and **rating**. Quality-controlled credit and default data forms the basis for our high-quality internal rating systems, which are recognised by the regulatory authorities.

We not only develop rating processes for our clients, and review and amend them on a regular basis, we also function as an application service provider (ASP), hosting IT operations on their behalf. Our teams of experts are available to provide detailed answers to all questions surrounding the introduction of rating systems and to offer support during day-to-day operations.

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EXPERTS FOR INTERNAL RATING SYSTEMS

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## Success factors for our clients

- ▶ *A proven rating platform with a broad application range*
- ▶ *High levels of regulatory acceptance*
- ▶ *Highly professional team of experts ensures long-term model accuracy*
- ▶ *Systematic focus on service*

## Aspects of a successful partnership

- ▶ *Easy integration in existing lending processes and control systems*
  - ▶ *Clear rules for the data pool partnership*
  - ▶ *Diverse range of users*
  - ▶ *Excellent connections within the rating community*
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*“Operating pool-based rating systems is about more than just mathematics and statistics. It is the interaction between the users and pool operators that is the key to success.”*

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*Dear Readers,*

In recent years, requirements for the deployment of rating systems have become much more stringent. One reason for this has been the advent of pan-European financial and capital market regulation, the goal of which is to regulate many details of internal (rating) models so as to make the results of such models more readily comparable across Europe. Another reason is that many companies outside the finance industry already use internal rating processes to manage their own counterparty default risks better.

In the face of growing international criticism, both the European Central Bank (ECB) and the European Banking Authority (EBA) have come to recognize internal (rating) models as a fundamentally suitable method of ensuring the solvency of the credit industry within the Single Supervisory Mechanism (SSM). This presupposes, however, that such models meet comprehensive requirements in terms of their design, validation, processes and governance.

Since CredaRate was founded, our primary aim has been to enforce the highest quality standards in the development, operation and validation of pool-based rating processes. In doing so, we adhere closely to the Capital Requirements Regulation (CRR) and the prerequisites formulated by the European Banking Authority (EBA) for the (permanent) certification of rating models for the IRBA (the Internal Ratings-Based Approach).

Not only those of our clients who are already IRBA-approved or plan to become so can benefit from this; all our clients stand to profit from our IRBA-compliant rating models – models they could hardly develop for themselves in a comparable quality and for a comparable price.

This brochure has a dual purpose:

- Firstly, we want to provide you with a comprehensive overview of our service portfolio and acquaint you with our high quality standards.

That entails describing not only of our process organisation and pool governance structure, but, in particular, the main model-, IT- and project-related issues that are of importance when you opt for CredaRate.

- Secondly, the brochure details, in a clear and concise form, the salient points of our application range and the design features of our pool-based rating models.

Nothing remains but for me to wish you some interesting insights into the opportunities that pool-based rating processes – and a partnership with us – can open up for you.

We look forward to talking to you soon.

*Christoph Müller-Masiá*



Christoph Müller-Masiá,  
CEO CredaRate Solutions GmbH

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*"The best way to predict  
your future is to create it."*

Peter F. Drucker  
Business visionary  
1909-2005

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*Dear Readers,*

The finance industry is in a phase of unparalleled change: the interplay of technological innovation and societal change in the shape of social media is accelerating the transformation of the strategic framework within which financial market players operate. This process is embedded in a system of financial market oversight that is both increasingly quantitative and relies more and more on the technological possibilities of data capture and analysis.

Even though this change process will open up an array of new opportunities for all market players, it will compel traditional providers of financial services to review their business models. Those providers who focus on the modularisation of supply and demand structures will be the ones to benefit most from this realignment: open architectures will not only enable clients to access a wide range of services via multiple delivery channels, but also allow providers to gear their services to a sensible make-or-buy decision.

The present publication offers readers not only a detailed overview of the services CredaRate provides in connection with internal rating processes, it also places such services within a broader regulatory context and the relevant overall market environment. In doing so, it clearly delineates the possibilities - and the limits - of pool-based rating systems as a risk management tool.

Although internal, pool-based rating models can play an important part in modularizing the financial-services process chain and significantly enhance the effectiveness and efficiency of risk management processes, this will lead to success in the long run only if the operators of pool-based rating systems are in a position to fully master the complexity involved in the operation and ongoing improvement of pool-based ratings.

CredaRate Solutions GmbH is excellently positioned to meet these requirements. Given the high levels of regulatory approval for its rating processes and the ease with which those processes can be integrated in lending and decision-making processes, it comes as no surprise then that the company has continually been able to expand its customer base across all segments of the banking industry.

I hope this brochure provides you with a clear picture of the full range of services offered by CredaRate.

Kind regards



Prof. Thomas A. Lange  
Chairman of the Advisory Board

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## OUR MODEL

We aspire to develop and operate rating systems for our clients that display the highest levels of precision and sustainability. We have geared our entire corporate governance structure, our organisation and our processes to this goal.

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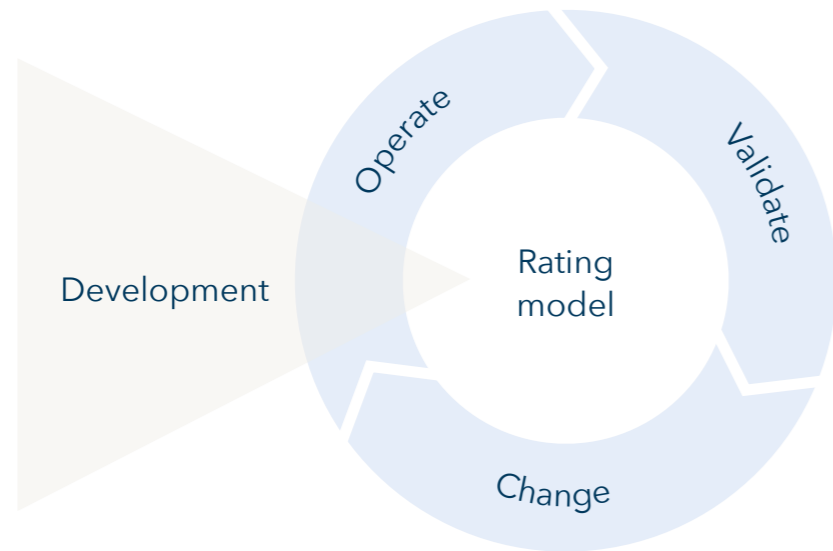
*“Communication and collaboration between the operator and the users of a pool-based model are pivotal to its proper deployment. In addition to the quality of CredaRate’s models, we consider this aspect to be decisive for the success of their products at our bank.”*

Roland Kleffmann  
Head of Strategic Methods and  
Processes for Bank Management  
Bremer Kreditbank AG

# The CredaRate process

We at CredaRate offer more than just excellent rating processes. We provide everything – the development and implementation of functions, operational support as well as the validation and evolution of CredaRate processes – from a single source.

OUR PROCESS MODEL: DOVETAILING OF DEVELOPMENT, VALIDATION AND OPERATION



DEVELOPMENT

Development of models: the optimum mix of credit expertise, database and model know-how

The hallmark of a successful internal rating model is not just that it is based on scientifically proven mathematical and statistical fundamentals. It is more a question of having the right mix of data, statistics and credit expertise at your disposal during development of the model. It is the interplay of these three factors that makes it possible in the first place to develop reliable estimates of the probability that borrowers will default.

That is why we place great emphasis not only on the collaboration between our highly qualified employees from various disciplines, but also on integrating the users of our rating models in the process of their development and review. That involves not only taking quality assurance measures as regards the data used, but also ensuring the models' viability in everyday banking practice.

OPERATE

Specialist and technical support for day-to-day operation

When clients deploy CredaRate as an ASP solution, we assume responsibility for managing the entire content and technology of the application. Service and comprehensive support are key factors for us. During day-to-day operations CredaRate users can contact our service desk staff, who will quickly address any questions they have on the technology or content of the system.

