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Application of Business Intelligence in the Banking Industry

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Summary

A highly dynamic market, changing client demands, fierce competition, the necessity of strict control and risk management are only some of the characteristics of the business environment where modern banks conduct their operations. Better management and better decision-making process make the difference between the successful and the unsuccessful on the market with these characteristics.

Business intelligence solutions for banks should provide the decision makers from all business segments of a bank with the ability to manage and exploit information resources, in order to solve the problems and make timely and high-quality decisions.

Business intelligence systems in banks must be comprehensive and yet simple for the end user. Business intelligence covers many areas of the bank, and among the most important are: Customer Relationship Management (CRM), Performance Management (PM), Risk Management (RM), Asset and Liability Management (ALM), and Compliance. Data warehouse and online analytical processes (OLAP) form the informational basis for the application of business intelligence.

Data mining and knowledge retrieval are also important segments of business intelligence and deal with complex statistical analysis, discovering „hidden'' relationships between data and forecasting the behaviour trends of business systems.

Keywords

business intelligence, performance management, asset and liability management

1. Introduction

Modern banks must respond to challenges such as process automation, increased client expectations, aggressive competition, mergers and acquisitions, new product development and market segmentation. At the same time, banks must also manage risks and harmonise their business operations with the growing national and international regulations, such as IAS, AML, BASEL II etc. Management comes down to decision making, and decisions must be timely, efficient and based on accurate and reliable information derived from data. Banks record large amounts of data daily; data are recorded for all clients on their personal, psycho-social, property and financial features, as well as all their accounts, transactions per account, credit liabilities etc. This data is generated in the bank's basic information system and stored in transactional databases. Experience has shown that transactional databases are a rich information source that can be used for enhancing the business of any company, especially a bank, due to the above mentioned facts about the availability of large amounts of data. It became clear a long time ago that banks have a lot of data but little information, and very little knowledge on many aspects of their operations. Transactional databases, however, are enormous.

Let us suppose that bank management wants to establish the characteristics of clients that have been insolvent in the past. Such information can usually be requested from IT personnel at the bank, who, in such cases, must spend a considerable amount of time to produce the requested report, on top of their regular workload. By the time the report reaches the manager's desk, it may be too late for decision making. (Infosistem, n.d.)

The development of information and communication technologies (ICT) provides successful solution to the above mentioned problems. A large subset of business information and knowledge management, and the first step towards a learning organisation is a set of methods, tools and applications denoted by the blanket term "business intelligence" (BI). Nowadays, BI is regarded as a separate discipline encompassing elements of information technology, strategy, managerial accounting, corporate analysis and marketing. It enables gathering, analysing, disseminating and acting based on the business information, aimed at facilitating the resolution of management problems and making the best business decisions (Balaban & Ristić, 2006). A business intelligence system does not exist as a final product; its producers offer technological platforms and knowledge for their implementation.

Modern banks are known to be among leaders in the area of adopting new technologies and knowledge, which is exactly why they are the fertile soil for implementing such an infrastructure. A special type of databases, referred to as data warehouses (DW), are generated to meet the needs these systems, where data is organised in a manner convenient for conducting analytical processes on large data sets. A data warehouse contains a copy of data isolated from operational databases and structured specifically for reports and analyses. Data warehouses and OnLine Analytical Processing (OLAP) form the informational basis for applying business intelligence (Ćirić, 2006). Data mining and knowledge discovery are also important segments of business intelligence, dealing with complex statistical analyses and discovering „hidden" relationships between data and forecasting the behaviour trends of business systems. (Asset - Liability Management System in banks – Guidelines, n.d.; Krsmanović, 2002)

2. Areas Encompassed by Business Intelligence in Banks

Business intelligence solutions for banks should provide the decision makers from all business segments of the bank with the ability to manage and exploit the information potential of a multitude internal and external data resources.

Business intelligence covers many areas of banking business, the most important being (Figure 1):

- Analytical Customer Relationship Management;
- Bank Performance Management;
- Enterprise Risk Management;
- Asset and Liability Management; and
- Compliance.

