

A low-angle, upward-looking photograph of a modern building's glass and steel facade, set against a clear blue sky. The perspective creates a sense of height and architectural scale.

MODERNIZING CREDIT PROCESSES

**Cutting-edge solutions for
improved financing**

In an increasingly competitive credit market, companies need to save costs and lower time-to-cash while preserving risk metrics. Reply is working on innovative end-to-end solutions to support the design of streamlined onboarding and credit origination processes.



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1 MARKET INSIGHTS

1.1 SMEs are the backbone of EU economy

Before starting with any consideration on the SME market, it is important to give a clear definition of “Small and Medium Enterprises”. According to the European commission standards (EU Recommendation 2003/361), SME companies are companies with less than 250 employees and with an annual turnover or balance sheet not exceeding €50M or €43M respectively.

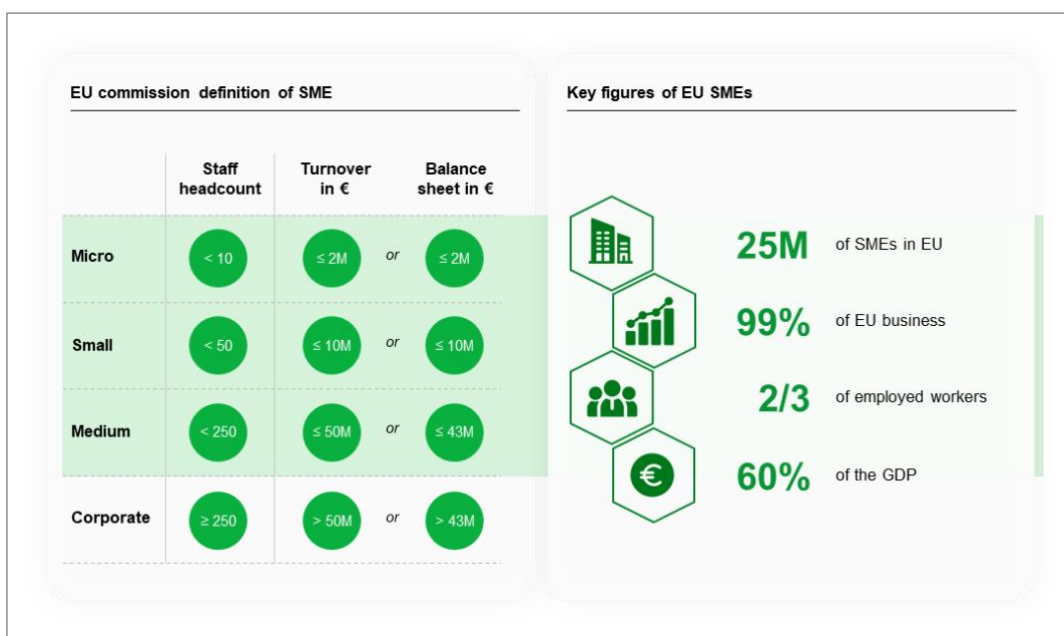


Figure 1: Definition of SME and key figures for European market. Source: EU commission.

Under this definition fall about 25 millions of SMEs across the European region, representing the 99% of the business, 2/3 of the employed workers and about 60% of the Gross domestic product (source European Commission).

1.2 Financing gap for SMEs is partially due to outdated lending processes

Given the uncontested economic impact, it is not difficult to understand why SME segment is extremely important and why financial institutions should be concerned in well addressing one of their essential needs: financing.

On the one hand, financing is essential for companies: it may be used for inventory and working capital, fixed investment, hiring and training employees, developing and launching of new products, refinancing and for many other operations to sustain growth and competitiveness.

On the other hand, financing is equally important for financial institutions: out of total revenues from SME clients, up to 70% may come from lending; moreover, SME clients with ongoing financing have more exchanges with the bank, which



pave the way for cross-selling opportunities: on average these customers have twice as many other products (2 to 4) as customers without loans (1 to 2).

Despite the importance of financing for both parties, there is still a gap between the demand and supply of credit.

According to SAFE report, in 2021, 29% of the SME, which indicated that Bank loans were relevant for them, did not applied for fear of rejection (5%) or for other reasons (24%). Of the 21% of SMEs that applied for a Bank loan, only 71% were granted in full, 10% received less money then asked and 8% were rejected (7%) or declined (1%).

