

A PRACTICAL APPROACH FOR INTEGRATING HETEROGENEOUS SYSTEMS

Assoc. Prof. Monika Tsaneva¹, PhD

Abstract: The adoption of cloud computing is a major requirement for expanding a conventional business into an electronic one. In order to benefit fully from the advantages of cloud computing, companies need to have their business applications redesigned, yet this requires substantial financial, human and time resources which even the largest enterprises cannot afford. A feasible option is developing a strategy for gradual transition to cloud systems and technologies, which implies integrating the conventional systems of enterprises with newly developed cloud solutions.

The underlying idea of this research is that the priorities of such gradual transition should be identified on the basis of the major characteristics of the activities comprising the overall business process, such as its dynamics and prospects, the current and the potential level of automation, the volume of processed data, the workload they create for the systems processing those data, etc.

The research paper proposes an approach for integrating a conventional and a cloud system to service the business process 'Requesting a consumer loan' that requires real-time data exchange. The integration solution uses data structures which have been created in an intermediate data base for communication between systems. The rules for accessing and manipulating data by each of the integrated systems are defined. Interoperability is ensured through programme components (triggers and stored procedures) that are created in the data base of the operational system and ensure data exchange for real-time processing. The approach proposed in the paper has been employed in the business practice of a large Bulgarian bank. Its major advantages relate to the comprehensive service of the business process, as well as the greater flexibility, adaptability and scalability achieved with minimum financial and time resources.

Key words: integration approach; cloud systems and technologies; consumer lending; credit risk assessment.

JEL: O32, O33.

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Introduction

The contemporary information environment of enterprises consists of multiple different software systems which jointly perform a wide range of business processes. Those systems usually take a long time to build and therefore have different, frequently incompatible, architectures and implement totally different software paradigms. There have been three major trends in the development of business information systems over the last years: the wide adoption of cloud technologies; the introduction of business intelligence solutions, including mobile ones (Mihova et al., 2016) and the establishment of the necessary prerequisites for making the transition from conventional to electronic business. Although the three trends have rendered the performance of enterprises much more profitable, their further development requires that currently used business applications should be redesigned (Lazarova, 2015). In most cases, reference systems, especially those with business intelligence elements that use multiple heterogeneous data sources (Stefanov & Marzovanova., 2015) were designed a few years ago and implement cutting-edge information technologies. In contrast, the software systems that are used to automate operations have been used for years (or even decades). Although the latter still meet the requirements of businesses, they have become obsolete in terms of modern technologies. Due to their scope and complexity, the process of having those systems completely redesigned requires substantial financial resources and time which even the biggest enterprises cannot afford to allocate at once. A more viable alternative is designing a strategy for gradual transition to cloud systems and technologies, which, in turn, requires integrating newly built cloud solutions into the conventional systems that are currently operating in enterprises.

The aim of this research is to propose a practical approach for integrating the business applications which already exist within an organization with cloud-based applications. The object of the research are the business information systems used by banking institutions to extend consumer loans. The subject of the research are the approaches for integrating the heterogeneous systems that are used to automate the overall business process.

The proposed integration solution is based on:

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- Analysing the specific features of the business process and identifying the priorities of the transition to cloud systems and technologies;
- Designing and introducing integration modules between conventional and cloud systems that will interact within a common business process.

Identifying the Priorities of the Transition to Cloud Technologies

The objective of any Business information system is to optimize the execution of business processes within enterprises by automating the implementation of activities and the processing of related data as much as possible. Applying the contemporary approach to the development of information systems in enterprises requires that these systems should be full-featured and affordable, innovative and adaptable. They should cover all aspects of managing the business, while at the same time their design and development should require as few resources as possible (Shishmanov, 2013). Any decision that is made in terms of the architecture and the information technologies used to design those systems will depend on the impact that a system will have on the efficiency of the performance and the time and costs required to execute the business process which is served by the system.

Cloud technologies offer several advantages to the owners of e-business information systems (Lazarova, 2015):

- They spare to organisations the costs of developing an IT infrastructure and hiring highly-qualified specialists;
- They help reduce capital expenditure and improve cash flows;
- They enable companies to remain flexible by only hiring the hardware they need;
- Instead of focusing on developing and maintaining networks and servers, e-business companies can allocate more time and resources to their customers.

