

Modern Information Technologies Used In Market Research

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Abstract: - 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. “International companies need to communicate with their customers in any market that they target and any company with a web site has the potential to do business internationally.”[1] 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 into the corporation websites has also become almost a necessity today. 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.

Key-Words: - market research, information system, information technology, online surveys, geographical information system, information security

1 Introduction

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”[www1]. 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” [www2] said Alina Blaga,

Marketing Manager for Public Euroconsulting - HR & Marketing Agency, Romania.

“The main research methods used in marketing are: documentation, observation, experiment, test, simulation and market investigation”[www3] and 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” [www3].

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.

1.1 The Market Research in the “information technology era”

“Several authors have identified the influence of information systems on market structure in different industries.”[1]. 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 Wang argue 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: [2]

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.

2 Conducting online surveys

The questionnaire is the most frequently used method of collecting information in market research, as mentioned above. But living in the “Internet era”, “many disciplines are re-evaluating their strategies and techniques in view of the services offered by the Internet.”[3] and as expected, most of the information collecting campaigns “moved” from the real world to the virtual environment or online.

The problems which arise in the development and implementation of the information systems for conducting online surveys and analyzing the data collected, 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 ?

2.1 Technologies used in developing the web-based information systems

The Programming Platform is the main support for the development of an information system.

2.1.1 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”[www4] or which can be 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.”[www4]

“One of the major factors in take up of any language is how good the IDE (Integrated Design Environment) is.

The support for writing code is a major advance in the IDE (for .NET, Microsoft Visual Studio). 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.”[4]

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.” [5]

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.”[4] 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.”[4] 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 and 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.”[4]

2.1.2 The Java Platform

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).”[www5]

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 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.”[www6]

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).

2.2 Market research analysis using Geographical Information Systems (GIS)

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?”.

2.2.1 Geographical Information Systems (GIS) in Business

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 [9].

The authors of the research paper [10] have shown how a web GIS collaborative portal could be used to identify the suitable locations for developing wind farms in UK. Also, paper [7] 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 [6] 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.

2.2.2 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. 2 – 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.

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 [8].

2.3 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).

2.3.1 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 [www7] 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 [www8].

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.

2.3.2 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. [www9] 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. [www10]

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. [www11].

3 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 can also benefit from their advantages by using the proposed technologies in this paper which are viable and low cost tools.

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