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# Designing an Information System for Decision Support Lending

**Adrian LUPASC**[*]

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ABSTRACT

The successful development of financial and banking activities requires a strong information support to ensure the competitive edge over the other competitors on the market. The exponential growth in the volume of lending financial operations made the use of modern information technology in banking has become fundamental to improving lending activity. Thus, the design and use of a computer system adapted to specific requirements of bank lending will provide opportunities to diversify and modernize the procedures for granting, repayment and credit guarantee to correlate products offer credit demands and customer needs. In this regard, the related objectives of this work are oriented to emphasize the positive impact of the adoption of modern information technologies in decision making in the banking field. The proposed objectives are justified by presenting solutions support system of credit decision which aims to automate ongoing operations specific to a banking allowing bank clerks to process a large number of loan applications in a time very short and to the right decisions and substantiated.



## 1. Introduction

In the paper-based era, the decision to grant a loan was made based on personal knowledge. Success or failure in such an action depended on how well the creditor knows his potential client and the confidence he has in him. However, with the passing of time, this practice was oriented to a less personal appreciation. Upgrading the bank's lending activity was achieved by integrating new information technologies.

A banking information system is designed in such a way as to automate as much of the bank's current operations and provide the information necessary for strategic and operational decision making. Use of information technologies in the bank lending activity has fully demonstrated its usefulness in making lending decisions, significantly reducing specific risks while increasing the speed of the loan applications processing. The speed of the decision making is essential in this process because one day delay of the final decision can make the loan applicant to turn to another banking institution.

In this sense, the purpose of this paper is to highlight the impact of information technology in decision making processes in the banking field. Thus, the design and implementation of an information system for credit decision support in a bank was presented. The main purpose of this system is to automate a large number of current operations of the bank. In this way, it enables bank officials to make the right and better substantiated decisions in a short time.

The main objectives in this paper were related to: highlighting the role of information systems in the loans granting decision; presenting a few UML diagrams that resulted after analyzing the real model; summarizing the technologies used in developing the MoneyTree system; a brief description of the implementation steps; description of the achieved functionality of the information system. The information system developed and introduced (MoneyTree) includes the management of loan applications, the ability to add new types of loans and choose between various types of loans predefined, applications analysis and the decision to grant a loan, suggestions for loans variants for interested persons, but also the record of current or potential customers and credit contracts and their associated accounts.

## 2. Paper theoretical foundation and related literature

The credit decision is difficult; finding an optimal solution in most cases requires the processing of large quantities of information, the factors to be considered are often numerous. In this respect, any mistake can have significant effects, with serious repercussions for both parties. The existence of an expert system for decision making is extremely useful for increased quality assurance of the financial resources management and of risk reduction.

[*] Dunarea de Jos University of Galati, Romania. E-mail address: alupasc@ugal.ro (A. Lupasc)

Designing and implementing an information system determines the reorganization of the informational system it contains, resulting in its improvement. This can be achieved by: improving the nature and content of the information conveyed in the informational system; improving information flows; improving information processing carried on, by modifying the nature, place or their frequency; removing repetitive or parallel processing of data, etc.

As shown in (Georgescu&Georgescu, 2005), a banking information system is effective when it provides: the elimination of manual processing and creation of more complex ones in a short time; increased access to data; reducing the volume of data archiving supports and improved security of their storage and processing; removing barriers caused by physical distances (at bank branches level); better use of data in support of the work of the entire organization.

The evolution of information and communication technology influences the evolution of the management process by offering instruments and means of increasing performance for solving the tasks of managers, among which we can mention ES (Expert Systems), DSS (Decision Support Systems), KWS (Knowledge Work Systems), OAS (Office Automation Systems), etc. Information systems facilitate quick retrieval, analysis and interpretation of large amounts of data and information, helping decision makers to adapt rapidly to a changing economic environment. They also provide a high level of responsibility and decision-making to lower levels.