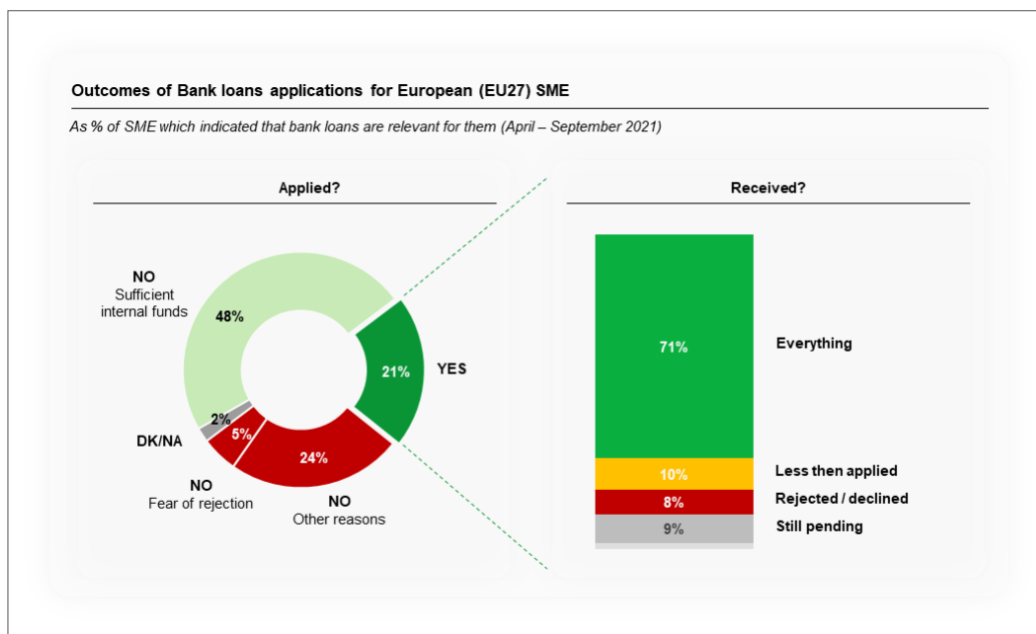


Figure 2: Gap between demand and supply of credit. Source: SAFE report 2021

The credit gap was evident also considering other types of external financing (credit line, overdraft, trade credit or other forms). Moreover, in 2021 access to finance was reported as the most pressing problem by 7% of SMEs.

There are different reasons for which SMEs financial needs may be left unaddressed. Most relevant are high costs, lender strict requirements and outdated lending processes.

- **High costs:** numbers of SMEs complain about too high interest rates, which have further deteriorated in last years for a consistent number of companies. According to a EU commission and EU Central Bank Survey (SAFE report), in 2021 8% of SMEs agreed that interest rate or commission are too high and 20% of SMEs were faced with a deterioration in the rates by banks.
- **Lenders strict requirements**, for example in terms of collateral required (lack of owned asset due to the modest size of SME or assets already collateral for other banks) or covenants (adoption of financial covenants / mortgage of buildings / wares pledge that allow banks to influence business decision) which may represent important barriers for certain SMEs.
- **Outdated lending process**, which many financial institutions have still in place, characterized by:



- (I) “Obsolete” credit rating system, not always suitable at effectively assess SMEs capabilities to repay;
- (II) time consuming low-value administrative tasks, which can consume 2 to 8 hours (for application) of relationship managers time reducing space for more relational / commercial activities;
- (III) “Heavy bureaucracy” which may require clients to provide (often) paper-based document recording financial and economic situation;
- (IV) Lack of skilled bankers able to guide the SME client towards the most suitable solution to pursue their objectives.

All these inefficiencies lead to high cost-to-serve and extended time-to-yes / time-to-cash period, up to 30 days.

1.3 New lending propositions for SMEs

Unreached by traditional credit offering, many SMEs have started to look at alternative solutions, asking for better and more flexible conditions, faster response time, less stringent requirements for collateral and simple and fully digitalized processes.

Heeding the call, a relevant number of new entrants have stepped up in the lending market in the last years, taking advantage of the gap left by traditional lenders, not always capable to address SMEs needs. These new digital players have leveraged on cutting-edge technologies, innovative and light operating/distribution models and less regulated environment to develop compelling lending propositions tailored on SME segment.

