The ECMR System – a Multi-tier Solution for Marketing Research

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Abstract

In this paper we investigate issues pertaining to the application of the latest technologies in the development of management information systems for marketing research. The J2EE standard supports component-based enterprise solutions. Various complex functionalities inherently required by any enterprise application, such as transaction management, life-cycle management, load balancing, and resource pooling, are integrated into the J2EE platform and are provided automatically to the components it supports. Following the J2EE-based multi-tier architecture for enterprise solutions, the ECMR System was developed for the needs of marketing research and management decision support. The resulting system combines extensively relational database systems for remote Internet/Intranet data management with a multi-tier application structure.

Key Words: *Management information systems, J2EE multi-tier approach, marketing research, database marketing*

1. INTRODUCTION

Management is inseparably related to and relying on software applications that strongly facilitate the decision-making process. Companies extensively use management information systems to support their administrative, business and organizational practices. To facilitate Sales and Marketing departments, especially throughout the product positioning, marketing, and sales processes, the development of a management information system that makes use of corporate data and registration systems, effective support of organizational processes, and innovative application of business models acquires primary importance. Marketing research methods might be employed to evaluate opportunities for offering new products and services, direct efforts to products, services and segments that require the most support, and evaluate existing marketing programs.

In a real world environment, there is no standardized method or technology for the integration of multiple systems and applications. However, there are powerful, open, and generic technologies, which might serve as foundation for developing robust and reliable systems. On such a framework dedicated specific components can be built up to support the multitude of organizational activities. J2EE (Java 2 Enterprise Edition) compliant application servers provide such a component-based middle-ware infrastructure and content-delivery functionality required to build integrated enterprise business solutions [3].

There is a growing trend towards enabling distant access to existing databases from the Web. Building Web-based information systems that exchange data using Internet applications enhances database usability, promotes organizational efficiency, and significantly favors the human-computer interaction. In this context, the main goal of our research is to apply a Web-based approach to marketing research.

In this paper we present our effort to develop a management information system for marketing research and management decision support. The proposed solution consists of applying relational database systems and Java technologies for remote Internet/Intranet data management. Considering our previous experience and results in the field of Human Resource Management software applications [1,6] we have proceeded to the development of the ECMR System. The resulting management information system combines and extensively employs the relational database model with multi-tier client/server architecture. The ECMR system ensures interoperability by offering a J2EE-based multi-tier approach, JSP and Java Applets support, as well as the capability to adopt for any support of existing legacy systems.

The design of the ECMR System has been driven by the complex and diverse requirements of the electronic components industry. The ECMR System addresses the

workflow and the creation of value starting with product awareness and pre-sale customer support, wholesale of products and services, online marketing, and unified management decision support. For all aspects of the workflow the intuitive usability of the system is a major design goal. The ECMR System fulfills the solution requirements for effective management and administration over the complete life cycle. The set of requirements covers openness, flexibility, security, scalability and support of standards, reliability, redundancy, and easy and safe configuration.

The rest of the paper is organized as follows. In Section 2, we introduce the Model-View-Controller (MVC) paradigm for breaking down the application into components. We also briefly outline the basic features of the J2EE multi-tier architecture for enterprise solutions. Section 3 focuses on the nature and importance of database marketing as an integral part of a corporate management information system. Section 4 deals with design issues, the ECMR System J2EE-based architecture, and the major system functionalities for management decision support. We summarize our results in Section 5.

2. THE MVC MODEL AND THE UNDERLYING J2EE TECHNOLOGY

One of the most important choices in designing a multi-tier application is how to break the application into components that are easier to create, understand and maintain. The Model-View-Controller (MVC) paradigm is often used to accomplish at least a part of this goal. There are many flavors of MVC but what they all have in common is the separation of the business logic (the model) from the presentation logic (the view) in the application, as it is presented in Fig.1.