As shown in (Gherasim&Fusaru&Andronie, 2008), decision-making is a process that, in addition to technical support, needs a cognitive support that is provided by the human constituent of the decision. Cognitive support includes knowledge and experience of the decision maker and his reasoning ability.

## 3. Methodology

Assisted decision systems are interactive systems that, via decision models and specialized databases, provide useful information that then support the decision making process adopted by managers or any other actor involved in the decision. These systems process data found in the data warehouse of the organization and work based on the analysis and aggregation of data. This type of system is the result of the creation of special technologies such as storage of enormous volumes of historical data of the organization (Data Warehousing) or the exploitation of these deposits through online analytical processing (OLAP Online Analytical Processing).

The advantages of introducing software systems to assist in the decision making consist in fast collection and processing of large volumes of data using rigorous mathematical-economic models in analyzing and interpreting the information, and delivering multiple correlations between elements and phenomena characteristic to the analyzed decisional situations. These correlations enable complex analysis and interpretations and are usually presented in a suggestive manner for the decider.

Use of technology in banking is fundamental to improving lending activity, offering opportunities to diversify and modernize the procedures for granting, reimbursement and credit guarantee, in order to correlate credit products offer with the customer's demands and needs. A banking system is designed in such a way as to automate as many of the bank's current operations as possible and to provide strategic, tactical and operational information required in the decision-making process. Integrating information technology into the bank's lending activity has demonstrated its usefulness in making lending decisions, significantly reducing specific risks and increasing the processing speed of loan applications.

The information systems used in banking activity allow banks to adapt lending policies to available resources. Based on complex algorithms the credit limits are set, depending on the structure of available resources, on requests for loans and credit terms. When a customer applies for a loan, the software specialist determines the maximum amount of credit that can be granted to a customer so as to be able to pay his interest and credit on time.

In the field of loans for individuals, banking systems should provide the possibility of building databases with essential elements and specific analysis structures. The procedure includes the following steps: the bank official enters the essential data from the credit documents, then gives the command for the automated execution of the documentation. This automatically issues all the necessary loan documents. The computer systems used in banking also allow automatic creation of reimbursement schemes for loans and interest payments.

## 4. Results and Discussions

Any information system requires a detailed analysis prior to coding and implementation. Analysis is the most important step in developing a professional information system. The MoneyTree system is designed for the intern use of the bank and, therefore, the only users who can access it are employees of the institution. When a customer submits a credit application, the user searches for the Personal Identification Number of the person in the bank's database to determine whether he is a new client or is already in the system. In the case of customers already in the database, the customer's data is displayed and the user can update them if it finds that they are no longer topical. For new customers, the data are first introduced for the individual loan

claimant and then the data on the type of loan requested and the amount desired to be borrowed or the time desired for the credit payment are introduced.

The system checks whether the requested amount and repayment period falls within the desired limits for the type of credit requested, and if the age of the customer meets the requirements of the desired credit typology. In addition, the reimbursement period must be a multiple of six. If all these requirements are met, a new application will be created that will have as status "Submitted".

The analysis phase of the application can be launched only by a specially authorized user to execute this procedure. In this stage, the system extracts all applications for credit that are in the "Filed" state and it displays them. For each such request, the data of the customer that submitted the application is extracted and the total income of each applicant is calculated by adding the income of the applicant to that of the co-debtor, where appropriate. From the revenue obtained the value of the daily basket for each family member is subtracted and the real income value is obtained.

The behavior of a system from the point of view of the user is described using the cases of use. They allow users to structure requirements, define how they will interact with the system to achieve the desired result. A use case is always initiated by an actor and always expresses a function of the system, triggered in response. The complete functionality of the system is given by all the use cases. The use case diagram includes actors and use cases.

### 4.1. Use Cases Diagram

Given the complexity of the diagram that results after analyzing possible cases, the main application scenarios have been established. The credit request scenario, illustrated in figure 1, includes the registration request scenario that is launched automatically each time a client requests a loan. The credit request registration can be expanded, either by inserting customer data if it is not already in the database, or by updating customer data, where the customer is already registered but their personal details have changed in the meantime. The registration request scenario automatically includes credit demand analysis. The request analysis in turn includes three scenarios: analysis of the amount required, credit data analysis and desired credit period analysis.

