BABES-BOLYAI UNIVERSITY OF CLUJ-NAPOCA

FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

PhD THESIS

RESUME

CONTRIBUTIONS TO AN INTEGRATED INFORMATION SYSTEM IN MEDIUM AND LARGE COMPANIES WITH ERP METHODOLOGY (ENTERPRISE RESOURCE PLANNING)

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Contents

"..., so wird Natürlehre nür so viel eigentliche Wissenschaft enthalten, als Mathematik in ihr angewandt werden kann." (Kant, 1786)

Metaphysische Anfangsgründe der Natürwissenschaft [1]
- Vorrede IX/X - 1786

Immanuel Kant

(1724–1804)

RESUME

Key words:Enterprise Resource Planning(ERP), MRP, SQL, PL/SQL, NoSQL, Stored Procedure, Stored Procedure Migration, Formal Language.

EVOLUTION of new information technologies and globalization of economies has led to a rising line of integrated solutions for managing enterprise resources and their management efficiency. The large number of offers under the name Enterprise Resource Planning (ERP) and scale IT projects being implemented, supports the view that the consecrated as Enterprise Application Integration is booming and transformation.

Chapter **1**, "ERP SYSTEMS IN LARGE ENTERPRISES' illustrates strategy of multinational economic organizations objectives, methods and techniques to achieve them. Chapter **2** "ERP SYSTEMS AND THEIR GENERAL FEATURES" present the characteristics of multinational organizations: concepts, definitions, acceptions, their management features through computer technology for process automation and general considerations on the design of information systems. Chapter 3 deals with 'IT TECHNIQUES' theoretical elements of information systems within multinational organizations on its morphology component subsystems with classical and modern methods. Chapter 4 "ERPCO PROTOTYPE integrated INFORMATION SYSTEM" is based on NoSQL concept that allows horizontal scalability of information system. Chapter 5 "DEFINING THE MIGRATION PROCESS ISSUES" shows the extension of ERP Information System through social networking concept, via user-group relationships, networks, and interact regulations for the actions of these R & D initially with possibility of extension to other modules. In Chapter 6, "CONCLUSION AND CONTRIBUTIONS" are highlighted results for author: implementations, papers, attending conferences doctoral, doctoral grants and prospects for further research.

[1] ..., *but every natural science is only as real science, mathematics quote contains*, Immanuel Kant, preface to Metaphysical Foundations of Natural Science, Riga, IX/X, 1786.

Chapter 1

ERP SYSTEMS IN LARGE ENTERPRISE

ERP SYSTEMS play an important role in the strategy of multinational organizations, information is regarded as components of processes, phenomena, events, dates appear as strings (graphemes) in a given alphabet that is processed through the formal procedures automatically.

1.1 Classic and contemporary in the evolution and use of ERP systems

ERP systems are complex deployment based on client / server architecture on two or more levels developed for processing transactions and integrating all processes from planning phase, development of production, up to relationships with suppliers, customers or other business partners is considered an expression the faithful interdependence of economic and information technology. Production functions were introduced in 1894 by economist Wicksteed [2] and applied for the first time, by Douglas, P. and Cobb, C.W. and developed after 1961, when Arrow, K.J., Chenery, H.B., Minhas B.S., and Solow R.M. proposed to model the U.S. economy **Constant Elasticity of Substitution** function - **CES** (Wicksteed, 1894).

$$Q = f(x_1, x_2, \cdots, x_n) \tag{1.1}$$

, where Q is is the product of labor, production, and $x_1, x_2, \cdots, x_n$, production factors.

Cobb, C. W., şi Douglas P. (Cobb and Douglas, 1928) brought production to two factors: labor and capital, whose quantities are denoted by L (labor) şi K (capital). Function has the following form as 1.2, this representation was originally proposed by Knut Wicksell in (Wicksell, 1898):

[2] In 1894, Philip Henry Wicksteed published his famous *Essay on the laws of distributie coordinates*, in which he tried to prove mathematically marginal productivity system to function.

$$Q(t) = A \cdot K^{\alpha}(t) \cdot L^{\beta}(t) \tag{1.2}$$

1.1.1 CES Production Function

An extension of the production function Cobb-Douglas, Constant Elasticity of Substitution(CES) was presented by Arrow, KJ, Chenery, HB, Minhas BS and Solow R.M. in the paper (Arrow et all., 1961) with the following expression:

$$Q(t) = A \cdot K^{\alpha}(t) \cdot L^{\beta}(t) \cdot e^{\bar{\gamma}}(t) \tag{1.3}$$

, where

e - the natural logarithm, γ - rate of technical progress, t - number of years projected.

Variations on "theme" Cobb-Douglas and CES were presented by: Borts-Mishan production function, Rowe-Sato production function, Visnev production function, and the Allen production function.

