UNIVERSITY OF CRAIOVA
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DOCTORAL THESIS

DISTRIBUTED INFORMATIONAL SYSTEM FOR E-COMMERCE WITH AGRICULTURAL MACHINERY

SCIENTIFIC SUPERVISOR
Prof. LASCU RÎCU, PhD

DOCTORAL CANDIDATE
LIVIA IULIANA OPRAN

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SUMMARY OF DOCTORAL THESIS
„DISTRIBUTED INFORMATIONAL SYSTEM FOR E-COMMERCE WITH AGRICULTURAL MACHINERY"

of PhD candidate LIVIA-IULIANA OPRAN, with the scientific supervisor Professor LASCU RICU PhD. Present thesis is structured in five chapters and ends with conclusions and bibliography, as follows:

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KEYWORDS OF THE DOCTORAL THESIS

Information content of the thesis can be summarized by the following keywords*:*

- Information Society
- Internet - Cyberspace
- Convergence of technologies
- Digital Economy
- Virtual enterprise
- Electronic Business
- E-Commerce
- Agricultural machinery
- System information
- Distributed information system
- Security systems
- Applications integration
- Open Standards
- Web Services
- Knowledge Society

- Globalization
- Software Components
- Service oriented architecture SOA
- Object-oriented design
- Object-oriented programming
- Distributed Databases
- Online Transactions
- Chain value
- ePortal
- Management based on knowledge
- Strategic Advantage
- Competitiveness
- Communication
- Accessibility
- Virtualization

SYNTHESIS OF THE MAIN PARTS OF THE DOCTORAL THESIS

Since the end of twentieth century can be distinguished a globalization trend of scientific research, the intermingling of laboratories and research institutes worldwide, due to the impact of information technologies and Internet. So, can be noticed that scientific research goes beyond national framework especially in fundamental research such as genetics, bio-technologies, the discovery of new energy sources, performance increase in the mechanization of agriculture, all of that being possible by overcoming barriers of communication and use of advanced technologies.

Thus we must mention paradigms as information technology and its benefits in agriculture, there are no more present as a novelty today when databases are widely used and computer simulations are a considerable support in many work areas and research. In this context it should be noted that **our country's future is related to the maintenance of life support systems (environment and agriculture) and use of scientific knowledge to respond to the needs of human society.**

For Romania, where per capita arable land and favorable climatic conditions represent a significant agricultural potential, increase of mechanization is very important in the context of excessive fragmentation of arable land, by the promulgation of the restitution land law for state-owned proprieties before 1989. Thus, we can say that use of information technology in an area such as trade with agricultural equipment, from the perspective of an agricultural machinery building company, represents a substantial contribution to achieve performance in agriculture, in terms of increased productivity and overcoming current problems.

Integrated computer system allows increased productivity, an improved control of costs and qualitative management of a company, from the perspective offered by a full visibility throughout the value chain. It provides all key functionalities that an enterprise needs in order to increase its efficiency, including those addressing the most critical business processes. Subsequently, due to technological progress this perspective has changed, moving from individual planning resources beyond the boundaries of the enterprise resource planning. So, advanced planning systems and resource flows have rose standards starting from the local feasibility calculations to the flows optimizing and synchronization times minimizing of strategic planning, tactical and operational execution.

I have recommended for sales business development at SEMANATOAREA Plc. utilization of a software application for electronic commerce, in addition to the traditional distribution channels. The *e*Portal solution sets standards and introduces new integration levels of the business processes in environments of heterogeneous systems. The extended functionality, flexible options for development and global orientation justifies implementation effort, combining a stable and robust software solution like ERP implemented in the company with extensive capabilities in customer relationship, in order to allow a better management of critical business processes. Through recommendations proposed, the enterprise resource management system has been changed into a real environment of collaboration, accessible both within the organization and for customers, partners and authorized providers, thereby increasing the overall efficiency of business processes.

The paper refers to the most important concepts, standards and technologies that provide solutions for distributed informational systems development, data integration and applications, combining the main elements of data management systems based on a content management system and various enterprise applications. The thesis is divided into two parts: the first covers the most important theoretical aspects of the area studied, mainly related to the architecture of distributed computing solutions for electronic commerce, and the second part presents the practical ways of enterprise applications achievement which offers opportunities of Internet business practice and arrangements of management and data integration in heterogeneous environments.

