Proposing Intelligent Models Based on Geographic Information Systems for Organizations

Teresa Guarda[1,2,3,4], Maria Fernanda Augusto[1,2,3]

[1] Universidad Estatal Peninsula de Santa Elena, La Libertad, Ecuador

[2] CIST – Centro de Investigacion en Sistemas y Telecomunicaciones, Universidad Estatal Peninsula de Santa Elena
La Libertad, Ecuador

[3] BiTrum Research Group, Spain

[4] Algoritmi Centre, Minho University, Guimarães, Portugal

{tguarda@gmail.com} {mfg.augusto@gmail.com}

ABSTRACT: *While developing products, organization basically consider the requirements of customers, their views in the form of feedback and regular assessment which help ultimately to improve the products and may lead to establish an edge over other rival products. For this task, the information systems particularly the Geographic information systems which are the tools can help. For this purpose a wider variety of tools are used that provide very efficient results for assertive and effective decision making. To achieve it, the spatial organizations need to contribute with the needs of the entities whether they are from the public or private sector. The developments in information and communication technologies would provide other possible ways to accessing information and storage data, as well greater accessibility to multiple devices. These developments coupled with Internet of Things into a big digital ecosystem, revolutionizing the business models also in the area of marketing. Evidences are available for IoT which is increasingly growing in the economy, creating new opportunities and as a consequence innovative business model. We in this paper advocated a conceptual model that addresses geographic market intelligence, examining how the benefits of these can contribute to greater effectiveness in marketing programs and ultimately reap benefits to acquire skills.*

1. Introduction

The globalization of markets and the stagnation of the world economy have led companies to a high level of competition. The growing demand of consumers has put companies in the face of the need for a differentiated treatment for each segment of consumption and, intensifying the search for new offers of services or products to guarantee survival.

The competitiveness resulting from globalization and also the evolution of information technology has scarified the market

view, since the extent of competition is no longer limited by the geographical space of a city, state or country, but rather has competitors for the whole world to a click away. In an increasingly competitive and aggressive market, corporate survival is dependent on customer focus as a key success factor.

Companies must have the appropriate tools to extract strategic information aiming at maximizing profits by expanding their customer base and customer powers, offering new services/products, finding new niche markets, conducting campaigns marketing, and reliability in demand estimates [10, 13].

Currently, statistical and market analysis have evolved with the incorporation of spatial dimensions into problem-solving. The strategy is directed to segments of customers associated with geographical information, such as geolocation; the concentration of consumers; the concentration of competitors; and proximity to distribution channels [3].

Previously the theoretical basis of GeoMarketing (GM) was limited to spatial models of the market to support decision-making. Currently, there are Spatial Information Systems (SIS) that use numerous elements to support decisionmaking. These systems combine large volumes of data stored in databases, in Spatial Data Warehouses (SDW), Geographic Information System (GIS), Database Marketing (DBM), using Data Mining (DM) techniques and OLAP tools.

In this paper, a conceptual model for Geographic Marketing Intelligence (GMI) is proposed. The second section of the paper presents the background concepts of Database Marketing, Data mining, Spatial Data Warehouse and Geodemography, and On-Line Analytical Processing. The third section analyses the Geographic Information Systems. The proposal for the smart marketing conceptual model is presented in the fourth section. Finally, the conclusions are presented in the last section.

2. Background

Over the last decades, organizations have increasingly come to trust in technology to support communication and information processing in almost all areas of their operations. Marketers and others related to marketing function have been seeking the best way to introduce such information and communication technology successfully into their business.

2.1 Database Marketing
The basis of the DBM is that at least part of the communication of organizations with their customers is direct [16]. We can say that the DBM is normally covered by classical statistical inference, which may fail when data are complex, multidimensional, and incomplete.

With the advancement of information technology, in terms of processing speed, and in terms of storage space, the flow of data in organizations has grown exponentially, suggesting different approaches to the DBM. Generally, it is the art of using the data collected, to create new ideas to make money [6], or add other customer information in a database (lifestyle, transaction history, and others), and use these information as the basis for customer loyalty programs to facilitate contacts and to enable future marketing planning, [5]. The DBM can be set to collect, store and use the maximum of useful knowledge about customers and prospects, to their benefit and profit [19]. DBM support marketing decisions and activities by understanding customers, which will satisfy their needs and anticipate their desires.