Production function 1.1, 1.2, 1.3 are deterministic representation, "real case" functions are stochastic 1.4:

$$Q = f\left(x_1, x_2, \cdots, x_n\right) + \epsilon \tag{1.4}$$

, where ϵ represents the deviation, economic processes exhibit random factors isomorphic with Wiener processes, martingale, Poisson processes, Levy processes or Brownian motion.

, or with 1.5:

$$Q\left(x_1(t), x_2(t), \cdots, x_n(t)\right) = f\left(x_1(t), x_2(t), \cdots, x_n(t)\right) + \epsilon_t \tag{1.5}$$

, where $Q : D_1 \subset R^n \rightarrow D_2 \subset R$, $f : D_3 \subset R^n \rightarrow D_4 \subset R$. Q and f functions defined in this case are not Riemann and Lebesque integrable are not differentiable, differentiable in the classic sense. Q function optimization is achieved through the study of monotony and determine inflection points in the case of Darboux integrability and diferentialitatii in the classical case. Stochastic process optimization requires a different mathematical apparatus with different conceptual approaches: Wiener processes, Markov processes, Levy processes, Malliavin calculus.

1.2 Material requirements planning MRP

In the decade 1970 program material requirements planning (MRP, Material Requirements Planning acronym) makes its appearance. (Waldner, 1992), (Lunn and Neff, 1992); MRP software used for scheduling production processes of the company. MRP generates programming operations and procurement of raw materials based on existing requirements and department production capacity,

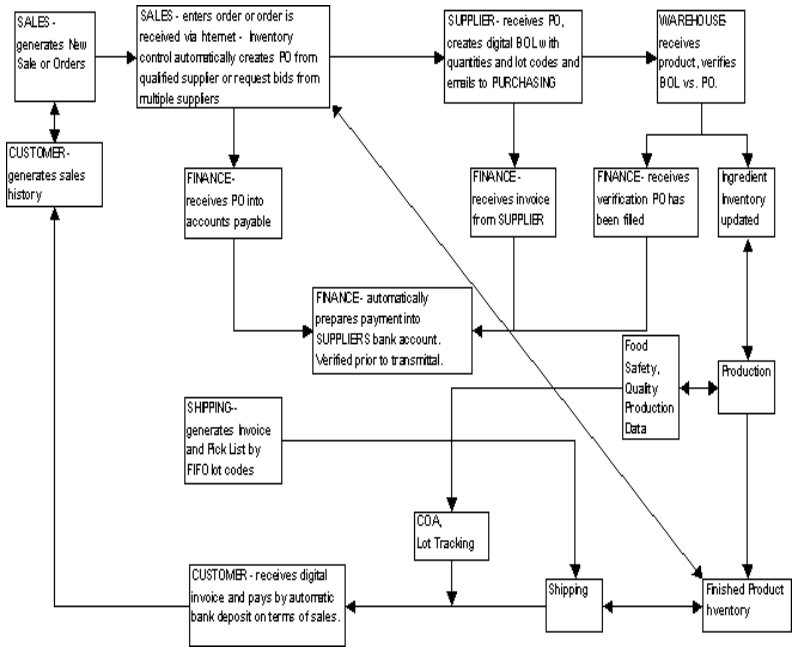

Figure 1.1: Material Requirements Planning, Source: WJ Hopp, ML Spearman Commissioned Paper To Pull or Not to Pull: What Is the Question? Manufacturing & Service Operations Management, 2004

taking into account both the quantities available in stock as well as the procedure for determining batch size Figure 1.1.

The 1980s manifested through evolution MRP concept turning into manufacturing requirements planning (MRP II Manufacturing Requirements Planning) (Waldner, 1992), (Toomey, 1996), (Drexl and Kimms A., 1998) an extension of MRP functionality, using software applications for coordinating manufacturing processes, production planning and purchasing of raw materials until the inventory control and distribution to customers, the benefits were limited to MRP II manufacturing sector, but fail to achieve desired results due to exorbitant costs involved it necessary technical expertise and implementing a system of this scale, see Figure 1.2.

1.3 Elements of economic strategy at large enterprises

Strategic management of large companies - corporations - is a combination of art and science, analysis and evaluation intra / inter departmental, intra / inter corporate decisions in choosing which allow and allow short-term goals, medium and remove (David, 1989). Evaluation of the strategy involves the use of methodologies: the matrix ***SWOT***[3], ***Boston Counsulting Group*** matrix, ***benchmarking***, ***Arthur D.Little*** *matrix, and* ***Mc Kinsey*** matrix.