Considering and analysing the total client relationships is vital for successful bank operations in the conditions of growing competition. Most software solutions in the business intelligence domain are focussed on market segmentation, defining a clear picture of the clients and their relationships with banks, defining a clear picture of the market potential and the bank's ability to use this potential (Mosimann & Connelly, 2007):

- Segmentation: a customer segment is a group of client composed based on specific shared characteristics;
- Customer profitability: profitability analysis is the analysis of clients in accordance with the expected impact on the bank's profit, and thus the total return on equity (ROE);
- Cross-selling and up-selling: these types analysis enable assessing clients in terms of the ability to use several products and services simultaneously (loans, deposits, cards, e-banking, etc.);

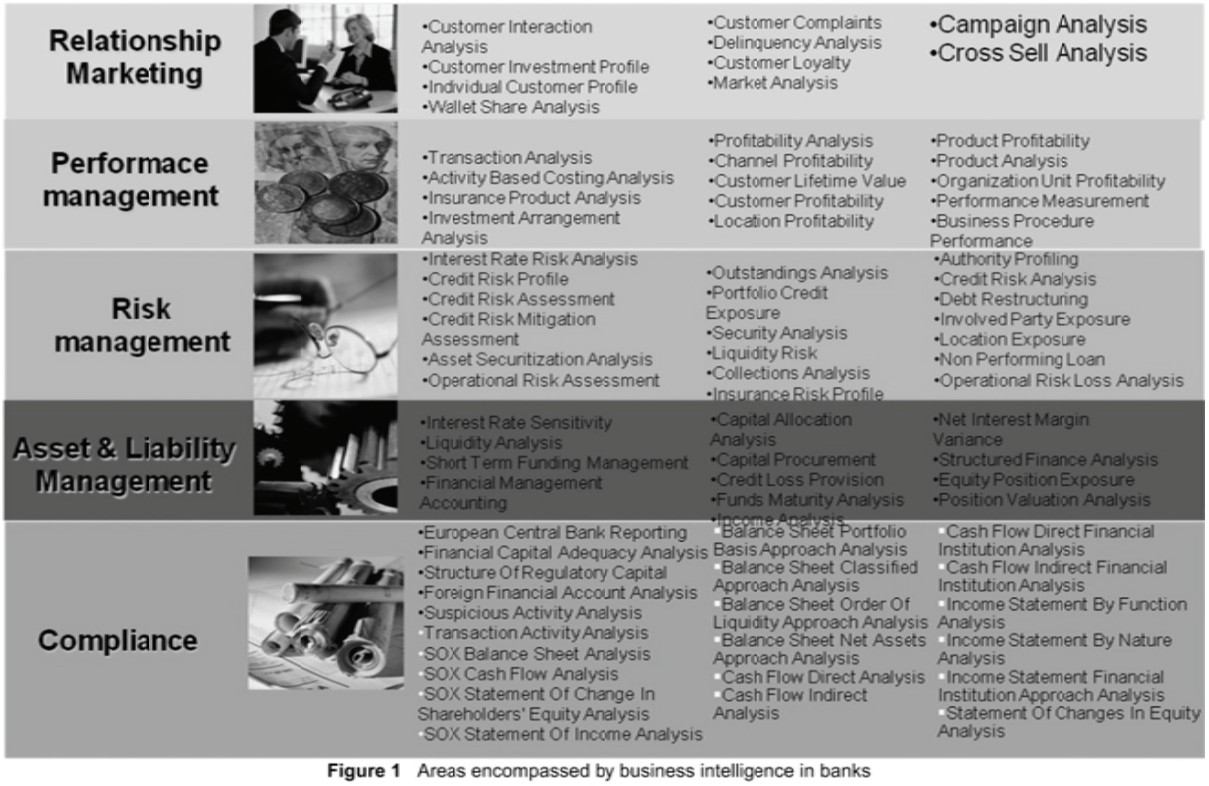

Figure 1 Areas encompassed by business intelligence in banks

Source: Ćirić and Mirčetić, 2008.

