



LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

Department of Information Technology

Choosing a platform for a billing system

The subject of this Master's thesis was approved by the department council of the Department of Information Technology on _____.

Examiners: Professor Kari Smolander

Supervisor : M.Sc. Alexander Bern

Lappeenranta, 16.04.2008

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Vassiliy Kornev

Karankokatu 4 A 3

53810 Lappeenranta

Finland

ABSTRACT

Lappeenranta University of Technology

Department of Information Technology

Vassiliy Kornev

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Master's Thesis, 2008

49 pages, 8 figures and 15 tables

Examiners: Professor Kari Smolander

Keywords: Platform, billing system, software development, information
technology (IT)

Enterprises have a need in use of billing. Before actual choose of a billing system an appropriate platform has to be deployed.

This work presents a study of a platform choosing for a billing system and shows the role of optimally chosen platform. In evaluation of a platform several criteria were considered: cost, scalability, reliability, safety, usability, portability and efficiency.

In the thesis three different platforms MAC OS, Linux and MS Windows were studied. The results of the evaluation of each platform are shown and according to this results the most suitable platform for a billing system was chosen

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1. Introduction

1.1. Background

Billing system (BS) is a system realizing accounting of consumable services by subscribers, calculation and allowances of cash assets. It is aimed for calculation of services' costs or goods based on the tariff. Also it is used to bill and close the accounts. [1]

Prototypes of the modern electronic BS were born together with expansion of modern computers some tens years ago.[3]. Hence, 1868 can be mentioned as the date of the first BS. One system is used for calculation telegraphic communication statements between telegraph offices. The first electronic invoice appeared in 1918 when Fedwire payment system was created. This facility linked the twelve Federal Reserve banks across the U.S.A over leased telegraph lines to electronically settle central bank balances.[2] Calculations between the enterprises with the help of electronic transactions, instead of the traditional scheme of calculations are now in great use everywhere. The aspiration to simplify process of payment as much as possible is natural, to make it's as much as possible convenient for the client.

Every company has a specific character which has to be considered when a billing system is selected or developed. The solution can be good for some companies and a disaster for others. There are solutions providing required functionality, quick installation but their prices are unjustified high. Forcible argument for a development of an own BS is price of the prototypes and imperfection of cheap or average solutions. When developing a BS one of the main questions which arise is to select a platform.

The author of the paper considers three platforms (Microsoft, LINUX and MAC) and all aspects concerning this selection. Platform is a system on which programs operate. [4] Nowadays, almost all billing procedures between companies operate either offline (connected to the local network) or on-line

(connected to the internet) bill presentment platforms. Offline bills, for now, are often passed from branch to branch for approval. In other case (there are no connections at all), the procedure is slowed. [5]

As a rule, some area requires a development of an independent highly adjusted BS for own needs. Correct selection of BS and operating platform is an essential point for profitability of a company. BS allows analyzing company productivity and becomes a tool for improvement of company processes. Customer retention and vender abilities depend on reliability of BS and platform. For instance, fast and accurate receiving of statistic sales figures, customer transactions and activity of the client helps to define new ways of the company development, plan actions of the service technical improvement, to react on new customer's request. These are very important for a company.

One of the most important aspects of using a BS is selecting an appropriate platform. There is a broad range of platforms in the market. Factors to consider include the functionality available within the platform, security, IT issues and cost considerations. Selecting the right platform for the project is the necessary task for achieving these objectives.

1.2. Objectives

The main aims of this study are to evaluate and to select the optimal platform for a BS. These objectives are based on formalized system and specific project which allow increasing efficiency and quality of service. The project considers a BS.

The list of tasks to study:

- Researching Design Company – to consider a company structure;
- Researching business process of the Company – to consider how a system of the sequent, purposeful and regulated kinds of activity that are being input the process will be transformed to outputs (the results of process) which are of value for the customers;

- Researching quality assessment criteria of platform – to consider and select criteria which meet valid requirements for the BS;
- Assessment and selection optimal platform for the BS – evaluate several different platforms and select the best fitted platform for the BS on basis of selected criteria.

1.3. Methods of the study

Methodological basis of study consists of data collection, comparative analysis of the different platforms (basic quality characteristic were taken from ISO 9126 and evaluated for every taken platform); study of the business process of the Company, scientific publications and articles review. Platforms Linux, Windows, Mac OS X were evaluated by cost. It gives possibility to optimize operation's speed, quality of service, cost of development and exploitation BS.

1.4. Structure

This thesis is composed of seven chapters. Chapter 2 describes motivation for evaluation platform for BS. Chapter 3 describes role of the optimal platform. Chapter 4 presents a business process of Company "X". Chapter 5 defines company requirements. Chapter 6 presents quality criteria of operating system. Chapter 6 illustrates a selection of the optimal platform. Finally, Chapter 7 gives the conclusions of the study.

2. Motivation of evaluation

The project cost depends on chosen solution, set and complexity of functional modules, number of licenses and duration of project realization. Selection of platform might suppose money availability, because some platforms, components, application tools are free, cost of the development and administration of the BS also differ for platforms. We also should take into account inactivity of the company applying a BS in industry. If the BS is organized in a complicated manner the Company suffers additional losses for its realization.

BS can be used in different areas. Billing presents where a relationship between customer and salesman exist. Example of using a BS is a telecommunication where we have a deal with an enormous number of the transactions which are not possible to trace and service manually; and regular account has already digital nature and doesn't need a basic part of the information to be input manually. [6] BS is unavoidable in all industrial and business areas: electrical, insurance [8], transportation [9], rent-a-car, cable TV [10], community services, medicine [11], etc.

Software is executed on some hardware. Resulting system presents combination of software and hardware. The combination gives characteristics: safety and performance of the company. Therefore we select the optimal¹ platform which is compatible with different hardware. So, if we take Mac Os X developed by Apple Company which supports only computers Macintosh - we may lose; in comparison with the platforms Windows and LINUX supporting wide range hardware.

BS of Energy Company was realized on basis of Microsoft components. This project was published by Microsoft in the case study. The case study realizes a billing system for power company CHESK. I will evaluate platform which was picked in the project and compare alternatives LINUX and MAC OS X. For

¹Optimal platform is the best fitted platform for the BS on basis of selected criteria.

construction the BS Microsoft Company program components have been used. These components are listed in the first column of Table 1.

#	Windows	Linux	MAC OS X
1	Microsoft SQL Server 2000 Price 3,700 Support: all included	MySQL-5.0 Price FREE Commercial Support	MySQL-5.0 Price FREE Commercial Support
2	Microsoft Visual Studio .NET Price \$799 Support: all included	DotGNU Price FREE Commercial Support	DotGNU Price FREE Commercial Support
3	Microsoft Windows Server 2003 Price \$999 Support: all included	Red Hat Enterprise Linux Price \$ 2 499 Support: all included	Mac OS X Server v10.4.7 "Tiger" Price \$540 Support: all included
4	Active Directory component of Microsoft Windows Server 2003 Support: all included	Ldap Price FREE Support \$6250	Ldap Price FREE Support \$6250
5	Microsoft Certificate Services component of Microsoft Windows Server 2003 Support: all included	eToken PKI Client 3.65 Price € 3.142,4 Support: all included	eToken PKI Client 3.65 Price € 3.142,4 Support: all included
6	Microsoft SQL Server 2000 Reporting Services 2.0 component of Microsoft Windows Server 2003 Support: all included	MicroStrategy 7i (7.5.2) Price \$795 Commercial Support	MicroStrategy 7i (7.5.2) Price \$795 Commercial Support

7	Microsoft SQL Server 2000 Analysis Services component of Microsoft Windows Server 2003 Support: all included	MicroStrategy 7i (7.5.2) Price \$795 Commercial Support	MicroStrategy 7i (7.5.2) Price \$795 Commercial Support
8	Microsoft Internet Explorer component of OS Windows Support: all included	Firefox Price FREE Support FREE	Camino 1.5.1 Price FREE Support FREE
9	Microsoft SharePoint Services component of the Windows Server 2003 Support: all included	IBM Workplace for Business Controls and Reporting ² Price \$29600 Support: all included	IBM Workplace for Business Controls and Reporting Price \$29600 Support: all included
10	Microsoft .NET Framework 1.1 Price FREE Support: all included	DotGNU Price FREE Commercial Support	DotGNU Price FREE Commercial Support
11	IntraTools (The tool was developed for easy business process building.) Price \$6000 Support: all included	ArgoUML (WORKS ALSO IN WINDOWS) Price FREE Commercial Support	ArgoUML (WORKS ALSO IN WINDOWS) Price FREE Commercial Support
12	Microsoft Windows XP Professional SP2 Price \$299 Support: all included	Ubuntu 6.06 LTS Price FREE Support: \$4000	Mac OS X 10.5 (Leopard) Price \$129 Support: all included

Table 1. Analogue products for different platforms.