[3]SWOT - Strengths Weaknesses Opportunities and Threats

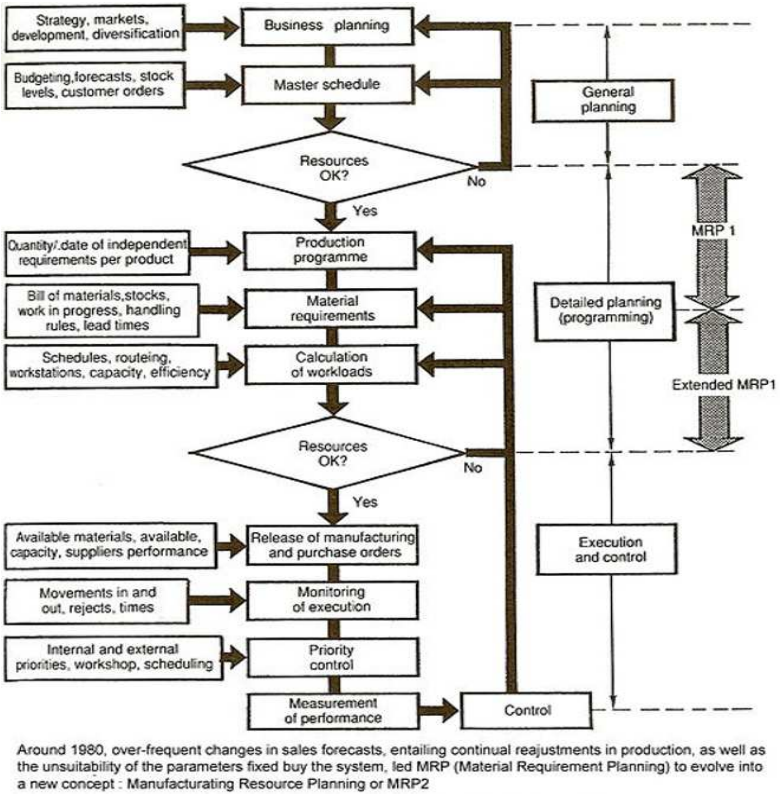

Figure 1.2: Manufacturing Resource Planning, Source: CIM: Principles of Computer Integrated Manufacturing, Jean-Baptiste Waldner, John Wiley & Sons, 1992

1.4 The concept of economic strategy

The Art of War, Sun Tzu mention for the first time the notion of military strategy (Sun Tzu, 544–496), author emphasizes the need to comply with two conditions to achieve purpose. Strategic terms (Hansen, 1987) comes from the Greek ***strategos*** -$\sigma\tau\rho\alpha\tau\epsilon\gamma o\sigma$ with plural ***strategoi*** -$\sigma\tau\rho\alpha\tau\epsilon\gamma o\iota$ used in ancient Greece to designate army general. In the small of economic strategy Henry Mintzberg, one of the most original thinkers in management, strategic planning advocates in companies of all types and sizes. A classic definition based economic strategy for the organization and actions deriving from this perspective is presented in (Andrews, 1971) "***... strategy is a system of goals and aspirations of the objectives of key policies and plans formulated so as to define the scope of actual or potential profile of the organization and its actual or potential***", this definition integrates the concepts of purpose and appropriate actions.

Chapter 2

ERP SYSTEMS AND THEIR GENERAL FEATURES

MRP II SYSTEM caused major shortcomings in the decade 1990 which allowed the emergence of the concept of enterprise resource planning **ERP** (Wallace and Kremzar, 2001), (Harwood, 2003), an extension of MRP II functionality on multiple areas of the company, using an extended software application with many modules to improve performance of internal business processes. ERP has revolutionized the business world, and its effectiveness has been multiplied in time, due to subsequent innovations have been made solution, the rollout has led to a new revolution in the world of ERP systems today are parameterized so as to use the internet. The subject is supplemented with topical elements where integration is researched further to the electronic markets and corporate fashion by applications: *Supply Chain Management* (Mentzer, 2001); (Chopra and Meindl, 2007); (Blanchard, 2007), *Enterprise Application Integration* (Linthicum, 2003); (Serain, 2002), *Enterprise Service Bus* (Chappell, 2004); (Miller et all., 2004), *Business Intelligence*(Loshin, 2003); (Whitehorn and Whitehorn, 2003) , *Customer Relationship Management*(Buttle, 2009); (Kincaid, 2003), *Business Process Management* (Weske, 2007); (Verma, 2009), *Business Process Integration*(Redlein, 2004); (Jain, 2006), *Enterprise Nervous System* (McNurlin and Sprague R. H., 2006). Literature of our country consists of the following books that tackled topics large family tional information systems such as ERP with their extensions by (Fotache and Hurubean, 2007); (Fotache et all., 2010) ; (Rusu, 2005); and collection of articles in Economic Informatics, Faculty of Cybernetics, Statistics and Economic Informatics from A.S.E. Bucharest (Mocean et all., 2007) (Rizescu, 2010); (Avram, 2010), respective Oeconomica from FSEGA Cluj-Napoca (Mocean, 2009),

2.1 Considerations of using ERP systems in Romania

The decade 2000-2010 was a real boom for the implementation of complex applications, or maintenance, reconfiguration of Information Systems of previous implementations. In Romania entered the arena big houses integrated software for managing organization, such as SAP, Oracle, Baan - now Invensys, respectively bidders on the median QAD, Epicor Scala by now, LLP Group. Subsidiaries

of multinational organizations operating in Romania have adopted one of the solutions proposed by the so-called group BOPS (Baan, Oracle, PeopleSoft, SAP, JD Edwards) after JD Edwards was acquired by PeopleSoft in 2003, which in turn or enter into heritage Oracle Corporation in 2005.