- Channel effectiveness: enables the identification and analysis of various channels for communication with clients and delivery of products through these channels;
- Campaign management: the main objective is to analyse and compare the effects of marketing campaign on the increase in client numbers, increase in the numbers and level sold products, earnings, etc.

Bank asset and liability management (ALM) is a process of managing a bank's liabilities and receivables, aimed at establishing profit and risk balance, establishing a relation between the liabilities and receivables, and controlling the impact of risk on the bank's operations and financial results. Business intelligence solutions for ALM should enable generating a complete set of internal reports – starting from balance sheets, liquidity analysis and cash flow, down to maturity and interest rate structure. In addition to these, they also include income structure analyses and analyses of long-term syndicated loan agreement analyses.

Risk management is a process in which a bank methodologically manages all the risk processing phases (identification, analysis, measurement, control and reporting) posing a threat to the achievement of its goals and individual business activities, so that the achieved risk level should not endanger the bank's safe and stable operation. Some of the risks faced by banks include credit risks, market risks, interest rate risks, foreign change risks, liquidity risks, operational risks, reputational risks, etc.

Credit risk is defined as the possibility that the client will not repay the loan taken from the bank within the terms agreed by contract. This risk can be defined more broadly – as a probability that the bank's credit portfolio will lose its value. The purpose of banking risk analysis solutions is to enable analysing credit risk analysis depending on how loan losses affect variations in the bank's profit. They include credit risk analysis, credit risk assessment and credit risk mitigation assessment. The solution should offer the possibility for setting measures for risk mitigation, i.e. identification of market segments, portfolio segments, transactions and clients. It also warns about the need for changing the limit, activating instruments for protection against risks and/or changing the strategic orientation in a market segment, a client, a business process or a product.

Some of the characteristic types of analysis BI solutions for credit risk management support should offer include (Ćirić & Mirčetić, 2008):

- Collections Analysis
- Credit Risk Assessment
- Credit Risk Mitigation Assessment
- Customer Credit Risk Profile
- Debt Restructure Analysis
- Involved Party Exposure
- Non Performing Loan Analysis
- Outstanding Analysis
- Portfolio Credit Exposure
- Security Analysis

Within their performance management tasks, managers monitor key business performance indicators through scorecard reports, used for continuous monitoring of the current balance with defined objectives. Scorecarding support solutions should provide users (notably managers) with rapid and efficient access to scorecards showing the key performance indicator values, alert them when these values exceed the allowed limits, and facilitate drill-down. In addition to the above mentioned reporting system, meeting performance management methodology requirements also requires providing an infrastructure to support the planning and budgeting process. This means that the system should support the possibility of defining the target values across of all dimensions of business operations (clients, products and organisational units), considering the time dimension (Mossimann & Conelly, 2007).

3. Business Intelligence System for Support to ALM Concept

3.1. The ALM Concept

In order to cope with the challenges of the market and competition successfully, a bank creates various strategies and methodologies, including a contemporary approach to managing the bank's assets and liabilities, in the form of the ALM concept. Rapid changes on the financial market cause rapid changes in the bank's balance sheet assets and liabilities, and their exposure to various risks, such as credit risk, foreign exchange risk and interest rate risk. For the purpose of protection and more efficient risk managements, banks opt for an integrated approach to managing the entire on-balance and off-balance structure. This creates conditions for linking projected risks to the coverage of high risks. Within the application of the ALM concept, bank management is obliged to

monitor daily changes in the structure of assets and liabilities, and limit the risks to which the bank is exposed. The fundamental task of the ALM concept is to establish the correlation between the risk and profitability of individual bank transactions. This is a method of preventing high risks, which can lead to losses in banks.

Introduction and application of the ALM concepts creates more flexible banking structures, capable of faster adaptation to all possible changes on the financial market. Hence, the function of the ALM concept is based on the requirement for providing satisfactory profitability levels in banks, efficient asset liability management, and control over the banking risk management (Vunjak & Kovačević, 2006).

3.2. Risk Management Within the ALM Concept

The purpose of risk management is to enable the bank to monitor and control the sizes and concentrations of risks resulting from its activities. The risk management process is conducted in several interconnected stages: risk exposure identification, risk evaluation and assessment, risk control, risk financing and risk management. The risk management process implies identifying and analysing all risks within the bank, defining appropriate risk limits, and monitoring risk limits via contemporary information systems in a controlled manner. (Boulier & Chambron, n.d.)