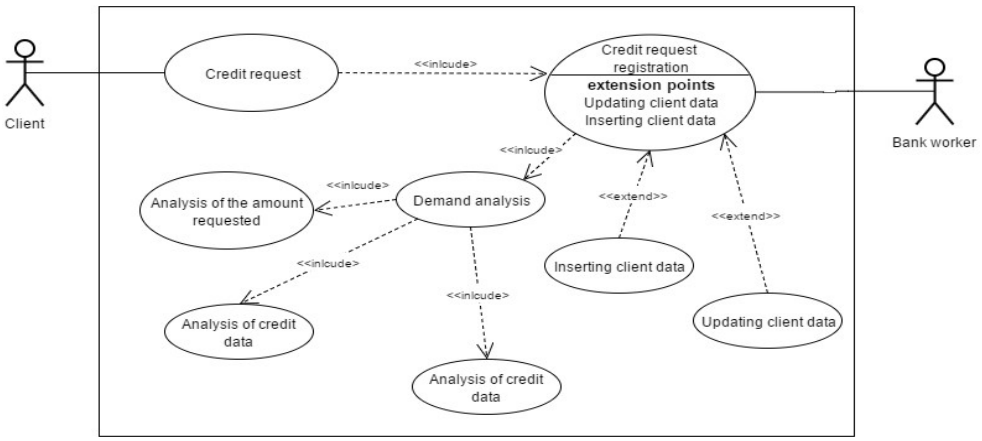


**Figure 1. Request registration scenario**

The credit analysis scenario (figure 2) includes the analysis of the customer data (to check his compatibility with the desired credit type), the calculation of the rate the customer will pay, but also the calculation of the indebtedness level of the client after the loan. Credit analysis can be expanded through rejection of the credit request or through its approval, but both scenarios include notifying the client. Further, the credit request rejection scenario includes the calculation of a credit alternative, while the credit request approval scenario includes creating an account in the customer's name from which the amounts owed to the bank will be extracted.

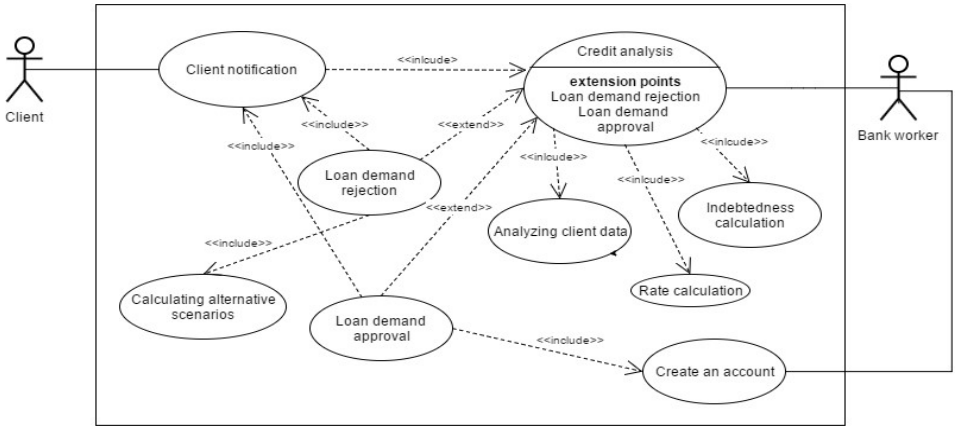


**Figure 2. Credit analysis scenario**

Credit contract generation scenario (Figure 3) includes other five scenarios: client type verification, period of credit verification and credit type verification, to decide the type of contract and which items it will contain, installments plan generation for the applicant to see exactly what and when he has to pay, and credit contract management. The credit type verification scenario is a generalization of existing credit types: personal needs loan, education loan, auto loan, mortgage respectively.