Via a clearly differentiated system of first-, second- and third-level support, our product and IT specialists, who have a wealth of know-how and experience, are available to provide the rapid support needed to solve users' problems. Beyond that, we provide professional assistance to first-time users of CredaRate as well as to users wanting to brush up their knowledge after major changes in the rating processes.

VALIDATE

Support for validation and proof of representativeness at both pool and institution level

When our clients use CredaRate, their rating results and data on defaults are anonymised and transferred to our data pools, thus creating a database large enough for performing statistical tests and analyses. Guidelines and standards that are binding for all users ensure the exceptionally high quality of the data pools underpinning our rating systems.

This high-quality database means that, when the annual validations prescribed by the regulatory authorities are conducted, the performance, stability and suitability of our rating models can be monitored. CredaRate supports these processes not only in the design and implementation phases, but also when it comes to documentation and reports.

CHANGE

Designing and implementing changes to models

The successful long-term deployment of internal rating processes requires that the models be adjusted from time to time to reflect altered parameters. That is why we have defined a fixed standard for the process of evolving and refining our models, and also anchored that standard in our entire process organisation. This involves, among other things, maintaining regular contact – in the form of joint

working groups – with the specialists at the financial institutions using our system.

In addition, our IRBA Competence Centre ensures that, in addition to technical issues, the numerous IRBA-specific regulatory aspects that need to be taken into account when changing rating models are given due consideration.

# The CredaRate organisation

We have geared our organisation to the long-term operation of pool-based rating systems of the highest quality.

In addition to specialist expertise, that requires, above all else, the ability to cooperate closely in interdisciplinary teams.

## EXPERTS FOR RISK, DATA SCIENCE AND IT

Our highly qualified staff have a comprehensive understanding of business administration, statistics and IT. Our modern and professional organizational structure allows us to achieve a high degree of knowledge networking, granting us the flexibility and the potential to evolve and develop.

That not only enables us to build and expand on the general foundations for the development and operation of rating models, but also creates a basis for anchoring our specific knowledge of the operation of pool-based rating processes within our organisation in a lasting and systematic manner.

Our experts work hand in hand when developing, programming and testing models, ensuring that we can provide our clients with ongoing support and review and adapt our rating processes in day-to-day operations.

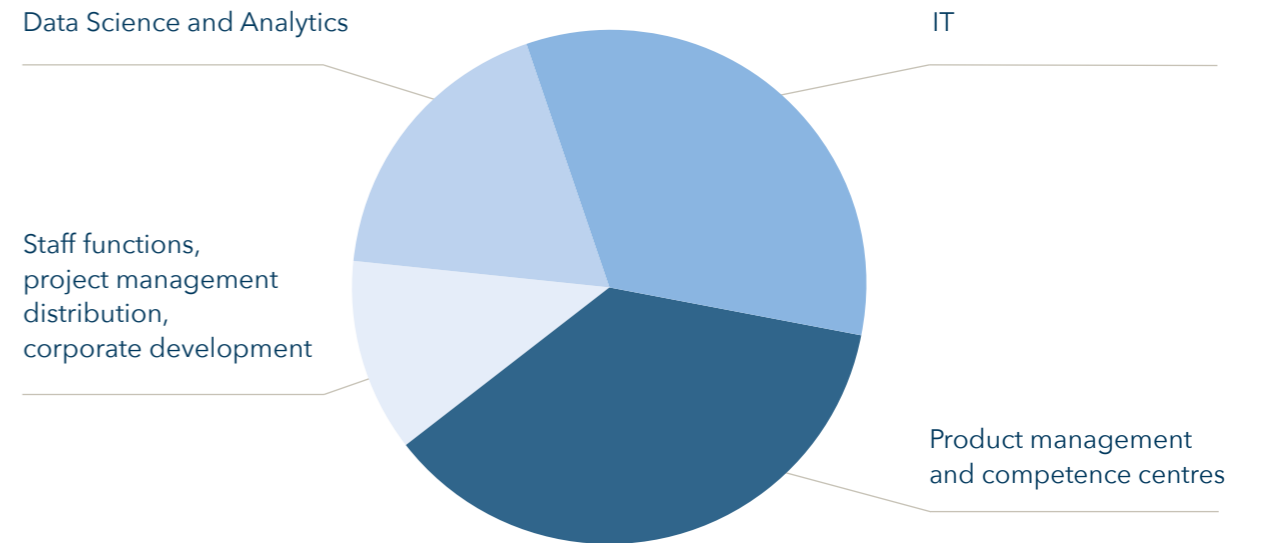
We have created competence centres within our organisation in order to concentrate our expertise in the following areas: Accounting, IRBA and Automated Risk Classification. That puts us in a position to provide our clients with optimum support when it comes to these cross-sectoral issues.

We place special emphasis on knowledge transfer so that our younger employees can develop their specialist and personal skills.



Our organisational structure enables us to assist our clients in audit situations as well.

## ALL CORE AREAS UNDER ONE ROOF



## INTERDISCIPLINARY, PROJECT-ORIENTED COLLABORATION

Our core processes are extremely multidimensional. That is due, for one thing, to the highly complex regulatory framework in which we operate. For another, it is down to the dynamic environment in which rating systems are deployed. What is more, the use of pool-based rating processes demands very close coordination between the pool operator and users of the rating processes.

the models) within a strict project organisation framework. That way we can ensure an optimum degree of interdisciplinary teamwork.

In order to do justice to this complex and dynamic environment, we perform the most important core processes (such as pool validations or adjustments to

Users and other external partners can be integrated into this project organisation as and when required. We have a long-established network of partners with expertise in risk management and IT development, which gives us the flexibility to steer and control our capacity, and ensure our clients high-quality service.



# Pool governance at CredaRate

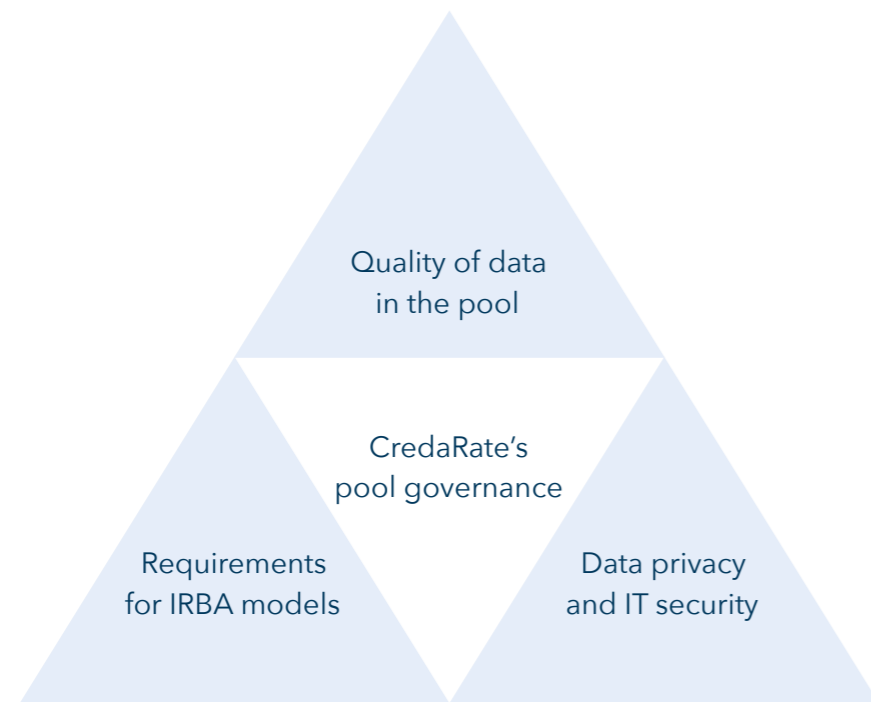
Operating a rating platform calls for particularly high levels of trustworthiness and integrity in the management of user data. CredaRate’s system of pool governance ensures an extraordinarily high level of compliance in this regard.