2.2 Data Mining
Every day, companies produce a huge amount of information. Data can be very useful for business, but its necessary to have the knowledge and tools to transform it into relevant conclusions. Not being processed, they are lost and companies continue to work based on general standards.

DM uses this information to customize and optimize products and services. It is a set of technologies and computational techniques to explore databases automatically or semi-automatically, and the objective is to draw conclusions from a data set, applying reusable analysis structures [18]. To achieve this, it uses methods of artificial intelligence, machine learning, statistics and database systems.

Data Mining is used to understand consumer behavior [8]. The identification of user behavior patterns, interests and habits are key in segmentation strategies. With this information it is possible to create personalized content, improving loyalty. In addition, the same conclusions can be used to attract similar users. Thus, the strategies are based on concrete data, which can be adjusted

later to integrate any changes.

Data analysis through DM can provide numerous advantages to companies for the optimization of their management and time, but also for the acquisition and loyalty of customers, which will allow them to increase their sales.

The DM process has four different steps: (1) determination of the objectives (determines which objectives we want to achieve); (2) data processing (selection, cleaning, enrichment, reduction and transformation of the database); (3) determination of the model (first a statistical analysis of the data must be made and then a graphic visualization of them); (4) analysis of the results (in this step it will be necessary to verify if the results obtained are consistent).

Currently, this type of work is being carried out in data security, marketing, fraud detection, finance, health, online searches, smart cities, natural language processing among others.

Some of the conclusions or findings that can be reached with the DM are the particular characteristics of potential customers; the key elements that influence the purchase decision; the most appropriate recommendations for each user; the ideal products for cross-selling; and the type of content that will appeal to a certain audience [14].

Then in this way, DM allows us to take advantage of all the information generated by a company. Marketing strategies, in particular, can benefit greatly from these systems, adjusting each technique according to the data.

2.3 Spatial Data Warehouse
Today there is a big explosion in data volume, whether in public or private companies. The advent of computers with increasing processing power and increasing business complexity have led to this explosion. These data are found in various systems, not integrated and with operational characteristics, that is, each one fulfills a specific operational task. There are duplication of information and incompatibilities and inconsistencies, as the updates take place independently. The customer name, because it is spelled differently on different bases, and that can distort information about this customer [7]. Thus, it is not possible to seek information that has a unique view of the customer and in a manner that allows decision-making from a managerial and strategic focus. The Data Warehouse is the answer to this business vision need. The Data Warehouse is a place where a set of information is stored which, associated with a set of tools and procedures, from the data population, the transformation and standardization of all data, the fixation of the data temporal value, as well as all the infrastructure for consultation, online analysis and detailed trend analysis by Data Mining techniques, which build on the business decision-making database [7].

2.4 On-Line Analytical Processing
In recent years the term Business Intelligence (BI) has been widely used in the market as a synonym for analytical systems, OLAP, cubes, among others. Although these denominations may be associated with each other, they are conceptually distinct [7].

Strictly speaking, Business Intelligence can be obtained by any artifact, technological or not, that allows the extraction of knowledge from business analysis. For obvious reasons, the effectiveness of these analyzes will be greater if the data is consistently available and preferably consolidated.

Analytical systems or OLAP are a set of tools whose technology enables business analysts, managers, and executives to quickly and consistently and primarily interactively analyze and view corporate data; characterized by providing support for decision making based on analysis of historical databases, sometimes a huge amount of records [12].

OLAP functionality is initially characterized by dynamic and multidimensional analysis of an organization's consolidated data allowing end-user activities to be both analytical and navigational.

These analytical tools have the ability to analyze large volumes of information from a variety of perspectives within a Data Warehouse (DW). These tools are capable of navigating the data of a Data Warehouse, having a structure suitable for both research and information presentation.