In the **Chapter I: GLOBAL INFORMATION SOCIETY AND THE INTERNET MARKET, PREMISES OF THE NEW ECONOMY** I have emphasized the role of information technology in today's society and their impact on scientific and technological development in general, thanks to possibilities of modeling and simulating complex phenomena and also advanced processing of experimental data, which essentially have contributed to the understanding and use of phenomena and therefore to progress in general.

According to some experts, information society technologies have a profound integrating nature, both at the level of "*information management*" and at physical implementation of technical systems, their intensive development causing as their potential to grow at a rate that exceeded the most optimistic

forecasts, becoming widely available, meaning that, beyond some security restrictions, they can be purchased. Moreover, even if technology itself is expensive, the product of high technology is relatively inexpensive, which opens new fields of application. The report price/ performance in ICT, for example, has experienced spectacular growth, thus the limitation agent in development will be linked more by *knowledge*, the capacity (human) of assimilation and development of these technologies and by their utilization in new areas of activity for new products and services.

Information society can not be viewed only in terms of technological development equated with simple development of information and communication technologies, because behind of these technologies with great flexibility and simplicity there is utilization manner. Thus, its universal and global character has been revealed, demonstrating new behaviors of humans and human groups, by changing their way of thinking, learning, working, and collaborating, so could say that information society carries within it the fundamental principle of progress: open and easy movement of information and ideas, opening new perspectives on education and training, providing easy access to documentation and knowledge.

In the next stage of development, progress is made towards a knowledge society, crossing from one era to another does not lead to disappearances, but to transformations. The technology of the information society evolves and have to be brought in reach of the knowledge process, which means storage, transmission and generation of knowledge. Future global competitiveness is directly related to the ability to develop communication infrastructure and connecting to global networks of information, the new environment being composed of converging technologies which are merging. Thus, technological mutations produced have lead to major changes in productive and cultural practices of people and organizations, deeply transforming communication processes, working and training, helping organizations to rethink and find new ways and coherent practical rules.

In the information society is developing Internet economy, but in the knowledge society is formed truly a *new economy* which will cover the Internet economy, namely **economy of the information and knowledge society where the innovation process** (ability to absorb and convert knowledge for creating new services and products) **becomes crucial**. New economy based on knowledge creation and use of knowledge in the economy, especially through innovation that seeks to improve productivity in general, not only the conventional productivities in relation to labor and capital, but also the new ones related to energy resources, natural materials and environment protection. Therefore the new economy involves encouraging creating and developing innovative businesses with their own knowledge structure

The new economy is not reduced only to the digital economy owing that, in the XXI century besides objective of the knowledge and information society, humanity must reach the stage of an **environmentally sustainable society**. This objective by which the survival of mankind depends can not be achieved without knowledge and knowledge management. The ecological problems of humanity, global and local, can not be solved outside the knowledge society and important elements of the new economy will be imposed by environmental considerations, not just information, because without scientific knowledge, technological knowledge and their management will be unable to produce those goods, structures, technological and economic changes necessary to protect humanity from future threats.

In the **Chapter II: ELECTRONIC COMMERCE IN NETECONOMY ERA** I have addressed specific problem of the application domain studied, stressing that the digital economy is primarily about **creation of a new business model** through the Intra and Internet, who radically changes their effectiveness in cost reducing, including transactional ones. Thus, the new economy places in the foreground the **demands and needs of the consumers** who engage in a measure increasingly higher in the design, implementation and use of goods and services from the early stage of research and development. Thus, it can be said that the new economy has a interactive and participatory character, realizing interface between supply and demand on a complex of volume and structure in space and time, much more rigorous.

Consumer role increases, meaning that it might become an important source of innovative ideas for production, or of forcing innovation in order to maintain or expand the market, enhance the comfort or, what is very important, raising the sustainability of economic development. Thus, **competition and cooperation are two inseparable sides of the digital economy**, taking into account the interaction between supply and demand, that forms of manifestation of competition between producers are radically changed by the priority given to a consumer in continuous and rapid change in terms of needs, tastes and requirements, so competitors are forced to cooperate.

Digital economy requires a higher consumption of design and highly skilled work, creating a higher added value, jobs, unlimited business opportunities and creativity sections, by the existence of flexible interconnect standards that facilitate the needs of integration and/or individualization of various consumers. Reducing resource consumption, increasing the innovative and entrepreneurial spirit, labor productivity growth, speed improvement of the production and the change of phenomena and the economic processes, increase of the value added economic impacts are only a few of economic effects which have promoted digital economy as an advanced form of economy in general. It is important to underline that each principle of the new economy opens specific paradigm for economic science in general, but especially for its various disciplines and specializations.