## COMPREHENSIVE QUALITY ASSURANCE AND COMPLIANCE

The following three aspects of the CredaRate process model are especially sensitive in terms of compliance:

- Ensuring the homogeneity of the data added to each pool
- Meeting regulatory requirements for the development and validation of rating models
- Guaranteeing data privacy and IT security

We take an end-to-end approach to make sure each of these aspects is given due consideration. In addition to our internal control system (ICS), the integration of CredaRate users has an important role to play in this. Our service-related internal processes are certified according to ISAE 3402 Type 1 and 2.



## ENSURING HOMOGENEITY OF DATA ACROSS THE POOL

Using data from various sources to develop rating models is a convincing solution to the problem of insufficient data only if the data in question displays at least a minimum level of homogeneity. In this context, homogeneity means two things:

Firstly, the key criteria of relevance to creditworthiness must be comparable among the borrowers being assessed when calculating the rating. Secondly, these creditworthiness criteria must be assessed by the different rating users in the same way during the rating process. In other words, only if different users at different financial institutions use each rating process in a virtually identical manner for comparable

borrowers, will that result in homogeneous, and thus meaningful, data pools for the development and validation of rating models.

To this end, CredaRate has formulated pool governance guidelines that are binding for all participating institutions, with the aim of ensuring that all users in the pool apply the CredaRate rating processes in as consistent a manner as possible. These governance guidelines contain a catalogue of measures comprising all key process steps from conclusion of the contract through to the support services provided to ensure the quality of the annual validation procedures.

## COMPLIANCE WITH REGULATORY REQUIREMENTS FOR RATING MODELS

Since a uniform European supervisory mechanism was put in place, the requirements for the development and validation of rating models have become markedly more detailed and complex. In addition to the requirements of the CRD and CRR, we have to take account of a whole array of guidelines and technical regulatory standards of the EBA.

In order to ensure compliance with these requirements, CredaRate has set up the IRBA Competence

Centre and made it an integral part of its organizational structure. It not only monitors our internal processes to ensure they comply with the IRBA requirements, but functions as an interface for the coordination of IRBA-related issues with the financial institutions using CredaRate. This is of particular relevance, for example, when we assist our clients with regulatory auditing activities (e.g. first-time IRBA approval or MaRisk audits) or when coordinating the financial institutions' model change reports to the regulatory authorities.

## GUARANTEEING DATA PRIVACY AND IT SECURITY

It goes without saying that the operation of data pools calls for extremely high standards of data privacy and data security. Specifically, we have to protect the data entrusted to us in such a way that its integrity, availability, confidentiality and reliability are guaranteed at all times.

We have taken every precaution to ensure this is the case. That includes not only enforcing stringent

data-privacy and IT-security guidelines, but also putting in place a comprehensive contingency plan - embedded in an IT strategy spanning several years. We place special emphasis on integrating our client institutions, CredaRate and our data centre operator in this contingency plan. When activities are outsourced, we ensure that our users are fully informed of all our control mechanisms.

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## OUR SERVICES

We not only provide rating models, but also deliver comprehensive support to our clients with their content and technical issues. Our state-of-the-art IT architecture and flexible interfaces mean that CredaRate applications can be easily integrated as ASP solutions in the client's individual system landscape.

*"We were impressed not only with the accuracy of CredaRate's models, but in particular with the company's highly qualified professionals and their close personal contact with our users in day-to-day operations."*

Thomas Grimmer  
Head of the Credit Risk Management Division  
Thüringer Aufbaubank AöR

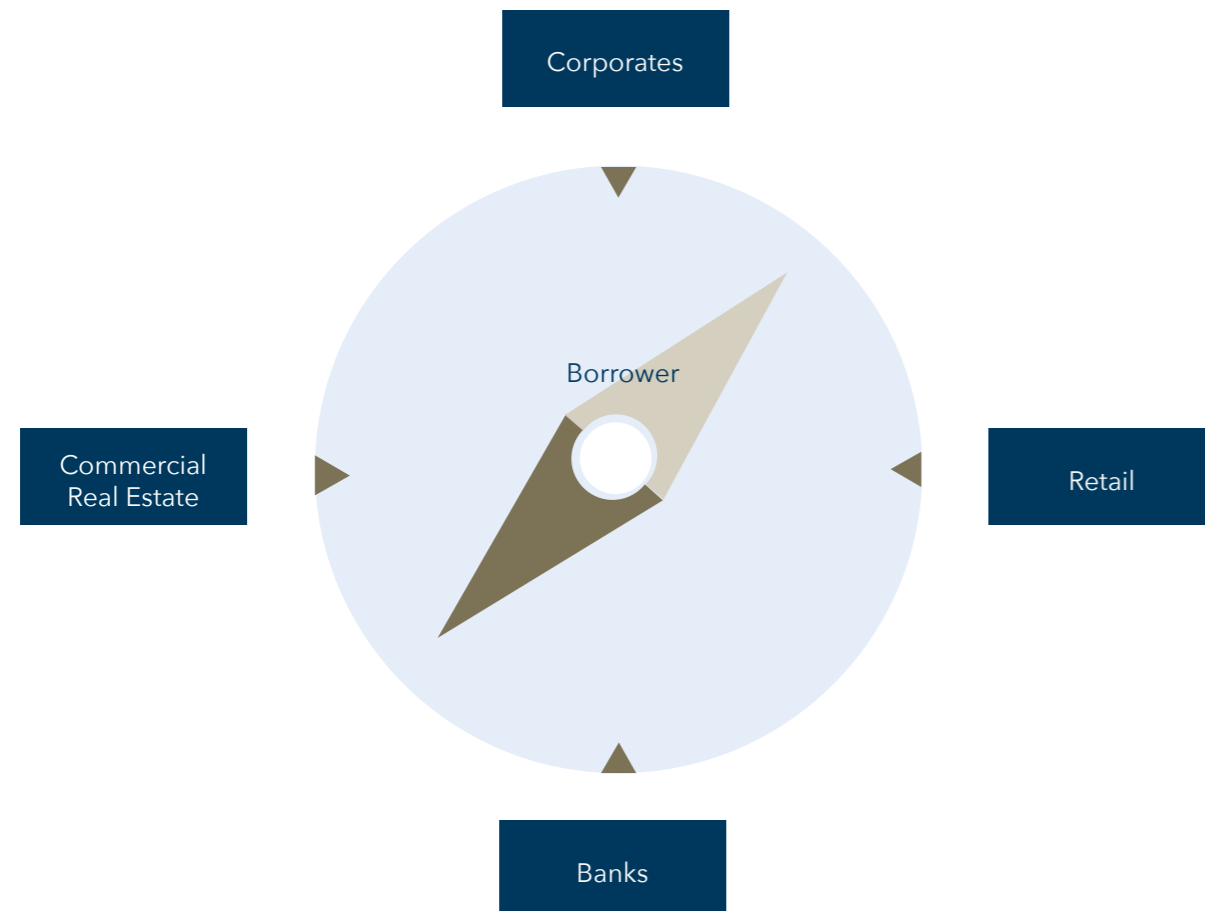
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# Rating processes

CredaRate's rating processes cover the key borrower groups. Over many years, they have proven their worth in daily use at leading financial institutions, which are using these within the scope of the IRBA.

## SELECTING THE RIGHT RATING/SCORING METHOD

Finding exactly the right rating or scoring method to apply to a group of customers calls for an intimate knowledge of the rating landscape. It is important to ascertain, for instance, whether the rating method for credit customers is to be carried out manually or whether an automated risk-classification procedure is to be deployed.



A STANDARDIZED WORKFLOW ENSURES A UNIFORM RATING PROCESS

The data needed to calculate ratings is captured in a user-friendly dialogue application.

The structure of the intuitive, process-based workflow is identical for all the rating processes offered.