2.1.1 Oracle E-Business

Oracle E-Business is the solution offered by Oracle for modeling an Information System Enterprise Resource Planning - ERP platform on three levels: client web browser, the view that Windows GUI, CDE, Motif, Mac OS, Windows server or application platforms UNIX / Linux database server for Windows or UNIX / Linux.

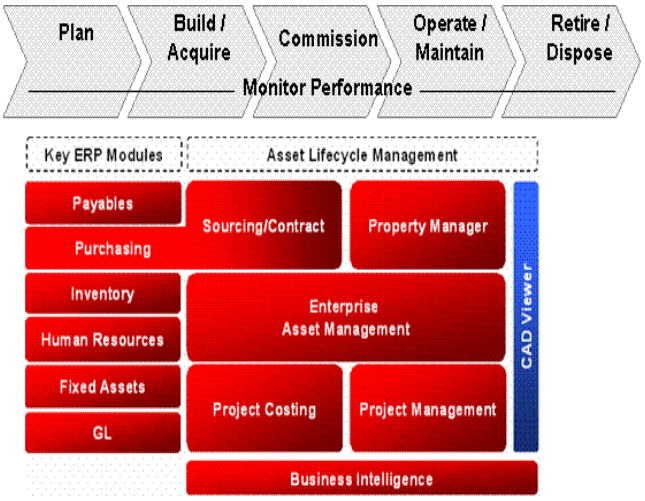

Figure 2.1: Modulele - Oracle E-Business - source http://download.oracle.com/docs at 21 May 2012

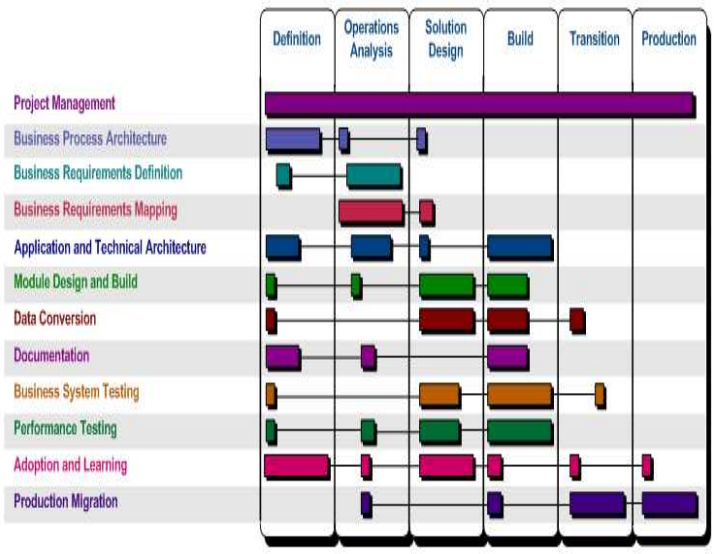

Figure 2.2: AIM - Oracle - source http://download.oracle.com/docs consultată at 22 May 2012

Application Implementation Method - AIM in Figure 2.2 methodology is the implementation

of the Oracle family type GANTT the activities / processes following steps: Define activities of the Integrated Information System, Integrated Information System Analysis, Integrated Information System Configuration, Implementation of Integrated Information System, Information System Transition from previously current Information System, maintenance Information System.

2.1.2 SAP R/3

SAP R/3 is an integrated system for managing an organization's business components: accounting, controlling, materials management, marketing production management, human resource management, et c. PThe first version of the system of financial accounting incorprorat organizations called R / 1 or COBOL YSR made in later with the advent of mainframe integration in the decade 1970-1980 by FI financial accounting, management accounting or the Materials Management - MM was born R / 2, implemented in COBOL clone called ABAP(*Advanced Business Application Programming* translated from the original German *Allgemeiner Berichts-Aufbereitungs-Prozessor*), symbol R comes from the Real Time Data Proccesing subsequently with separate levels (presentation, application server, database server) we transition to SAP R/3 (*System, Anwendungen und Produkte*), după after 2000 Java environment ^{TM} became an option ABAP application server level. Initial implementations of SAP R / 3 interacted with database servers ORACLE ^{TM} implementations success SAPR / 3 were correlated with success ORACLE - because 75% to 85% - use Oracle, german concern has shifted strategy in 1999 acquired the right to sell the database server ADABAS D, respectively compatriot Software AG's ADABAS R - Further embellished two versions of ADABAS, ADABAS D and product R in SAP DB database server "cross platform".