In this chapter I have also revealed that, last successful approach to electronic portals is an effective demonstration of a new way of relationship with client. It consists of an individualized approach to customer relations, but thanks to modern information technologies will succeed in establishing relationships with a much larger number of customers than traditional approaches. This is a good example for *eBusiness*, as an effective use of the new information technologies in business.

For large companies, it seems that the safest solution would be to treat *eCommerce* such as one of their own distribution channels, while continuing its traditional business on the other channels. But option for e-commerce requires development and implementation of an inter-organizational informational architecture based on information and communication technologies and particularly Internet technology in the processes of achieving commercial transactions, and also has to be taken into account the changes which it induces to firms.

Electronic commerce is the key to competitiveness in the information age, providing access to new market segments, speed increase of developing business, higher flexibility of the trade policies, reduced cost of supply, sales and advertising, procedures simplification, aso. Therefore it becomes an opportunity of competitiveness growth at both micro and macro level. Undoubtedly, developing various forms of electronic commerce will contribute to exploration and acceleration of the globalizing economy process, in particular the globalization of trade. This will create a coherent universal system, operating in the new environment, the system will have to cover all aspects of the society: economic, legal, financial, safety, liability and property protection.

In the context of technological evolution, the enterprise as basic link of the value chain must operate in line with established targets and there are currently many factors that impose behavioral changes to a company for being able to survive. On the road to modernity, it also constitutes conduct theater of transition operations to future global information society, so by correlating the results of careful research on the characteristics that enterprise must have for the modernization process to be effective, with the trends of the future global information society I have reached the next set of features for **a virtual company: flexibility, openness, receptivity to integration and globalization and intelligence.**

SEMANATOAREA Plc. specialized in production of agricultural machinery and sole producer of self-propelled combine in the country, is a good example in this respect, the changes occurred are both at technological and economic level but most importantly at the level of knowledge of employees and management. Such products obtained as Dropia and Gloria are among the best agricultural combines, since achieving these machines represents combining thorough research with practical testing or in laboratory conducted by specialists and applying advanced information technologies in design processes and design.

Information technology has intervened both in the strategic planning and in defining the size and directions of change of the company, which demonstrates that the technological determinism has an important place in the process of organizational change. Relationship between IT and the organizational transformations has determined adoption of a more flexible attitude in defining strategic objectives, which often involved fundamental changes in organizational structure and culture of the company. It has been proved that the application of the advanced technology may be the result of the organizational change, but also its catalyst so in turn may influence the firm's strategic objectives change, this process being cyclical and iterative.

In the **Chapter III: DISTRIBUTED INFORMATIONAL SYSEM FOR E-COMMERCE WITH AGRICULTURAL MACHINERY** I have approached theoretical and practical aspects related to challenges that organizations must quickly respond, looking for new solutions, since changes are so constant and frequent, almost majority of them are in a continuous improvement process or transformation of the systems. They represent an important functional component organizations, which

integrates into all their other functional elements, representing one of the key concerns of the business management, which is motivated by the following:

♦ represents a functional service for successful organization, serving as information support to other functional components: marketing, human resources management, financial accounting, production;

♦ is one of the factors influencing operational efficiency, productivity and employee motivation and customer satisfaction level;

♦ represents the main source of information which supports an effective decision-making process, allowing at the same time, adaptation of the products and services to the market, so strategic advantages can be obtained through an informational system.

SEMANATOAREA company has opted to implement an enterprise resource planning system which allows the finite scheduling of capacity production and the tracking of the entire activity performed along the manufacturing process. More important, the integrated information system implemented permit viewing of the entire value chain who has led to economic efficiency growth and market competitiveness.