	E-commerce lenders	P2P lenders	Other new direct lenders
Model	<ul style="list-style-type: none"> Offer short term lending products leveraging their privileged position as operators of e-commerce platforms 	<ul style="list-style-type: none"> Match borrowers (SMEs) with lenders (individuals, institutions, ...) via online platforms, making profits from fees and commissions 	<ul style="list-style-type: none"> Assume balance sheet risk making profits from the spread between the rates they take on their funds and the loan rates they offer to SMEs
Strengths	<ul style="list-style-type: none"> Possibility of: <ul style="list-style-type: none"> gathering and elaborate valuable transaction data to judge credit worthiness collecting credit repayments directly from sale revenues using stock as collateral 	<ul style="list-style-type: none"> Innovative risk scoring models New data sources Streamlined fully digital processes Lower-cost operating / distribution models Lower compliance costs compared to highly regulated bank intermediation Better ability to match risk appetite of borrower and investors (P2P lenders) 	
Players* / Products	<ul style="list-style-type: none"> Mainly short-term / working capital lending products 	<ul style="list-style-type: none"> Different products (according to the player) ranging from factoring, invoice discounting, supply chain / trade finance to short/med./long term loans 	<ul style="list-style-type: none"> Different products (according to the player) ranging from factoring, invoice discounting, supply chain / trade finance to short/med./long term loans

Figure 3: Examples of new entrants in the lending market and relative business models



Considering for instance “standard” loans, new players have done a great job at streamline onboarding and credit origination processes achieving a dramatic reduction of the time-to-yes and time-to-cash (also for relevant amounts) from weeks/month to only few days or even hours for most “daring” players.

Examples of relevant players with main focus on ST/MT/LT loans operating in European market

Company	Type	Year	Country	Market	TTY*	TTC*	Cur	Amount**	Duration**
Funding Circle	P2P	2010			5 h	24 h	£ (UK)	10k - 500k	2y - 6y
iwoca	Direct	2011			24 h	2 d	£ (UK)	1k - 750k	1d - 5y
OPYN	P2P	2012			24 h	3d -1w	€	50k - 2M	3m - 5y
LENDICO	Direct ¹	2013			2 d	1 w	€	10k - 750k	1y - 5y
october	P2P	2014			2 d ²	1 w	€	30k - 5M	3m - 7y
Spotcap	Direct	2014			24 h	2-3 d	£ (UK)	50k - 350k	1m - 24m
OakNorth Bank	Direct	2015			Few days / weeks		£ (UK)	250k - 10M	n.a.
Capcito	Direct	2015			24 h	2 d	Kr	10k - 15M	6m - 48m
new10	Direct	2016			15 min	2 d	€	5k - 500k	3m - 5y
floryn	P2P	2016			24 h	2 d	€	10k - 3M	3m - 5y
CREDIMI	Hybrid	2017			3 d	1/2 w	€	15k - 2M	5y or 8y
Mansa.	Direct	2019			24 h	2 d	€	1k - 20k	3m - 12m
BANCA AIDEXA	Direct	2020			20 min	2 d	€	10k - 300k	12m - 24m

* Approximate declared time for time to yes and time to cash ** Considering different loan products¹ In partnership with ING
² Proposal in few minutes for state backed loans with amount up to € 250k

Figure 4: Examples of relevant players with focus on loan processes operating in European market

An interesting article on fintech new models’ performance was recently published by the Bank for International Settlements (G. Cornelli, J. Frost, L. Gambacorta, J. Jagtiani – “*The impact of fintech lending on credit access for U.S. small businesses*”, September 2022). Comparing data from two fintech operating in the US market (Funding Circle and LendingClub), authors have shown that: “*fintech platforms’ internal credit scores were able to predict future loan performance more accurately than the traditional approach to credit scoring, particularly in areas with high unemployment*”, arguing that: “*Overall, fintech lenders have a potential to create a more inclusive financial system, allowing small businesses that were less likely to receive credit through traditional lenders to access credit and to do so at lower cost.*”

1.4 Financial institutions should enhance their credit processes to keep up with the lending revolution

To keep up with the ongoing lending revolution, financial institutions should consider to revise and enhance their credit processes (improve customer experience, reduce approval time, adopt advanced risk models and new data sources, etc.).

As the implementation strategy is concerned, they may leverage advanced technologies to develop custom components (make) or integrate plug&play solutions (buy) which have become very popular over the past few years.

Both these aspects will be deepen further in the next chapters.