KEY FACTS ABOUT THE RATING MODULES

	Commercial Real Estate	Corporates	Retail	Banks
Application area	Domestic and international companies and private investors in the field of commercial real estate financing: housing companies, builders and developers, conglomerates focusing on real estate, closed-end and open-end real estate funds, SPVs, private real estate investors (that are not retail customers), real-estate customers with property purchase financing.	Domestic and international manufacturing, commercial and service enterprises of all sizes, (non-)capital market oriented companies, groups and sole proprietorships, sole traders (provided their private income and financial status is of secondary importance for the credit rating).	Rating of loans to natural persons, e.g.: <ul style="list-style-type: none"> <li>• Overdraft credits / overdraft facilities</li> <li>• Credit cards</li> <li>• Instalment credits</li> <li>• Private home loan financing</li> <li>• Personal loans to natural persons</li> <li>• Fully collateralised loans (including Lombard loans)</li> </ul>	Domestic and international credit banks, clearing houses and savings banks, cooperative central banks and credit unions, mortgage banks, specialist credit institutions, building societies and central banks.
Segmentation	The following are distinguished in the Commercial Real Estate rating process: <ul style="list-style-type: none"> <li>• Investors publishing financial statements - as portfolio holders</li> <li>• Investors publishing financial statements - as builders/ developers</li> <li>• Private investors - as portfolio holders</li> </ul>	The Corporates rating process distinguishes between small business facilities (SBFs - with annual revenues ≤ EUR 5 million and total exposure ≤ EUR 1 million) and medium-sized and large companies (MLCs - with annual revenues > EUR 5 million and total exposure > EUR 1 million).  In addition, a special rating process is offered for start-ups (where no financial statements are available).	Three different procedures are distinguished: <ul style="list-style-type: none"> <li>• Simplified procedure</li> <li>• Standard procedure</li> <li>• Advanced procedure</li> </ul> In the case of the self-employed and freelancers, it is possible to include data on the company sphere (CF-based profit & loss account; HGB sole-trader accounts - total cost format). Separate procedures are offered for joint borrowers (natural persons).	A differentiation is made between Developed Countries (Zone-A states as defined by the KWG plus OECD states) and Emerging Markets, so as to take account of the varying levels of development in different countries.
Segment-specific risk factors	Segment-specific quantitative and qualitative risk factors for the company and property levels, differentiated by type of measure.	Quantitative and qualitative risk factors for the company level, differentiated by segment.	Quantitative and qualitative risk factors, number and weighting differ according to the procedure used. As an additional option, a Schufa score can be used as a risk criterion.	Quantitative and qualitative risk factors, divided into two segments.
Data pool	Around two-thirds of the data pool comprises domestic borrowers and properties while one-third comprises international borrowers and properties.  In view of the broad data history stretching back to 2006, the statistical power of the pool is very good.	The data pool mainly comprises German borrowers. The data pool dates back to the year 2006.	The data pool mainly comprises the ratings of German borrowers.  The history of the data pool dates back to the year 2005.	The data pool mainly comprises ratings from the Developed Countries segment. Over half of the ratings are for domestic counterparties, while the smaller share refers to counterparties domiciled abroad.  The pool contains statistical data stretching back to 2008.
Mathematical and statistical foundations of the model	Statistical default model (logistic regression model); expert-based development of model with increasing empirical review and adjustment over time.	Statistical default model (logistic regression model); direct modelling of individual probability of default based on various risk factors	Statistical default model (logistic regression model); direct modelling of individual probability of default based on various risk factors.	Shadow-rating approach: This approach is used as an alternative rating process for determining the PD of low-default portfolios. This method is used to reproduce the ratings of external rating agencies as precisely as possible on the basis of a bank's own internal assessment criteria.
IRBA approval	The regulatory authorities first approved this process for IRBA use in 2008; it is used today at many IRBA financial institutions.	The regulatory authorities approved this process for IRBA use in 2011.	The rating process is MaRisk- compliant.	The rating process is MaRisk- compliant.

## RATING MODULES FOR THE MANUAL RATING PROCESS

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CredaRate offers four rating modules for those application areas in which manual rating processes are an option: Corporates, Commercial Real Estate, Retail and Banks. You can choose the appropriate rating module

for the borrower in question by selecting key data in the workflow of the CredaRate application. In this way, you can ensure that the optimum rating process for each class of customer is set for the entire pool.

## USE OF AUTOMATED RISK CLASSIFICATION PROCESSES (SCORING)

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For those areas in which automated classification of risks is an option, we offer you the possibility of using individually parametrised scoring methods via the CredaRate platform. This may involve accessing available account information or integrating data from external rating agencies.

The results of these automatically generated scores are fully integrated elements of the client view in CredaRate. The advantage of this is that the credit analyst always has a single overview of the customer, e.g. in cases where an initial manual rating was carried out using the Retail module and subsequently only automated scoring methods were used due to a lack of information.

### DIGRESSION:

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#### PROSPECTS FOR THE USE OF AUTOMATED RISK CLASSIFICATION PROCESSES (SCORING)

The goal of rating all customers if possible is often one that financial institutions can achieve to a limited extent only. This is because they lack up-to-date information on credit customers in cases where no problems have arisen since disbursement and there has been no need to request updated credit rating documentation. In such cases it is neither possible, nor advisable, to have the analysts perform ad hoc assessments of individual borrowers.

In such cases, CredaRate offers a range of options for the automated classification of risks. On the basis of only a very small number of customer-related risk criteria - e.g. the existence of negative criteria, duration of customer relationship, account transaction data - scoring functions can be developed and implemented for the relevant borrowers and used to assign probabilities of default. In the course of regular validations, these functions are continually examined for accuracy and adapted where necessary.

A credit analyst does not need to intervene in such cases. In addition, scoring methods of this kind can serve as an early-warning system, enabling customers identified as being problematical to receive more intensive support or to be assessed using a manual rating process.

At the end of the day, the automated classification of risks enables clients to achieve an excellent trade-off between forecast accuracy and process costs. What is more, the use of credit risk models enable clients to gain greater insights into the credit risk in a certain cluster at portfolio level, for instance when economic fluctuations occur.

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**CROSS-MODULE APPLICATION CRITERIA**

The CredaRate rating processes are based on a score-card approach, in which quantitative and qualitative risk factors are taken into account and weighted. User-friendly guidance and numerous help texts, plausibility checks and intuitive documentation make for ease of use. The rating system is available in English and German and can be used with foreign currencies. External risk factors can also be integrated in the application if needed.

**Rating result and reporting**

All CredaRate rating processes result in an individual, one-year PD, which is always assigned to a rating class in accordance with the CredaRate master scale. If available, you can also use an institution-specific master scale.

The standard CredaRate reports comprise borrower- and client-specific evaluations. Borrower-specific reports are offered at the customer level via the web interface. They contain all the rating-relevant information required for both lending and auditing purposes. Once a rating has been completed, this information is stored in a rating file (in PDF and XML formats) and can be accessed at any time. The XML files, in particular, are suitable for internal automatic processing.

Another standard feature of CredaRate is client-specific reports for entire portfolios (e.g. portfolio reports, overview of rating classes, default analyses, overview of rating portfolio quality, list of customers with an overridden rating). These reports can be generated for particular cut-off dates, either as PDF or CSV files, and processed internally if required.

On request, reports can be tailored to meet a client's specific requirements.

**Authorisation system**

The application includes a comprehensive authorisation system. With the aid of an additional application, clients themselves can manage and assign their user-specific roles and rights, individually configuring each user's access to customer and/or rating data.

In CredaRate, a control step (a submission and approval mechanism based on the dual-/multiple-control principle) can be added to every process step. The customisable configuration ensures that the control steps in the application can be made to fit a financial institution's internal processes.

CredaRate also offers an override option, meaning it is possible to manually overwrite a rating result generated automatically. This option can be configured to suit each client's needs in terms of authority ("Who can override?") and bandwidth ("To what extent can they override?").

**Statistical model**

In order to determine probabilities of default, the individual rating processes contain models developed using logistic regression analyses. The borrower-specific probability of default is modelled directly on the individual characteristics of the risk factors identified as relevant.