2.1.3 Microsoft Dynamics NAV

BOPSE market slice determined, spurred the emergence of a jackal used to steal market and competitor products, Microsoft Dynamics NAV is Microsoft's offer scalable customer relationship management (CRM) and business resource planning (ERP) - initially through the acquisition of two BOPSE competitors minors at that time - Great plains Software, acquired in April 2001, respectively Navision in July 2002 - the emergence of a mature product market Microsoft Dynamics NAV 2003 - designed to meet the business requirements to help employees in the decision. Microsoft Dynamics NAV enables decisions in a smart, strategic and tactics at every level in organizations, executive managers have access to key business metrics, managers of various departments have to provide the data and tools they need to successfully plan and manage their areas of responsibility; employees, regardless of their position in company, from economics to management and customer relations always have access to the data they need to make the best decisions for the organization and its partners.

2.1.4 BaaN

BaaN[1] Dynamic Enterprise Modeling famous by DEM has become a major player in the ERP market Famous for winning an international tender against SAP R / 3 TM at Boeing in 1994, range from 1995 to 1997 was characterized by explosive growth in turnover propelling the company hierarchy BOPS 3rd in a European supplier becoming a global provider of services in the field until its saturation in 2003. Suite BaaN V iBaaN Enterprise has been developed in line with market trends allows applications to connect to systems of other suppliers, then these modules were extended in 2002 by iBaaN for Product Lifecycle, iBaaN for Supply Chain Management, Customer Relationship Management for iBaaN respectively in 2003 solution Business Intelligence, Corporate Performance Management iBaaN.

2.1.5 Scala-Epicor

Epicor Software Corporation is headquartered in Irvine, California was founded in 1984 as Advanced Business Microsystems, Inc., in 1992, the company changed its name to Platinum Software Corporation, in the late 1990s, strategic managers have acquired several companies to help Platinum has evolved from a provider of accounting from a supplier of integrated solutions, end-to-end. To transform the company has undergone a name change in May 1999, Platinum software has changed its name to Epicor Software Corporation, one of the major acquisitions was Scala Business Solutions in 2004.

IScala functionality is comprehensive both vertically and horizontally, from customer management, continuing with that of manufacturing, after-sales respectively. Epicor offers a wide range of SCM as part of ERP solutions based on service-oriented architecture (SOA) enriched with a lot of skills for businesses, including Customer Relationship Management (CRM), Supplier Relationship Management (SRM) and Supply Chain Execution (SCE).

2.2 Conclusions and personal assessments of ERP systems

Application modules are grouped into suites: accounting, finance, purchasing, production, marketing / promotion, or distribution, there is no rule to terminological level - the names used ERP suite vendors, modules, functions, etc.. differs from an integrated system to another.

Advantage	Description
Scalability	Horizontal and vertical scalability
Quality data	Centralized database
eliminating redundancy	Eliminate repetitive operations
collaborative environment	Extensions CRM / SCM extends relationship with suppliers / customers
adaptability	Process change = Change configuration process

Table 2.1: ERP Advantage: source author

[1] Jan Baan,1978, from Barneveld, Netherland

Advantages and disadvantages of using an Integrated Information System are relatively organizational development it has a powerful tool which is only a necessary condition, sufficient to resolve the effort and tenacity. Vertical scalability allows a multinational organization expanding geographic area that control flow and data in a complex application. Horizontal scalability ensures the control group, division, department BLOB data type, CLOB sizes over 2GB, quality management, dependent on the high standards of validation in the pharmaceutical supply business integration, production of research in the pharmaceutical development has led to the proposal of solutions "social networks" type - with NoSQL.

Disadvantages	Description
Time factor	Require a long implementation
Cost factor	High cost for implementation
Provider factor	Dependent on a particular supplier
Complexity factor	Require user + key personnel consultant dedicated

Table 2.2: ERP disadvantages: source author

Long period of implementation, high cost, depending on provider and need to use a specialized staff: consultants in the field, key users and modules intake creates a tense situation analysis, configuration, testing, implementation, maintenance of an integrated information system that brings the a common financial systems, organizational culture mixed distinct geographic areas that are interesting colored spots that require integration. Using an Information System ERP methodology and its extensions SCM, CRM, BI within an Information System to a certain house software implementation success not guaranteed by the degree of improvement human resource remains a decisive factor for success; implementation successful information system is actually not a sine qua non of successful business at the current time or in the future.

Chapter 3

INTEGRATED INFORMATION TECHNOLOGY

"Suppose that solutions to a problem can be verified quickly.
Then, can the solutions themselves also be computed quickly?"