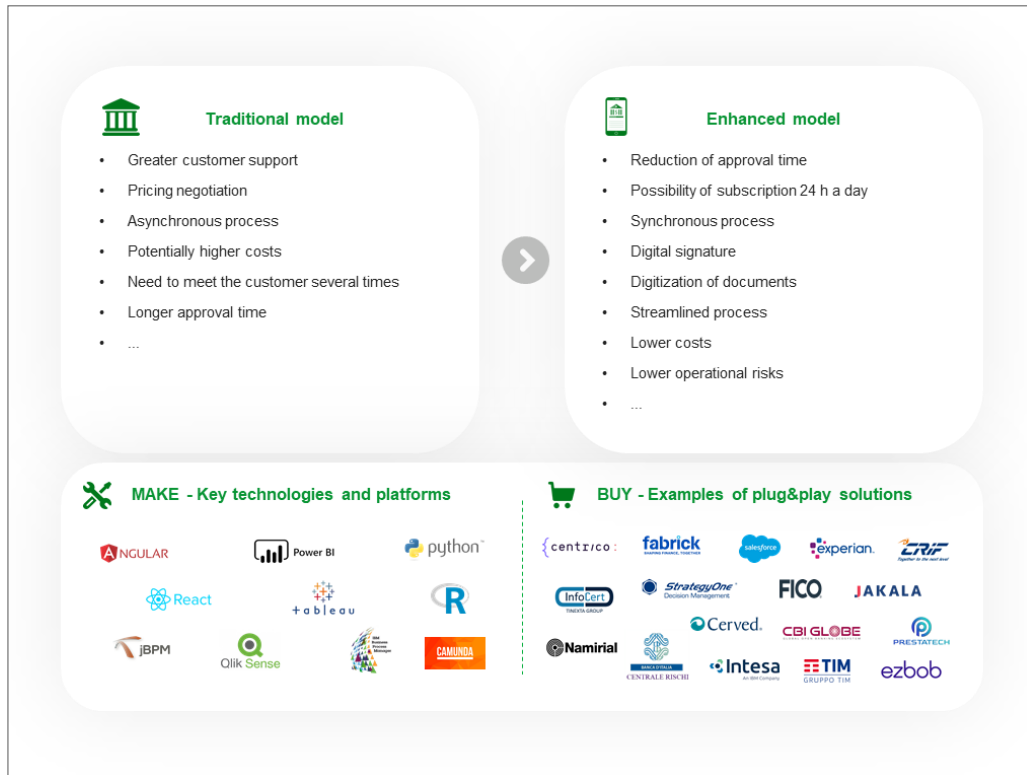


Figure 5: Example of relevant technologies and players offering plug & play solutions for lending processes



2 REPLY'S APPROACH FOR INNOVATIVE END-TO-END SOLUTIONS

As seen in the previous chapter, the current market for credit is imposing new credit processes to keep up with the increasing competition, with the aim of cost saving (both in terms of time and resources), lowering the *time-to-cash* while preserving the risk metrics defined by the lender to be coherent with his risk appetite.

Reply's approach aims at structuring innovative end-to-end solutions to support the design of streamlined onboarding and credit origination processes. Our expertise covers all the building blocks involved in these processes: from data management to the design of applications, calculation systems and decision engines, both from functional and technological point of view.

2.1 From data to information

Data is the fundamental starting point from which credit processes start. Once collected, it is elaborated through modelling techniques to extrapolate useful information to feed credit models and to orchestrate credit processes and it is finally stored - either in cloud or in physical databases - for both regulatory purposes and for future data analysis. Data management is therefore an extremely important activity as the quality of data is determinant for the quality of information, which is, as we have seen, the basis of the credit evaluation processes.

The first challenge regarding data, is to understand which data is necessary, which is useful and which is redundant. In fact, too much data will only slow the process while not providing additional useful information. Once the necessary data has been identified, the process of selecting the right data provider starts. Data may be gathered directly from user input or from other internal / external sources (e.g. infoproviders and/or Credit Bureau). In SME lending processes, it is important to collect both data regarding company and data regarding its key individuals.

Considering company data, they may be for example categorized as *Company General Information* (name, legal form, foundation year, registered office address, PEC, n. of employees, type, tenure, sector, list of beneficial owners and other key individuals, etc.), *Financials and Performance* (revenues and expenses, balance sheet data, loans repayment history, presence of extraordinary wages guarantee fund, etc.) and *Negative Events* (e.g. already rejected, black list, protest and prejudicial events, etc.).