To this end, a multi-stage process is deployed during development of the model to first select those risk factors that are both statistically significant and have a causal economic relationship with the default behaviour of borrowers. In the subsequent stages, these preselected risk factors are combined to create an overall model using multivariate analyses.

In line with regulatory requirements, CredaRate's models are calibrated to the long-term average of observable default rates. As we do not use any explicit macroeconomic indicators, our models respond to economic fluctuations only to the extent that the risk factors used are themselves sensitive to changes in the economy.

We carry out validations at pool level once a year in order to evaluate the continued accuracy of our models as regards selectivity, stability and calibration.

**LGD/EAD data capture tool**

In addition to rating processes, CredaRate offers a workflow-based process for capturing and evaluating data and information on the administration of loans and collateral. Uniformly captured and consistent, this CredaRate pool information may be utilised by financial institutions in line with their specific requirements and can form the basis for internal estimates of LGD-/EAD-relevant parameters.



Our rating processes stand out for the accuracy of their models, their practicality and their ease of use.

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## Rating services

The services we offer in connection with our pool-based rating processes relate, first and foremost, to user support. We also provide our clients with comprehensive assistance for their risk-controlling activities and advise them on all methodological and regulatory issues.

### LENDING-RELATED SUPPORT FOR USERS

#### User training

Before our users go live with CredaRate, we make sure they are properly trained to operate the system. These training sessions are especially tailored to those employees whose later role will be to disseminate information and coach others during normal operations. Additional training sessions are carried out at regular intervals, e.g. ahead of major product innovations or upgrades.

As a rule, training courses are conducted on the client's premises. The content of the training sessions can be discussed and agreed in advance with the client. It generally focuses on how to enter data in a correct and uniform manner, and takes the client's existing internal lending processes into account. Course participants can enter test or real-life cases in the system and discuss them with the trainers. Our

training is conducted by highly experienced staff members who otherwise work as product managers for the relevant rating modules.

#### Support during day-to-day operations

In everyday practice, even experienced users can encounter situations in which they are unsure of the correct use of the rating process. Examples include cases in which the borrower's corporate structure is complex or when questions of detail arise when completing the soft-fact questionnaire.

In cases like these, we are at hand to advise and assist our clients' users. Optimum user support not only makes for high levels of satisfaction and acceptance among users, but ensures the data entered in the pool is of the highest quality.



Personal support ensures a high degree of user acceptance.

### SUPPORT FOR RISK-CONTROLLING ACTIVITIES

#### Validations

We perform pool validations for the CredaRate rating processes once a year in accordance with the regulatory requirements of Art. 185 of the CRR. We have established a validation cycle that comprises the following five steps:

1. Portfolio comparison as a basis for the quality-assured calculation of default rates for each client and for the pool as a whole
2. Segment-specific data compilation
3. Statistical analyses
4. Presentation of results and recommended action points by a group of experts (before the end of June each year)
5. Compilation of comprehensive validation documentation (before the end of September each year)

At the end of this cycle, our clients have comprehensive documentation of all validation results for the pool, which they can use as a basis for institution-specific reviews of functional accuracy. On request, we can supplement this documentation with additional detailed analyses of possible deviations between the accuracy of the rating function at pool level and at institution level.

#### Proof of representativeness

In addition to regular validations, users also have to test regularly whether the rating processes deployed are at all suitable for the borrowers being rated.

As a pool operator, we can play a key role in helping our (potential) clients prove the suitability (or representativeness) of these processes. On the basis of our experience from multiple IRBA approval audits, we know that it is not just a matter of carrying out quantitative comparative analyses (such as the distribution

of risk factors and structural characteristics, selectivity analyses of risk factors, or analyses of the level of calibration). Qualitative analyses also have to be performed to demonstrate that the internal credit processes match the process requirements from the point of view of the pool rating process or that the risk factors used in the rating process are also of relevance for the financial institution's own decision-making process.

#### Correlations and migration matrices

On request, we can provide default-rate correlations calculated on the basis of the pool data for credit risk models (e.g. CreditRisk+). On the basis of a division into economic sectors agreed with the client, this data can be used, for example, to determine mean default rates per sector, sector variances and sector correlations.

In addition, migration matrices can be determined at pool level, which the client can use to calculate multi-year PDs (e.g. within the context of IFRS 9).

#### Support with stress tests

Today, conducting stress tests at institution level is an integral part of risk controlling. The EBA and ECB have developed fixed stress test standards for rating models which are already in widespread use.

Apart from stressing individual risk factors used in the CredaRate processes, we can, at the client's request, also play an active role in the execution of stress tests. On the basis of predefined stressed default-rate levels, we can also provide correspondingly recalibrated model variants for stress tests.

#### Assistance with audits

We are regularly asked by our clients to assist them with audits and approval procedures. This is not only an opportunity for us to add key value for our clients, but also to present and explain our models to different teams of auditors in a variety of audit situations.

# Technology

The IT architecture we use to operate our pool-based rating systems is highly sophisticated – and grants us the flexibility to integrate CredaRate in our clients’ diverse IT landscapes. We have in place the highest standards of security and availability to ensure trouble-free operations for our clients.

What is more, we have established a comprehensive system of service and support to ensure our users efficient and seamless operations on a day-to-day basis.

## IT ARCHITECTURE

CredaRate offers everything to do with rating systems. That means we can handle every step in the process for our clients – from the development of statistical functions and the creation and maintenance of business-side concepts and software through to operations. CredaRate functions as an application service provider, meaning that its rating processes are accessed by users over the internet.

Behind the CredaRate application’s single-sign-on interface lies a multi-layered, cutting-edge IT architecture. Our application runs on actively redundant web servers in line with the distributed-computing principle, enabling it to respond flexibly when new clients are added. Both the application servers and database servers, which are operated in a certified data centre, boast high availability.

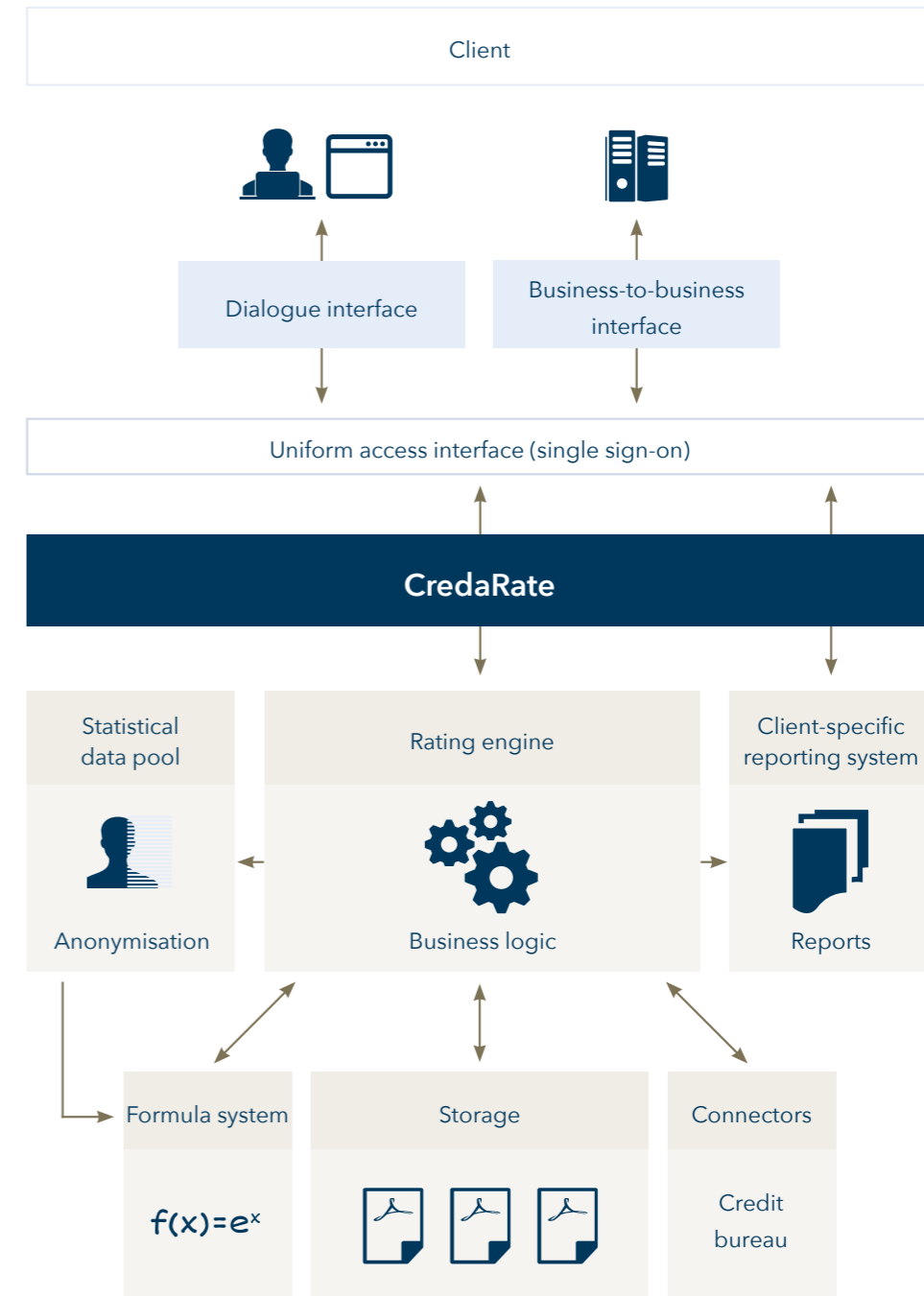
In very simple terms, the entire CredaRate architecture can be described as follows:

