

Requirements

Dexis bank wishes to reorganize its granting loans operations in order to make these more efficient and fair. The bank's top management hopes, after this reorganization, to see a minimum 5% increase of the demand for loans in the coming year. It also hopes to attract new clients and consolidate its image.

The client of a Dexis bank's branch (i.e. a local agency) has to submit its loan application to the customer service of that branch. The application must indicate the amount he wishes to borrow, the duration of the loan, as well as general data like his name, address and monthly income. He expects the service offered by Dexis to be professional and qualitative.

The customer service of the branch creates a file based on the different data and transfers it to the head office's credit department; it centralizes the credit files. The client wishes this transfer to happen as confidentially as possible. A same file can contain several loans if all the loans of the file concern the same client.

The credit department takes a decision on acceptance or refusal of the loans. It examines each file in detail, evaluates the information and takes a decision based on the monthly income and the reason of the loan. The credit department takes its decision according to standards issued by the legal department of the bank. In case of problems, the employee of the credit department can seek the advice from the legal department in order to be able to correctly give reasons for his decision. The credit department may also ask the investment department of the bank for information about the client's assets if the legal department does not object to this transfer of information.

In the case of a more detailed examination of the file, the credit department issues a request for data to the information department. Those data refer on the one hand to the way the client has eventually refunded previous loans and, on the other hand, to the client's identity, monthly income, etc. Unlike the credit department, the information department is free to choose a way for the realization of its objectives although it must respect the privacy act.

The credit department expects the requested data to be accurate and objective. It also verifies that the file is transmitted in its entirety.

Until these data are available, the credit department establishes a first funding plan encompassing the applied rate, the amount and the duration of the loan. Upon receipt of the answer of the information department, it can either refuse the demand, or formulate one or several proposals for the client. The proposals are attached as an appendix to the demand that is sent back to the branch. Upon receipt of the file, the management of the branch examines the proposals with the client. The following can then happen:

- the client accepts one of the proposals;
- the client does not accept any of them;
- the client accepts one proposal but wishes to have it modified (modification of the duration, lower loan amount, ...). In this last case, the management of the branch establishes, with the client, a new proposal that takes the discussed changes into account.

A loan proposal accepted by the client still has to be approved by the management of the bank. The latter treats the loan files at the end of the week or when there are at least 20 files waiting. The approval or refusal of the management leads to a note (acceptance or refusal) indicating the current date, the file number and the ground for refusal. Then, the approved files get back to the branch where they lead to the establishment of a loan contract.

In case of a refusal, the client may immediately contact the legal department of Dexis for further information or to launch an internal investigation if he feels himself aggrieved.

If the decision still does not suit the client, he can also turn to the ombudsman attached to the management of Dexis.

We know the name, address and monthly income of a client as well as the loans that he eventually obtained at the Dexis bank or another financial institution in the past. For each of these loans, we also know the way it has been refunded (regular, tardive or bad). We also know the loan applications that a client has eventually already addressed to the Dexis bank and, if these have been accepted, the different proposals to which they have lead.

A loan application contains the following data: amount and duration asked, introduction date of the demand, the reason for the loan and desired reimbursement rate.

If the client or the notary is not opposed to it, the administrative data of the notary that will make the official credit note are also useful for the establishment of the file. The client could also reference people that could act as a security in case of non-payment. The management of the branch, backed up by the information department, evaluates this data for the credit department in charge of accepting or refusing the loan.

For a financial institution, we know the name, the type (bank, private institution or public institution) and the different loans contracted by the clients of the Dexis bank with this third party institution.

For each loan, we know the number, amount borrowed, duration, client, the organism with which the loan has been contracted (if it is not the Dexis bank), the type of payment term (monthly, quarterly or yearly), the repayment start and end dates, the interest rate and the amount to be repaid (amount loaned + interests).

For legal reasons, the reimbursement must be subject to a reimbursement file that is separated from the loan file. It contains all the information related to the type of repayment and indexes the payment problems, the late payment interest, the reminder letters, ...