Considering key individuals data, they may be for example grouped in *Personal Data* (e.g. Name, Surname, Age, date/ place of birth, fiscal code, etc.), *Roles/Powers* (e.g. owner of the company, director, board member, legal representative, beneficial owner, etc.) and *Negative Events* (e.g. black list, protest and prejudicial events, etc.).

Once data sources have been identified, the next step is to define the data model, which is basically define how data are related. This activity is crucial as well, as a correct approach to data modelling will allow easier and more precise model implementation. In particular, the challenge is to define the correct relationship among the data without losing the concrete meaning of the data that we are modelling (considering for example that each data may be categorized in different entities, and every entity could have a 1:1, 1:n or m:n relationship to other entities)



2.2 Calculation Systems for KPIs

Internal calculation systems may be used by lenders to gather competitive advantage in estimating clients' risk. Using sophisticated data analytics techniques, advanced statistical analysis and machine learning algorithms (for example to estimate PD and a LGD based on clients' characteristics) may bring huge positive impacts in terms of risk estimation. The objective is to develop modular risk assessment models that allow to evaluate a broader range of clients while containing the need to request additional information to the user.

Calculation systems may be based on advanced statistical data analysis and/or machine learning, depending on top management objectives. The final output of these models will be the key variables that lenders use to determine the result of the loan proposal, for example: rating, fraud index, income model, pricing and ESG score.

- **Rating** is a measure of the clients' credit risk, determined by its Probability of Default and Loss Given Default, given the estimation of the Exposure at Default. Rating is necessary both from regulatory and accounting point of view and is the main driver of the credit proposals result.
- **Fraud index** is an index used to estimate the probability that the client is a fraudster. The calculation is based on specific characteristics of the clients, determined by advanced statistical analysis and machine learning techniques. The use of fraud index will reduce Underwriting Department workload, while keeping frauds risk under control.
- **Income model** is useful to estimate clients' reliability based on financial transactions (using internal data if possible or collecting them via PSD2 for example) and socio-demographic data. Having a good income estimation model allows lenders to estimate clients' affordability requesting less data to clients, thus also limiting the risk of false declarations.
- **Pricing** will depend on client risk; the more precise is risk estimation, the more precise is product pricing which will bring to a correct optimization of the risk reward of credit products.
- **ESG score** has recently increased its importance in the estimation and pricing of credit products given the higher awareness of climate change and the need to act to slow the process of climate deterioration. ESG score depends on clients' characteristics and may be estimated using advanced statistical techniques. This score will play a central role in the pricing of credit products in the near future.

2.3 Decision Engines for tailor made processes

Once all the scores and KPIs have been estimated, the following step is to determine upon which conditions a proposal should be declined or accepted. Credit decision engines (CDE) are used for this purpose. The *Origination Team* will define all the *expert-based* rules and strategies (e.g. credit risk policies) that will determine the final outcome of a loan request/proposal; all these rules are implemented in the CDEs, which therefore have a central role in credit processes. In particular, CDEs define the complete process that a loan request/proposal must follow to be compliant with both lender's policies and the law, allowing different outcomes based on clients' characteristics.



In designing lending processes, it is important to cover all the following aspects:

1. Policy Assessment

Analysis of the credit rules in the bank's "Loan policy", in order to define and model the data needs and their sources.

2. Policy Optimization

Implementation of the rules in order to simulate the expected impacts in terms of acceptance rate and credit risk.

These simulations will be carried out both before (to assess future impacts of the new policies) and after, in order to refine the rules currently in place.

3. Policy Implementation

Implementation and testing of the defined policies

4. Policy Strategy

Design of complex decision trees and credit strategies that allow strong "personalization" of the process based on customer characteristics (every loan proposal will follow a different process with different specific events, such as counter-offers, cross-selling, proof of income etc.)

5. Monitoring

All files processed in the decision engine will be historicized, to allow the lender to monitor, through appropriate KPIs, the main credit risk metrics (e.g. PD for acceptance rate, main reasons for rejection) and business metrics (Time to Yes, number of declines, number of automatic resolutions...)

Credit policies are rules typically defined as *if-then* statements based on the value of particular scores, for example the ones discussed in the previous chapter (rating, fraud index, income model, pricing, ESG score). These policies can determine either the manual approval or the decline of the proposal.

Credit strategies are instead more complex conditions. For example, if the client receives a decline for affordability (i.e. given his salary and monthly commitments, he/she does not satisfy the minimum affordability requirements defined by the Origination Team), he/she could receive a counter offer in down-selling, which is basically a new affordable proposal with a lower requested amount. In this case, it is up to the client to decide to accept the new proposal (receiving a lower amount) or to decline it.