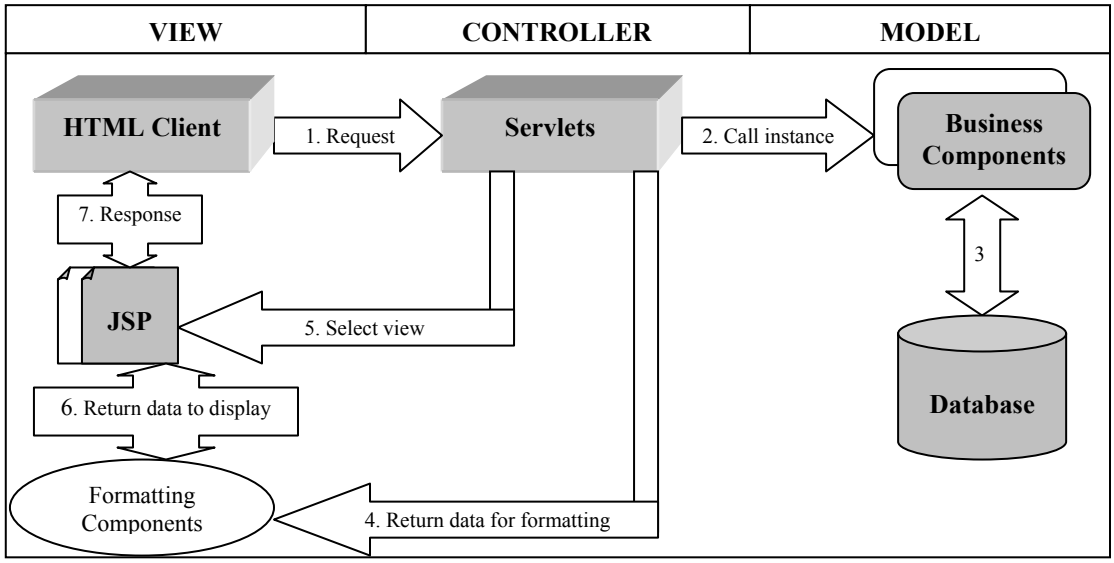

Fig.1 The Model-View-Controller Paradigm

In MVC , the controller manages the interaction between the model and the view. In traditional MVC designs, the view listens and responds to changes to the model. We relax this behavior and simply say that the view is updated by the controller with data from the model based on user input. This is typical for today's Web applications: the user fills in the fields in a form and submits it to the server for processing. The server responds with another screen whose content is dynamic depending on the values entered in the previous form [2].

A multi-tier Web architecture can be used to implement a wide variety of Internet/ Intranet applications ranging from high-volume e-commerce business solutions to mission-critical enterprise services. The multi-tier architecture allows to reap the benefits of the MVC design, such as dynamic content and separation of presentation from business logic. Thus, a scalable, manageable, reliable, and secure platform on which to deploy application services on the Web is provided.

Utilized in the implementation of the ECMR System design, the J2EE standard requires the building of component-based enterprise solutions. The J2EE-based multi-tier application represents a collection of software components, interfaces and standards that are engineered to be distributed across multiple computing tiers. The J2EE compliant application servers provide a component-based middle-ware infrastructure and content-delivery functionality required to build integrated enterprise business solutions. The J2EE compliant platform provides a multi-tiered distributed application model, ability to reuse components, security model, and flexible transaction control that ease application development by abstracting low-level details from the business logic.The J2EE platform is server-centric, i.e. applications typically offer services to a diverse set of clients. J2EE incorporates the JavaBeans component model. J2EE focuses on the business logic where business functions are implemented as Enterprise JavaBean (EJB) components. In the presentation tier, Java Servlets and Java Server Pages (JSP) shield business-tier clients from the complexity of the presentation tier environment while making it easy for web user interface developers to present the service to anyone with a browser. JSP pages are used to control the generation and presentation of dynamic and repetitive content [2].

The J2EE platform defines a model for implementing scalable, manageable, accessible, and secure multi-tier architectures. In our opinion this platform is therefore the most relevant and best suited to the needs of the ECMR System for supporting a flexible, secure, transactional application that exposes corporate information to both Internet and intranet clients.

3. THE MARKETING RESEARCH PROCESS

It is crucial to make management decisions on the basis of the best available information - through the appropriate marketing research techniques. *Marketing research* includes the planning, collection, and analysis of data relevant to marketing decision-making and the communication of the results of this analysis to the management [5]. The goal is to ensure an adequate corporate reaction in terms of a relevant and flexible marketing strategy that is capable of addressing the challenges and peculiarities of the ever-changing marketplace.