3. Geographic Information Systems

Geographic Information Systems is a system consisting of a set of computer programs, which integrate data, equipment, and

people for the purpose of collecting, storing, retrieving, manipulating, visualizing and analyzing data spatially referenced to a known coordinate system.

All GIS software encompasses a database management system capable of manipulating and integrating two types of data: spatial data and attribute data, enabling information to be created and easier to analyze, and this is an advantage of this system over other types of computerized systems. Spatial data can be represented in vector or matrix form, whereas attribute data is composed of alphanumeric codes stored in tables.

A GIS, as a computational environment, is composed of the following hierarchical structure: user interface; data entry and integration; query and spatial analysis functions; spatial data management (data storage and retrieval); and visualization and plotting (Figure 1).

One of the characteristics that differentiate GIS from conventional Information Systems (IS) is the ability to perform spatial analysis operations. Based on spatial and non-spatial attributes of a database, it is possible to study spatiotemporal relationships, outliers, and patterns of geographic, social, cultural, biological and physical phenomena, allowing the understanding of the distribution of data from phenomena occurred in a particular geographical location [4].

A GIS can be defined as a set of procedures designed to store, access and manipulate georeferenced information. In this sense, a GIS provides means for testing alternatives, and for turning data into information and hence knowledge.
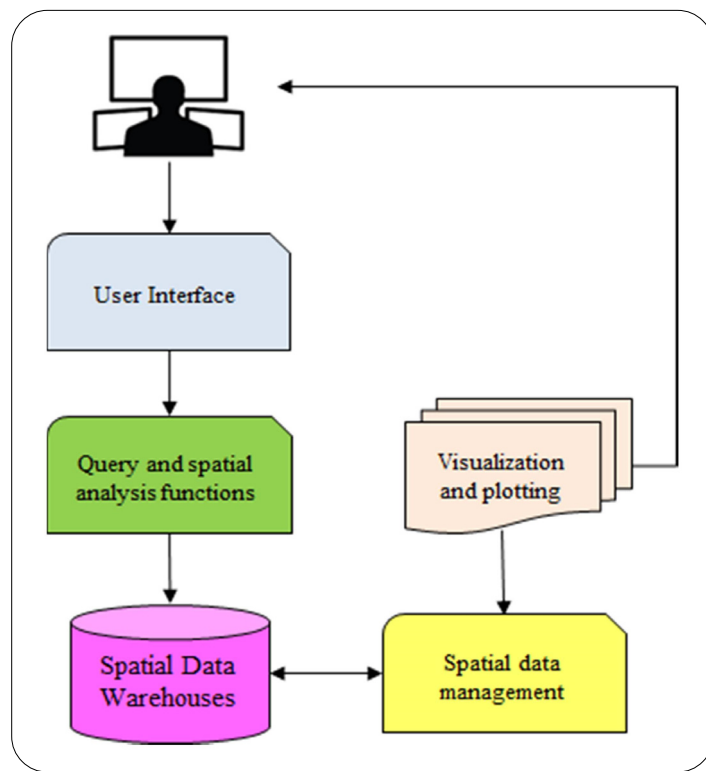

Figure 1. Geographic Information Systems general structure

4. Geographic Marketing Intelligence

Geographic Marketing Intelligence, is a methodology that provides effective strategies to sell more, reduce costs and increase results through georeferenced information.

Geocoding is one of several techniques used in Geomarketing that allows, for example, to find areas with a greater concentration

of customers, by transforming addresses into georeferenced points. Geographic Marketing Intelligence or GM, is an approach to marketing that allows the marketing mix to be adapted to the way the market is organized in space, that is, it allows the analysis of relevant variables through the visualization of this data in geographic maps, considering visualization (maps) and data analysis as a component in the decision-making process.

GM contributes to measure the market potential of each pre-established area within the company's operating territory [15]. Companies that do not know the size of the market cannot measure the potential of their area by failing to manage their stake.

The search for niches and market segments is a challenge for organizations. Identifying opportunities by studying the area of expertise demonstrates that the company is using sales management tools to its advantage. Strengthening the possibility of increasing its customer base and hence maximize the results.