In the database, we need to differentiate the people that are employees of Dexis and those that are not. A distinction is also done between the type of clients (individual, independent, ...).

A loan proposal is characterized by its date, the duration, and the amount of the proposed loan as well as the interest rate.

We daily record the bank rate (also called discount rate which is the rate of interest that member banks charge each other for loans between banks). The interest rate for a defined loan is fixed by the Dexis bank in function of the reason, the amount and the duration of the loan, but also in function of the bank rate. The value of the different data related to a loan that is confirmed and recorded as such are necessarily identical to the data corresponding to the proposal that lead to it (if it ex

- **Use-case Diagram**

To build the model, all actors are initially selected based on provided information about the internal operations of the bank. Hereby, an idea about the scale of the system emerged. Subsequently, the use cases were identified by analyzing the context provided, leading to a better understanding of the situation. Following this analysis, the possibility of merging some activities was explored. This led to the merger of approval or refusal of a file into handling of the file. The same applies for creating or transferring a file.

Lastly, relationships were created. Starting with the generalization relationship between the UML actor 'client' and 'human', and 'employee' and 'human'. It is important in helping to understand the model, highlighting shared characteristics between employees and clients. Furthermore, association relationships were created between use cases and the actor that executes it. This indicates the collaboration, communication and dependencies between them. Working according to a plan helps maintaining the overview when creating a model for an organization in a complex situation. The final model was refined and organized to enhance readability.

It is assumed that each actor logs into a system, which centralizes every use case and connects all of the entities. The chosen actors in the diagram represent the different departments within Dexis Bank. Every department has a function to fulfil in the application process, made up of multiple activities. The inclusion of the actor client is crucial, because this party initiates the entire process. Without a client there is no loan application. The use of association links enables the software system to operate efficiently. This aligns with the objective set by the management. However, extension relationships indicate that a certain use case can be reused. In other words, a use case with an extension relationship is more specific than a use case linked via association.

There are two hypotheses made in crafting the model. Firstly, competitors were left out of the model to safeguard competitive advantages. Hereby, the organization's strategic and tactical flexibility is preserved. Secondly, all departments are made up of people, employed by the bank via contracts. Essentially highlighting the exclusion of robots, reflected by the generalization relationship. Please refer to figure 1 in appendix for a visual representation of the model.

- **Activity Diagram**

The activity diagram was formulated to represent the sequential flow of actions, activities and behaviors by related actors in the application of a loan at Dexis Bank. The initiator of the flow is the client seeking a loan. The purpose of the diagram is to give specific details of the workflow process. Swimlanes were used to distinguish the main actors and group their workflow activities in a column.

Firstly, the related actors were identified and a mapping of their actions within the workflow was documented. These included the client, Dexis' branches, Dexis' headquarters (including their respective departments active in the workflow process), along with external parties and institutions holding relevant data to the active loan application of the client. Connections and interrelations between the actors were then identified and processed, assessing the objects essential for key flows. Similarly, decisions were identified and their respective control flows to other actors and processes were established. A visual representation of the activity diagram can be found in figure 2 of the appendix.

Within the activity diagram, both control and object flows were utilized. Control flows showed the shift of action responsibilities related to the process between actors, while object flows represented the paths where important data objects for the loan processing were referenced or transferred between the actors. The usage of object nodes was nonetheless limited.

Additionally, decision nodes were used at points where actors had to make choices resulting in at least two outcomes. Merge nodes were used to pass any of the multiple incoming flows through to the next process, especially where a decision node was used in the previous process. Fork and join nodes were used to continue an inflow into multiple outgoing concurrent flows, and merge multiple incoming flows to one outflow respectively. For join nodes, receiving all inflows was necessary for an outflow to be executed unlike the merge nodes where any inflow from a decision node would execute an outflow. An event action was used once at a point where time or quantity was a factor to execute an actor's behavior.

