Market Research – a significant step in propelling a business or a solution for the e-government systems to the top

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Abstract—Market research... a real treasure which can trigger performance in any business, but most of the times it seems unexploited at its true value. The marketing analysis brings information about competitors, clients, business partners and so on, guiding the business towards success. Because during the last years the information technologies have been applied in so many aspects of our lives, they have also been used for marketing research. The most used marketing research method is the questionnaire, that is why many of the well known companies from this field have left the "real" environment and they are focusing now to the "online" environment. Therefore, today one can not do a marketing analysis without specialized IT tools (for the online surveys or for data analysis). In the current paper, we search and offer some answers regarding the information technologies used, or which could be used, for developing and implementing information systems for marketing research. In the same time, on the one hand, we are opening new perspectives and propose new ways of considering the marketing research: used to design an e-government system about the citizens needs, expectations or preferences; and on the other hand: online survey systems "seen" like a first step for a large scale usage of e-voting concept.

Keywords—e-government, geographical information system, information security, information technology, market research.

I. INTRODUCTION

PRODUCTIVITY, competition, performance… are words that we encounter everywhere in companies around the world, no matter what their fields of activity are. As we know, a company is built up primarily to make a profit and to increase the profit of its initiators. But in a world where performance is the watchword, in a world where competition, "the fierce enemy" makes its presence felt everywhere supported by the new information technologies…productivity and profit are in danger of turning into pale shadows of dreams which are slowly fading out.

And yet... it is known that human nature, no matter how developed its rational side may be, can never stop dreaming. It is often said that we must first dream and long for one thing in order to start fighting to get it… so everything starts with a dream. Therefore, no matter how tough the world we live in may be, however fierce the competition or how big the obstacles encountered by a company in the way of its development and performance, there are always viable solutions to reach the top. A solution that we want to analyze in this paper is market research - a significant step in developing and propelling a business to the top.

"Market research is the tool that provides the necessary information for marketing decision-making and must be carried out by specialized staff"[1]. More specifically, by market research we understand all the techniques and ways of collecting and processing the "information in order to find out the existing market trends, the consumer needs concerning a particular product, but it also suggests ways of improving the company's activity, according to results obtained by investigating targeted subjects" [2] said Alina Blaga, Marketing Manager for Public Euroconsulting - HR & Marketing Agency, Romania. Therefore, as expected, a market research should be performed when:
- introducing a new product on the market or an existing product in a particular market;
- a company wants to increase its sales;
- you want to improve the company image, the product market position, etc.

"The main research methods used in marketing are: documentation, observation, experiment, test, simulation and market investigation"[3]. All these research methods involve the use of some information sources such as: company's internal reports; official statistics published by the governmental bodies, public institutions, foundations, catalogues, flyers, brochures and various promotional materials, magazines and various specialized publications, opinion motivation and attitude surveys, estimates of the market share, of the sales, of the size of the consumer population, etc. However, the main research tool is the questionnaire. "The survey questionnaire is the tool that allows the collection of responses within the interviewed sample. It consists of a set of questions, but may also include graphics, drawings, photographs"[3].

Among the modalities of implementation and completion of a questionnaire as part of a market research we can remind at least three possibilities: surveys carried out in the streets, shops, etc., surveys conducted by phone, fax, surveys conducted on the Internet.

Due to the necessity of drawing up guidelines and requirements on how the studies of market research are planned, put into practice, supervised and reported to the clients as final projects, an International Standard: ISO 20252

has been developed. "ISO 20252 is the creation of ISO Technical Committee <<ISO/TC 225 – Market, opinions and social research>> that appeared in response to the initiative of EFAMRO (European Federation of Associations of Market Research Organizations) participating as a liaison organization between ESOMAR (World Association of Research Professionals) and WAPOR (World Association for Public Opinion Research). ISO 20252 has aroused the interest of ISO members, with the following participating countries: Algeria, Argentina, Australia, Brazil, Bulgaria, Britain, Canada, the Czech Republic, France, Germany, Israel, Italy, Japan, Korea Republic, Mexico, Netherlands, The Russian Federation, Serbia and Montenegro, South Africa, Spain, Sweden and the USA. In addition, the following countries are observers: Austria, Egypt, Iran, Morocco, Romania, Thailand, Turkey and Uruguay."[4].

As we live in "the century of information technology", the information used in market research studies can be processed only with the help of the information systems and, obviously, they are most frequently collected via the online environment or the Internet. In this paper, we will proceed to the analysis, presentation and comparison of the current most important technologies which are being used in the market research field.

II. THE MARKET RESEARCH IN THE "INFORMATION TECHNOLOGY ERA"

"The globalisation of markets has presented firms with many challenges and communicating with their networks of customers and suppliers is a significant one. International firms need to communicate with customers in any market that they target and any firm with a web site has the potential to do business internationally."[5]. As for keeping in touch with customers anywhere in the world, the use of the advanced technology to develop a website presenting its activity is an absolutely compelling requirement for a company, the integration of some modules dedicated to market research studies with the corporation websites has also become almost a necessity today.

"Several authors have identified the influence of information systems on market structure in different industries."[5]. The results obtained from processing the data "collected" for carrying out a market research through marketing information systems influence on the strategic management decisions, finally leaving their mark on the financial performance as Yinghong (Susan) Wei and Qiong Wangargue in their work Making sense of a market information system for superior performance: The roles of organizational responsiveness and innovation strategy (Fig. 1).

Fig. 1, Source: [6]

So, the performance of the information systems plays a significant role in achieving the company's objectives, in its effectiveness of overcoming competition, in reaching the estimated profit or, in one word, in reaching performance.