The application of the ALM concept requires the top management to continuously modify and enhance the risk management system, notably in the following banking risks:

- Market risks (interest rate change risk, currency risk i.e. exchange rate risk and capital market risks);
- Liquidity risks;
- Credit risks;
- Financial derivatives transactions risks; and
- Business, legal and financial risks.

Market risks stem from the risk of loss resulting from unfavourable changes on the financial market where the bank participates. The bank's exposure to market risk stems from fluctuations in interest rates and exchange rate courses on various markets where the bank participates. The key market risk management elements are (1) setting limits for loss rates and (2) setting limits for maximum risk exposure.

Banks are exposed to interest rate risk when the relationship between loan maturity dates and changes in exchange rates are not coordinated. To lower the level of a bank's exposure to interest rate risk, it is necessary to monitor constantly the positions of interest rate risks and the adopted short-term risk limits. Interest rate risk is monitored by using two types of analysis: gap analysis and sensitivity analysis. Gap analysis identifies mismatches between interest rates, whereas sensitivity analysis measures the impact of changes in return on the bank's assets and liabilities. Interest rate management requires good monitoring related to the structure of instrument, on both assets and liabilities side of the bank's balance sheet. This approach groups the interest-sensitive segments of assets and liabilities that are more or less exposed to risk, so that the bank management can calculate the size of disparity for each maturity group.

Currency risk or exchange rate risk occurs in cases of changes in foreign currency exchange rates. Contemporary banking is characterised by growing foreign exchange risk, caused by the growing involvement of banks in foreign exchange transactions dominated by floating exchange rates. It is for this reason that the ALM concept should follow the foreign exchange risk, depending on whether the currency has appreciated or depreciated, i.e. whether the bank's balance sheet in this currency is positive or negative.

Credit risk is the basic risk encountered by banks in their business operations. It occurs when the debtors are unable to repay loans with the interest due on their maturity date. ALM is used by the top management so that the bank can complete the approval procedure, monitor and control the credit risk.

The past experience from developing countries indicates that banks can efficiently manage credit risk by:

- Using limits (risky to total assets ratio, cash to total assets ratio, capital reserve ratio);
- Rigorous selection of loan applications;
- Diversification of asset loan placements;
- Security instruments.

The correlation between the credit risk and the ALM concept also occurs when negotiating interest rates for approved loans.

Business risk may result from a whole range of factors, such as irregularly documented transatctions, inappropriate business and information procedures, flaws in information technologies, or human error. The application of ALM concept enables internal revision and internal audit and thus managing the potential business risks.

Liquidity is one of the fundamental principles of doing business in banking and denotes the bank's ability to meet its current financial obligations continuously. The essence of liquidity is manifested in disposal of liquid assets, meaning that the bank can, at any given moment, meet its current due liabilities to depositors ad creditors. Liquidity risk is the risk from the occurrence of adverse effects on the bank's financial performance and capital due to the bank's inability to meet its due obligations. Contemporary bank management in the ALM concept approaches the position of bank liquidity from the structural aspect: the assets are classfied into liquid and non-liquid, and liabilites into varialbe and fixed, with the aim to identify the bank's possible liquidity requirements and level of it liquid resources. Liquidity risk management is one of the bank's key activities in its regular day-to-day operation and maintaining overal stability.

3.3. Information Support to the ALM Concept

Bearing in mind the above described range encompassed by the ALM concept, it can be infrerred that the success and efficiency of the modern asset and liability concept stems from the following preconditions:

- that the bank has good monitoring of its on-balance and off-balance items, and
- that the bank management assesses continuously whether the achieved value of items on the asset and liability sides shows dicrepancies from the expected value, and adjusts these discrepancies towards the expected values accordingly.