² Workplace for Business Controls and Reporting is provided here because analogues of Microsoft SharePoint Services is absent for Linux and MAC OS X.

For the platforms comparison and evaluation I have picked up analogous products of Microsoft for Linux and Mac OS X platforms. Analogues are listed in the neighbor columns. Cost of the license and support of each software product is also listed in the table 1.

2.1. When to evaluate a platform for a BS?

This chapter discusses time when a platform for a BS should be evaluated.

A correct choose of an optimal platform makes BS better and clearer. For example, optimal platform allows reducing the price; build a safe system and understandable interface for users. There are many methodologies for evaluation software. When we developed a BS, we should not copy blindly a structure of BS that was driven to success. Some architecture is success for some company; other can lead to failure. It is necessary to understand final is high-quality software and using methods, methodologies, standards, systems are just essential tools for achievement problem. Further gives expert opinion about stage of the software evaluation.

“Our primary recommendations are that an evaluation be held as early as possible in the life cycle of the project, and that the evaluation be conducted as a formal review. Ideally, such a review is held early enough so that decisions that have been made can be revoked without extensive cost, but late enough so that bindings to hardware have been made so that performance characteristics of the system can be analyzed. This places the evaluation somewhere in the early phases of high-level system design“. [12]

3. Company Requirements

As obligatory requirements for BS the company defines following criteria for choosing platform [23]:

- Cost
- Scalability
- Reliability
- Safety
- Usability
- Portability
- Efficiency

Requirements listed above should have high value. The best fitted platform is a platform with the highest value of criteria in sum.

For performance of the customer requirements it is necessary to construct the effective and safe infrastructure uniting all branches (Figure 1 p. 14). System topology of the company “X” is illustrated by Figure 2 p. 15.