III. THE PERFORMANCE OF AN E-GOVERNMENT SYSTEM, RESULT OF A MARKET RESEARCH

Large amounts of money have been invested in the information systems of e-Government type, both in Romania and in other European countries (a well known example in Romania is the e-Romania project), and European Union (EU), in turn "has provided a strong support to implementation of ICT into public administration at all levels to strengthen development of information society and e-Government."[7]. Also, campaigns have been carried out in order to inform the citizens and acquaint them with the e-Government concept.

However, despite the efforts made by the national or international authorities, despite the fact that the annual number of Internet users increases, the percentage of e-Government systems users at European level in general and in Romania in particular does not show a significant rise. According to Eurostat (The statistical office of the European Union) "on average, 28 % of the European citizens accessed information on public authorities' websites in 2009. Only 13 % of European citizens sent information electronically within 3 months prior to the survey in 2009."[8]. And obviously, as expected, as far as Romania is concerned, the situation is not encouraging either: in 2009 "only 6 % of Romanian citizens have searched for information on Public Authorities' websites".

Nevertheless, countries such as Denmark, the Netherlands, Estonia and Sweden where the percentage of e-Government systems users is almost 65% (Denmark), according to the same source [8], have already demonstrated that these information systems represent a viable solution that can successfully replace the traditional process of interaction between the state and the citizen. At the opposite end there are countries such as Czech Republic, Bulgaria, Greece and Romania, where this percentage was below 5% in 2009.

And yet how can we explain that in the "Internet era" only 28% of the European citizens accessed information from the public administrative sites in 2009? How should we explain

these huge differences between the European countries as to the use of e-Government information systems? Perhaps the managers of the companies also ask themselves a series of similar questions regarding the profit earned below the targeted one, without taking into account the possibility of carrying out a market research. As you may have already guessed, the answer to the above questions is: conducting a market research for each individual state where the percentage of e-Government type information systems users is very low.

Just as the market research is more often than not the key for achieving business performance, similar research concerning the e-Government type information systems can provide useful information for "modeling" such a system regarding the citizens' needs, expectations and preferences which will implicitly lead to an increase in the number of e-Government information systems users.

IV. CONDUCTING ONLINE SURVEYS

"The Internet and its multimedia front-end, the World-Wide-Web (WWW), has experienced tremendous growth since its development by Tim Berners-Lee of CERN (Centre for European Nuclear Research) in the early 1990s, achieving world wide acceptance. Many disciplines are re-evaluating their strategies and techniques in view of the services offered by the Internet."[9]

The questionnaire is the most frequently used method of collecting information in market research, as mentioned above. But, living in the "Internet era", as expected, most of the information collecting campaigns "moved" from the real world to the virtual environment or online.

It is common knowledge that a questionnaire which aims at collecting information for a market research should be conducted by experts in marketing, and the analysis of the data obtained must be submitted to experts in statistics. However, these activities cannot take place without the support of specialized information systems:
- information systems for conducting online surveys;
- information systems for analyzing the data collected.

The problems which arise in the development and implementation of the two types of systems listed above and for which we are trying to find answers in this work are:
- which is the most suitable technology for the development of these types of information systems?
- what type of database should be "behind" an information system for carrying out online surveys or analyzing the data collected?
- how could the security of an information system be ensured in order to conduct online surveys?

A. Technologies for information systems development to conduct online surveys

Since we are discussing about online information systems, we will proceed to the analysis, presentation and comparison of the current most important technologies which are being used in the development of information systems for carrying out online surveys.

a) The design and generation of Web interfaces

The Programming Platform is the main support for the development of a computer system. Currently, the most popular programming platforms are:
- .NET Framework, with Visual Microsoft Studio 2005/ 2008, Microsoft ASP.NET AJAX and programming language such as ASP.NET and C#;
- JEE[TM], with JDeveloper Studio Edition, AJAX for Java[TM] platforms such as Eclipse Modeling Framework and Ecore models and programming languages such as JSP and Java[TM].

A modular architecture for developing Web applications based on Semantic Web and Web 2.0 technologies can be seen in Fig. 2. As you can see, the architecture in Fig. 2 allows the use of any of the two platforms: .NET or Java.
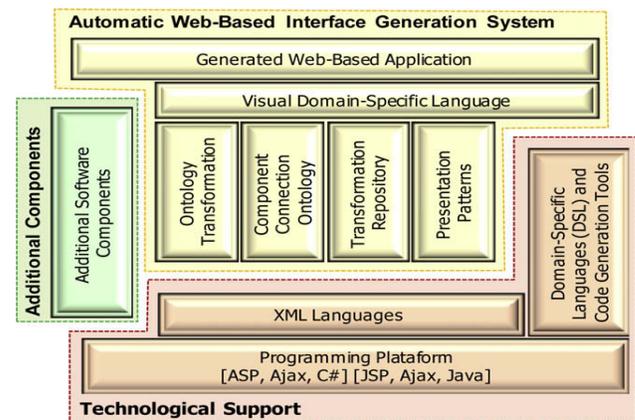

Fig. 2, Source: [10]

"The system comprises three different parts:
- The first part, namely the Technological Support, includes: the Programming Platform, the XML Languages, the Domain-Specific Languages and the Code Generation Tools.
- The second part comprises the Automatic Web-Based Interface Generation System, which includes: the Ontology Transformation System, the Component Connection Ontology, the Transformation Repository, the Presentation Patterns and the Visual Domain-Specific Language."[10]. This part covers the entire process of reading and displaying the information in the database attached to the information system.
- "Additionally, as the system is based on a Model-Based User Interface approach, in most of the cases one cannot get 100% of the generated code. It is required, therefore, a third part composed by a group of Additional Software Components or specific framework for the solution domain."[10].

b) Technologies used in developing the web-based information systems

- ### Microsoft .NET Framework

".NET is a software development framework unit (*Framework*) that enables to develop, distribute and run the desktop Windows applications and the Web applications.