GeoMarketing was initially designed to create strategies for companies by analyzing the characteristics of the public in a given region and thus determining the location of a new physical store based on the most promising areas for sales. However, today GM encompasses a broader concept and is called GM to any strategy that optimizes campaigns and reaches local consumers, and all using only location intelligence.

GM gives the opportunity to define, map, and find those profiles that are right for your business, and is an important step for any business as it facilitates the delivery of products and content to a specific audience.

The data crucial for the development of GM strategies are obtained through Big Data. In a simple and general way, Big Data is formed by the set of information located in the databases of several servers and companies. This data is freely accessible and interconnected, that is, it is available on the world wide web [1, 2, 17].

5. GMI Model

GMI is a set of processes, techniques, and tools that allow you to respond to business needs, gathering information from internal and external sources, processing, analyzing and distributing in order to assist marketers in the decision-making process.

The model supports business processes by working primarily with variables that can be classified into sociodemographic, economic, behavioral, physical territorial, business and competitive. Its main applications are the detection of market niches and points of presence, the definition of sales targets and the attractiveness of consumption.

In the conceptual model (see Figure 2), the analysis operation in GMI is usually preceded by two important steps: the availability of a georeferenced database of systematic elements; and the database of objects of interest that is generally made up of the customer base or prospects that we want to map. These customers must have some information that allows their location on the map, or, as already discussed, their geocoding.

After this data entry, the database of objects of interest is geocoded and all spatial analysis available on tools is potentially useful. At this point in the process, building the SDW comprises the infrastructure that will enable the various analyzes supported by geodemography. The customer database is associated with information from a georeferenced database with census sociodemographic information for a small area; identification and qualification of market players; knowledge of the elements that influence the business being studied; influence zones; and others.

The main practical results that can be obtained are field research analysis; profile and segmentation studies; optimization of distribution strategies; micromarket forecasting; coverage analysis; getting new customers; and communication optimization. The combination of statistical techniques, online analytical process (OLAP), geospatial analysis, and DM makes SDW a repository of information that cyclically acquires new knowledge according to its operation and is feedback with the new information obtained, which allows, in the medium term, an increasing knowledge of customers and prospects, the area of operation and their competitors [11].

In research analysis, internal information sources (such as company databases) are used, complemented by the incorporation of external information sources. The data is extracted, within the concept of ETL (Extraction, Transformation and Load) and incorporated into the SDW, which keeps them in a multidimensional structure, which facilitates the integration and the search for
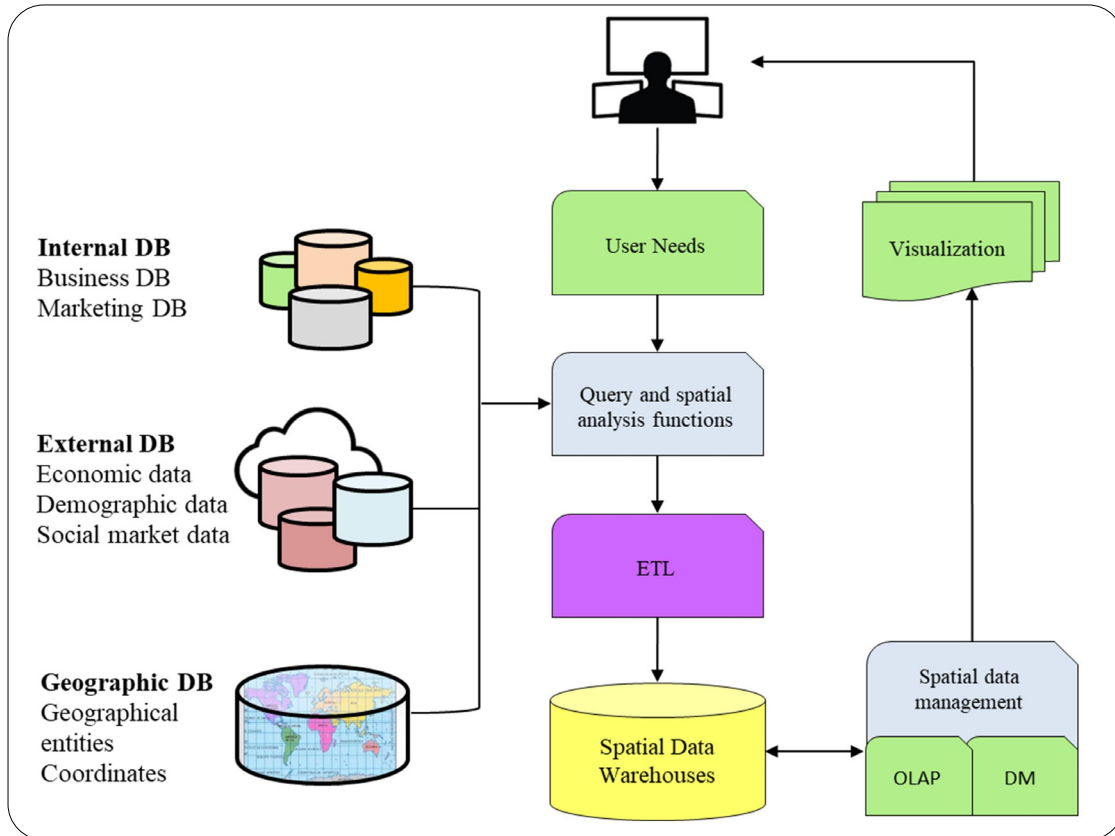
Figure 2. GMI conceptual model