The relationship between the use case and activity diagram is that each use case is represented by an activity with the actors being the partition of corresponding activity diagrams. Therefore, only related actors and their actions are represented in the activity diagram.

Assumptions made for the activity diagram include firstly, differentiating types of clients as clients submitting loans individually, and clients associated with a notary to submit an aggregate loan application inclusive of generated administrative data and an official credit note. In both cases, the client can decide to include references that act as security in case of non-payment. Secondly, the administration data generated by the notary can only be assessed and evaluated jointly by the branch management and headquarters information department after a loan application is submitted to a branch customer service. Thirdly, the evaluation of the administrative data is stored by the information department and transferred to the credit department when they ask for a detailed examination file. The credit department then reviews and verifies both the administration data and official credit note among other data. Thereafter, the decision process on acceptance or refusal of the loans is done. Lastly, the optional possibility of establishment of a credit file by the notary's credit note is assumed to be added to the loan application at the client level.

- **Class Diagram**

To illustrate the logical structure at the level of Dexis Bank's system, the class diagram is created with Visual Paradigm. A visual representation is provided in figure 3 of the appendix. Initially, the entities which are classes of the organization, detected by the help of the use case and the activity diagrams, are explained. Then, they are compared and checked with the requirements of the bank. Since the class diagram is needed to support the workflows, attributes and operations are defined while considering the parallelism between sequence and class diagrams. Lastly, the relationships between the classes and multiplicities of the relationships are defined.

Despite the autonomy of the legal, information and investment departments, they are aggregated by the credit department in the context of loan-granting operations. This is necessitated by the overarching role the credit department fulfills, functioning as a whole entity. In other words, these departments are parts of the credit department since it demands their functions to push the main operation of loan-granting. However, the parts have their own data and behavior and can exist on their own without the credit department. Similarly, the ombudsman (part) incorporates into the bank management.

To ensure uniformity in interest rates throughout the entire loan granting process for the client, the requirement mandates that the value of various data associated with a confirmed loan align precisely with the data from the originating proposal (if it exists). This implementation is achieved by setting the maximum multiplicities to 1 for related entities: the first funding plan, loan proposal, accepted loan proposal, and loan contract. These entities typically exhibit a multiplicity range of 0 to * on their side, allowing the other entity on the other side of the relation to have many of those mentioned instances about the loan. However, the specified requirement necessitates a modification, restricting them to a maximum cardinality of 1. This assumption is crucial for maintaining identical interest rates across the comprehensive lifecycle of the loan process.

Unlike the use case and activity diagram which offer a broader view, the class diagram represents more detailed operations. Thus, every detail in the loan granting process, starting from the client's application to customer service through the examination of the file by departments, is encapsulated within the relevant class. This ensures that both attributes and operations are integrated in the sequence diagram, while defining the related parameters and data types.

- **Sequence Diagram**

To develop the sequence diagram, an examination of the loan application process was executed, focusing on the sequence of interactions and communications between the various components within Dexis Bank's system. This laid the foundation for constructing a visual representation which captures the dynamic flow of activities. During the construction of the sequence diagram, both the activity and class diagram were extensively used, as they provide the flow of activities and executed operations by the various components.

The first step was to identify the classes in the class diagram which play a key role in the loan application process and subsequently communicate with each other throughout the process. This led to the identification of the client as the actor initiating the whole process and the operational classes as key lifelines within the sequence diagram. A lifeline represents a role or object instance that interacts with another lifeline through messages. The operational classes identified are notary, branch management, branch customer service, bank management, credit department, legal department, investment department and information department.

Following this identification, the activity diagram was consulted to determine which activities required communication between the different lifelines and messages were defined based on the operations of the different classes. Based on the activity diagram the sequential flow of activities was determined to map out the sequential flow of these messages between the lifelines.

This was then modeled within Visual Paradigm, detailing these messages and their sequential flow. Decision nodes and their guard conditions (criteria for certain decision path), used in the activity diagram, were considered to construct relevant alternate and optional combined fragments within the sequence diagram. Overall ensuring a comprehensive and accurate depiction of the sequential loan application process.