Both prerequisites imply a developed management information system in the bank, without which it would be impossible to implement the ALM concept. The decision-making process within the ALM concept is based on a large amount of high-quality, reliable data, translated into useful information by means of certain analytic processes. The data generated in the bank's basic information system are inadequate, as they are not in a form necessary for complex reports required by the application of the ALM concept. For instance, a bank that wishes to manage its liquidity position efficiently and effectively throughout the year should provide for a projection of data for the forthcoming period within its annual operative business plan. Projections generate data on the planned known and unknown capital inflow and outlow by volume and structure in the bank's planned liquidity position. The data on the known inflows and outflow exist within the bank and must be regularly updated with new changes. As for the unknown inflows and outflows, the bank should make a projection of these changes in the forthcoming period (Ćurčić, 1999).

The above mentioned projections, together with other required data, are provided at the BI system level, more precisely, in the above mentioned analytic database. These data are gathered and organised so as to be readily available and enable the management and the staff to use them quickly and simply for the needs of a large number of analyses required by the ALM concept itself. The analytic database also serves as the source data fed to special applications – Application Solution Templates (ASTs), built specially for individual areas. The most common examples of these "smart" applications are ALM applications, designed based on complex financial and mathematic models.

In most cases, ALM software solutions provide for the following activities:

- Portfolio evaluation;
- Cash flow analysis, interest rate income analysis and fund transfer pricing analysis;
- Liquidity analysis;
- Calculating capital requirements for market risk, etc.

Portfolio analysis enables calculating portfolio value on the evaluation date, taking into account the terms and conditions of contracts from portfolio items, for current and/or scenario-simulated interest values, currency exchange rates and liquidity flows. The basis for calculation is the total cash flow of all items comprising the porfolio until their final maturity date, within the period we wish to analyse.

Portfolio evaluation provides information such as:

- The current nominal value of all capital and interest flows in the portfolio, under the contract terms and conditions currently in force;
- The current discounted net value of all capital and interest flows in the portfolio, under the contract terms and conditions currently in force, as shown by the reference interest rate curve;
- The value of capital, income and expenditure compared to planned amounts;

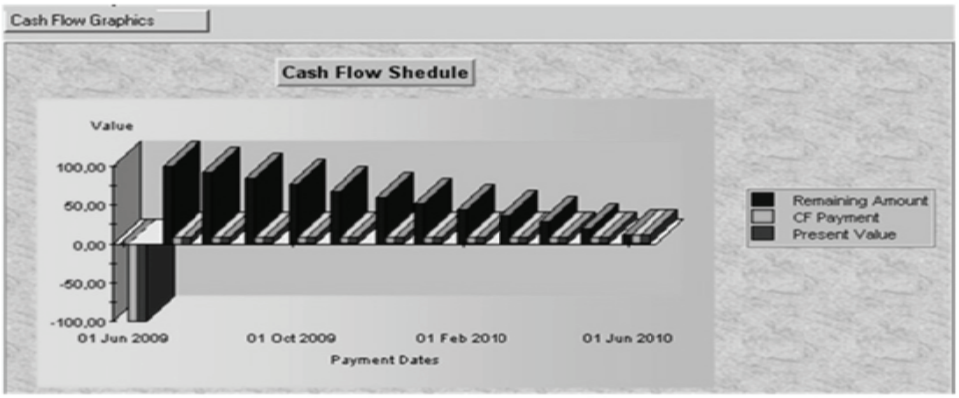

Figure 2 ALM – Cash flow analysis

- The portfolio's sensitivity to possible changes in interest or currency exchange rates, i.e. how much the portfolio's value will change per basis point of changing interest rates (Interest Rate Sensitivity Analysis).

Cash flow analysis calculates the value of capital and interest cash flows, and provides information on the nominal value of capital and interest cash flows, as well as the net current value of cash flows. Cash flow analysis also offers the possibility of compiling gap analyses.

Interest rate income analysis provides information on:

- The average amount of interest over a given observation period, divided into custom time intervals within the analytic scheme;
- Average interest rate;
- interest rate
- Variation of interest income in relation to changes in interest rates (Net Interest Margin Valiance);
- Conditional margin (difference between the interest rates contracted with clients and the opportunity interest rate);
- Transformation margin (difference between the opportunity interest rate on a portfolio or an item and the base rate of interest.