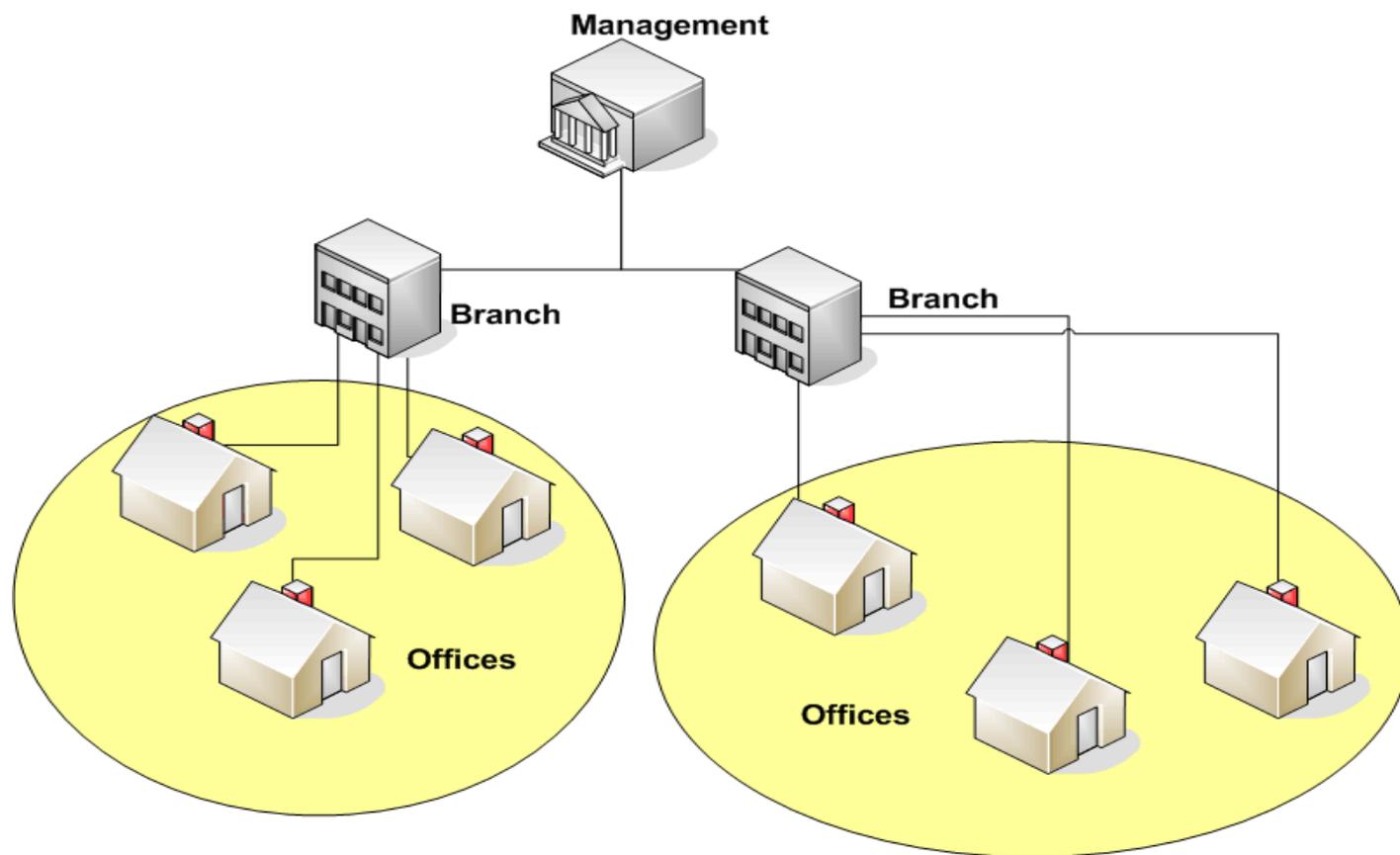


Figure 1. Topology of the Company Organization

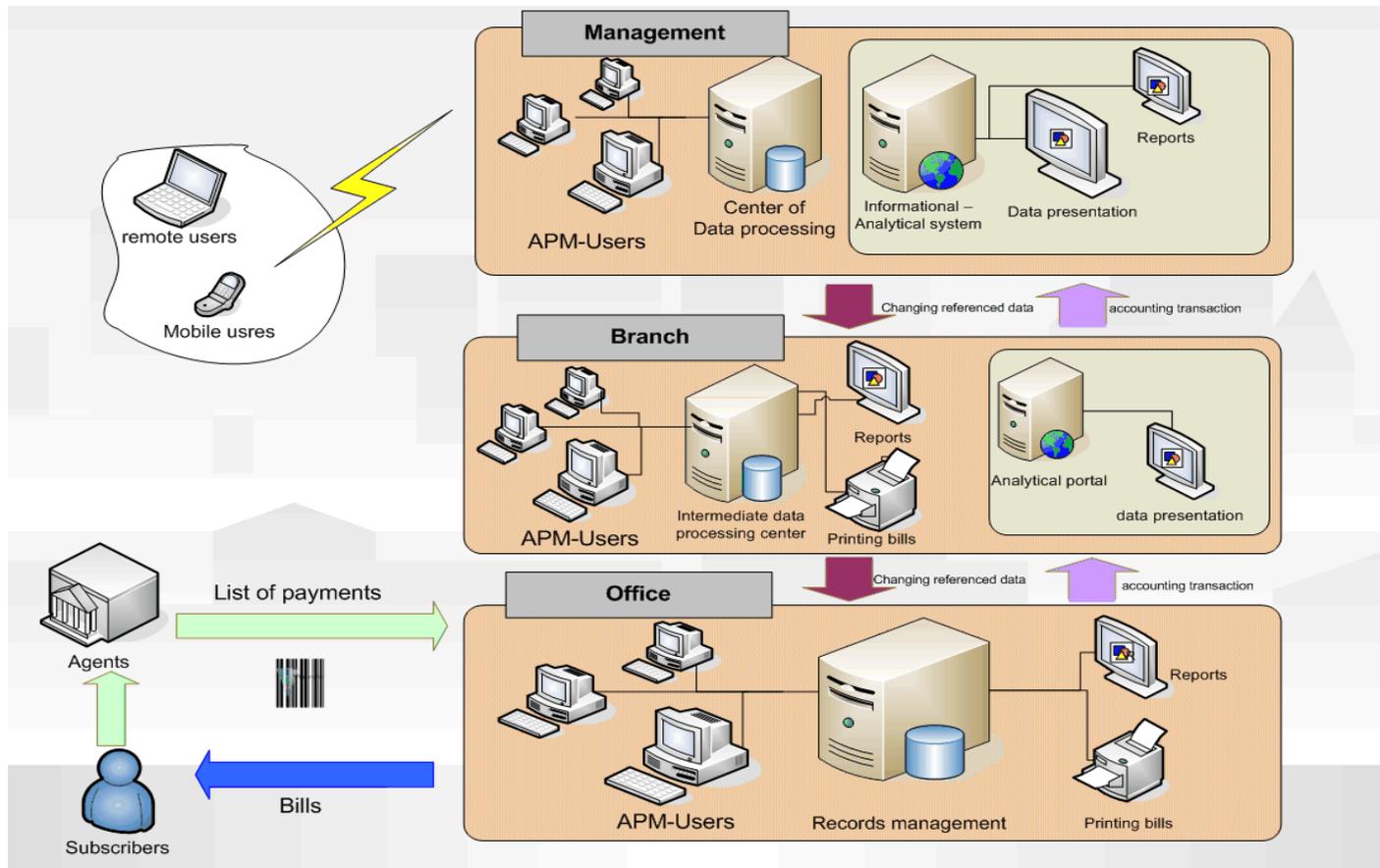


Figure 2. System topology
Source: CHSK Company

4. Scheme of the business process

Energy Company (Company “X”) is being considered in the thesis. For development BS it is necessary to describe a structure of Company “X” business processes. The basis activities of Company “X” are [16]:

- Purchase electric energy on wholesale and the retail markets of electric energy;
- Sale of electric energy to consumers (including citizens);
- Rendering services to inhabitants from offices (Gathering payments for the sold goods and rendered services);
- Diagnostics, operation, maintains, replacement and testing active energy meter, calculation of consumed electric and thermal energy;
- Rendering public utilities to inhabitants;
- Development, organization energy-efficient actions.

The business processes of the Company “X” is illustrated by Figure 3 p. 17.

The business process shown in Figure 3 consists of the following steps [17].

1. A customer contacts to “The BUSINESS” and initiates an order for rendering services or goods.
2. The Order control system grasps details of the order from the customer. The Order control system checks that this client has placed enough information to get goods or services. If information is not enough a staff member inputs missing information to the database. The order is marked in a database as “order in process” and it is sent to supplier.
3. Customer is told that the order is received and it is being processed. Supplier notifies the Employee about the status of the order.

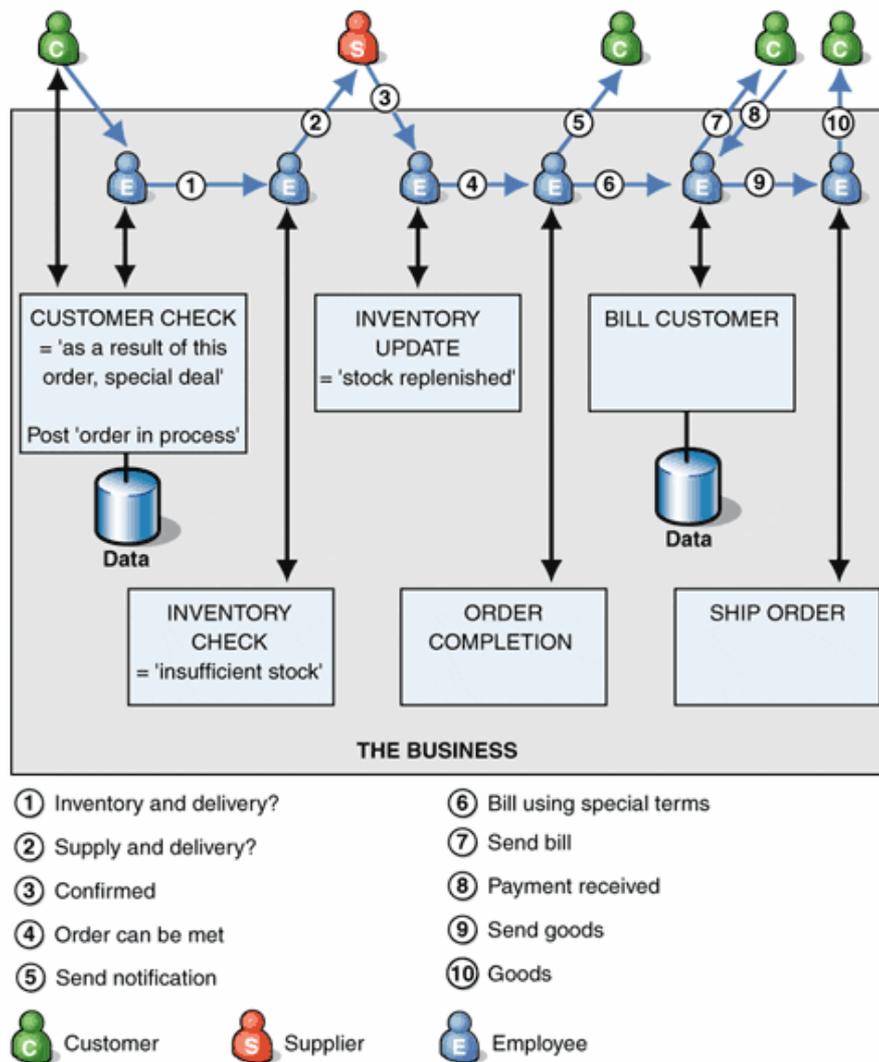


Figure 3. Model of a complex business process
Source: Microsoft Corporation [35]

- Employee starts inquiry to check up availability a service or goods and identifies delivering terms.
- Employee informs Customer person-to-person by e-mail, by other mean of communication (a written note, a phone call) about status of the order and produces a bill to be paid in advance. Key details are input into the database of the order Completion.
- Employee checks if the customer has any debts.
- In case there are any debts billing repeatedly calculates the bill, updates a database of billing, Employee informs about it and produces a bill with final date to be paid. This bill can be sent by e-mail or by a standard post.

In case of debts absence Customer will get his services or goods on the date specified in the bill.

8. Customer has paid the bill.
9. Employee updates the information in the database, checks if the orders are paid, and if so notifies the Order Management department to fulfill the order on the date that the Supplier has promised.
10. Employee from the Service department schedules the delivering date and notifies the Customer about it.

5. An optimal platform role

This chapter describes general and significant criteria of platform influencing on the cost of the system development, installation and configuration, duration of the system development and software installation. Herein I picked out seven criteria of evaluation and selection of an optimal platform:

- Cost
- Scalability
- Reliability
- Safety
- Usability
- Portability
- Efficiency

They are taken from ISO 9126³ [36] and characterize quality of software.

³ ISO 9126 is an international standard for the evaluation of software quality.