Great emphasis is placed on the correctness and accurateness of the information gathered at the lowest reasonable cost. It is this reason, together with the increasing sophistication and reliability of communication, computer, and information technology that justifies database marketing as the most suitable research approach for the ECMR System.

The nature and importance of database marketing, as an integral part of a corporate management information system [4,5] can be fully appreciated in the context of *the seven stages of the marketing research process*, described on Fig. 2

Problem/opportunity identification:

A marketing manager must take into consideration and shape both the internal and the external organizational environment. The primary environmental variables the manager utilizes are price, place, promotion and product, defined as the *marketing mix* of the organization. As changes occur in the environment, the marketing manager has to adequately adapt the marketing mix to take maximum advantage of product, promotion, distribution, and pricing alternatives in new market opportunities.

Creating the research design:

Research can be descriptive or causal. Descriptive studies answer the questions who, what, when, where, and how, while the causal studies examine whether one variable causes or determines the value of another variable. While the descriptive research approach provides information about the existence of interrelationship between two variables (e.g. intensive advertising and increased sales), causal study changes one independent variable and demonstrates its effect on the dependent variable. The research design targeted in the ECMR System combines the description of the organizational

environment with the search for causality and temporal sequence in the external environment, i.e. whether an appropriate causal order of events exists.

Choosing the basic method of research:

Of the three basic research methods – survey, observation and experiment – the first one is the most suitable for implementation in the ECMR system. In our case it involves interacting with respondents by means of online questionnaires to obtain customer data, opinions, and attitudes and to ensure a structured approach to data gathering.

Selecting the sampling procedure:

The population of interest which will be surveyed comprises both registered customers and accidental visitors of the company's Website due to the fact that all people whose opinions, preferences, and attitudes are relevant to the decision making process are targeted. From these two groups the sample is drawn. For registered users specific online forms and questionnaires are used to gather representative data, while the preferences of accidental users are examined through promotional pop-up questionnaires.

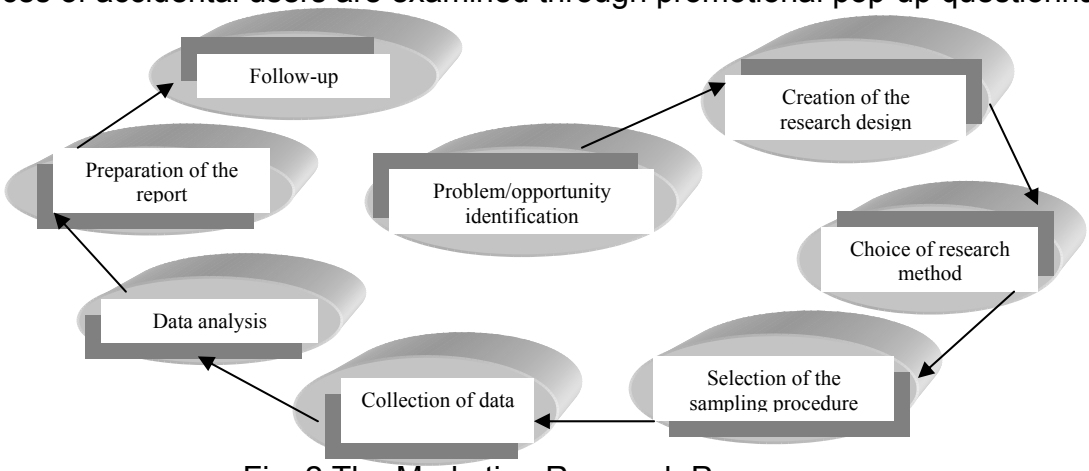

Fig. 2 The Marketing Research Process

Collecting the data:

This is the stage at which *database marketing* is employed. The *primary data* needed for the respective analysis is provided through the specific functional modules of the system. The database marketing research approach is related to the collection of *secondary data* - pieces of information that have previously been gathered through enterprise-wide information systems and only might be relevant to the problem at hand. For the purposes of database marketing the focus is on the internal corporate database, which stores data collected by the company itself. It is exactly the systematic creation of extensive customer and prospect profiles and purchasing patterns that form the essence of database marketing. Some of its basic functionalities comprise evaluation of sales territories, identification of the most profitable market segments, which will facilitate the targeting of organizational resources with greater efficiency and effectiveness, and identification of the most profitable and the least profitable customers.