Liquidity analysis provides information on:

- The bank's current and projected liquidity position;
- Effects of simulated liquidity stress tests;
- Maximum gain or loss on a portfolio or item, by means of various liquidity scenarios and assumed values of exchange and interest rates;
- Absolute maturity of principal and interest on all portfolio items analyses over the chosen period;
- Liquidity gap (numeric and graphic) and liquidity ratio;
- Deposit maturity; etc.

4. Business Intelligence System Architecture in the Banking Industry

The architecture of a bank's business intelligence system is very heterogeneous and comprises several layers (Figure 4):

- Operational database and external data;
- The data integration and transformation layers;
- The data warehouse layer;
- The data access layer (applications, OLAP, data mining, etc); and
- The front end (layer for access to information).

Operational (transactional) databases are created to meet the needs of day-to-day operation.

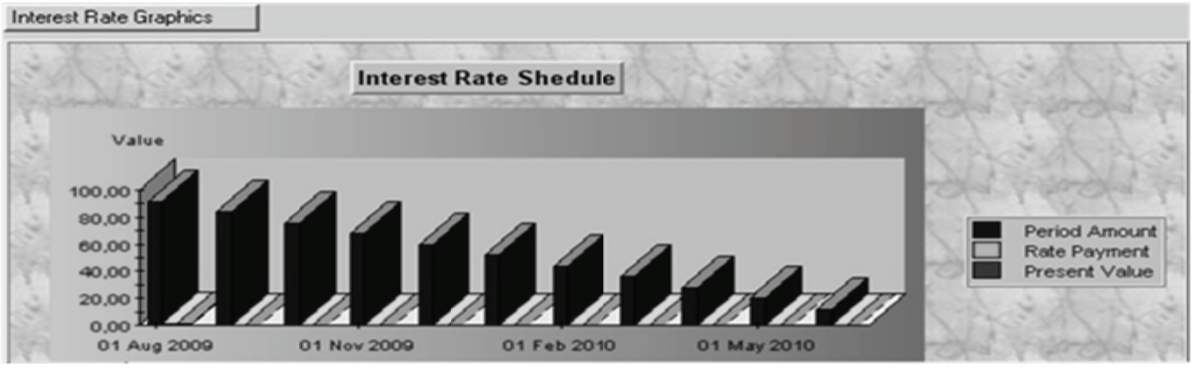

Figure 3 Exchange rate income analysis

The bank's transactional data processing system, i.e. OnLine Transaction Processing (OLTP) is the bank's basic information system. Its role is to support daily business transaction activities (entering and processing payment orders, entering and processing deposit and loan contracts, recording transactions, commission processing and interest rate transactions, etc.).

The data integration and transformation layer includes processes transforming data from operational and external sources into a form suitable for database storage. They are referred to cumulatively as Extract Transform and Load (ETL) processes.

A data warehouse (DW) is an alaytical database used as the basis for BI systems, designed for large amounts of data in a manner enabling simple and efficient data management for purpose of creating information required in the decision-making process.

The term OLAP (OnLine Analytical Processing) refers to the category of software technology enabling users (such as analysts, managers etc.) to gain insight into data in a quick, consistent and interactive. OLAP is the database's interface and a form of data processing which enables the user to extract data quickly and easily, and translate them into information in an almost unlimited number of ways. OLAP reports may take the form of regulatory status reports or multidimensional analyses, but they can also be presented in particularly effective formats such as key performance indicators (the Balanced Scorecard).

Data mining (DM) is the proces of exploring and analysing meaningful stacks and rules. Data mining uses techniques and algorithms from the areas of statistics and artificial inteligence to find significant hidden stacks in large data sets. Data mining can be very useful in the banking industry and there are numerous instances of their application. For example, based on the clients' characteristcs, the bank may forecast which of them could use certain services and target their marketing campaign at this narrow segment, thus reducing costs and increasing customer loyalty. In addition, based on historic data, a bank may define characteristics of clients who are unlikely to repay the loan and thus reduce operational risks. It is certain that a bank already has developed methods for earmarking clients who could use additional products, as well as methods of detecting potential bad debtors.