5.1. Cost

The system cost considerably depends on its components. Comparison and selection of the platforms give possibility to select architecture with minimal expenses. Optimal platform allow cutting time of the software development based on evaluation labor-intensiveness of functional blocks. Technology cost can be a significant part of the BS and have to be considered when selecting a platform. Cost contains from the following items:

- Software license.
- Updating system.
- Training and support: Some vendors charge nominal fees for these services.
- Universal platform or application software. Platform which supports broad range of languages and functions on all hardware configurations, automatically upgrades as needed and is guaranteed to improve your work process, productivity from the moment you install it. Costs may be less with a universal platform.

I evaluate different platforms for BS, and goal of evaluation is to select optimal BS for a specific practical task. The result of evaluation may reduce expenses when a new system will be developed for some specific task mentioned above.

One should remember that license is only one components of the cost. The aggregate cost of the platform and BS make together installation and technical support. Before the license will be bought it is useful to know if it includes technical support, consultation of specialists, old error correction and updating the system.

- **License.** In connection with the fact the software product can have insufficient or superfluous functionality it is necessary to specify attentively each point of software specification in the contract to define precisely which software will be supplied by developers. This action has to exclude a situation when functionality of the unified system will be provided by a great number of software products, otherwise every of them require separate license.

- **Cost of additional software.** Basic configuration of the system without additional modules often does not respond to all functional and technical requirements. This information has to be known before license was bought. If exterior software is used you should know cost and possibility to buy the license.
- **Cost of installation.** Basic installation usually is cheaper then installation made by exterior consultants. Basic criteria of an optimal platform choice are specialists' skills and knowledge and also their labor cost (outsourcing and own specialists). There is a possibility to minimize expenses if qualification of own specialists allow to make installation by their own forces.
- **Cost of technical support.** It depends on who provides the technical support - either supplier or developer. In case if the technical support is provided by a foreign company it is preferably and will be more efficiently to choose the company located close to the Company "X". Also there is an important item to be considered: it is the way of system updating and error correction - from web-site, by e-mail or private visit.
- **Time of installation.** It is necessary to provide time for stuff training, installation and checking the system. The period of the system installation has also to be specified in the contract for it influences on the system cost.

5.2. Scalability

Scalability is a property of the computing system which provides predicted growth of system characteristics, for example, numbers of supported users, speed of reaction, the general productivity and so forth, when new computing resources are add.[18] In case of server database management system (DBMS) it is possible to consider two ways of scaling - vertical and horizontal (Figure 4). Horizontal scaling increases the number of servers DBMS, probably, cooperating with each other in a transparent mode⁴, dividing thus the general loading of

⁴ Transparent mode is a method (process), application (execution) which is not visible for user or program.

system. Such decision, probably, will be more and more popular with growth of support loosely-coupled architecture⁵ and the distributed databases, however usually it is characterized by complicated system administration. [18]

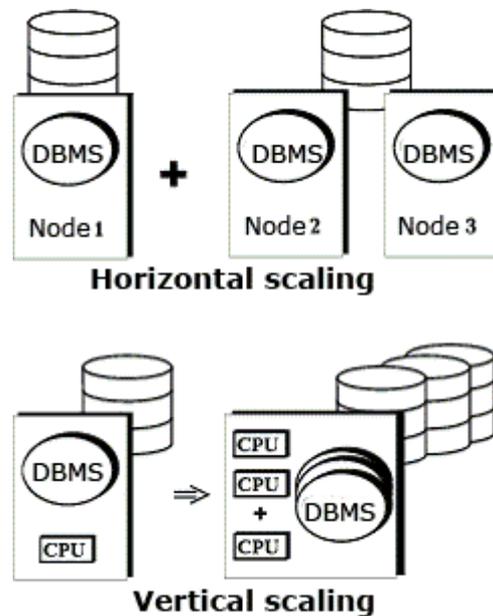


Figure 4. Scalability Methods of DBMS.

Source: Computer Architecture News [18]

Vertical scaling means increasing capacity of separate server DBMS and it is reached by replacement of hardware maintenance (the processor, disks) by more high-speed one or adding of additional units. As result a vertical scaling leads to increasing a number of processors in symmetric multiprocessing (SMP) platforms.

Thus the software of a server should remain the same (in particular, if it is impossible to purchase additional modules) as it would increase complexity of administration and make worse the system predictability. Benefits of either vertical or horizontal scalability are defined by completeness of using the available source of the computer [18].

⁵ Loosely-coupled architecture is architecture of the spitted disk which interacts with several processors without using of common memory. Every processor executes independently of others.[30]

Property of scalability is relevant by two principal reasons. First of all, conditions of modern business vary so quickly and it is impossible to predict changes of hardware. Instead of long-term planning gradual strategy comes; when information systems capacity grow step-by-step.

On the other hand, changes in technology lead to occurrence of new solutions and to reduction of prices on hardware maintenance, which potentially does architecture of information systems more flexible.

5.3. Reliability

Reliability is an ability of the software product to operate without errors when the certain functions take place under the set conditions during the set period of time with predictable result. [18]

System low reliability sources are programmers' errors made on development stage and not corrected during the program compilation. A program is correct if it does not have any errors. This program gives correct results thus it is absolutely reliable. Wrong result can be consequence of several errors. Errors can compensate each other and after correction of some of them the program will function worse. Therefore reliability characterizes frequency of error appearance but do not number of errors. Errors appear with different frequency; some errors are overlooked after a long period of service.

5.4. Safety

The special security system is a method which surely protects interests of business from inside and outside threats. Safety of the data is one of the significant aspects of the company security. Different methods of security are being applied. File Integrity and Secure Execution allow administrator to trace changes, get warning about security violation and prevent occurrence. User and Process Rights Management decrease problem of work with BS. [14]

Nowadays a special attention is being paid to the security of a company. Safety data storage and transmission secure a company against losses of important data and industrial espionage. Good security of the company helps business; bad safety can have catastrophic consequences for shareholders. For prevention of dangerous cases the following actions are undertaken:

- Restriction of physical access to a network;
- Differentiation of access rights to the operative information for employees;
- Restriction of access to archive, protection of archive against damage by water and other reasons which can entail losses or damage of original documents. [19]

5.5. Usability

Usability is simplicity and convenience in a program usage. This requirement concerns, first of all, the user's interface. This criterion includes lucidity, attraction of the software using and learning capability of the users. Though this is a subjective estimation of software but some attributes of usability can be evaluated numerically as for: by labor-intensiveness, duration of operation executions, also it can be evaluated by amount of necessary literature to be studied before using the software.

When we introduce a new BS the staff of the company is required a lot of time to be taught and acquired habits of work in the BS. If staff of the company spends more time for getting used to the software the company suffers more losses in adaptation period. Best comprehensive platform provides the user maximum comfort in hand. Possibility to work in a usual environment allows using usual methods of work and reduces task time. It is important to lay out some goals for the software framework. They should be:

- Clear – Simple and understandable logic of the program which allow to find information and make effective operations.
- Useful - Define methods that can help make practical decisions.
- Valuable - The framework should ensure that information technology is supporting the business. [13]

5.6. Portability

This is an opportunity of integration with external programs and equipment on the basis of the conventional open standards and reports of data transmission; to create, to process and exchange data of various formats, to support various reports of an exchange, to support standards of interaction with other subsystems. [20]

5.7. Efficiency

Efficiency is a property of the software which provides required performance taking into account number of used computer power. [21]

There is a list of efficiency parameters which software should have:

- Running with hardware independent operating system;
- Operating system tasks;
- Automation configuration and business workflow processes;
- Selection, modification of configurable parameters;
- Configuration of data import programs;
- Possibility to operate quickly and efficiently, with acceptable system performance;
- Real time processing;
- Running on industry standard hardware.

Situation with automated service is an ideal situation because service is an essential part of the working time of IT and Business employees. Thus, unfortunately real work of the company interrupts while OS, antivirus is being updated, or while waiting the moment problem is being solved. [15]

Evaluation and selection of an optimal platform for BS Company “X” will be considered in the thesis. Selection consists of three possible choices: Linux, Windows and Mac OS X.