Cook Stephen - 1971 (Cook, 1971)

ENTERPRISE ARCHITECTURE (EA) (Zachman, 1996), (Giachetti, 2010) is a rigorous description of the structure of an organization, the decomposition into subsystems, relationships between subsystems, the relationships with the external environment, ie the guiding principles for design and its evolution.

3.1 Enterprise Architecture

Architects business organizations use different methods, techniques and tools to understand the conceptual analysis documents an organization's structure and dynamics through documetelor they produce: lists, drawings, models, called artifacts, they describe organizing business logic functions, capabilities business, business processes, human resources, information resources, business systems, software, computing capabilities, exchange of information and communications infrastructure within it.

Enterprise Architecture concept manifested through the frameworks presented by Zachman in 1987, anticipated that by implementing a framework for Enterprise Architecture Framework on Technical Arhitecura management information systems - Technical Architecture Framework for Information Management (TAFIM); continued in 1991 through TAFIM Model (TRM TAFIM). TOGAF TRM derived thereafter (TAFIM), which in turn was derived from the model or POSIX IEEE 1003.0: "*a standard for information processing systems, consumer information, integrators systems, application developers, system suppliers and procurement agencies*"(Haren, 2007) (POSIX, 2008).

Enterprise Modeling concept is rooted in information systems modeling, the first works (Young and Kent, 1958) în modeling information systems was presented by Young and Kent, where they held these on Enterprise Modeling: a precise, abstract specification of the characteristics of information and data processing.

A modeling step was designed by CODASYL, an IT industry consortium formed in 1959, aiming the same elements as Young and Kent: Enterprise Modeling an appropriate structure for independent physical devices, defining a problem in a common language at data processing system.

3.2 Enterprise Grid Computing - Cloud Computing

Enterprise Grid Computing is a combination of computer resources from multiple administrative domains for a common purpose according to (Berman et all., 2003) is to apply the resources of several computers in a network to a single application at a time - to solve a scientific or technical problem that requires a large number of processing cycles or require access to resources hard large amounts of data (Plaszczak and Wellner, 2005). One of the key strategies of the Enterprise Grid Computing middleware is used to divide and assign parts of a program across multiple physical resources to cooperate distributed, aggregated at cluster scale (Lelli et all., 2007).

3.3 UML Language

Methods to synthesize language notations: *Booch, Object Modeling Technique - OMT* and object-oriented software engineering (*OOSE*) by unifying them to jointly model on a large scale processes in organizations becoming a de facto standard *Object Management Group* under the auspices of *OMG*. UML artifacts can be automatically transformed in various specific languages: Java, C + +, Oberon, Eiffel, through QVT transformation specifications, that is extensible, providing mechanisms for customization: profiles and stereotype sites. UML is not a development method by itself (Hunt, 2000), however, was designed to be compatible with object-oriented design methods of modern development (Avornicului et all., 2004)(OMT, Booch method, Objectory) evolved over time some of these methods have been reformulated to make the notation us, and new methods have been created based on UML, such as IBM Rational Unified, Process (RUP) through an iterative method comprising (business modeling, establishing the requirements, Design, Implementation, Test Execution), and Together from Borland (Inprise) extension to Eclipse with JBuilder and UML facilities, a bi-univocal i.e. to transform QVT, MOF models.

Literature in the country marked the popularization of UML concepts through (Avornicului et all., 2004), (Oprea, 1999), (Chiorean et all., 1994).

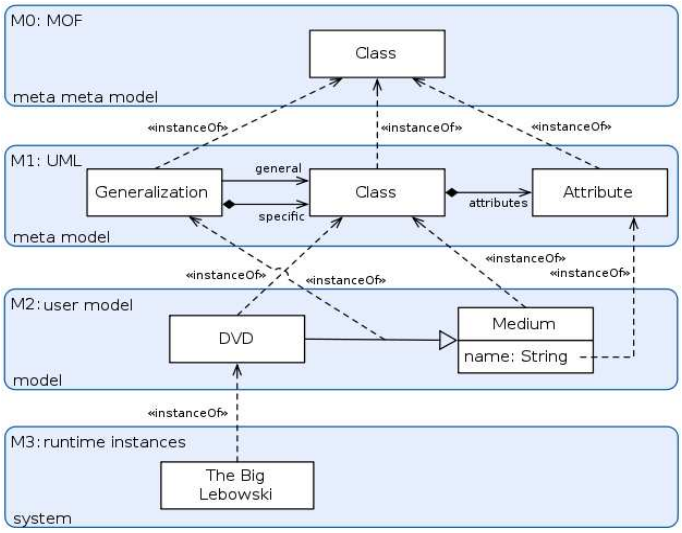

Figure 3.1: source: Jens von Pilgrim, *Unified Modeling Language: Infrastructure*, formal/07-02-06, version 2.1.1, page 31, 2006.