Here after some examples of possible strategies directly driven by the CDE:

- **Counteroffer in Down-selling:** the client is not affordable with the current requested amount so the lender offers smaller amount in line with client's affordability;
- **Counteroffer in Upselling:** the requested amount is far less than the affordable one, so the lender propose – but not impose - higher amount;
- **Proof of Income:** if the client declares an income that is not consistent with the one estimated by lender's models or not enough information is available, he/she will be required to upload further documentation - e.g payslip;
- **Fraud Check:** based on a Scorecard, if the client is likely to be a fraudster, a manual check will be required;
- **Authorization levels:** request of different levels of authorization based on the requested amount.



Even considering these simple examples, it is not difficult to understand how important credit decision engines are in the credit evaluation and origination processes.

CDEs can operate online or in a batch mode. Operating in batch mode (possible for example for existing customers) allows to make periodic estimation of the risk which may lead to lower time-to-yes. A typical example is the so called *pre-evaluation process*. The pre-evaluation consists in a batch monthly activity which assigns a pre-approved ticket (for based on amount or instalment) to existing customers.

2.4 Automatic controls

Thanks to the technological progress of last years (especially in the field of document / images detection and data extraction), it is possible to increase the level of automation of the credit processes, simplifying UX and minimizing risk and effort for lenders while keeping operating costs low. Automatic controls are often based on deep learning algorithms used for image recognition, both for documents and for face recognition.

If the credit origination process requires personal documents check or a proof of income, the user has to upload this required documentation. The system runs a DL algorithm to “read” documents and to verify the correctness of the information provided. Moreover, the algorithm will check that the image reported on the document is consistent with user’s face (for example matching this image with the user’s video selfie).

Clearly, automatic controls allow faster processes, as they are performed real time and no human intervention is required (or it is required only in certain cases) and allows to keep operational risks low. Another positive impact of automatic controls is the reduction of the workload of the Underwriting Department personnel, with an optimization of resources in terms of activities and costs.



3 TECHNOLOGY

In order to quickly satisfy new business requirements, Digital Lending Platforms need to be more and more flexible and agile. These needs, in addition to the trend that sees an increasing part of the final users moving to mobile devices, bring the ecosystem architecture to evolve in something more scalable, modular and decoupled. Picture below represent a high-level architecture containing an example of the main modules required.

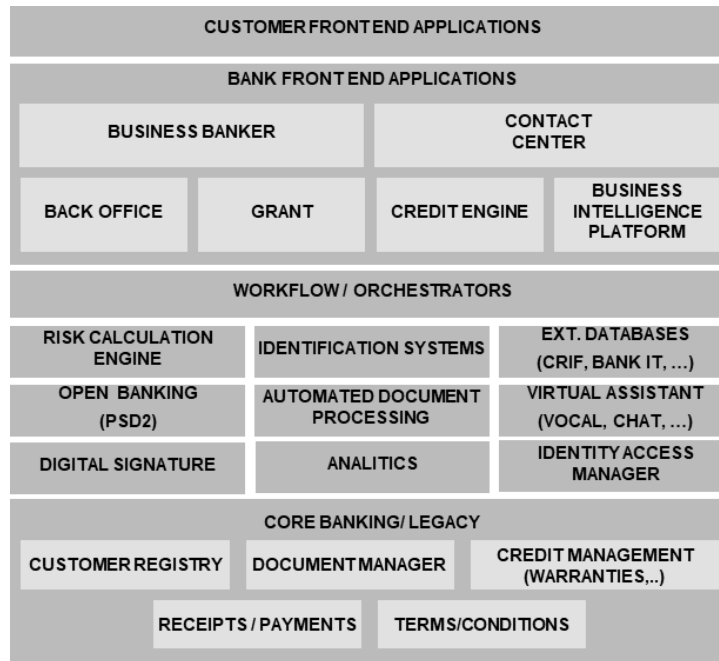


Figure 6: Representation of high-level architecture

In particular, in this picture are represented all the main components (physical and logical) required to address the functionalities of a Digital Lending Platform: in the next chapters some of these components will be described in details with their roles and capabilities.

3.1 Customer and bank front-end application

For the front-end applications used by customers, we can distinguish between the web application via desktop browser and the mobile application. Following the principle of mobile first, the main crossroads is between native application and hybrid.