6. Evaluation

This chapter discusses process evaluation and selection of the optimal platform based on requirements of the Company. Also, hereunder components which contain a selected architecture are described. Comparison analyses of platforms components are made. My task is to select optimal platform on two management levels: lower one - a branch level and upper one – a management level (Figure 2 p. 15). Selection consists of three platforms: Windows, Mac OS X and Linux. First of all I define which platform requires fewer investments, then reliability, safety and so on.

Thus, each platform criterion will be evaluated by the following grades:

Grade	Description
1	The final information system incorporating an integration platform will not correspond to BS since the integration platform has the restrictions connected with required performance based on criterion set.
2	The integration platform does not support the set function, but allows BS to execute the required criterion, at observance of some conditions.
3	The set functionality is supported by an integration platform partially.
4	The set functionality is supported by an integration platform totally.

Table 2. Grades

6.1. Cost evaluation

We have to know the cost of every component which contains the BS for assessment of advantage investment. Table 1 (p. 10-11) shows us a cost of the components necessity for development and building architecture of the BS. There are three alternatives of platforms for the BS-Windows, MAC OS X and LINUX. BS on basis of Windows platform has been already developed. My goal is to compare these platforms and choose an optimal one. The selection is made on functionality and cost criteria. I evaluate platforms for the further

development a new BS. It helps to understand which platform is a favorable, to measure cost, choice, performance, and security.

From Table 1 we see that many architecture components existed on basis platform LINUX and Mac Os X. Lots of them are spread for free. Some components can be exceeded overall cost of the system on basis Windows platform. But alternatives MAC OS X and LINUX did not have such functionality as components of Microsoft SQL Server 2000 Reporting Services 2.0, Microsoft SQL Server 2000 Analysis Services. For functionality provision additional development is required. In its turn it can lead to development time and BS price increasing.

Comparison and evaluation different platforms allow selecting architecture with minimal expenses for buying or development components of BS. Now we see the components on platforms Mac Os X and LINUX require additional investments on this evaluation stage. An additional investment is a remuneration of experts' labor for development analog component. Another variant is to buy very expensive alternatives which already exist. Let's calculate approximately the cost of the component development. We take approximate duration of the components development on basis of Mac Os X and LINUX platforms - three months - and salary of the specialist - \$2000. Then we consider the component cost - 6000\$. Resulting sum much exceeded the sum on Windows platform solution. Windows platform is more favorable and profitable for BS based on this evaluation; all the components already exist and there is no need to develop new components.

Technical support during software development exploitation is a great importance for customer and developer. «Windows or Linux? » the report researched by independent company Lawrence Associates LLC [24] published a statistic of the cost supported software. According to the research technical support has higher price then cost of supported product. Based on Table 2 we can see that LINUX and Mac Os X components have commercial support. Cost of support Windows components is included in price during the period specified by Microsoft.

Example:” *Microsoft's support road map currently says that extended support for Windows XP ends in April 2014. You need to be on the latest service pack*

within one year of its release for continued support, which at this point means you must be running XP Service Pack 2.” [32]

Also, there is complexity of computability of LINUX and Mac Os X components, because they were created by different development teams that may lead to unexpected result. Prepared analyzes show that selection BS on basis of platforms LINUX and Mac Os X is irrational selection, because they have a high cost of the support software. LINUX and Mac Os X are more difficult to install comparing with Windows.

Platform	Mac OS X	Linux	MS Windows
Point	3	3	4

Table 3. Cost evaluation

6.2. Evaluation of scalability

Table 4 describes hardware which supports evaluated platforms. Mac OS X has limited hardware number supported for BS. Therefore Mac Os X architecture has grade 2. In stead of these fact platforms LINUX and Windows support broad range hardware [26]

Name	Computer architecture supported
Mac OS X (www.apple.com)	PPC, x86
GNU/Linux (www.linux.org)	x86, x86-64, PPC, SPARC, Alpha, etc
Windows Server (www.microsoft.com)	x86, x86-64, IA-64

Table 4. Supporting hardware

Name	Mac OS X	Linux	MS Windows
Point	2	4	4

Table 5. Evaluation of scalability

6.3. Evaluation of safety

Architectures of the compared platforms above have public key [27] infrastructure which allow following:

- Security information;

- Integrity information;
- Users authentication and sources for users;
- Possibility to confirm actions made by users

These factors provide a high level of security of all mentioned above platforms.

Name	Mac OS X	Linux	MS Windows
Grade	4	4	4

Table 6. Evaluation Protection system

6.4. Evaluation of reliability

All considered platforms have rather good reliability. Hence, they differ by various levels of reliability and maintenance methods of this reliability. But for evaluation and comparison with each other we have to take number of fixed and unfixed vulnerabilities.

Secunia⁶ have published vulnerabilities statistics of Windows XP [38], Linux and Mac OS X [40]. The report about reliability OS includes annual report of vulnerabilities which were fixed and unfixed. Further information represents statistics of vulnerability from the reports Figure 5 and 6.

The graphs below show the number of issued Secunia advisories affecting Microsoft Windows XP Professional on a month-by-month basis. Statistics can be used to see how many Secunia advisories are being reported in these products.



⁶ Secunia is a Danish service provider of vulnerability intelligence and provides vulnerability management tools for the entire corporate IT infrastructure.

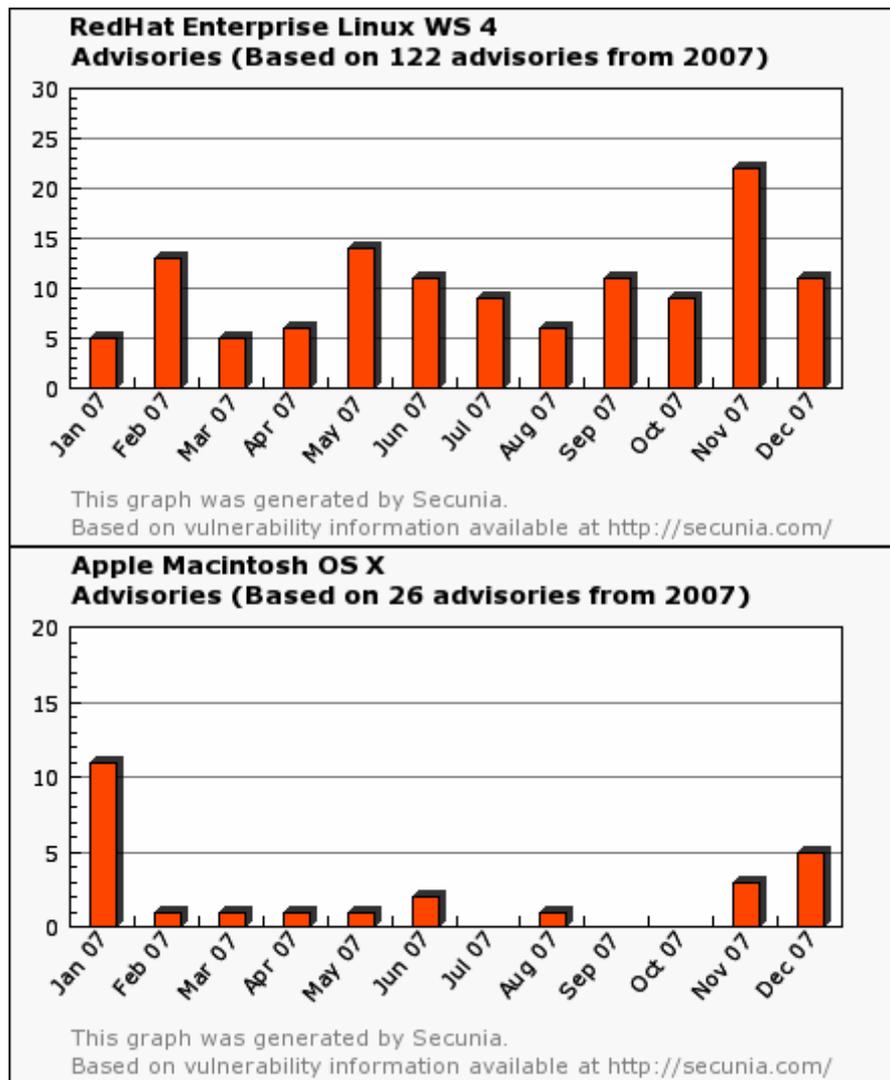


Figure 5. Windows XP, RH Enterprise Linux and Mac OS X Advisories 2007

The "Solution Status" pie graph below shows the percentages of "Unpatched", "Vendor Patched", «Vendor Workaround" and "Partial Fixed" Secunia advisories affecting Microsoft Windows XP Professional.