3.4 OCL and CCL Languages

OCL is used with any MOF is a precise language that provides constraint and object query expressions on any MOF model that can not otherwise be expressed by completing schematic diagrams. OCL is a key component of the new recommendations of UML 2.x / GMO QVT transformation models. Literature in Romania is represented by the following scientific publications (Chiorean et all., 1994), (Chiorean, 2004), (Andronescu, 2004), Comes (2006).

3.5 Conclusions and personal contributions techniques and information technologies

By participating in conferences IEEE / ACM Models 2005 (Comes, 2005) şi 2006 (Comes, 2006) We defined Object Constraint Language axiomatisation Language - Complete Constraint Language OCL through CCL; formalism is useful for generating and testing source code. Subsequently we defined Date Constraint Language - DCL*Data Constraint Language - DCL* (Comes and Ghişoiu, 2006) as a tool able to manage migration source to source type in the stored procedures in the context of heterogeneous database servers, **zDB** (Comes et all., 2008b) dispatcher is able to migrate stored procedures.

Chapter 4

INTEGRATED INFORMATION SYSTEM - PROTOTYPE ERPCO

ORGANIZATIONAL ENTITY is a direct sum of resources, their transformation into finished products, financial resources, human resources - part of a group that creates, manufactures and delivered to you within a generic concern - a dynamic that tends towards equilibrium in the pharmaceutical industry in Romania, where the main producer in the EU which has supremacy, namely global fight the big players in the field - which contains an earlier, according to current and future quantitative criteria.

4.1 Organizational data - stocks and logistics execution

Logistics unit defines a factory or a warehouse where materials are stored, each plant is assigned to company code and contains one or more management. Materials management is the physical storage of bounded in terms of responsibility relevant to SD Module are divisions from which to sell products. *Delivery points* are organizational elements responsible for making deliveries to customers. Represents the point where the disposition rises delivery products within the project are defined for each plant one point of delivery for each delivery point can be defined loading ramp.

4.1.1 Basic data - Master Data File

The material is created in MM module - which defines basic data (code, name, unit of measure, etc.) and will be extended for use by persons with SD module. Sectors of industry groups defining materials industry sectors, where our project we will denote by **M**

Layouts (displays) are described in Table Maintenance 4.1

Material groups provides the ability to group products according to some criteria defined free for reporting needs. Product hierarchy enables grouping by combining several criteria were used in analyzing and determining pricing policies. Based on customer data are divided into 3 areas:

- *General* - address, control, payment transactions, marketing, export data, people CUI or CNP-dependent contact depending on the nature of the client;

Display Sales	Maintenance fields
Base Data 1	Name of material Basic Unit material group
Base Data 1	Industry standard description
Sales: Sales Department data 1	Shipping point Tirgu Mures
Sales: Sales Department data 2	Warranty shipping Ooint-Custody
General sales / logistics unit	group Transportation group Loading
Supply	supply group Manufacturer part number manufacturer

Table 4.1: Points expedition: source author

- *Financial data* - account management, payment transactions, correspondence, insurance dependent CUI or CNP;
- *Data Sales* - Sales: Sales office, group sales, customer group, currency, price determination procedure, Expedition: priority delivery, shipping conditions, unit logistics of delivery, Billing: rebates, price determination, billing information, payment terms, account assignment group, relevant VAT partner functions: Client - SP, Payer - LP, Attn bill - DF, Receiver products - DT.

Customer Account group defines: Beach customer numbers are created, on or suprimatea of fields in client file, use only certain functions. Access sequence is the sequence in which a condition of price regulations is accessed and defined as a price policy. A condition of registration is defined price data by type of conditions that are saved in the system by various characteristics: validity, scale of application etc.

4.2 Solution for improving the existing system

ERP information system scalability is provided on vertical levels through the implementation of three layers: the presentation layer, the application server, or database specific to the SAP R/3. Horizontal scalability can cause malfunctions relational databases have this deficiency. NoSQL systems have appeared as a necessity issues the performance of traditional relational databases, by eliminating some limits of relational schemas and facilitate the construction of distributed storage systems were built systems that meet a much higher volume of requests, also increasing efficiency and speed, especially in the current Web application. NoSQL databases shows some disadvantages of lack of strict structure of stored data, although effective key-value type scenarios, not all cases that require data storage are of this type, requiring a thorough study before choosing a NoSQL solution.

4.3 Aspects of the new system need

Relational model has strict structure, requiring normalization and the search is done not only after but also by other key fields within a tuple - for example, human resource data in an organization is difficult to use NoSQL, a NoSQL database will not allow ad-Hoce, corresponding SQL queries or PL / SQL is done using an HTTP API or, in the absence of standardized language, which can be a disadvantage if we want to solve a problem quickly. Need to implement modules of thin films over part of research and development and quality management can be provided with NoSQL as these large multimedia files over 2GB that need to be used concurrently on a short time.