.NET Framework is a component which is delivered together with the Windows operating system"[11] or which can ve installed on earlier versions of Windows Servers 2003. ".NET 3.0 comes installed on Windows Vista and can also be installed on XP Windows version with SP2 and Windows Server 2003 with SP1 or more."[11].

"The .NET Framework component underlying the .NET technology is the last interface between the NET applications and the operating system and contains (Fig. 3):

- Languages C#, VB.NET, C++ and J#. In order to be integrated into the platform. .NET, all these languages comply with some OOP specifications called *Common Type System* (CTS). Their basic elements are: classes, interfaces, delegations, value and reference types, and as mechanisms: inheritance, polymorphism and dealing with exceptions.
- The common platform for the execution of programs called the *Common Language Runtime* (CLR), used by all four languages. CTS is part of the CLR.
- The set of libraries necessary for carrying out desktop or Web applications, called the *Framework Class Library* (FCL)."[11]

Fig. 3 - Architecture .NET Framework, Source: [12]

"One of the major factors in take up of any language is how good the IDE (Integrated Design Environment) is. The IDE for VB.NET 2005 is used by all the languages that are part of Microsoft Visual Studio 2005, these are: Visual C#, Visual C++ and Visual J#, VB.NET. The IDE has form designers for Windows Forms, traditional Windows applications, and Web Forms using ASP.NET pages. Designing and coding Windows Forms and Web Forms has been made as similar as possible so that both types of applications can share components and much of the complexity of coding Web applications is kept hidden.

The support for writing code is a major advance in the IDE. When writing code, suggestions are made and syntax errors and warnings are highlighted. There is a library of reusable code snippets that can be dragged into the code window to speed up development. It is also possible to define and reuse your own code snippets."[13]

Why should a company choose to develop applications using the .NET platform? Firstly, because it provides programmers with tools that can be also used in other programs, easy access to databases and the drawings and graphics can be easily developed. A disadvantage is the fact that the platform .NET is not an open-source platform like Java and can be run only on Windows-based operating systems.

The most commonly used programming languages of the platform .NET are: Microsoft Visual Basic (VB.NET) and Visual C#.

"The main reasons for choosing Visual C# .Net are related to the high advantages provided by an object oriented language, together with the Microsoft .NET technology:

- code reusability;
- managed runtime environment;
- rapid development of windows forms applications;
- XCOPY deployment strategy;
- benefit from all functionalities included in the .Net framework library, etc."[14]

At the same time VB.NET proved to be a common programming language, especially for business information systems. "This is because of the familiarity many people have with VB.NET for Applications (VBA) through using other Microsoft products such as Excel and Word."[13] The VB.NET' language is like Visual C#, object oriented. "It allows Visual Basic programmers to tackle much larger applications, through improved scalability and reusability."[13] However most programmers use C# as a first programming language, the only relevant advantage of C# being:

- the number of books which have been written concerning C# language is greater than those regarding the VB.NET language;
- the community of Internet users who use the language C# is greater than the one of VB.NET language users.

"Which language is more efficient or productive really is a matter of personal choice and application specific. For some projects, C# is more suitable than VB.NET and vice versa as each interacts with the .NET framework in different ways. There is no common consensus on the language that is best, although all programmers seem to have an opinion. The choice of language ultimately comes down to how easy the syntax is to use. An application developed in VB.NET may require more code than an application developed using C++, but if it is easier to understand and therefore quicker to code in, then this becomes irrelevant. Once the application is complied and it works as required, no-one will be concerned about the lines of code used or the language choice. "[13]

- *The Java Platform*

The main components of the Java Platform: Java Virtual Machine (JVM) and Java API (Java Application Programming Interface). Java is an object-oriented programming language designed by Sun Microsystems in the early 1990s.

Java Platform is the set of Java classes which exist in every Java installation kit. These classes will be used by any Java application running on the computer where they have been installed. The Java platform is called Java environment or API Java kernel (Application Programming Interface).

Java Virtual Machine is the cornerstone of Java. Java programmes are portable across any operating system,

hardware architecture that supports Java interpreter. Certainly all the programmers know the Sun company's motto from the early '90s, when the Java language was launched: "Once written it will run anywhere", because Java Virtual Machine supports interpreters for Solaris platforms, Microsoft and Linux. Interpreters have also been created for devices that use Windows CE operating system or PalmOS.

Java Programming Language is an object-oriented language like C + +, and a very strong one.

"*Java 2 Enterprise Edition* (J2EE) is a Java platform designed to process data for large organizations that use *mainframes*. The J2EE Platform provides a model for achieving multi tier distributed applications. This means that different parts of the application can run on different computers. J2EE architecture defines a *Client Tier*, a *Middle Tier* (which may consist of several *sub tiers*, usually called the *Web tier* and EJB tier) and an *Enterprise Information Tier*, which provides services using existing information systems (usually databases).", fig. 4., [15].
- *Client Tier*: supports a wide variety of clients who may be or not after firewall;
- *Middle Tier*: on the one hand provides services for customers using the Web container and on the other hand business components using Enterprise JavaBeans containers;
- *Enterprise Information System* provides access to existing information systems using standardized APIs (Application Programming Interfaces).
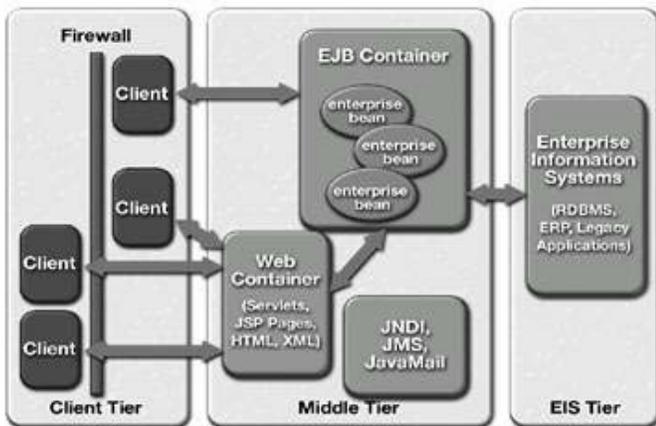