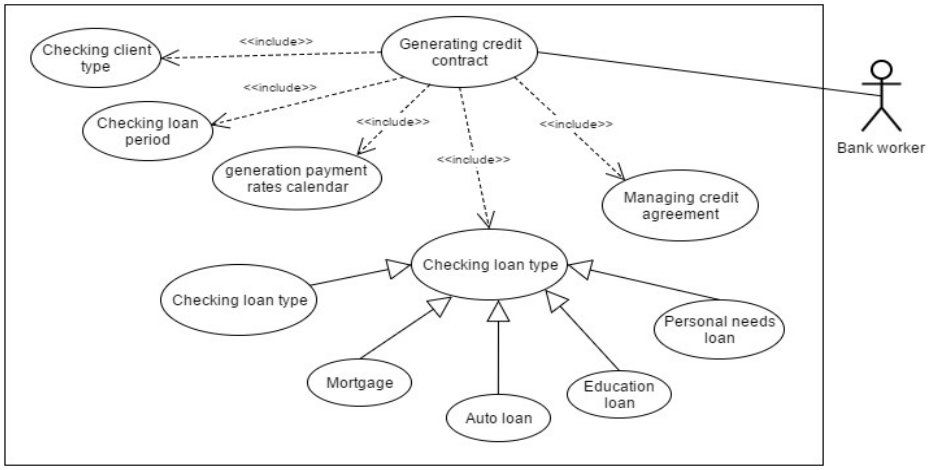


**Figure 3. Credit contract generation scenario**

According to the credit contract generation scenario (figure 3), an important functionality corresponding to the implemented information system is represented by an XML document generation that contains all the data about the client that are going to be in the credit contract.

```
<INFORMATII_PERSONALE>
      <NUME>Lupasc</NUME>
<PRENUME>Adrian</PRENUME>
<CNP>1701010000000</CNP>
<ADRESA>
      <JUDET>Galati</JUDET>
      <LOCALITATE>Galati</LOCALITATE>
      <STRADA>Domneasca</STRADA>
      <NUMAR>10</NUMAR>
      <BLOC>A1</BLOC>
      <APARTAMENT>100</APARTAMENT>
</ADRESA>
<DATA_NASTERII>10/10/1970</DATA_NASTERII>
</INFORMATII_PERSONALE>
```

**Figure 4. XML source code with data about the client that could be found in the credit contract**

This XML document is then combined with the XLS document that contains information regarding the format of the contract and a PDF document is generated, representing the actual contract.

```
System.out.println("Input: XML (" + xmlfile + ")");
System.out.println("Stylesheet: " + xsltfile);
System.out.println("Output: PDF (" + pdffile + ")");
System.out.println("Transforming...");

FopFactory fopFactory = FopFactory.newInstance();
FOUserAgent foUserAgent = fopFactory.newFOUserAgent();
OutputStream out = new java.io.FileOutputStream(pdffile);
out = new java.io.BufferedOutputStream(out);
try {
  Fop fop = fopFactory.newFop(MimeConstants.MIME_PDF, foUserAgent, out);
  TransformerFactory factory = TransformerFactory.newInstance();
  Transformer transformer = factory.newTransformer(new StreamSource(xsltfile));
  transformer.setParameter("versionParam", ".");
  Source src = new StreamSource(xmlfile);
  Result res = new SAXResult(fop.getDefaultHandler());
  transformer.transform(src, res);
  } finally {
    out.close();
  }
System.out.println("Success!");
```

**Figure 5. XSL document with data referring to the contract generated as PDF document**

### 4.2. State diagram

The state diagram describes the behavior of objects of a class through states and events. They are built only for classes with a dynamic behavior, complementing the description of a use case. The state diagram models the life cycle of a single class that has clearly identifiable states and a complex behavior. A state is usually a complement of a class description. A state diagram shows all states through which and object of the class passes, as well as the events that caused its state to change.

Figure 6 shows the state diagram related to the lifecycle of a credit application in the bank's information system. Depending on the checks that are made on the data it contains, an application can go through the following states: submitted, approved or rejected, which can be modified to be submitted again.