Finally, the sequence diagram was refined based on a comparison to the activity diagram, ensuring their alignment. Within the sequence diagram, the messages used are based on the operations of the classes in the class diagram. Reply messages are logically named based on the object (file, data ...) that would return based on the initial message.

The sequence diagram serves as a dynamic blueprint, highlighting the step-by-step interactions and communications taking place throughout the loan application process at Dexis Bank. It captures the dependencies among the different components and departments, while also indicating the crucial decision points and conditions throughout the process. It provides an understanding of the information and control flows within Dexis Bank's system. A visual representation is provided in figure 4 of the appendix.

- **State Machine Diagram**

The State Machine diagram; illustrated in figure 5 of the appendix, models the process that a loan proposal undergoes from the moment it is accepted by a client to the point at which it is either approved or rejected by the bank's management. In other words, in the diagram we assume that the loan proposal is accepted. The diagram captures the various states and transitions that the loan experiences, as well as the decision-making procedures and client options in response to management decisions. For full disclosure: in making the diagram, we assumed that all possible processes are described in the case document.

Starting from the initial state, a loan proposal is received, which transitions into an 'Accepted loan proposal' state when the client accepts the proposal. Once in this state, the loan proposal is added to the 'Loan files' state. This is a holding state where files accumulate until they are processed. The transition from this state occurs either at the end of the week or when there are 20 or more loan files in the queue, as indicated by the guard conditions [count>=20] or [end of week].

Once the files are ready for review, they transition into an 'Approval' state. Entry into this state triggers an action where the file is examined. In the 'Approval' state, a decision is made on each file, represented by the activity 'do / approval decision'.

If a loan is approved, it transitions to the 'Acceptance note' state, where a note with necessary data is generated. This leads to the completion of the process for approved loans, the first final state.

If the loan is refused, it transitions to the 'Refusal note' state. From here the client has two options: he can either accept the refusal, which leads to another final state, or he can contact the legal department immediately if he does not accept the decision of his refused loan. This leads to the 'Internal investigation' state. From there, the loan can be refused again, or accepted, the latter leading to the 'Acceptance note' and its final state.

To conclude, the State Machine diagram concisely models the flow of loan proposals within Dexis. It depicts the main states and incorporates the client's options in case of a refusal. In building the diagram, there was a trade-off between readability and exhaustiveness. While initially considering client recourse options, including contacting the ombuds through a composite state, readability concerns led to the adoption of a simpler diagram. This provides a clear and structured representation of the process for stakeholder examination or for use by stakeholders within the banking institution.

Conclusion

The various diagrams described throughout the report offer comprehensive solutions for the development of the system. The use case and activity diagrams facilitate a better understanding of user interactions and workflow processes, which are essential for customer-centric banking services. On the other hand, the class, sequence, and state machine diagrams provide a more robust framework for designing scalable and efficient software architectures, which are crucial for handling complex banking transactions and ensuring data security.

From these diagrams, key recommendations emerge for the Dexis Bank management. These are focused on the software system designed to support their management of loans.

1. Automation of routine tasks

Identify the routine tasks within the loan management process and automate these tasks to improve overall efficiency, reduce errors and accelerate the processing of loan applications.

2. Implementing client recourse options

Enhance the client's experience by clearly defining and implementing recourse options in case of a refused loan. Emphasize communication channels provided by the bank to contact the legal department, facilitating an internal investigation if deemed necessary.

3. Continuous updating of Class Diagram

Continuously update the class diagram, ensuring alignment with evolving requirements every moment in time. This ensures that it effectively supports the workflows identified in the use case and activity diagram. This involves reviewing attributes, operations, and relationships between classes regularly. For example, when a certain class needs to incorporate new tasks (operations) this must be updated in the class diagram so that everyone understands their roles and responsibilities.