In order to benefit fully from cloud technologies, entities should not merely install their systems in a cloud infrastructure. Rather, software systems need to be totally redesigned in order to build the paradigms that are inherent to cloud applications.

The business process on which our research focuses consists of three major activities:

- Filing consumer loan applications;
- (Fully automated or automated and human) risk assessment of the submitted loan application;
- Generating a loan agreement for approved applications.

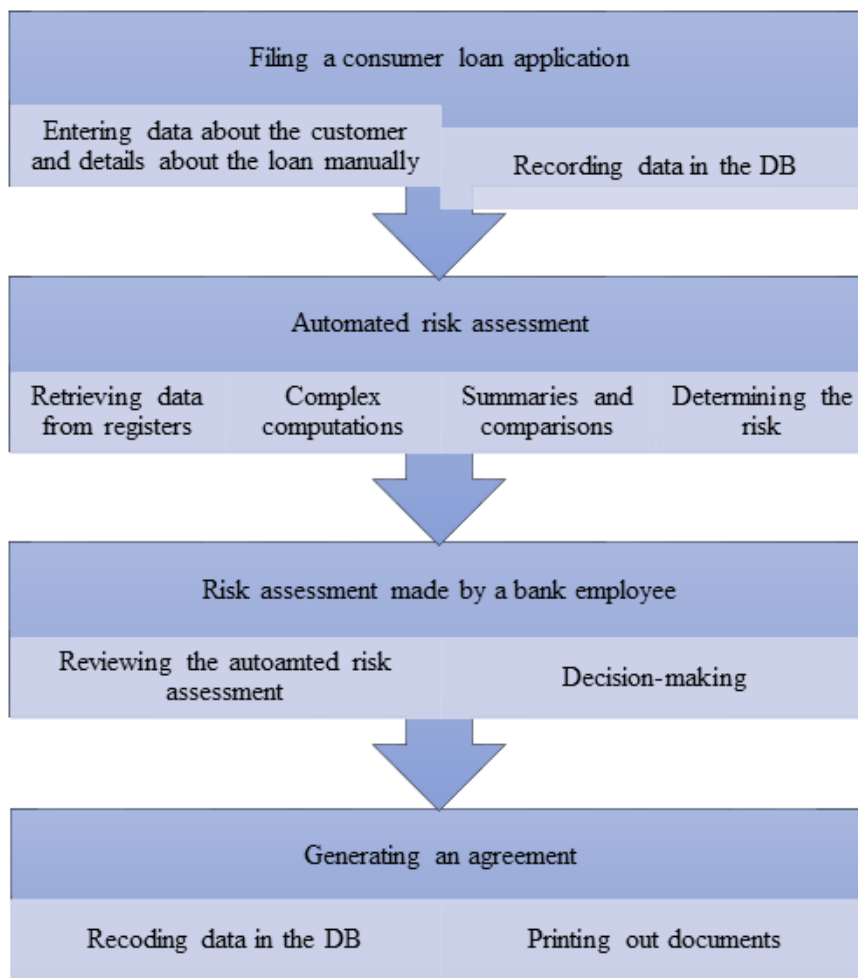


Fig. 1. Processing consumer loan applications

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Filing consumer loan applications is an activity in which data is chiefly entered manually. Those include details about the loan applicant, the financial parameters of the requested loan, contact persons/co-debtors. Whether the activity is performed by the end customer or an employee of the loan-extending institution, the opportunities for automation of the process are restricted mainly to substituting manual data entry with data retrieval from the national registers of the Civil Registration and Administrative Services Directorate (CRAS), the National Statistical Institute (NSI) and the Central Credit Register (CCR). The activity requires customers to provide multiple data even in cases when there is a comparatively reliable source from which such data could be retrieved. This is usually done to compare the data declared by customers to the information that is officially available, and thus assess their creditworthiness. Hence, the relatively low requirements to the productivity of the system, since the time it takes to perform that activity ultimately depends on the time that is necessary to enter all required data.

Credit risk assessment is usually performed at two stages:

- Automated assessment,
- Manual assessment.