Starting from this context favorable for **sales expansion of agricultural equipment via Internet**, I have developed and proposed to be implemented at SEMANATOAREA Plc. a portal solution for e-commerce that enable sales to be performed in a well developed manner, easily and quickly, owed to the application's architecture, working specifically for the distributed environment and also to the data processing advantages offered by computer networks. Thus, I have demonstrated that another perspective from which can be seen the **strategic role of information systems** in general and of information technologies in particular **is that one of overcoming traditional barriers for the firms: time, geographic, cost, structural.**

I have developed the *e*Portal application with a significantly reduced investment amount, implementation effort being justified by the flexible included development options and its global orientation. The extended functionality that have resulted due to integration with a stable and robust software solution like ERP implemented at the enterprise level, enables a better management of critical business processes in relations with partners. Thus it can be argued that **the *e*Portal application impose standards and introduces new levels of integration of business processes in heterogeneous system environments**, remarking the following advantages of its use: **provides a quick and convenient way to provide information, cost reduction,** especially for the international communications, **will strengthen relationships with suppliers and customers** and most importantly **provides an alternative sales channel** through e-commerce portal.

In terms of technology, **the option for a distributed system architecture** was motivated by some specific advantages, most important of them being:

- *information exchange* – the massive increase in amount of information and the need of quickly information change between different points in distant geographical places, make necessary a direct connection between autonomous computers;

- *resources sharing* – the cost of capacity increase for a distributed system is much lower than in case of the resources connected to a single computer server, that will become obsolete in time;

- *operations safety increase* – for a computer system consisting in a single computer, its failure makes impossible use of the entire system, while in a distributed system the failure of a node do not interfere with functioning of others, in most cases the tasks of unavailable node being taken over;

- *performance improvement* – the presence of several processors in a distributed system makes it possible reducing of the computing time for a massive operation, by dividing tasks among different processors, subsequent collection of partial results and determination of the final outcome, this method being known as parallelization calculation;

- *nodes specializations* – design of an autonomous computer system with more functionalities might be very difficult and for practical reasons it has been simplified by dividing the system into modules, each of them implementing a part of the features and communicating with other modules, which reveals two aspects: the first covers the hardware and computing machines that are seen as a multitude of autonomous entities, and the second part related to the software meaning that all users must perceive the program as one system.

In this chapter are also reviewed aspects of application integration that connects the information systems at the informational level - through the exchange of information- and at the services level - through real-time processes control - and I have approached other specific issues of the distributed systems for achieving a higher performance level and presenting the optimal solutions for the case study conducted within the SEMANATOAREA Plc. enterprise.

Chapter IV: DESIGN OF THE SOFTWARE APPLICATION PORTAL FOR ELECTRONIC COMMERCE deals with all aspects of the *e*Portal application design, solving at a higher technological level, modality to conduct commercial transactions online, for sales of agricultural equipment. Results oriented and constrained of being integrated, modern information system for SEMANATOAREA's business management in the context of a digital economy is achieved:

- ***based on the service oriented applications architecture*** (SOA), fundamented by the concept of independent software components which are involved through the prediction over services. Prediction of services is a metaphor of the real world where companies and individuals are engaged in the consumer - service provider type of relationship (also called client-server mechanism), the relationship where responsibilities, constraints and expectations are governed by a contract between parties;

- ***through the software components***, that reflects the metaphor "prediction of services" by the local providing of the services which are realized through the well-known interfaces. The interface acts as a contact point, specifying responsibilities, expectations, and constraints in the interaction between software components so that the maintenance, the reutilization and parallel development of components and software services, the purchase from external sources and the exploitation of a distributed computing resources to be effective;

- ***by grouping software services into categories*** with the aim of establishing useful directions for leading the company to obtain benefits and realizing advantages. For example, dividing the business applications in a manner such as support and visual interface, business rules and data seems to promote a useful starting point for planning, design and implementation of software components that reach the level claimed by a wide range of business applications;

- ***based on the business objects modeling***, by the reason of IT projects based on software components easily maintained and reused. Business objects are concepts used by the object oriented business modeling that encapsulates business rules, policies and elements of business decision. Since they exist both in business models and in models of software projects, business objects are a common reference which determines understanding of specialized business users (business people), by translating the business model into software components at the running time;

- ***by using specific software services***, activities and various distributed software components requiring coordination. The special services or the business transactions are often key operations of a business object which require special services infrastructure components such as management, monitoring and coordination of a successful accomplishment. The transactions coordination is an example of service infrastructure, that required to be provided by software components, independent of any particular application;

- ***through the choice of the instruments and technologies*** that assist in managing the development lifecycle of the components and software services, not only in the context of a single application, but over the entire common core base of services and business components.