4. Frequent review and updating of State Machine Diagram

Lastly, we recommend frequently reviewing and updating the state machine diagram to reflect any changes in the loan proposal process. For example, if the conditions for when to process the loan files change from - let's assume - 20 to 30 files, it must be updated in the state machine diagram as well as other diagrams where this is important. This ensures that the diagrams accurately represent the current states, transitions and decision-making procedures.

5. Ensure system scalability

Ensure that the software system is scalable to accommodate future growth and changes in loan management operations. Include flexibility within the system to integrate new features, adapt to increased demand and remain efficient through growth of the organization. In the case of implementing new features, identifying and facing the risk and its related use case soon would play a crucial role for the early mitigation of the risk, since the banking industry tends to be risk averse.

Implementing these recommendations aims to enhance efficiency, transparency, and client satisfaction within Dexis Bank's loan management process. While also contributing to a more streamlined and effective system that aligns with the bank's objectives, facilitating its pursuit of increased loan demand, attraction of new clients and consolidation of its image.

1. Appendices

Figure 1: Use case diagram

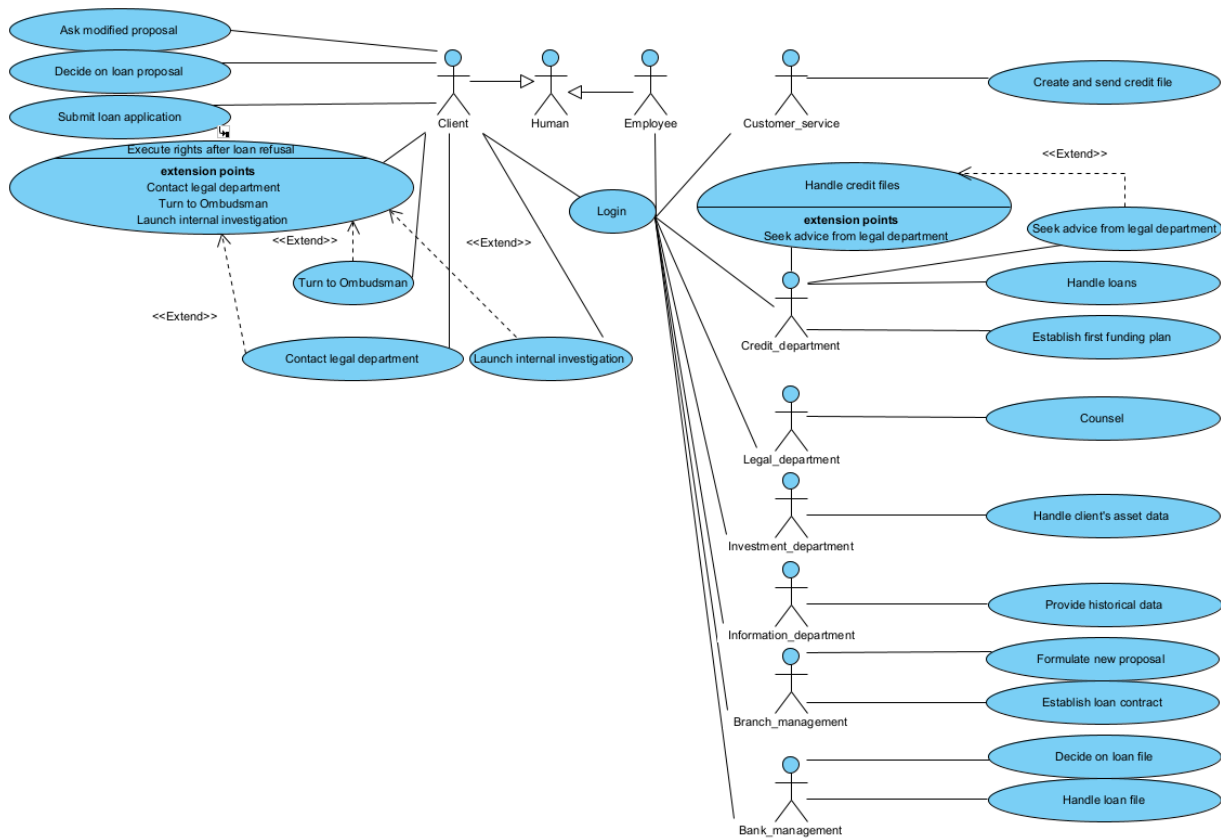


Figure 2: Activity diagram

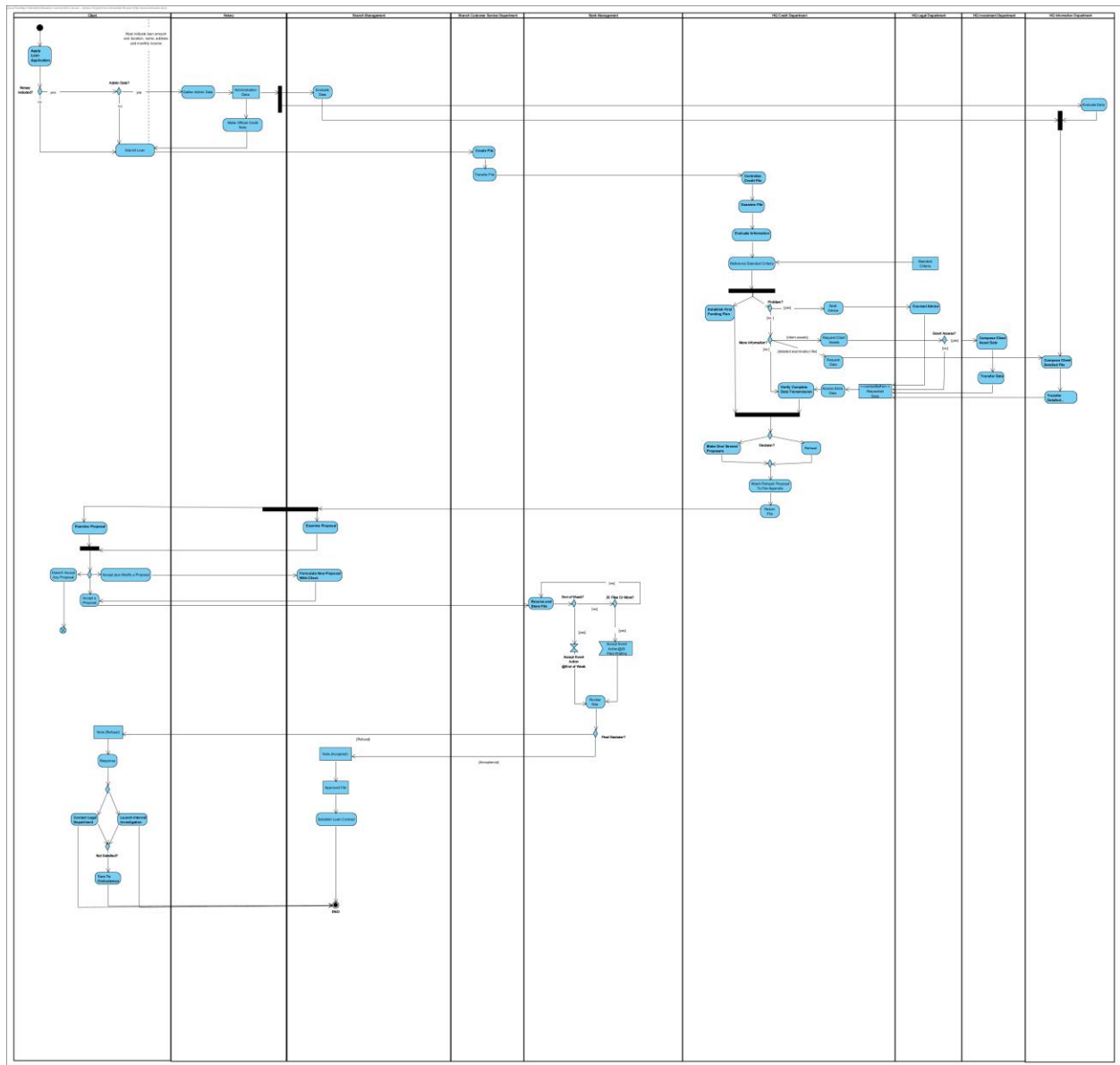
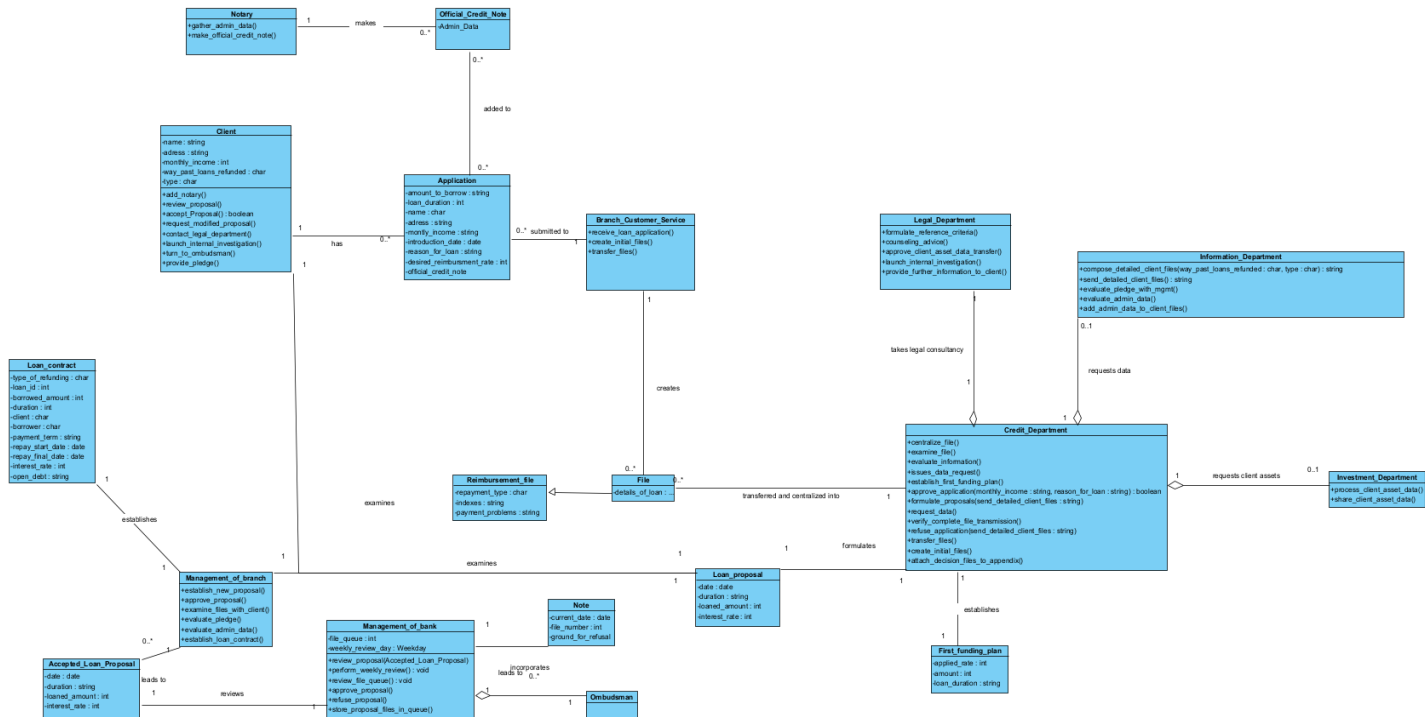


Figure 3: Class Diagram



[illegible]

Figure 5: State Machine Diagram

[State Machine Diagram1]