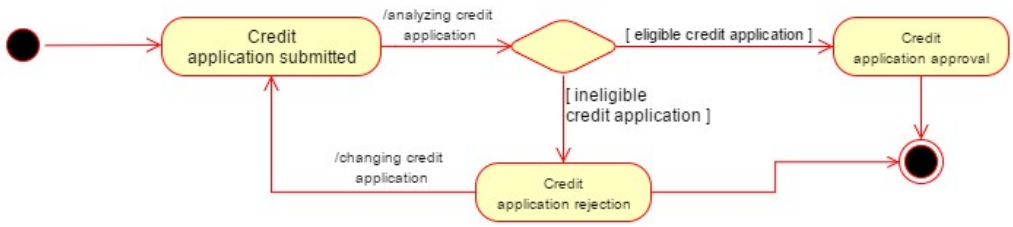


**Figure 6. State diagram of a credit request**

When the client requests a loan, the data of the request made by the system are recorded in the form of a credit application. An application filed in this way will be analyzed by the system. Following this analysis, the application can be approved or rejected. Regardless of the outcome, the customer is notified. In the case of refusals he can return and request changes for his credit application. After modification, the application will again have the status of "Submitted" and will be examined again. An application approved remains in this state in the system, without being altered, because it contains data that has been approved for a loan and according to which the loan contract will be generated.

The form for entering data on a credit application is shown in Figure 7. In addition to the usual checks on the format of the data, the data in this form are analyzed to determine if data related to a credit request a client wishes to make are compatible with the type of credit chosen and the customer's personal data, because each type of credit has a minimum or maximum amount and timeframe which may be granted and various types of loans may be granted only to persons who have a certain age.


**Figure 7. User interface for the data insertion form for a credit request**

### 4.3. MoneyTree system implementation

For the development of the banking MoneyTree system several technologies were used:

- ✓ Java programming language because it is one of the most important and popular open-source programming languages.
- ✓ Technology Servlet / JSP because it is based on Java and inherits its advantages.
- ✓ Hibernate for data mapping between relational model of the database and the object of the language used.
- ✓ Oracle Database as it supports databases of any size and offers safety features to limit and monitor access to data.
- ✓ GlassFish application server because it is an open-source application server that has its own security system and enables scaling of applications across multiple hosts.
- ✓ XML Language (Extensible Markup Language) is a standard format for international data storage that allows the definition of its own tag structures based on needs.
- ✓ XSL (Extensible Stylesheet Language) to describe the layout of a page.

## 5. Conclusions

Use of information technology in banking is fundamental to improving lending activity, offering opportunities to diversify and modernize the procedures for granting loans, in order to match the supply of credit products with applications and customer needs. Implementation of information technology in bank lending is essential to modernize and increase the competitiveness of banks, helping to increase lending activity and providing better-informed decisions in a short amount of time. Using information technologies in bank lending activity has demonstrated its usefulness in making lending decisions, significantly reducing specific risks and increasing the processing speed of loan applications.

It can be thus considered that information systems specific to banking bring significant contributions to credit lending activities. In this context, personal contribution to the field is linked to the development and implementation of such a system dedicated to banking and financial institutions, based on web technologies. Administration of loan applications, the ability to add new types of loans and choose between various types of predefined loans, the analysis of the applications and the decision to grant or deny a loan, suggestions of other options for lending to stakeholders, and tracking of current or potential customers, as well as credit contracts and their associated accounts are the main features of the proposed IT solution.

Information system implementation is not limited to the features presented in this paper. As directions for further research, the possibility of adding new modules or improving existing ones will be considered. The more advanced the system is, the more information is available to decision makers in order to make decisions.

However, information systems remain only auxiliary tools that cannot replace the human factor activity. These systems help the human decision-maker in the preselection requests for lending and in the preparation of a comprehensive and multilateral decision. In most cases, however, the decision rests with men, in all the complexity of the responsibilities that they assume.

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