The central component of the system is the business logic, which is flanked, in particular, by the formula system and by client-specific reports. There are also a variety of internal and external connections, such as to

- the data pool for statistical evaluations (e.g. for validation of the rating processes),
- a storage system for saving the complete rating documentation,
- external data sources.

The modular design makes it easy to integrate input and output data in the rating process to suit each client’s specific needs.

## OUR IT ARCHITECTURE





IT ARCHITECTURE: KEY PERFORMANCE FEATURES

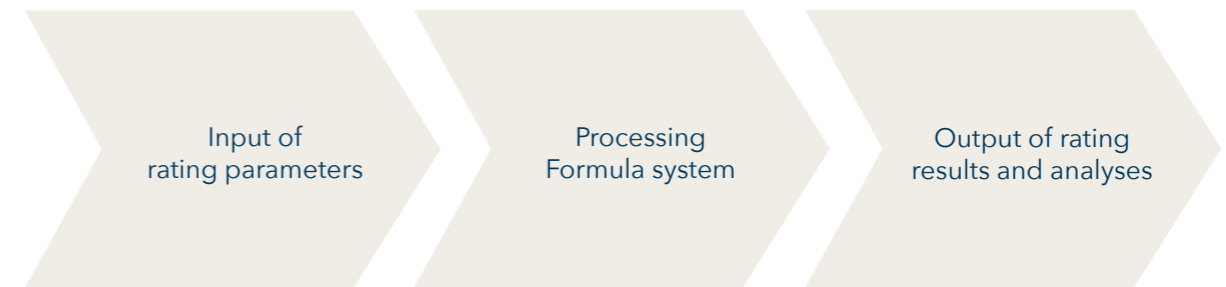
- ▶ ASP operations from an ISO 27001 certified data centre
- ▶ Manual access (single sign-on) via an encrypted internet connection
- ▶ Automated access via an encrypted B2B interface
- ▶ Central user management (BOS): client’s own administrator can assign roles and rights
- ▶ Comprehensive application features to ensure high quality of data (e.g. help texts and plausibility checks integrated in the workflow)
- ▶ Capture of balance-sheet and property data independently of the rating process
- ▶ Establishment of a client-specific master scale
- ▶ Comprehensive analytical options (e.g. export of customer and balance-sheet data, client- and borrower-specific reports)

INTEGRATION

The following questions need to be answered before CredaRate can be integrated in the client’s IT landscape:

1. How are users going to access CredaRate from the core banking system?
2. How can/must the data capture process be automated to avoid media discontinuities? Among other things, this concerns the capture of
  - customer master data,
  - financial-statement data,
  - default data,
  - other data (e.g. soft facts, external scores).
3. How can/must the output process for rating results be automated to avoid media disruptions? This can be accomplished, for example,
  - by restoring entry and result data,
  - by generating reports for automated processing.

CredaRate offers many options along the typical internal-rating process chain to design the entire data throughput cycle - from the user to CredaRate and back again - in a highly efficient manner and free of media disruptions.



- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>• Customer master data (manual or automated)</li> <li>• Rating master data</li> <li>• Financial-statement data (manual or automated)</li> <li>• Soft facts</li> </ul> | <ul style="list-style-type: none"> <li>• Computational logic for determining (one-year) PD</li> <li>• Separate formula systems permit flexible maintenance within the context of validations (adjustment of weightings, replacement of risk factors, etc.)</li> </ul> | <ul style="list-style-type: none"> <li>• Borrower-specific reports</li> <li>• Institution-specific reports, e.g.:                             <ul style="list-style-type: none"> <li>- Migration matrix (CSV and PDF)</li> <li>- Portfolio reports (CSV)</li> <li>- Data warehouse</li> <li>- Processing journal</li> </ul> </li> <li>• Client-specific analyses</li> </ul> |
|--|---|---|

Consequently, it is possible to customise the level of integration of CredaRate in the client-side infrastructure (in line with the client’s requirements). Different options are possible for the re-transfer

of rating data (input data, interim results and output information). These range from personalised reports and output files through to real-time data transfer via a B2B interface.



CredaRate’s modular structure allows fast and easy integration in the client’s IT landscape.

**CASE FROM EVERYDAY PRACTICE:**

Automated transfer of balance-sheet and income-statement data to CredaRate

**Task definition:**

Previously, a CredaRate user manually entered the financial-statement data required by the Corporate rating module using the system's dialogue application. In future, the data capture process is to be outsourced to an external service provider, with the result that the relevant information now has to be available in the form of a digital file.

With a view to integrating this data into CredaRate, the task at hand was to set up an automated process to import the data without media disruptions.

**Two-phase project:**

First, the individual financial-statement items entered by the service provider were mapped to the corresponding CredaRate data entry mask. Then the CredaRate Rating Factory was deployed online in order to implement data transfer. The Rating Factory is a generic online interface that can be used for the secure transfer (HTTPS) of data to CredaRate.

Comprehensive plausibility checks were integrated in the transfer process to ensure that the data can be transferred to the CredaRate balance-sheet data entry mask, if possible without any errors. If errors do arise during transfer, the sender (external service provider) is immediately alerted to the fact via corresponding online error logs, enabling the erroneous data to be corrected accordingly.

**Project outcome:**

After the test phase, the process quickly went into normal operation. The automated solution not only substantially reduces the time needed to perform ratings, it also makes it possible to focus much more strongly on the issues material to the rating process when analysing annual financial statements.

**IT SECURITY**

In order to protect the data collected during order processing, CredaRate has put in place exceptionally stringent security standards, similar to those proposed by the German Federal Office for Information Security (BSI). In addition to that, CredaRate complies with the data-privacy provisions applicable in Germany (Federal Data Protection Act and the Basic Regulation on Data Protection). We have entrusted very experienced employees and companies with the duties of data protection officer and IT auditing,

and they cooperate closely with the Auditing Association of German Banks (Prüfungsverband deutscher Banken e.V.), Cologne.

We thus comply fully with the applicable requirements for financial institutions set down in Section 25b of the German Banking Act (Kreditwesengesetz - KWG) and AT9 MaRisk concerning the outsourcing of activities and processes.