Native development means to design the mobile apps specific to a single platform, like iOS and Android. These apps are built with programming languages that are specific to a particular platform.




Hybrid development involves creating apps that works on multiple platforms. This is achievable in multiple ways creating websites packaged into a native wrapper or implementing the solution in a programming language that at compile time is translated to native components.



The use of native technologies allows the use of the proprietary frameworks of Apple and Google and their programming languages: Swift / Objective-C for iOS and Java/Kotlin for Android. Using native technologies, the user experience and usability are adaptable at their best for the application requirements. The quality of the application is coherent to the standards of the smartphone producer. The security standards are high, but technical expertise is required for both frameworks. Moreover, development costs are higher than hybrid solution.

Regarding hybrid technologies, we can mention *React Native*, a framework to develop cross-platform applications created by Facebook on its own React Javascript library, and *Flutter*, a modern framework created by Google for cross-plaform applications. With these solutions, the UI is rendered with native components increasing the UX compared to hybrid technologies. We need to remember that for hybrid technologies the testing is onerous, and the the size of the application is bigger than native apps and some native expertise is still required (es. Push notifications). They are respectively maintained from Facebook / Google and in case of updates from Apple or Google, the maintenance teams publish the adjustments lately.

Regarding cross-platform solutions (Mobile/Web) we can mention Cordova, a development framework open-source that allows to create mobile applications using Web technologies (JS – HTML – CSS). The framework is based on web views visualized in native containers. The source code is the same on all the platforms; many plugins are available to access the native HW. Even if it is useful to create prototypes, the UX is below the standards of the native solutions. Slow performances due to the single-thread capabilities of Javascript that limits the background elaborations. In addition, as every web applications, at least the client is vulnerable to inspections.

	 NATIVE	 CROSS - PLATFORM	 HYBRID
UI UX	EXCELLENT	GOOD	NORMAL
MANTENAINCE	GOOD	GOOD	NORMAL
SECURITY	EXCELLENT	EXCELLENT - NORMAL	NORMAL
ECONOMIC EFFICIENCY	NORMAL	GOOD	EXCELLENT
TIME TO MARKET	EXCELLENT	GOOD	GOOD
USABILITY ON COMPLEX PROJECTS	EXCELLENT	NORMAL	LOW

The apps are implemented in Kotlin / Java for Android and Swift for iOS	The apps share the same source code. When the app is built, the native components are rendered.	The hybrid apps use a native web view to show the web functionalities (JS, HTML, CSS)
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Figure 7: Comparison between “Native”, “Cross-platform” and “Hybrid” solutions

Native or Hybrid are technological choices with high impacts on the development lifecycle.

To take the optimal choice, different aspects need to be considered:

- Application state: live, to be created, dismissing
- Application architecture: modern / scalable or to be reimplemented
- Budget



- AS IS Team Expertises
- Actual Requirements on UI, Security and forecast evolutions
- Time To Market necessities

According to our experience, as the applications used by the bank's employees are concerned, there are two main solutions commonly used: custom web applications used via web browser or product front-end application solutions such as Salesforce or Pega. The comparison between a custom solution and a product would require a specific study to better analyze the context (e.g. specific needs and products on the market).

3.2 Workflow Manager and Process Orchestrator

In order to realize more flexible and decoupled solution for Digital Lending platform we need to introduce two different types of orchestrators. The first one to manage all the aspects related to the UX and which defines the Steps flow, the second one to manage the process (for instance an on-boarding process) from a business point of view.

Both these components are useful to better support business requests and the natural evolution of the lending processes, minimizing the impacts to manage new products and maximizing the decoupling between the FE (both mobile and web) and all the other systems involved.