This can be used to get a quick overview of how many unresolved issues these products have.

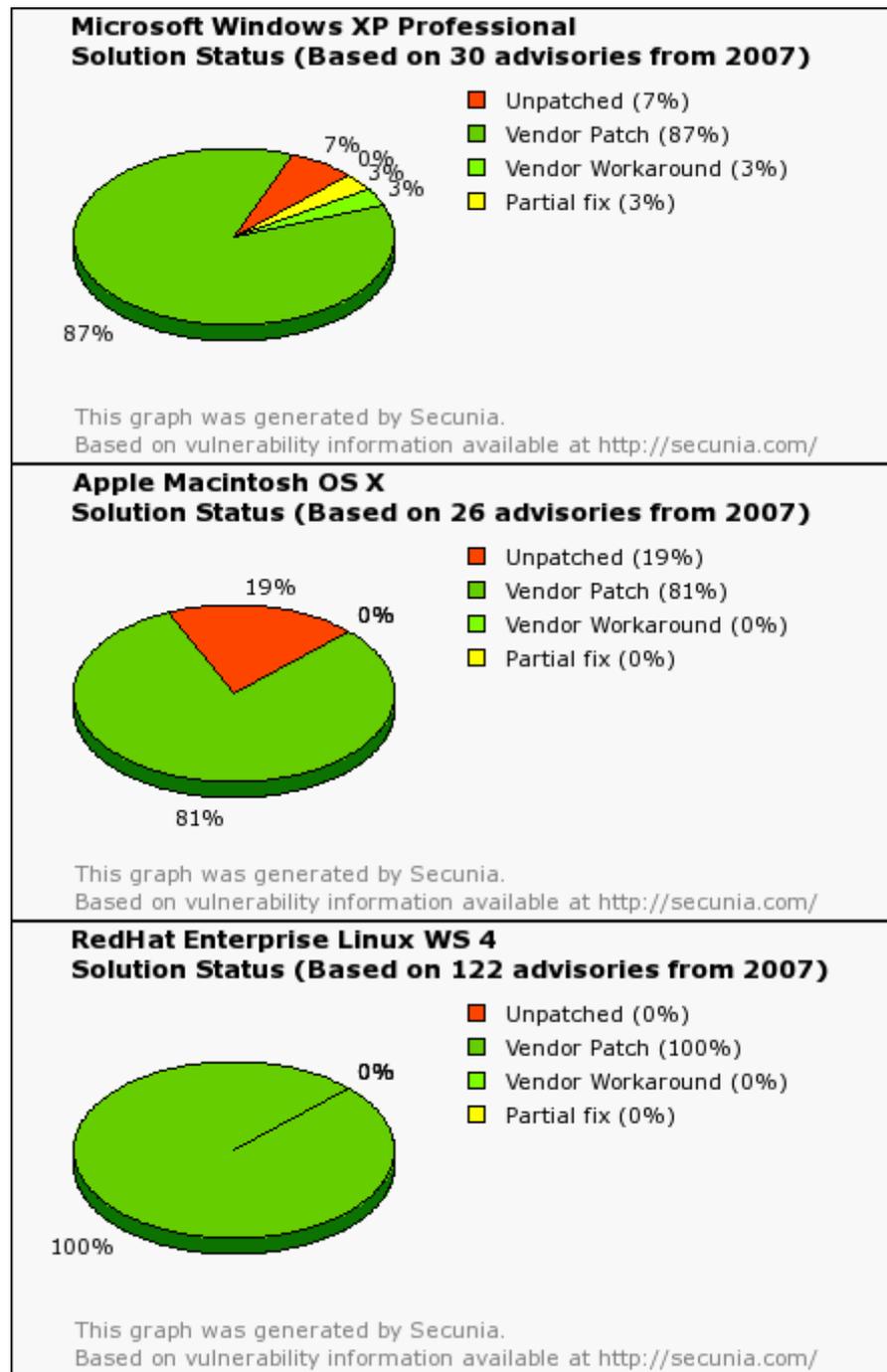


Figure 6. Solution status of Windows, Mac OS X and RH Enterprise Linux

On the basis of statistics I evaluated platforms for BS.

Name	Mac OS X	Linux	MS Windows
Grade	3	2	4

Table 7. Reliability evaluation

6.5. Evaluation of portability

Portability platforms for BS means following:

- Providing interface for commercial Databases and separate business-logic developed systems for others systems;
- Create, process and exchange data of different formats;
- Support different data communications protocol;
- integration with other operation systems;
- Providing automation consolidated data from slave node ;

Example: Data is gathered from Branches level to management level. (Figure 2 p.15)

- Providing automation synchronization of data;
- Changing a structure organization of the system manually;
- Move and adapt across a class of hardware (from old hardware to a new one) [34]

Architecture of considered above platforms have possibility to be integrated with other systems therefore they are evaluated by grade 4.

Name	Mac OS X	Linux	MS Windows
Grade	4	4	4

Table 8. Portability evaluation

6.6. Evaluation of usability

Nowadays many people use products Microsoft, this fact is proved by statistics published on web site <http://www.w3counter.com/globalstats.php>. Based on article “Switching to Windows: Not as easy as you think” published on web site www.madpenguin.org by Simon Gerber Windows platform is suitable for installation and configuration that also prove the same statistics.

Operating Systems	
1	Windows XP 82.98%
2	Windows Vista 4.11%
3	Windows 2000 3.84%
4	Mac OS X 3.79%
5	Linux 1.38%
6	Windows 98 1.25%
7	Windows 2003 0.70%
8	Windows ME 0.44%
9	Windows NT 0.06%
10	Mac PowerPC 0.03%

Table 9. Operation systems statistics

Source: web site statistics [33]

When a user changes operating software he needs time for adaptation and to study new software. Windows differ from Linux and MAC OS X very much. The reason is in the new different functionality components available in the operating software. Users and maintenance staff tuition on the new software require additional investments. In case if a user is a beginner in OS studies it takes approximately equal time to study LINUX, Windows or Mac Os X. Table 9 shows us OS popularity in the world. A preferred brand is more usable referring to usability research by Turkka Keinonen.[37] For these reasons and the operation system statistics I evaluated platforms for BS.

Name	Mac OS X	Linux	MS Windows
Grade	3	2	4

Table 10. Usability evaluation

6.7. Evaluation of efficiency

A platform can be updated and there may occur a situation when there is a necessity to buy new more advanced hardware. Further, there are platform

requirements

listed

below:

Windows (Microsoft Windows XP Professional) [28]

- PC with 300 megahertz or higher processor clock speed recommended; 233 MHz minimum required (single or dual processor system); Intel Pentium/Celeron family, or AMD K6/Athlon/Duron family, or compatible processor recommended
- 128 megabytes (MB) of RAM or higher recommended (64 MB minimum supported; may limit performance and some features)
- 1.5 gigabytes (GB) of available hard disk space
- Super VGA (800 x 600) or higher-resolution video adapter and monitor
- CD-ROM or DVD drive
- Keyboard and Microsoft Mouse or compatible pointing device.