Analyzing the data:

After the data has been collected, the data analysis ensures user-friendly and meaningful interpretation of the needed subset of the mass of collected data. The feedback provided to the management represents important decision support in terms of reports, graphs, and preliminary recommendations for adequate reaction to the new internal and external conditions. As an important part of the ECMR System, the database marketing creates, rather than simply manipulates data, and presents it in a form useful to a variety of people within the organization.

4.THE ECMR SYSTEM FOR MARKETING RESEARCH

Production platforms:

The development phase of the ECMR System utilized Windows 2000 Professional as a production operating system, Oracle 8*i* Database Server, Oracle9*i*AS Container for J2EE

(OC4J) as an Enterprise Java Beans container, and TomCat 3.2.1 as a Web server and Servlet Engine for the presentation tier. Windows 2000 Professional and Windows 2000 Server were defined as the target operating systems.

Development tools:

HTML Editors, JDK1.3 or higher, and Oracle JDeveloper 3.1 were used for the development of the application logic of the ECMR System. Oracle 8.1.7 Enterprise Edition and Oracle Designer 6.0 were used for the database layer implementation and database administration.

System architecture:

Following the J2EE multi-tier standard, the ECMR System consists of the following system components and tiers (Fig.3):

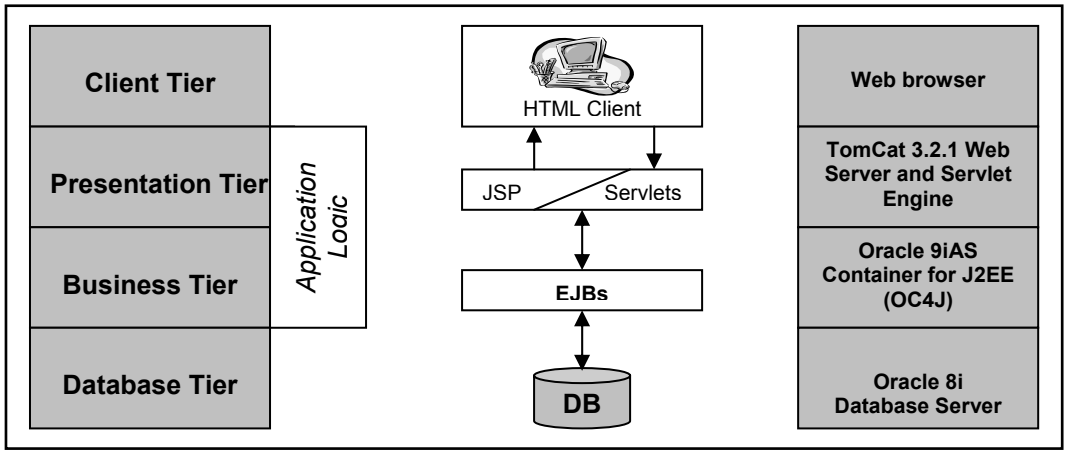

Fig. 3 The ECMR System J2EE-based Multi-tier Architecture

The J2EE-based multi-tier architecture consists of components that hold presentation or business logic (JSPs, servlets, EJBs), containers that provide context for the components (Web Server, EJB container–Application server), and connectors (HTTP, JDBC, CORBA, etc.). The multi-tier architecture divides the application logic into components according to their function. Thus, the different application components that make up a J2EE application can be installed on the same or different servers. Where an application module is installed depends on which tier in the multi-tier J2EE environment the application component belongs to. The tiers possess well-specified interfaces and may include application components based on one or more technologies. The resulting system combines extensively relational database systems for remote Internet/Intranet data management.