Fig. 4 - Multi tier architecture made available by the J2EE platform, Source: [15]

As to the future of Java Platform, the platform which was sold not long ago to Oracle Company at the annual conference Oracle Openworld held in San Francisco in September 2010, Thomas Kurian, Vice President of Oracle Product Development, outlined the plans for the future of Java platform:
- "*Java Platform, Standard Edition (Java SE)* - Oracle improves and optimizes the Java platform for new applications and hardware models, includes expanded support for scripting languages, increased productivity for developers and lower operational costs.
- *Java client systems* – Oracle is designing an improved programming model that combines the power of Java with

the ease of FX in order to provide advanced graphics, high fidelity multimedia and the best web features HTML 5, JavaScript and CSS, along with support for the native platform Java.
- *Java devices* - Oracle is working on upgrading mobile Java platform by providing Java solutions with web site support in consumer type devices."[16]

Why should a company choose to develop applications using java platform? Firstly because it is an open-source technology that can run on any operating system, as mentioned above. The platform also enables the use of Java which is object-oriented but, unlike the .NET platform, when developing an application the programmer is the one who will write almost 100% the source code, much less helped by the chosen IDE in comparison with an IDE of the .NET platform (Microsoft Visual Studio).

- *Comparison between .NET and Java Frameworks*

Obviously, the two platforms: .NET and Java both have advantages and disadvantages. When a company has to decide what technology to use when it is going to develop a powerful new information system, it will have to take into account the advantages and disadvantages of the two platforms listed below.

Characteristics	Microsoft .NET Framework	Java Framework
Operating system	Windows	-Linux -Mac OS X -Solaris -FreeBSD -AIX -Windows -Android
The technical implementation of infrastructure	Uses Microsoft Virtual Machine that allows efficient coupling with Windows, using: - IIS web server; - Active Directory; - OLEDB; -Windows Load Balancing.	Uses Java Virtual Machine which is not always effectively coupled with the operating system.
Number of lines of code - programming language	Small number of lines.	Great number of lines.
License costs	Average price	- High price (J2EE solutions: IBM, BEA); - Free: Eclipse, Struts, etc.
Staff costs	Average costs	High costs
Independence from the manufacturer	Dependent	Less dependent
Stability provided by the manufacturer (concerning the appearance of the following versions)	Big	Big

Table I – Comparison between .NET and Java Frameworks

Analyzing the data from Table I, we can easily notice that the advantages and disadvantages of the two platforms compensate each other in terms of cost. As to portability, Java platform has a clear advantage over the .NET Platform. But as far as coupling with the operating system is concerned, the Java platform is on the minus side this time.

However, if we should draw a line and give a "verdict" on the choice of either platform to develop an information system, we couldn't practically choose it without taking into account the type of system that should be developed. For example, if the computer system in question would require drawings and graphics, then the platform. .NET should be chosen so that these things could be performed more easily.

If we were supposed to decide strictly upon the election of the platform for the development of an online survey information system or for an e-voting system type, then either of the two platforms, .NET or Java, could successfully contribute to the implementation and operation of that system.

B. Market research analysis using Geographical Information Systems (GIS)

After collecting the information to achieve a market research, it follows their analysis. Typically, a market research analysis result is presented in the form of report/reports directly to company managers concerned. As these reports in "classical" form are difficult to follow and interpret, the presentation of results of a market research through maps of analyzed geographical areas, significantly simplifies the process of understanding, assimilation and interpretation of the followed information.

- *Geographical Information Systems (GIS) in Business*

Geographical Information Systems (GIS) are defined by the Open Geospatial Consortium as information systems used to capture, store, verify, integrate, manipulate, analyze and visualize geospatial data (data regarding geographic location of a certain object on the Earth).

In the early history of GIS, we have seen these systems used in the public sector, by the governmental organizations in military campaigns, urban planning, regional development, monitoring and spatial analysis of different environmental issues. Because the costs of these kind of systems have lowered, in the last 10 years the usage of GIS in business, by private companies, has increased, especially in the US and Western World. In Romania also, in recent years, more and more retail big companies have gained the competitive advantage of using GIS in their marketing policies [17].

Because in business "where" is a very important question, GIS can answer it by analyzing different factors and has the ability to show the results of the analysis in friendly reports which can be used by the top management of a company in order to make fast and very well documented decisions. The synergy between GIS and KMS (knowledge management systems) could be successfully used when making big decisions [18].

For market analysis, GIS is used especially in the site selection analysis. Most scientific research papers in the field focus on GIS ability to analyze different factors such as infrastructure, physical capital, knowledge capital,

geodemographic information and customer profiles in order to answer questions such as "where should we place a specific new business?" or "where to open a new store?" or "where to place a new distribution service?". The authors of the research paper [19] have shown how a web GIS collaborative portal could be used to identify the suitable locations for developing wind farms in UK. Also, paper [20] describes how GIS can be used to choose the possible locations for aquaculture in Chittagong (Bangladesh) according to some criteria such as: the water quality, soil quality, infrastructure and other socio-economical factors.