The automated risk assessment of loan applications is based on inductive and deductive models that are specific to each financial institution. It consists of a series of data processing operations – retrieving data from big data bases, requesting services from various registers, making comparisons, computations, etc. Human intervention is reduced to a minimum and the time the activity takes largely depends on the efficiency of the system for credit risk assessment. We should note that the workload of the system varies substantially during the year (the greatest number of loan applications are usually submitted before major holidays) and at different times of the day (the busiest times being noon and the end of the business day). This feature of the credit risk assessment activity renders the application of cloud technologies extremely appropriate due to their high elasticity. In some cases, financial institutions may outsource the credit scoring activity in strict compliance with the requirements of the European Data Protection Regulation (GDPR), i.e. data used to assess a loan application is processed by the credit risk assessment system but is not made visible or stored in its data structures.

When the automated assessment cannot definitely approve or reject a loan application, a manual assessment is made, i.e. the findings of the automated assessment are reviewed and a final decision is made. Manual risk assessment is an intellectual activity which mainly involves reviewing data, so its implementation does not increase the workload of the systems. There has been a trend towards reducing the relative share of manual risk assessment and, if possible, totally excluding it from the processing of loan applications.

Generating a loan agreement is an activity initiated by users, yet it is fully automated. The activity does not require any registration or data editing as that could affect the result of the credit risk assessment which has already been made. Generating a loan agreement typically requires a number of processing operations such as postings, the transfer of funds to the accounts of vendors (when financing the purchase of goods) or customers (when extending a consumer loan or issuing a credit card), filing a request for issuing a bank card, etc. Some of these processing operations must be done in real time (for example, printing out the loan agreement, so that it could be signed by both parties), while others could be processed as a package outside the working hours of the financial institution (for example, postings, transferring funds to vendors, processing bank card requests). The requirements to the high efficiency of the system mainly refer to the activities related to fast customer service.

The analysis of the business process leads to the following conclusions:

- The activity of filing a loan application is relatively static and involves numerous manual operations, while its performance requires using a complex information structure and a huge data base, which, at this stage, could hardly be redesigned and migrated to a cloud environment without substantial investments and costs, including downtime (i.e. suspending the operation of the business for a certain period of time).

- The automated assessment of credit risk is a specific activity that is executed in an environment of varying workloads, while input models of risk assessment frequently change. Processing activities involve numerous data of different type that is only used temporarily and does not need to be stored. Those features and the availability of suitable solutions render the automated assessment of credit risk extremely suitable for employing cloud solutions.

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- Manual risk assessment is gradually becoming obsolete, therefore its potential implementation into a cloud environment will not pay off.
- Generating a loan agreement is a business process which involves several operational information systems that are currently integrated, which would substantially delay and increase the costs of using a cloud architecture.

Designing and Introducing Integration Modules for Conventional and Cloud Systems

The conducted research and classification of integration approaches based on their advantages, disadvantages and applicability (Kouzmanov, S., 2015), indicate that integration solutions strongly depend on the specifics of the business issue that needs to be solved as well as the data which needs to be integrated so as to be processed in real time. In this model, the initiating system starts a transaction and provides data to the related system as parameters of a stored procedure that serves the target system and is accessible via a database connection (Fig. 2). The target system performs all processing operations and then sends some feedback to the output system. The system which has initiated the transaction then completes the process or sends back the loan application (Tzaneva, M., Kouzmanov, S., 2013).