Linux (Red Hat Enterprise Linux) [29]

- PC with 800 megahertz or higher processor clock speed recommended; 1,5 MHz minimum required (single or dual processor system); Intel Pentium/Celeron family, or AMD K6/Athlon/Duron family, or compatible processor recommended
- 256 megabytes (MB) of RAM or higher recommended
- 6 gigabytes (GB) of available hard disk space
- Super VGA (800 x 600) or higher-resolution video adapter and monitor
- CD-ROM or DVD drive
- Keyboard and Microsoft Mouse or compatible pointing device.

Mac OS X (Leopard)

- Mac computer with Intel, PowerPC G5, or PowerPC G4 (867 MHz or faster) processor
- 512MB of memory
- DVD drive for installation
- 9GB of available disk space
- Some features require a compatible Internet service provider; fees may apply.
- Some features require Apple's .Mac service; fees apply.

Nowadays, companies acquire hardware which is much more powerful than system requirements mentioned above. Therefore platforms satisfy the requirements and get equal grades.

Name	Mac OS X	Linux	MS Windows
Grade	4	4	4

Table 11. Efficiency evaluation

6.8. Conclusion

Results summarized in Table 12 are based on analytical analysis:

Name	cost	Scalability evaluation	Portability evaluation	Reliability evaluation	Security evaluation	Usability evaluation	Efficiency evaluation
MAC OS X	3	2	4	4	4	3	4
LINUX	3	4	4	4	4	2	4
Windows	4	4	4	4	4	4	4

Table 12. Platform evaluation

Among all considered above platforms the Windows platform is more preferable because it satisfies all system requirements and has the highest grade. Components of BS will be described in the next chapter.

6.9. Functional components of architecture

BS is based on a client-server module technology. Server provides data storage and access and realizes necessary business logic; client provides visualization interface to users. Connection between server and client are being processed via local network or virtual private network (VPN). Description of the BS is taken from Microsoft Case study. [23]

The following software is installed on the server part:

Software	Assignment
MS Windows 2003	Component of infrastructure (operation system, safety, service informational net).
MS SQL Server 2005	Database server and business logic (using without application server).
MSSQL Reporting Services 2.0	Report server is used for building summary reports and documents forms. Reports creation is carried out on the server. Client gets a prepared report in a given format via Web-service.
MSSQL OLAP Server 2000	Analytical server is used for processing multidimensional cubes and provides fast forming summary reports.
Microsoft.NET 2.0	Environment for applications execution based on .Net technology.
Internet Information Server (IIS) 6.0	Application server is used for securing work of reports and server components of business logic.
Windows Sharepoint Services (WSS)	Infrastructural components used for report portals. Service allow grouping and correctly representing portal pages based on web-parts-software components created on the basis of open interface. WSS Configuration is used for purpose account system – called BIP 2003 (portal business logic). WSS Configuration can be easily set on the basis of Reporting Services and components MS Office (OWC11) components.
Office WebParts 2003 (Office Web Components - OWC)	Web-parts for representation related and multidimensional data similar to packet MS Office 2003.

MS Visual Studio 2005	Interface development environment for the system.
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Table 13. Server part

Client part contains from the following software:

Software	Assignment
Microsoft.NET	Environment applications execution based on .Net technology.
Browser IE 6.0	Internet browser. Browser components are used for representation reports on client application part.
Client	System client application, used for securing interface with operator account system. Application was developed on the basis of the .Net technology.

Table 14. Client part

Servers use operational system Windows Server 2003. Company “X” uses Domain Structure - Active Directory Windows Server 2003.

Active Directory is convenient for the following reasons:

- Every branch leads common security policy that reduces leaks due to unification that facilitates of the system support;
- The unified groups with restricted access users’ rights and sections of the calculation system facilitate the system support;
- The common set of users allows to simplify access to the branches’ data management and to provide the branch an opportunity not to interrupt working when there is a local server or allocated channel failure.

Every server of branches functions as the controller of the domain, carrying out authentication and authorization of the users in security domain of the calculation system. Every controller of the domain is placed on its own service site of Active Directory catalogues that allows branches to function rather

independently within the framework of the security domain. Also the advantage is traffic reduction between the branches.

Active Directory allows maintenance of the distributed parts of calculation system between the center and the branches; periodically to adjust replication the domain of database safety; updating client software and reports.

The network of the branches communicates via VPN-connections, through which all useful traffic is routed. Every branch ranges IP-addresses within the framework of the unified virtual network. All VPN-traffic is ciphered on the basis of algorithm RSA under report LP2TP. For delivery and verification of certificates the Microsoft Certificate Services are used. Such infrastructure allows providing a necessary level of network security. [23]

Management Server of company “X” carries out functions of the controlling and managing of the security domain operations of the calculation system. Both branches and management server have application server. The server contains a summary database of the marketing activities on all branches (data on storehouse), which replicates data of the branch application servers. The server also has a client database.

Analysis server and report server are also installed for the BS. They are used for reception of the branch summary reports on marketing activities or other analytical attributes. This is illustrated by Figure 7.

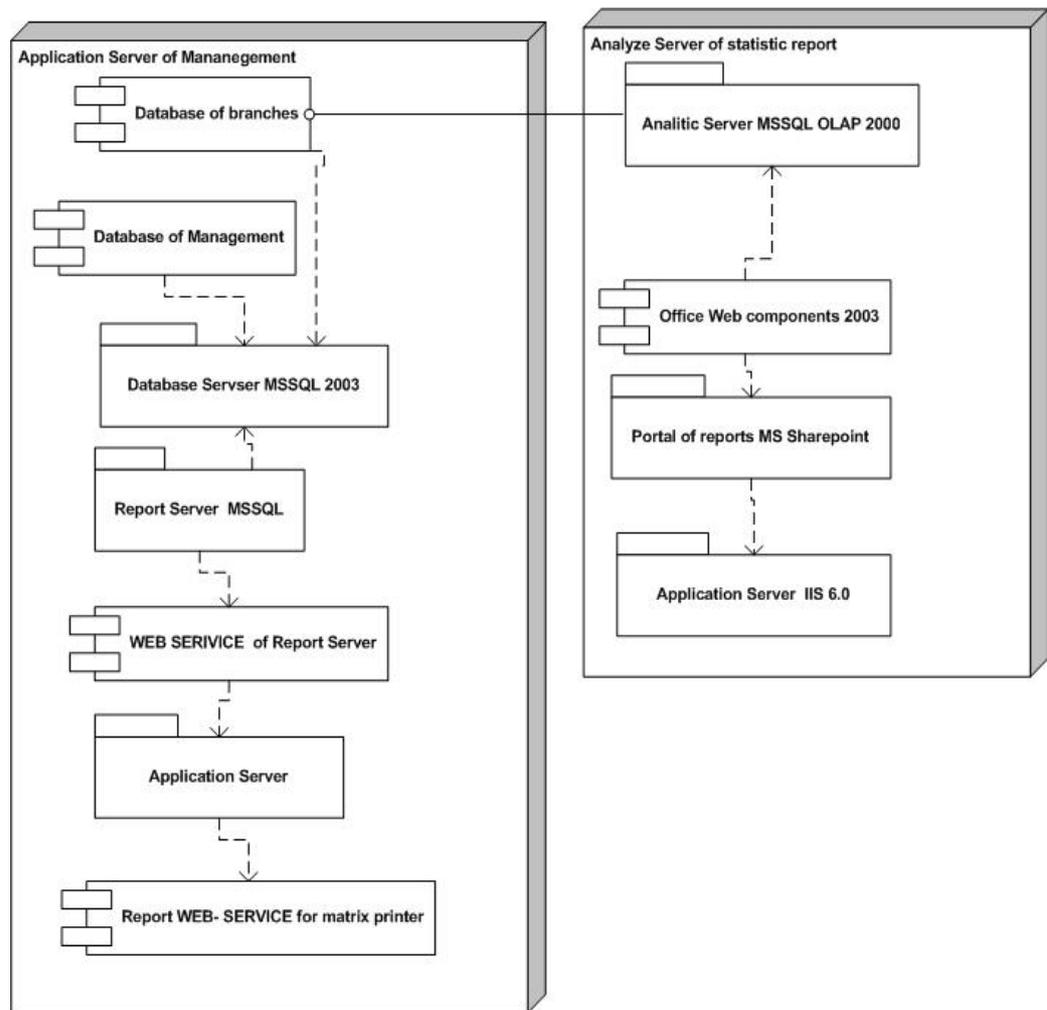


Figure 7. Architecture on management level

Source: CHSK Company [23]

Management and branches level of company “X” use Microsoft Windows XP Professional operation system. They are also included in the unified security domain of the calculation system.