Paper [21] shows the potential of GIS usage in all marketing mix components:
- Product (segment customers by lifestyle and product category);
- Price (implementation of pricing policy depending on location);
- Place (site selection and delivery routing);
- Promotion (develop target promotions and campaigns, geocode customers, understand customer spending).

The world most known GIS solutions provider, ESRI, has developed a series of desktop tools for business analysis such as: ArcGIS Business Analyst, Community Coder, Portfolio, ArcLogistics Route. These tools offer huge opportunities to analyze markets and customers, see trends and patterns on maps, build customer profiles, solve vehicle routing and scheduling problems, but they are expensive tools which can not be affordable by small or medium companies.

In Romania, most managers which we have talked with, think that the added value which is given by the use of GIS in market analysis problems may not always justify such a big investment in proprietary tools such as the ones from ESRI or Intergraph.

What *we propose* to the marketing analysis specialists is to use and benefit from GIS advantages without buying expensive tools, but, by using open source GIS tools or Oracle Spatial extension as, for sure, many companies rely on the Oracle database already for their operational activities.

- *Oracle Spatial and PostGIS overview*

Oracle Spatial is an extension of Oracle Enterprise Edition; it is an SQL schema which provides predefined objects and functions for storing, retrieving, manipulating and analyzing geospatial data.

Oracle Spatial components are:
- MDSYS schema which defines how to store the geospatial data, the syntax and semantics of different type of geospatial data;
- spatial indexing mechanism;
- operators and functions to make queries, joins and other spatial analysis operations.

Spatial supports the object-relational model for representing geometries.

The open source alternative to Oracle Spatial is PostGIS, the geospatial extension of the open source object-relational database PostgreSQL.

When we talk about geospatial data, we are referring mainly at vectorial data. PostGIS does not offer support for

raster data, only Oracle Spatial can store this kind of data, by using data type BLOB.

In Oracle Spatial, geospatial data is stored in a column, type *SDO_GEOMETRY*.

For example, to create a table in which we will store information regarding Romanian infrastructure, we will define a SDO_GEOMETRY column to store the vectorial data as a representation of the roads.
CREATE TABLE ROADS_RO (
type VARCHAR2(21),
name VARCHAR2(91),
geom MDSYS.SDO_GEOMETRY);

Oracle Spatial defines the object SDO_GEOMETRY like this:
CREATE TYPE sdo_geometry AS OBJECT (
SDO_GTYPE NUMBER,
SDO_SRID NUMBER,
SDO_POINT SDO_POINT_TYPE,
SDO_ELEM_INFO SDO_ELEM_INFO_ARRAY,
SDO_ORDINATES SDO_ORDINATE_ARRAY);

SDO_GTYPE attribute tells the type of the geospatial data: line, curve, polygon, collection, multiline, multipoint, multipolygon.

SDO_SRID attribute will associate a spatial coordinate system to data. The value must be found in SRID column of MDSYS.CS_SRS table.

SDO_POINT attribute is used to store point data, by filling the values for X and Y coordinates.

SDO_ELEM_INFO and SDO_ORDINATES attributes describe the data type and the pairs of points which define that data.

In PostGIS, there is used following syntax in order to add a geospatial column:
AddGeometryColumn(<table_name>,   <column_name>, <srid>, <data_type>, <dimension number>)

For example,
AddGeometryColumn(ROADS_RO,   GEOM,   4326, LINESTRING, 2);

PostGIS   data   types   are: POINT,   LINESTRING, POLYGON,   MULTIPOINT,   MULTILINESTRING, MULTIPOLYGON.

Both Oracle Spatial and PostGIS work with a special spatial data indexing mechanism named R-Tree.

R-Tree index approximates each geometry (representation of geospatial data) through a minimum bounding rectangle like shown in bellow figure:

Fig. 5 - MBR (Minimum Bounding Rectangle)

Oracle Spatial:
CREATE INDEX roads_ro_idx ON roads_ro(geom)
INDEXTYPE IS MDSYS.SPATIAL_INDEX;

PostGIS:

CREATE UNIQUE INDEX roads_ro_idx
ON roads_ro(geom) using gist (geom);

Spatial SQL, which is used in Oracle and PostGIS can replicate virtually every classic ESRI command using spatial SQL and, can do very sophisticated spatial analysis (join count, modifiable area unit problem, quadrate analysis, nearest neighbor, variogram creation) using a single declarative statement that includes spatial constructs with SQL.

Oracle Spatial has the MDSYS.SDO_SAM package which contains subprograms for spatial analysis and data mining described in table II.

Function	Explanation
SDO_SAM.AGGREGATES_FOR_GEOMETRY	Computes the thematic aggregate for a geometry.
SDO_SAM.AGGREGATES_FOR_LAYER	Computes thematic aggregates for a layer of geometries.
SDO_SAM.BIN_GEOMETRY	Computes the most-intersecting tile for a geometry.
SDO_SAM.BIN_LAYER	Assigns each location (and the corresponding row) in a data mining table to a spatial bin.
SDO_SAM.COLOCATED_REFERENCE_FEATURES	Performs a partial predicate-based join of tables, and materializes the join results into a table.
SDO_SAM.SIMPLIFY_GEOMETRY	Simplifies a geometry.
SDO_SAM.SIMPLIFY_LAYER	Simplifies a geometry layer.
SDO_SAM.SPATIAL_CLUSTERS	Computes clusters using the existing R-tree index, and returns a set of SDO_REGION objects where the geometry column specifies the boundary of each cluster and the geometry_key value is set to null.
SDO_SAM.TILED_AGGREGATES	Tiles aggregates for a domain. For each tile, computes the intersecting geometries from the theme table; the values in the aggr_col_string column are weighted proportionally to the area of the intersection, and aggregated according to aggr_col_string.
SDO_SAM.TILED_BINS	Tiles a two-dimensional space and returns geometries corresponding to those tiles.