**OVERVIEW OF MEASURES TAKEN TO COMPLY WITH THE REQUIREMENTS OF SECTION 25b OF THE KWG**

- ▶ Primary and backup data centres certified to ISO 22237, ISO 22301 (BCM) and ISO 27001
- ▶ IT security guideline complying with the requirements of the Federal Office for Information Security
- ▶ Error- and change-management systems conforming to the standards of the Information Technology Infrastructure Library (ITIL)
- ▶ External IT audits
- ▶ Data privacy officer
- ▶ IT security officer
- ▶ Committee for internal risk management (AIRM)
- ▶ Established ISAE-3402 reports
- ▶ Contingency plan including regular business continuity management (BCM) tests
- ▶ Regular penetration tests
- ▶ Preparation of regular reports on compliance with service level agreements as well as outsourcing control reports

**SERVICE**

We consider high-performance IT infrastructure with the highest levels of security to be an essential prerequisite for the successful operation of a rating platform. But a lot more is needed for the day-to-day collaboration between the system's users and CredaRate.

It is the support provided during normal operations and project work that is decisive for client satisfaction and for the overall success of the business relationship. This is something we feel particularly committed to, which is why we offer tailored support services and fast, professional solutions to our clients' rating and technical problems.

That includes our transparent, systematic change and release process, which grants users ample time to prepare themselves for upcoming content or technology changes.

Service culture is given top priority at CredaRate. We are firmly convinced that only through responsible management of the data entrusted to us can we generate the high-quality information that is so essential for the development and operation of a highly accurate rating platform.

# Project expertise

The path from selection of a pool-based rating system to its productive deployment comprises a large number of process steps. Our project management skills can help ensure the long-term success of CredaRate after client-side installation.

## INTRODUCTION: FROM SELECTION TO PRODUCTIVE DEPLOYMENT IN THREE MONTHS

The introduction of a new rating system represents a radical intervention in a financial institution's lending processes because the results of the rating process impact key aspects of lending operations.

To ensure this succeeds in the long term, the procedure for selecting the new rating process must be clearly structured. That way, once the system is in productive operation, the users can be certain that the new rating process is actually suitable for the loan decisions that have to be made - in other words: it is representative.

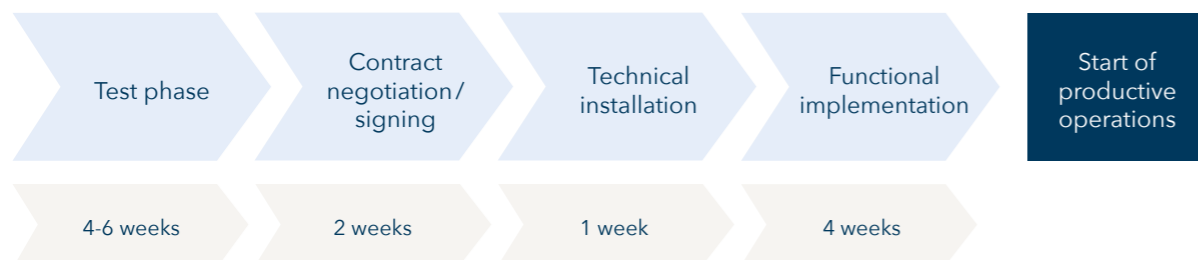
In our experience, it takes about three months from the start of the test phase until CredaRate can be used in productive operation. That time frame may be longer or shorter, particularly depending on how many rating processes have to be implemented. We are dedicated to providing our clients with end-

to-end support during this introductory phase and making the changeover to CredaRate as convenient and trouble-free as possible.

Our support services also continue after the CredaRate application has gone live. In addition to assisting users in all technical matters and all issues related to the program content, we can provide particular support for institution-specific validations and providing proof of representativeness.

We also provide professional assistance to financial institutions being audited by the regulatory authorities. That is especially true of banks planning to gain IRBA approval: in both the preparatory and auditing phases, we can help with all questions related to development and validation and to ensuring that all pool users apply the CredaRate functions in a uniform manner.

## TYPICAL INTRODUCTORY PROCESS



## STEPS IN A TYPICAL INTRODUCTORY PROCESS

- ▶ TEST PHASE
  - ▶ Set up a test client in order to perform test ratings
  - ▶ Determine test sample with the aim of achieving as representative a cross-section of the loan portfolio as possible
  - ▶ Train test team in use of CredaRate application
  - ▶ Carry out user tests with support from CredaRate
  - ▶ Conclude test phase and evaluate results
- ▶ CONTRACT NEGOTIATIONS
  - ▶ Negotiate commercial aspects of service relationship
  - ▶ Clarify IT-related questions in relation to order data processing, data privacy, IT security and interfaces
  - ▶ Vetting of legal aspects of contract
- ▶ TECHNICAL INSTALLATION
  - ▶ Set up new client in CredaRate
  - ▶ Configure CredaRate to suit institution's requirements (e.g. assignment of rights, establishment of dual-control rules)
  - ▶ Programme and test the interfaces
  - ▶ Perform integration tests for the entire rating process
- ▶ CREDIT-RELATED IMPLEMENTATION
  - ▶ Carry out training of users and administrators
  - ▶ Adjust internal credit guidelines to ensure conformity to the CredaRate manuals and user guidelines
  - ▶ Start productive rating

## SUMMARY OF SERVICES

	Standard	Additional service
<b>RATING PROCESSES</b>		
Manual initial and portfolio rating processes for the following segments: Commercial Real Estate, Corporates, Retail, and Banks (separate modules)	▲	
Automated risk classification processes for initial and portfolio ratings		△
Development of customised rating processes		△
Full disclosure of all models	▲	
Detailed theoretical underpinnings for every rating process	▲	
Customised calibration parameters	▲	
Use of customised master scales	▲	
<b>VALIDATION SERVICES / QUANTITATIVE ANALYSES</b>		
Annual comparative check of portfolio data	▲	
Oversight-compliant pool validation plans, including comprehensive documentation	▲	
Annual pool validations	▲	
Full documentation of pool validations	▲	
Support for institution-specific validations		△
Support for institution-specific proofs of representativeness		△
Determination of revenue and cost ratios for LGD calculations		△
Support for calculating borrower correlations		△
Generation of migration matrices and multi-year PDs for example BFA 7 and IFRS 9		△
<b>RATING-RELATED SUPPORT SERVICES</b>		
Professional support when calculating ratings	▲	
User training		△
Assistance with functional implementation	▲	
Consultation and support for IRBA approval processes		△
Support in the audit environment with issues related to the deployment of internal rating models		△
<b>IT PLATFORM</b>		
ASP operations 24/7	▲	
Single sign-on	▲	
Centralised user management via roles and rights	▲	
Storage system for rating files (PDF and XML) (data history)	▲	
Status queries	▲	
IP address check		△
Access to encrypted dedicated line		△
English-language version		△
Issue-tracking tool	▲	
Service desk	▲	
<b>DATA CAPTURE</b>		
Workflow-assisted data capture via a user-friendly interface	▲	
Assistance with data capture by means of comprehensive help texts and plausibility checks	▲	
Rating-independent capture of quantitative data	▲	
Separation of branches	▲	
Comprehensive user manuals and guidelines	▲	
Customised configuration of user rights	▲	
Customised configuration of control mechanisms (dual-/multiple-control principle)	▲	
Customised configuration of override bandwidths	▲	
Workflow-assisted entry of data on defaults	▲	
Data capture for specific types of collateral to calculate revenue and cost ratios	▲	