The objectives envisaged in achieving the distributed computing system are likely to replace a more complicated definition of it, but at the same time refers to the mandatory aspects that have been taken into account in its design, which are in particular:

- o **transparency** – the difference between different computing platforms and the manner of communication between them is transparent to the user, this remaining unchanged to internal logical level of a distributed system;

- o **openness** – users and other applications outside the system can interact with a distributed system in an uniform and consistent manner, regardless of where and when this interaction takes place;

- o **scalability** – the system must be easily expanded and scaled, this property being a direct consequence of the fact that is about a collection of calculating machines forming the system and interacts in a manner transparent to the user, creating the impression the whole;

- o **availability** – a distributed system as the one which I have proposed to SEMANATOAREA company will always be operational, for being utilized by users, even though some of its components may not operate at certain moments of time. Users and other applications that interact with it, should not see that some components were disconnected, substituted or that new components were added to the system to meet new requirements or to serve more users or multiple applications.

The modeling of the *e*Portal application was done using Rumbaugh's design method object oriented, a computer system being viewed as a set of objects that cooperate with each other and treats objects as instances of a class within a hierarchy. The notion of an object is dependent of the method implementation in the high level languages and this is the reason why I've chosen **Java as development**

language, being the most productive language from its class, by analyzing of the three important aspects: *the reality abstraction* which means that for the same problem it can be created several models that describe different aspects, *the scope of design* which is to focus on something known and not least *the communication*.

For database implementation I have chosen one of the most used systems, which offer extensive technological capabilities in distributed environment. **Oracle 11i** supports databases of any size, from smallest to largest, a large number of simultaneous users, minimize data access conflicts and ensure data simultaneity. It also allows the processing sharing between the database server and client application programs, providing full safety features for limiting and monitoring access to data and their use.

Chapter V: PREZENTATION OF THE SOFTWARE APPLICATION PORTAL FOR E-COMMERCE WITH AGRICULTURAL MACHINERY includes description of the application's main features and main pursued objectives through its implementation at SEMANATOAREA Plc. Thus, it can be said the need of its accomplishment in terms of business development was imposed by following economic issues: reducing costs for both undertaking and its business partners and also time for sale, planning improve consequently, processes standardization and scalability expansion across the enterprise and obtaining competitive advantage on the market.

In the context of the requirements imposed by information society premises, that is continuously changing, the *e*Portal application has the following objectives:

o   the complex representation of reality: company, customers, products, services, etc..;

o   managed information in a computer system tends to increase in complexity, and must be manipulated into a form easily perceived by the end user;

o   the information system must be flexible in relation with change of data structures and have to evolve naturally over time, thus adjusting itself to the organization evolution it serves;

o   the information system evolves toward approaches with extensive application fields for meeting the growing needs of users.

Optimization sales of agricultural machinery will be provided by achieving the following objectives: **structured communication, effective collaboration, closed and full circuit for orders, inventory and planning optimization, efficient management of suppliers and customers** and is accomplished by:

-   real-time data processing;
-   track of contractual conditions and payments;
-   automatic identification of exceptions and increase of data accuracy;
-   friendly interface, which does not require a specialized training;
-   proactive and effective communication with suppliers and customers;
-   increase of supply efficiency and collaborative planning;
-   elimination of temporary storage for products and telephony cost reduction;
-   automatic update inventory and automatic control of necessary volume for supply;
-   making electronic payments, electronic bidding of prices;
-   cost decrease of accounting.

From the viewpoint of SEMANATOAREA's clients, the *e*Portal application provides the following benefits: identifying the best deals through unified search tools, support for complex negotiations, automating the entire purchases stream through complete process of flow: requirement - payment, efficiency increasing through real time collaboration on Internet with XML messages and not least identifying opportunities for cost reduction through integrated expenses analysis and performance.

In this context the implementation of an applications with open architecture and oriented available services on-line will extend business processes automation starting from the internal ones up to the entire value chain of business partners: vendors, manufacturers and customers. Furthermore **correlating supply processes and sales** will lead to substantial improvements in performance and business profitability, because **value chain is enhanced through automated data management**. Thus, complete integration of processes and visibility of entire value chain will entail differentiation through service quality and competitivity increase on the market implicitly.

It can be said therefore that the solution proposed e-Commerce Portal to be implemented, will allow the introduction of a high level of management and control of online sales, providing a cost reduction, production planning and most importantly, a perfect functioning of the information circuit, thus distributed computing system resulted being fully integrated and flexible and providing support for the main trade activities of the company.