Table II - Oracle MDSYS.SDO_SAM Functions, Source: [22]

PostGIS does not have a specialized package for spatial analysis,   but   spatial   functions   (ST_DISTANCE, ST_INTERSECTS, ST_OVERLAPS) could be used as shown in research paper [23].

C. The security of the online Informatics Systems - Database security

Information protection, privacy and user confidence are the key concerns in today's online environment. Due to online transactions development, cryptology is indispensable for protecting the information flow through "closed networks" (Intranet) and "open networks" (Internet). "Especially when working with large databases, we shall not forget that usually there is more than one user, who would access the database. Generally there are several different users, with different access permissions. It is also the responsibility of the database designer to deal with the security issues."[24]

- *Implementing Transparent Data Encryption (TDE)*

Stored data encryption was done not long ago, on the cell-level for Microsoft Server 2005 and on column-level for Oracle database versions. This type of encryption had some

security flaws because of the availability to read the table structure. In addition, you could uncover important information about the table and user schema or tablespace.

The new releases from Microsoft and Oracle, SQL Server 2008 and Oracle 11g are using TDE technology, which stands for Transparent Data Encryption. Microsoft offers TDE as part of its Microsoft SQL Server 2008. Oracle requires the Advanced Security Option for Oracle 10g and 11g to enable TDE. Keys for TDE can be stored in a Hardware Security Module to manage keys across servers, protect keys with hardware, and introduce a separation of duties.

Users of Microsoft SQL Server 2008 can now make a full database-level encryption using TDE feature [25] Starting with Oracle 11g, users can now encrypt an entire tablespace instead of encrypting a single column. With the increased security concerns pertaining to data, this new feature can definitely help a lot. Data from encrypted tablespace remains encrypted when data is written to the disk system files or to a backup device [26].

Microsoft Server 2008 TDE [24]

To enable TDE, you must have the normal permissions associated with creating a database master key and certificates in the master database. You must also have CONTROL permissions on the user database.

To enable TDE perform the following steps in the master database:

a) If it does not already exist, create a database master key (DMK) for the master database. Ensure that the database master key is encrypted by the service master key (SMK).
CREATE MASTER KEY ENCRYPTION BY PASSWORD = 'some password';

b) Either create or designate an existing certificate for use as the database encryption key (DEK) protector. For the best security, it is recommended that you create a new certificate whose only function is to protect the DEK. Ensure that this certificate is protected by the DMK.
CREATE CERTIFICATE tdeCert WITH SUBJECT = 'TDE Certificate';

c) Create a backup of the certificate with the private key and store it in a secure location. (Note that the private key is stored in a separate file—be sure to keep both files). Be sure to maintain backups of the certificate as data loss may occur otherwise.
BACKUP CERTIFICATE tdeCert TO FILE = 'path_to_file'
WITH PRIVATE KEY (FILE = 'path_to_private_key_file',
ENCRYPTION BY PASSWORD = 'cert password');

d) Optionally, enable SSL on the server to protect data in transit.
Perform the following steps in the user database. These require CONTROL permissions on the database.

e) Create the database encryption key (DEK) encrypted with the certificate designated from step 2 above. This certificate is referenced as a *server certificate* to distinguish it from other certificates that may be stored in the user database.

CREATE DATABASE ENCRYPTION KEY
WITH ALGORITHM = AES_256
ENCRYPTION BY SERVER CERTIFICATE tdeCert

f) Enable TDE. This command starts a background thread (referred to as the *encryption scan*), which runs asynchronously.
ALTER DATABASE myDatabase SET ENCRYPTION ON
To monitor progress, query the sys.dm_database_encryption_keys view (the VIEW SERVER STATE permission is required) as in the following example:
SELECT db_name(database_id), encryption_state
FROM sys.dm_database_encryption_keys

Oracle 11g TDE

a) In order to encrypt a tablespace, the initialization parameter 'COMAPTIBLE' should be set to 11.1.0 or higher. When 11g is installed, compatible parameter is set to 11.1.0. We can check parameter-using following.
SQL> show parameter compatible

b) Since Oracle uses transparent data encryption feature we have to create an oracle wallet to store the master encryption of the database and it should be opened. Let us create wallet along with the key.
SQL> ALTER SYSTEM SET ENCRYPTION KEY IDENTIFIED BY "DeciPher";

We need to create a wallet directory under $ORACLE_BASE directory before issuing the above command. This is not created by default. If wallet directory does not exist, Oracle gives an error: "ORA-28368: cannot auto-create wallet" error. Above statement also opens the wallet. Once created, a wallet is always open unless we explicitly close it or the database is shut down. Wallet is available for all sessions.

c) Once above two steps are performed, now is the time to create encrypted tablespace.
CREATE TABLESPACE secdec
DATAFILE 'C: /app/oradata/orcl/secdec01.dbf' SIZE 100M
ENCRYPTION USING 'AES256'
DEFAULT STORAGE (ENCRYPT);

In the above command, if we omit the 'ENCRYPTION USING' clause, default algorithm for encryption will be 'AES128'.
Once tablespace is created, we can create objects just as if we create it in regular tablespace. Using new view, we can identify encrypted tablespaces in the database.
SELECT ts.name, es.encryptedts, es.encryptionalg
FROM v$tablespace ts
INNER JOIN v$encrypted_tablespaces see ON es.ts# = ts.ts#
/
Couples of restrictions we need to keep in mind are:
- Existing tablespaces cannot be encrypted using 'ALTER TABLESPACE' command.
- During the recovery process of the database, which contains the encrypted tablespace, oracle wallet, must be opened

when the database is in a mounted state. This helps the recovery process to decrypt the data blocks for easy recovery.