knowledge, integrated with the systematic spatial data, kept in layers of information [9]. Extraction is done through OLAP tools, which are applications that end users have access to extract data from their databases with which they generate reports able to answer their management questions. The Spatial Data Warehouse enables the storage of the spatial dimension, that is, integrates the localization element with the data. Adding this element to the data warehouse implies broad possibilities, options, and performance throughout the decision-making process and, as a result, the use of GIS as a tool for analysis and visualization of information is expanded. The transformation of data from the company's transactional systems into information to support decision making is part of an operational vision for a strategic and tactical vision that encompasses a holistic customer perspective.

Once this georeferenced database is set up, it must be constantly updated with customer relationship interactions, information obtained from the general media, and targeted research. The easy access to this database and the possibility of ad-hoc data crossover is the ultimate goal of a Spatial Data Warehouse. Seeking confirmation of behaviors, we suspect (OLAP research) or uncovering behaviors we did not suspect (DM) with high confidence and speed is the expected result of this system, as an aid to the market planning process.

The major function of SDW is debugging the various databases. The information that is part of the intersection set must match. Besides that, outliers, or points outside the curve, are easily identified. Another important function of SDW in the case of GM is the identification of well-defined spatialized market segments for marketing actions.

6. Conclusions

Today's business environment is highly competitive and increasingly globalized, demanding from organizations agility and intelligence in the constant search for competitive advantages. In this context, information and, above all, knowledgeenabled by the good use of information, plays a leading role in both tactical and strategic decision making.

Through GIS, it is possible to integrate information from different sources that would otherwise be impossible to integrate, and thus provide inputs to support decision making. Marketing Information Systems employs Geographic Information Systems thereby crossing data of various types and improving their interpretation through the unique way that they are arranged on maps. Of the various marketing activities, those that most use GIS are Market Segmentation, Market Potential Analysis, SalesForce Organization and Evaluation, Marketing Promotion, and Business Localization.

GM defines the use of geographic information in marketing using Geographic Information Systems and data with some kind of geographic context. Thus, it follows that whenever we talk about applying GIS to marketing, we are talking about GM, which is crucial for most marketing activities.

GMI conceptual model is characterized by the inclusion of geographic intelligence and the geographical analysis of different variables taking into account marketing logic and strategies. Thus, it translates into the result of geographic analyses performed on the use of data that support the various marketing decision-making. It also requires close observation of the field under study and analysis of trends or other concrete properties so that it becomes possible to include conclusions in the preparation and implementation of marketing activities or campaigns.

In today's globalization and increasingly aggressive markets with ever shorter life cycles, the use of GMI techniques and solutions is extremely relevant and decisive not only for identifying opportunities and being one step ahead of the competition, but also to maintain the innovation and competitive advantage of mores.

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