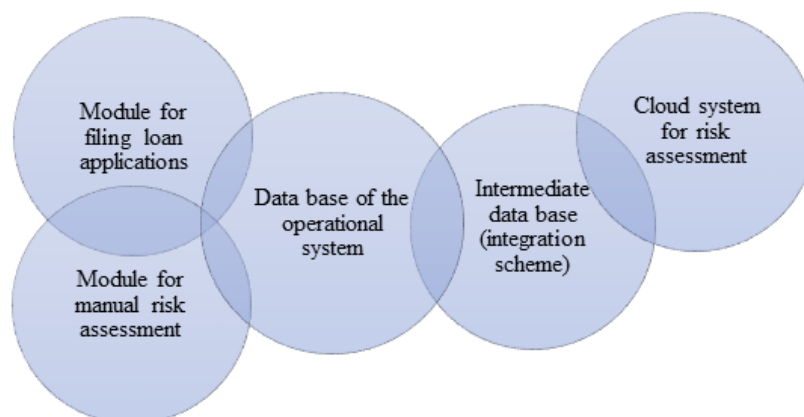


Fig. 2. An integration approach for conventional and cloud systems

When a new loan application is filed, the output (operational) system records in the intermediate data base (Fig. 3) data about the customer, the parameters of the requested loan (consumer loans, cash loans, issuing a credit card) and data about previous loan applications, loan agreements and their disbursement by the customer. Loan applications can only be sent to the intermediate scheme by the operational system, where they are filed as 'For assessment' and wait to be processed.

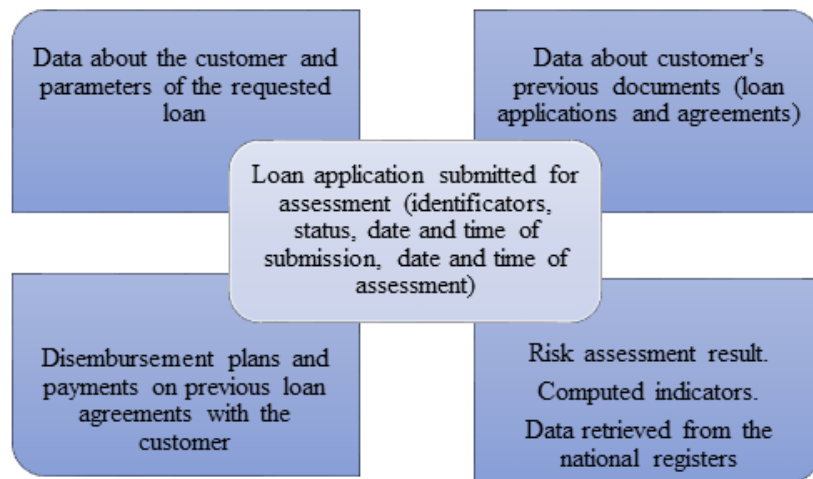


Fig. 3. Conceptual design of the integration scheme

The cloud system for credit risk assessment analyses submitted data based on the input deductive model for risk assessment and records the result of the assessment as well as indicators computed during the assessment and data retrieved from the national registers (NSI, CCR, CRAS) in special tables in the intermediate data base. When processing starts, the system changes the status of the request into 'Currently being assessed' and when processing finishes - into 'Assessed'. In compliance with the rules and restrictions established for accessing data in cloud systems (Lazarova, V. 2016, 2017), the risk assessment system does not record or visualize any data about customers or their documents but only uses them in the intermediate scheme of the processing activity.

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The operational system retrieves applications whose status is 'Assessed' together with the findings of the risk assessment process and transfers them into its own data base. At that time, the status of the loan application is changed to 'Transferred to the operational data base'. In case the loan application cannot be definitely approved or rejected, the data from the automated risk assessment are visualized for a credit analyst via the module for manual risk assessment.

The program implementation of the integration module consists of triggers and stored procedures that are part of the operational data base. Data exchange is initiated by an automated procedure that is performed every ten seconds. In order to increase agility, data is transferred in packages, every transaction transferring all applications with the same status.

Conclusion

The proposed integration approach offers a number of advantages to businesses: it covers the whole business process; the solution does not require substantial financial or time resources since it employs the IT infrastructure that already exists in companies. The designed integration module is highly efficient, flexible and scalable. It has been implemented for more than two years now and has been processing nearly 1,800 loan applications daily during the period (and as many as 2,800 applications per day in peak times), without any substantial delays in the operational system or the business process registered so far. Based on the integration data base, a business intelligent system with cloud architecture is developed. Migrating the intermediate scheme to a cloud data base is planned for some point in the future.

Based on the results accomplished with the introduction of the integrated solution, we could summarise that the gradual adoption of cloud technologies could improve business performance at moderate costs, provided that the priorities of switching to cloud technologies are defined by accounting for the specifics of automated activities and available applications and the integration approach that is employed is streamlined and efficient so

as to ensure compatibility of the operations performed by heterogeneous systems without any major investments in infrastructure or software.

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