There is a risk that organizations are assuming when they are storing the private keys used for encrypting data, in insecure locations, in applications, on company's database or even on the web. Storing the keys used for encryption of data in a database environment in the same database are not completely secured because there are many people with access to them, they are often miss-configured and are not often kept up to date with the latest patches.

Encrypting stored data implies good and secured key management capabilities for fast access to data.

- *Key management*

Microsoft Server 2008 key management

The new DBMS from Microsoft provides data encryption capabilities using Extensible Key Management (EKM) feature using Cryptographic API (MSCAPI) provider for encryption and key generation. Encryption keys for data and key encryption are created in transient key containers, and they must be exported from a provider before they are stored in the database. This approach enables key management that includes an encryption key hierarchy and key backup, to be handled by SQL Server [27]. SQL Server can use EKM keys to encrypt other keys in a database. You can create and use both symmetric and asymmetric keys on an EKM device. You can encrypt native (non-EKM) symmetric keys with EKM asymmetric keys.

Oracle 11g key management

All key values are stored as 2048-bit raw variables within the Oracle RDBMS - the potential mathematical seed of the eventual key to be utilized. At runtime, this key matrix is again Triple DES encrypted and cached in user memory. This allows for a hidden mutating key strategy for the Encryption Wizard's eventual sets of Triple DES 64 bit keys. Thus, the Encryption Wizard uses an algorithm to choose mutating 64-bit subsets of a 2048-bit key per encryption round. This key is Triple DES protected at runtime using Oracle's certified DBMS_Obfuscation_Toolkit.

All user-defined keys, or pass-phrases, are expanded to the 256-byte key value, obfuscated using Triple DES, and then again obfuscated at runtime. Yet with a user-defined key, recovery is possible if the key is lost. This recovery can only be performed using the Encryption Wizard API. All keys exist in the database table encrypted_column. This table, along with encrypted_table, can and should be backed up using your favorite database backup tool. [28]

Each table with encrypted columns has a single key, which is itself encrypted with the database master key and stored in the data dictionary with the table. No keys are stored in the clear, and the database key is stored in a security module external to the database.

The important thing for DBAs and IT security staff is that the master database key must be secured, and its location must remain known so that it can be used when its time to decrypt the data. I point this out because database master keys change

(or should change) over time. DBAs must put a plan in place now for ensuring that future staff will have access to the keys and therefore the data when needed.[29]

V. FROM ONLINE SURVEYS TO E-VOTING

From online surveys to e-voting there is only one step to take. The increasing development of online surveys in recent years is a very good assumption that the e-voting information systems will gain field in the near future getting ahead of the traditional system of voting.

"The most important function of an e-voting information system is the automatization of the voting process (mainly the electoral vote). Such an information system requires the population of a city or a state to vote via the Internet (without going to the polling sections) the president, the party or the mayor who will be at the head of that state or locality during the next electoral mandate."[30]

Using the online voting systems, more or less willingly (sometimes only as a way of accessing the website page they are interested in), the citizens will thus manage to become acquainted with this means of voting. The differences between an online survey system and an e-Voting one occur only at the level of security, that is more often than not the questions of an online survey can be answered under the "cover" of anonymity (only the IP of the computer/client where that page is accessed from is usually retained by the system), while in a process involving electronic voting it is mandatory to authenticate the e-voting system of the person giving the vote. For the rest, the entire voting process is similar to that of responding to an online survey.

Similar to the companies that use the online survey method both on their own website and on their partners' sites in order to improve their activity and performance, the public administrations could also use this method on their sites in order to consult their citizens on various issues that involve them directly, thus urging them to participate actively in the decision-making process of the local public administration and in the meantime getting them acquainted with the electronic voting or e-Voting process. We suggest that this method be applied especially in those countries where the e-Voting system has not been implemented yet or is in an early stage.

VI. CONCLUSION

In order to gain the competitive advantage, the companies have to keep in touch with the new information technologies and change the way in which they are doing the market research analysis. The time of old fashion polls or promotional brochures placed in our mailbox, has passed. Now, the online polls, online advertising, complex GIS tools and other statistical analysis placed together in an online information system are the key to success in business. Not only the big companies can afford to use the new information technologies, but small and medium companies public administrations can also benefit from their advantages by using the proposed technologies in this paper which are viable and low cost tools.

REFERENCES

[1] Market Research [Online]. Available:
http://www.publiceuroconsulting.ro

[2] Market Research - a first step in developing a business [Online]. Available: http://www.alinablaga.com

[3] F. Sabou. Trends of the Marketing Research Activity on the Romanian market, The West University "Vasile Goldis", Arad, Romania [Online]. Available: http://www.uvvg.ro

[4] ISO 20252, Standard for Market Research [Online]. Available:
http://www.consultanta-certificare.ro

[5] D. R. Shaw, C. P. Holland, "Strategy, networks and systems in the global translation services market", *Journal of Strategic Information Systems*, Article in press (to be published): Accepted 23 August 2010, (ISI Thomson).