The layer for acces to information interacts directly with end users. In essence, this layer contains tools and applications used daily by the end users. As technology develops, these tools tend to become increasingly sophisticated and offer numerous opportunities for manipulating, analysing and presenting information, always characterised by intuitive, easy-to-use and visually appealing user interface.

Contemporary practices use the following forms of accessing and presenting information:

- Reports are the basic form of presentation. They are usually static, have minimum analytic requirements, and are usually generated with classical SQL queries. Reports can answer

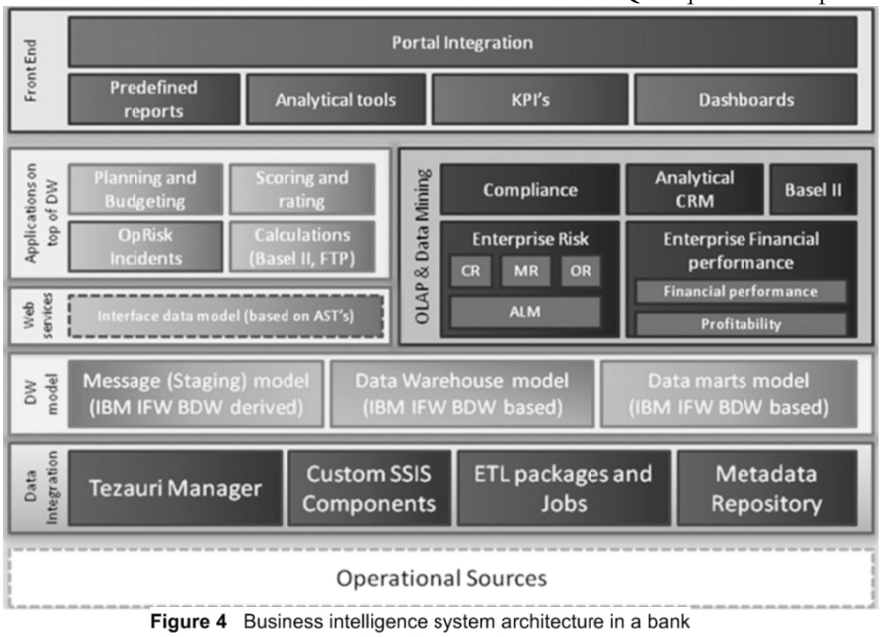

Figure 4 Business intelligence system architecture in a bank

Source: Ćirić & Mirčetić, 2008

classical banking queries, such as, "How many outstanding loans are and what is their total value?"
- Analyses meet the demands of far more complex queries (related to time, clients, products, distribution channels etc.), for instance, "What is the percentage of change in loan levels, compared with the same period last year, for each of the top 5 products, for each of top 10 clients?"
- Scorecard tables enable content-based and visual monitoring of key performance indicators, which can be used at any time for comparing and controlling the match between the current state and the defined target performances.
- Dashboards integrate all information required for decision making in one place, whether in the form of reorts, analyses, or scorecard tables, enabling personalisaton for each individual user or decision maker. Dashboards are abundant in graphic data representation, and are especially useful for top decision makers, providing easy and quick access to all key data and their trends.

5. Conclusion

The need to meet the increasingly complex demands posed by clients and the market, the need for automated business operations, more efficient process management and control in the contemporary banking industry is also related to the need for an adequate information system. The basic banking information systems are continuously developed and advanced so as to meet some of these demands. However, in order to make full use of the enormous potential generated in the basic information system on a daily basis, they require upgrades in the form of business intelligence systems. In additon to integrated insight into historic data, BI systems also enable banks to anticipate future behaviour of the system and most of their business indicators. They also enable modelling client behaviour – not only in terms of using new services but also from the perspective of potential risks. A characteristic instance of application of BI system support to high-quality and timely decision making is asset and liability management. In order to provide information support for contemporary ALM concept, software should enable projecting and calculating the future values of portfolios, liquidity, cash flows, down to providing projections of balance sheets and profit-and-loss accounts at all levels.

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