System functionalities:

The ECMR solution is two-fold – it provides an e-Business solution with essential management decision support functionalities. The main modules provide customers with facilities for registration and customer profile creation, online customer support, online catalogues and descriptions of products and solutions, online orders and order status tracking. From intra-organizational perspective, the ECMR System provides the company management with report facilities for aggregated market and market segment information, up-to-date sales and product lines analysis, online advertising and current advertising information, as well as observation of customer trends. The ECMR is *interactive* in terms of reports and graphical representation, as well as *flexible* since it sorts, regroups, totals, averages, and displays data in a way suitable to support management decision-making. Available are both highly aggregated figures and very detailed breakdowns. The system is *discovery-oriented* since it directs the manager's attention to new trends, appearing problems, and urgent questions. Fig. 4 presents the way the ECMR system works to facilitate the management decision-making.

5. CONCLUSIONS AND FUTURE WORK

The rapid development of information technologies permits their application for delivering various services to end-users. In this paper, we present our effort to develop a management information system for marketing research. The proposed solution – the ECMR System - combines and extensively employs the relational database model with a multi-tier client/server architecture. A significant advantage of this system is that it provides facilitation in crucial marketing research activities.

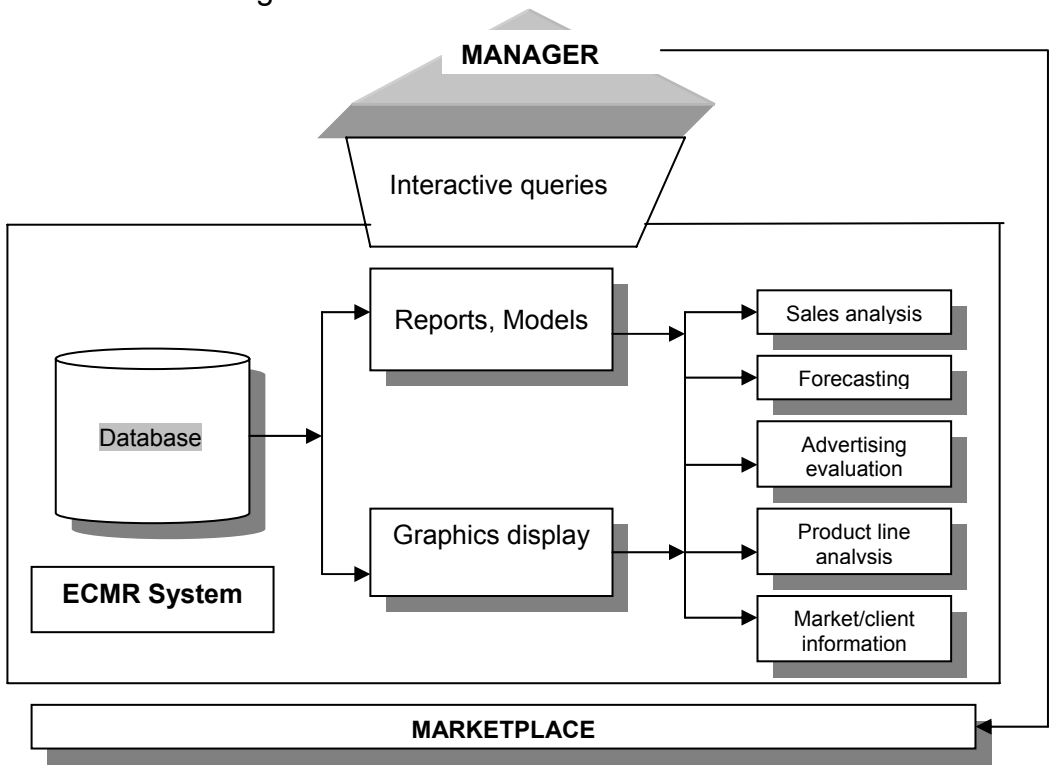

Fig.4 The ECMR Management Information System

It is hard to predict what marketing research will reach in the future, but several trends are foreseeable - research will expand both quantitatively and qualitatively, more studies will be conducted, which will inevitably lead to a sharp increase in costs, and more sophisticated approaches will be adopted and refined. Thus, future development of the ECMR system targets transition from the relational database model to a multi-dimensional database model using data mining techniques and click-stream data analysis for market-share tracking, pricing model analysis, and long-range planning and budgeting.

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