[6] Y. (Susan) Wei, Q. Wang, "Making sense of a market information system for superior performance: The roles of organizational responsiveness and innovation strategy", *Industrial Marketing Management*, Article in press (to be published): Accepted 14 June 2010, IMM-06532, No of Pages 11 (ISI Thomson).

[7] J. Komarkova, P. Sedlak, K. Langrova, "Information Society and its Development in the Czech Republic", *WSEAS TRANSACTIONS on COMPUTERS*, vol. 7, no. 9, pp. 1483-1494, 2008.

[8] Eurostat (The statistical office of the European Union) [Online]. Available:
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/E-government_statistics

[9] J. Byrne, C. Heavey, P.J. Byrne, "A review of Web-based simulation and supporting tools", *Simulation Modelling Practice and Theory*, vol. 18, issue 3, pp. 253–276, March 2010 (ISI Thomson).

[10] E. Chavarriaga, J. A. Macias, "A model-driven approach to building modern Semantic Web-Based User Interfaces", *Advances in Engineering Software*, vol. 40, pp. 1329–1334, 2009 (ISI Thomson).

[11] Microsoft. Object-oriented Programming and Visual Programming [Online]. Available:
http://www.pc-info.ro/download/Manual_POO_si_Vizuala.pdf

[12] N. Zagalo - Dept. Clencias Comunicacao, Universidade do Minho. (2010, Apr. 30). Google, Apple e Microsoft [Online]. Available: http://virtual-illusion.blogspot.com/2010/04/google-apple-e-microsoft.html

[13] R. Harkness, M. Crook, D. Povey, "Programming Review of Visual Basic.NET for the Laboratory Automation Industry", *Journal of the Association for Laboratory Automation (JALA)*, pp. 25-32, Feb. 2007.

[14] I.V. Grossu, C. Besliu, Al. Jipa, C.C. Bordeianu, D. Felea, E. Stan, T. Esanu, "Code C# for chaos analysis of relativistic many-body systems" *Computer Physics Communications*, vol. 181, pp. 1464–1470, 2010 (ISI Thomson).

[15] Java 2 Enterprise Edition Platform [Online]. Available:
http://www.scritube.com/stiinta/informatica/java/Platforma-Java-Enterprise-Edit51958.php

[16] EMEA Media Centre Home, Press Releases. (2010, Sept. 22). Oracle Openworld [Online]. Available: http://emeapressoffice.oracle.com

[17] R. Badea, C. Moise, V. Voicu, "Ways to Improve Sales Management for Romanian Retailers Using Geographical Information Systems", *The 9th WSEAS Int. Conf. on MATHEMATICS & COMPUTERS IN BUSINESS AND ECONOMICS (MCBE '08),* Bucharest, Romania, 2008, June 24-26.

[18] A. M. Mocanu, D. Litan, S. Olaru and A. Munteanu, "Information systems in the knowledge based economy", *WSEAS TRANSACTIONS on BUSINESS and ECONOMICS*, vol. 7, no. 1, pp. 11-21, 2010.

[19] A. Simao, P. J. Densham, M. (Muki) Haklay, "Web-based GIS for collaborative planning and public participation: An application to the strategic planning of wind farm sites", *Journal of Environmental Management*, vol. 90, no. 1, pg. 2027–2040, 2009.

[20] M. S. Hossain, S. R. Chowdhury, N. G. Das, S.M. Sharifuzzaman, A. Sultana, "Integration of GIS and multicriteria decision analysis for urban aquaculture development in Bangladesh", *Landscape and Urban Planning*, vol. 90, no. 3, pp. 119–133, 2009.

[21] R. L. Hessa, R. S. Rubinb, L. A. West Jr., "Geographic information systems as a marketing information system technology", *Decision Support Systems*, vol. 38, no. 2, pp. 197– 212, 2004.

[22] SDO_SAM Package (Spatial Analysis and Mining) [Online]. Available:
http://download.oracle.com/docs/cd/B19306_01/appdev.102/b14255/sdo_sam_ref.htm

[23] D. Litan, A. M. Mocanu, M. Velicanu, „<<WikiHealth>> for Public Health Mapping", *The International Conference on Economics and Administration*, Bucharest, Romania, 2010, June 4-5, pp. 333-340.

[24] Z. S. Zubi, M. Alkablawi, "Conceptual database security access permissions", *The 10th WSEAS International Conference on EVOLUTIONARY COMPUTING*, Prague, Czech Republic, pp. 77-83, 2009, March 23-25.

[25] S. Hsueh. (2008, Feb.). Database Encryption in SQL Server 2008 Enterprise Edition [Online]. Available: http://msdn.microsoft.com/en-us/library/cc278098.aspx

[26] Encrypted Tablespaces in Oracle 11g. (2008, February) [Online]. Available: http://decipherinfosys.wordpress.com/2008/02/05/encrypted-tablespaces-in-oracle-11g

[27] Understanding Extensible Key Management (EKM). (2008, Aug.) [Online]. Available:
http://technet.microsoft.com/en-us/library/bb895340.aspx

[28] FixUnix.com. (2007, Sept.) [Online]. Available:
http://fixunix.com/security/18203-oracle-database-encryption-software-free-downloads.html

[29] C. Sturdevant. (2007, October). Oracles Database 11g Streamlines Management [Online]. Available:
http://www.eweek.com/c/a/Enterprise-Applications/Oracles-Database-11g-Streamlines-Management

[30] M. Velicanu, A. Mocanu (Virgolici), D. Litan, "Specialized Hardware for Databases", *Studies and Research on Econoic Calculus and Economic Cybernetics Journal*, vol. 1, pp.35-45, 2010.

[31] Comparison of C Sharp and Visual Basic .NET [Online]. Available:
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