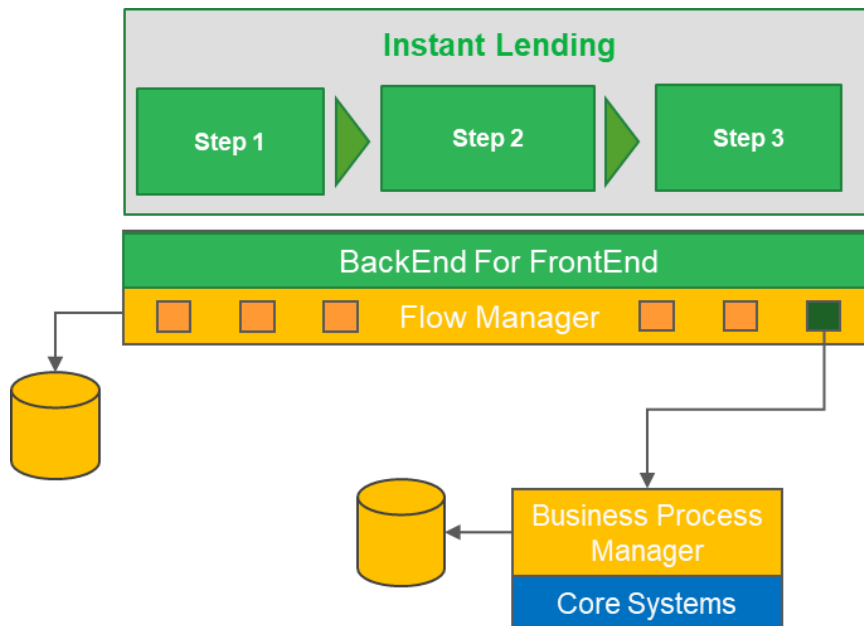


Figure 8: Interactions between WorkFlow Manager, BPM and other components

In the picture are represented the interactions between WorkFlow Manager, Business Process Manager (BPM) and the other components of the solutions. In particular:

- The WorkFlow manager manages the entire page flow of the specific channel synchronously ensuring consistency between the progress of the flow (UX) according to the master process (defined in the BPM)
- The BPM manages the progress of the multi-channel processes and plays the role of process state master (allowing the Workflow Manager to perform consistency checks on the navigation of channel pages)



In this solution, business data are totally managed from the BPM and stored in a dedicated Datasource; using the “*claim and check*” pattern, based on a unique key approach, allows to all different channels to reach process information and, when necessary to integrate Core Service.

One of the central aspects on which this solution is based, is the modeling of the business process on BPM which allows to:

- Manage easily the integration with the core systems in order to get all the required additional information
- Manage the on-boarding process
- Store the state of the process and its evolution to eventually support also ex-post activities such as reporting and monitoring

In order to satisfy omni-channel requirement, all the interactions with the BPM should be managed using a shared, channel independent operational data model.

The Workflow manager instead:

- Orchestrates the page flow for the specific channel
- Collects and validates the information from the end-user
- Interacts with the BPM to store information

As the channel flow proceeds, the data is gradually enriched. At each step of the state machine, this data is stored on a support DB through a core service of the Digital Lending process that centralizes the consistency checks on the data. This approach allows:

- the resume of the flow on the channel, starting from the last state crossed by the state machine
- the recovery of the cross-channel data (N.B.: the page flow of the different channels must be drawn in a coherent manner)

When the page flow reaches a consistency point for the process, the BPM will be engaged and the related process task is marked as completed.

3.3 Core banking

Regarding core banking, banks can opt for a “cloud-based” or “on-premise” solution.

Reply's experience shows that the current trend is to have a hybrid solution according to which a part of services considered safe (i.e. not core) is brought to the cloud to exploit its potential.

On the one hand, this approach implies some risks for the bank as functions such as disaster recovery and data storage will be managed from the cloud. On the other hand, it allows software scalability and almost immediate availability of resources and technologies.

The strategy will depend on the size of the bank and the complexity of the operations and IT systems currently in place.

For large banks, which perform complex operations and require flexibility in system architecture to meet a wide range of requirements the following alternative approaches are recommended:

- develop your own custom systems entirely in-house. This requires resources and technical skills, as well as an increase in costs but ensures that requirements can be achieved without compromise.
- purchase several software packages that fulfill specific needs, thus investing a lot in integration into as-is systems.



Mid-tier banks have lower IT budgets and require medium levels of customization.

The following strategies are recommended:

- Solutions based on customizable packages.
- Development of custom systems only for small vertical areas.

Small banks require lower levels of customization and can opt for white label core banking products in order to keep costs and time down.

Reply's experience in this area leads us to state that a typical core banking has the following technical characteristics:

- Cloud-based: They use a private or public cloud.
- RESTful API: Engineers access core functionality of platforms via core API.
- Event-driven: As an alternative to the API rest, the current Core architectures provide the asynchronous communication model (Apache Kafka) in order to increase fault tolerance and performance.
- Stateless Microservices Application Layer
- Scales linearly and horizontally without having to size for peak loads
- Optimizes for performance attributes including low latency, throughput or price

REPLY

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