	Standard	Additional service
<b>INTEGRATION/INTERFACES</b>		
Web integration	▲	
Support with IT implementation	▲	
B2B interface		△
Integrated calculation of ratings		△
Schufa connection for Retail process	▲	
Synchronisation of customer data		△
Support for automatic upload of financial-statement data		△
Interfaces for the import of data from credit portfolio systems		△
Interfaces for the upload of rental-agreement data		△
Interfaces for the export of data to credit portfolio systems		△
Automated reporting of defaults		△
<b>BORROWER- AND RATING-RELATED REPORTS (DEPENDING ON MODULE)</b>		
Condensed presentation of rating results and relevant risk drivers	▲	
Rating result history	▲	
Analyses of financial statements (rating-dependent and rating-independent)	▲	
Analyses of strengths and weaknesses	▲	
Calculation of capacity to make interest and principal payments	▲	
Rating information in accordance with BDSG	▲	
Risk and strategy analyses	▲	
Comprehensive risk analyses for individual items of real estate	▲	
Presentation of planned cash flows	▲	
Presentation of transfer risks (for individual items of real estate or individual companies)	▲	
Processing journal	▲	
Customised reports		△
<b>CLIENT-RELATED REPORTING</b>		
Support for portfolio management	▲	
Generation of KPIs for early-warning system		△
Logging of rating activities	▲	
Overview of existing defaults along with reasons for default	▲	
Evaluation of defaults	▲	
Customers with overridden rating	▲	
Portfolio-specific comparison of rating classes	▲	
Processing status of current rating portfolio	▲	
Overview of rating classes	▲	
Customer-specific adaptations and extensions		△
<b>OUTSOURCING REPORTING</b>		
Monthly reports on service level agreements	▲	
Outsourcing control report	▲	
Data privacy report	▲	
Internal auditing report	▲	
Risk report	▲	
Report on ISAE 4302 Type 1 and 2	▲	

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## OUR CLIENTS

Our rating processes are a key factor in the success of our clients' business strategies.

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- 42 Aspects of a successful partnership

*“The CredaRate Commercial Real Estate module enables us to perform optimum analyses of complex real-estate loans – both for new and existing customers – and thus provide solutions that are tailored to each particular case.”*

Judith Peters  
Head of Organisation Division  
DONNER & REUSCHEL Aktiengesellschaft

# What our clients appreciate

Not just banks, but also other finance industry players, trust in our expertise. Our client base includes both domestic and international companies.

Our applications, which have been given regulatory approval, are in use at IRBA banks, some of which are directly supervised by the ECB, as well as at banks using the standardised approach to credit risk.

## WHAT OUR CLIENTS APPRECIATE

The use of pool-based rating processes offers clear benefits for all companies wanting to manage their credit risks professionally. Quite simply, pools of homogeneous data have greater statistical power than the data of individual users.

Our clients also appreciate CredaRate's high levels of expertise and our strong focus on finding the right solutions for them when it comes to rating processes. CredaRate can also be used to supplement other (e.g. proprietary) rating processes. That way, our clients can maintain an optimum mix of rating tools for their entire credit portfolio, without having to accept any compromises as regards the suitability of a rating process for the specific risk characteristics of certain credit risk clusters (e.g. having to use a corporate customer rating for commercial borrowers in the real estate sector instead of a rating process specifically tailored to real estate customers).

Our prime concern is to ensure that the rating results CredaRate delivers help our clients to assess the credit situation properly. Beyond that, CredaRate enables rating processes to be integrated into a company's operational workflows and IT systems efficiently and flexibly, with top priority being given to meeting all regulatory requirements and ensuring IT compliance.

While banks were the first to use CredaRate for risk management due to regulatory requirements, many other companies in the financial and energy sectors are now doing the same. Our solutions are therefore used by the following users:

- Banks
- insurance companies
- investment houses
- auditors

Our customer relationships are very trusting, long-term and have existed for more than 10 years.

## OUR CLIENTS INCLUDE



## Success factors for our clients

- ▶ *A proven rating platform with a broad application range*
  - ▶ Statistical data pool of excellent quality to ensure representativeness for individual users
  - ▶ A high degree of transparency across all rating models because the central documentation (e.g. development and validation documents) is disclosed to all CredaRate users
- ▶ *High levels of regulatory acceptance*
  - ▶ Successful (IRBA-) rating models that have been thoroughly assessed and are highly regarded by banking regulators and auditors alike
  - ▶ Comprehensive pool governance to ensure compliance with the strict requirements of rating-process outsourcing
- ▶ *Highly professional team of experts ensures long-term model accuracy*
  - ▶ A team of professionals with many years of experience, both in providing support and in evolving pool-based rating processes
  - ▶ Outstanding interaction of experts in lending operations, data science and IT to ensure operation of the rating platform
- ▶ *Systematic focus on service*
  - ▶ End-to-end support throughout the entire rating calculation process
  - ▶ Additional services available, especially for validations and proofs of representativeness
  - ▶ Support with regulatory audits (e.g. with IRBA approvals)

## Aspects of a successful partnership

- ▶ *Easy integration in existing lending processes and control systems*
  - ▶ Easy integration in client-side IT landscape and process structure thanks to state-of-the-art ASP applications
  - ▶ High standards of IT security and data privacy
- ▶ *Clear rules for the data pool partnership*
  - ▶ Clear process rules when adapting the model
  - ▶ Establishment of an independent group of experts for annual pool validations
  - ▶ Detailed guidelines ensure uniformity of data capture and rating calculation
  - ▶ Regular training sessions for all users
- ▶ *Diverse range of users*
  - ▶ Clients include private, public and cooperative financial institutions
  - ▶ CredaRate is used by both locally supervised and ECB-regulated financial institutions
  - ▶ Other companies from the finance industry
- ▶ *Excellent connections within the rating community*
  - ▶ A hub between banks, regulators and industry associations
  - ▶ Organiser of regular events on rating-related issues

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## OUR COMPANY

With our focus on pool-based rating systems, we are already the leader in regulator-approved internal rating models – something that not only our clients, but also our employees appreciate.

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*“The combination of credit expertise and data management, embedded in a complex regulatory framework: that’s what makes my work at CredaRate fascinating and diversified.”*

Franziska Laknar  
Product Management  
CredaRate Solutions GmbH



OUR STAFF: EXPERTS FOR INTERNAL RATING SYSTEMS

On the back of our successful business performance, we have continually added to our workforce in the years since the Company was founded. The majority of our 50 employees have an academic background in economics or information technology.

In a close dialogue with our clients, we see ourselves as a channel and catalyst for the ongoing review and refinement of our rating systems - a task that is both appealing and challenging. This includes, in particular, the interaction between product management, data science, IT development and test management.

With our attractive location, our versatile working-time models and future-oriented office organisation, we are superbly placed to tackle the challenges of the modern working world. It is something our employees and our clients appreciate: for one thing, it makes us an attractive employer; for another, it puts us in a position to provide our clients with fast, professional and flexible service that owes much to our high degree of knowledge networking.



OUR SHAREHOLDERS

CredaRate Solutions GmbH is based in Cologne, Germany, and was established in 2008 under the direction of the Association of German Banks (Bundesverbandes deutscher Banken e.V.) Our shareholders comprise well-known German banks.

Our shareholders are:

- Aareal Bank AG, Wiesbaden
- Hauck Aufhäuser Lampe Privatbank AG
- Deutsche Apotheker- und Ärztebank eG, Düsseldorf
- M.M. Warburg & CO (AG & Co.) KGaA, Hamburg
- NATIONAL-BANK Aktiengesellschaft, Essen

OUR LOCATION

Our office is located at: Gladbacher Straße14, 50672 Köln



## LIST OF ABBREVIATIONS

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AIRM	Committee for internal risk management
ASP	Application service provider
BCM	Business continuity management
BDSG	Bundesdatenschutzgesetz (German Federal Data Protection Act)
BFA	Banking Expert Committee
BOS	User organization system
BSI	Bundesamt für Sicherheit in der Informationstechnik (German Federal Office for Information Security)
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
CUM	Central user management
EAD	Exposure at default
EBA	European Banking Authority
ECB	European Central Bank
IFRS	International Financial Reporting Standards
ICS	Internal control system
IRBA	Internal ratings based approach
ISAE	International Standard on Assurance Engagements
ITIL	Information technology infrastructure library
KWG	Kreditwesengesetz (German Banking Act)
LGD	Loss given default
MaRisk	Minimum requirements for risk management
MLC	Medium-sized or large company
PD	Probability of default
SA	Standardised approach to credit risk
SBF	Small business facility
SPV	Special-purpose vehicle
SSM	Single supervisory mechanism

## YOUR CONTACT

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