BS are developed on the basis of Microsoft .NET technology and Database Microsoft SQL Server 2000. [23] There are two types of the clients. Therefore reliability of the system was initially of a great importance; the client-part of the calculation system realizes as the Windows-application. SharePoint⁷ Services is used for getting access to reports and opportunity of the data operative analysis. Access is carried out with the help of Internet Explorer. Windows SharePoint Services allows providing access division to reports on the basis of user records

⁷ Server program facilitate collaboration, provide content management features, implement business processes, and supply access to information that is essential to organizational goals and processes.

registration of Active Directory. Active Directory is used for work maintenance of various services of the company.

Windows SharePoint Services plays a role of the infrastructural component for maintenance of the portal reports in the system. The service allows packing and correctly displaying portal pages on the basis of web parts. Windows SharePoint Services easily allow to adjust and to display data presentations on the basis of Reporting Services reports and Microsoft Office components. Microsoft IIS 6.0 is used for web reports maintenance. Microsoft SQL Server 2000 is used as a construction tool of reports and the data analysis of two applications - Analysis Services and Reporting Services 2.0.

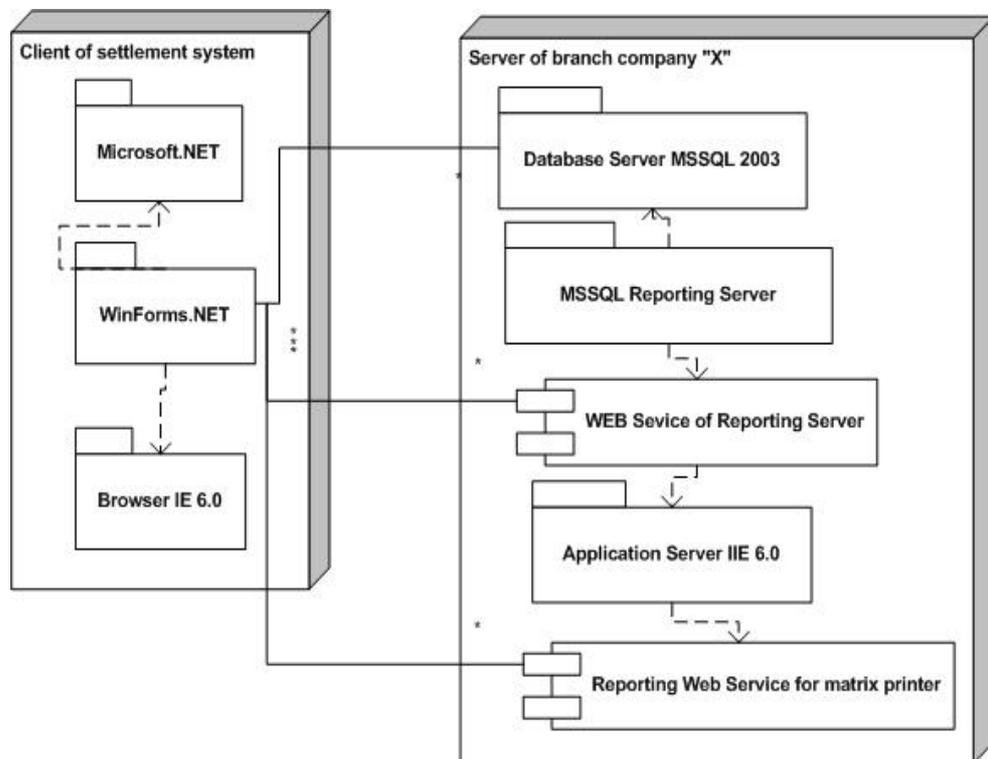


Figure 8. System Architecture on branch level

Source: CHSK Company [23]

Microsoft SQL Server Reporting Server 2.0 is a report server. The server is used for construction of summary reports and documents forming. Construction is carried out on a server. Client receives the constructed report in HTML format through the web service.

Data security is provided by Active Directory. Data access can be received only by user domain that has rights of the reception such information. A policy of

security domain provides a data access management both of users' groups' level and separate users' level.

7. Conclusion

In this thesis there was considered software evaluation and there has been made a choice of the optimal platform for BS development of a virtual company “X”. There has been considered a selection of three possible platforms: LINUX, Windows, and Mac Os X with different components and their structures. Considered platforms analysis shows an optimal platform for BS development with advantageous functions and minimal modification expenses satisfying requests of users and maintenance personal.

Platforms LINUX and Mac Os X and their components are open-source ones therefore they are modifiable. This fact is an advantage of these platforms unlike Microsoft platform. Also they have scalability and high level safety. Furthermore many products of LINUX and Mac Os X vendors distribute them for free. It was evident advantage for BS on the basis of these platforms and seemed to be a solution in the beginning of my research. But these platforms have their own disadvantages. Therefore they had not been chosen as optimal platform. Disadvantages of these platforms are such as: high cost of some components; abundance of the platforms producers make them difficult to be maintained; inconvenience for users’ installation. High cost of free components support makes this platform uncomfortable and unprofitable in use. Also LINUX platform disadvantage is a difficulty in the system setting. BS on the basis of Mac Os X platform has less supported hardware that limits the BS users.

The choice was done in favor of Windows platform that has the least cost and the least components development requirement. Selected platform has attributes of the highest grade: Cost Scalability, Reliability, Safety, Usability, Portability, and Efficiency.

It was discovered that products of Microsoft have all necessary components for BS; that allows optimizing speed, quality and cost of the BS development. Further Table 15 provides components of the billing system.

The following software is installed on server part:

Software	Assignment
MS Windows 2003	Component of infrastructure (operation system, safety, service informational net).
MS SQL Server 2005	Database server and business logic (using without application server).
MSSQL Reporting Services 2.0	Report server is used for building summary reports and documents forms. Reports creation is carried out on the server. Client gets a prepared report in a given format via Web-service.
MSSQL OLAP Server 2000	Analytical server is used for processing multidimensional cubes and provides fast forming summary reports.
Microsoft.NET 2.0	Environment for applications execution based on .Net technology.
Internet Information Server (IIS) 6.0	Application server is used for securing work of reports and server components of business logic.
Windows Sharepoint Services (WSS)	Infrastructural components used for report portals. Service allow grouping and correctly representing portal pages based on web-parts-software components created on the basis of open interface. WSS Configuration is used for purpose account system – called BIP 2003 (portal business logic). WSS Configuration can be easily set on the basis of Reporting Services and components MS Office (OWC11) components.
Office WebParts 2003 (Office Web Components - OWC)	Web-parts for representation related and multidimensional data similar to packet MS Office 2003.

MS Visual Studio 2005	Interface development environment for the system.
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Table 15. Selected architecture

One of the system requirements was Usability. A preferred brand is more usable referring to usability research by Turkka Keinonen. For these reasons and the operation system statistics I evaluated platforms for BS. Microsoft Products are ones of standard technology as they have 82.98% usability, at the same time Macintosh has 3.79% and LINUX has 1.38%. Usability allows saving money and time of users and supporting stuff tuition. These are significant factors for a company buying this BS.

Microsoft case study has been used as a basic example which allowed making platforms evaluation, their advantages and disadvantages research. The main aims of this study - the optimal platform for a BS evaluation and selection - I consider to be obtained.

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