4.4 New prototype architecture ERPCO

NoSQL databases are used primarily when most searches that efecteaza into a structured data set is made by a single key, NoSQL models are very similar to Hash Table sites and are therefore best suited for this situation. NoSQL can be optimized for speed, unlike relational systems, which in this area are particularly affected because of normalization. Relational databases have been designed for distributed systems, but rather is in the form of a monolithic system, optimized hard.

NoSQL follows precisely this problem, enabling improved performance, especially in terms of speed, this is done mainly by adding new nodes in a system, replication is easy, through lack of relational schemas and implicit forms of normal speed data access greatly increases. If you look especially light Web applications, another advantage is the possibility of accessing data from a NoSQL database via APIs (If Cassandra is very relevant for this) some NoSQL databases offer the possibility of accessing data via HTTP (Tokyo Office) or REST manner (Apache CouchDB).

Chapter 5

DEFINING THE PROCESS MIGRATION ISSUES

MIGRATION of stored procedures requires the definition of a formalism own formal languages (Saloma, 1981), Z, z notation comes from defining their own transactions in SAP R/3, different from conventional trading name specific way, sub-module, function, etc.

5.1 Methodology formal languages - migrate stored procedures

Definition 5.1.1 (Alphabet) *A collection of non-empty finite elements $\mathcal{Z}$, $z_1, z_2, \ldots, z_n$ call* ***alphabet***

Definition 5.1.2 (Word) *We all word z over a finite alphabet $\mathcal{Z}$sequence $z_1, z_2, \ldots, z_n$ of elements from $\mathcal{Z}$, $z = z_1 z_2 \ldots z_n$.*

Notation 5.1.1 (Word length) *Nummber $n \in \mathcal{N}^*$ is the word length $z = z_1 z_2 \ldots z_n$ over the alphabet $\mathcal{Z}$, $l(z) = n$.*

A word has length zero, empty word denoted by ϵ, $l(z) = \epsilon$.

Definition 5.1.3 (Equal relationship between words) *Let $\mathcal{Z}$ an alphabet, two words $x = \xi_1 \xi_2 \ldots \xi_m$ and $y = \zeta_1 \zeta_2 \ldots \zeta_n$ over a alphabet $\mathcal{Z}$ are* ***equal*** *if $m = n$ şi $\xi_i = \zeta_j$, for all $i = \overline{1,n}, j = \overline{1,n}$.*

Definition 5.1.4 (Concatenation of words) *Let $\mathcal{Z}$ an alphabet and two words $x = \xi_1 \xi_2 \ldots \xi_m$ şi $y = \zeta_1 \zeta_2 \ldots \zeta_n$ over a alphabet $\mathcal{Z}$ we call* ***concatenate*** *of them $z \in \mathcal{Z}, z = x \cdot y = xy = \xi_1 \xi_2 \ldots \xi_m \zeta_1 \zeta_2 \ldots \zeta_n$.*

Notation 5.1.2 ($\mathcal{Z}^*$) *If $\mathcal{Z}$ is a alphabet we note $\mathcal{Z}^*$ the collection of all words over $\mathcal{Z}$ inclusive ϵ, $\mathcal{Z}^* = \mathcal{Z} \cup \epsilon$*

Definition 5.1.5 (Free semigroup ($\mathcal{Z}$, $\cdot$)) *The pair ($\mathcal{Z}$, $\cdot$), where $\cdot$ represent the concatenation operation is* ***the free semigroup with unit elemet generate by the*** *$\mathcal{Z}$, with notation $\mathcal{Z}^*$.*

Definition 5.1.6 (Phrase structure grammar - SQL) *We call* ***phrase structure grammar - SQL*** *the qvartet with the following components*

$$\mathcal{G}_{sql} = \langle \mathcal{V}, \mathcal{Z}, \mathcal{P}, \sigma \rangle$$

, where:

1. $\mathcal{G}_{sql}$*, represent the* ***total alphabet****;*
2. $\mathcal{Z} \in \mathcal{V}$*, is the alphabet with components* ***terminal simbols****;*
3. $\mathcal{P}$*, is a set of cartesian product* $\left[(\mathcal{V} - \mathcal{Z})^* - \{\epsilon\}\right] \times \mathcal{V}^*$*. The component of collection* $\mathcal{P}$*, order pairs (x,y) with form* $x \to y$ *named* ***productions****, or* ***rules of writing****;*
4. $\sigma \in (\mathcal{V} - \mathcal{Z})$*, call* ***initial symbol****.*

The elements of $\mathcal{V} - \mathcal{Z}$ *are* ***metalinguistic variables****, or* ***unfinished****.*

Notation 5.1.3 *Reflexive and transitive closure of Kleene*

We note $\mathcal{Z}^* = \bigcup_{n=0}^{\infty} \mathcal{Z}^n, \mathcal{Z}^+ = \bigcup_{n=1}^{\infty} \mathcal{Z}^n$,

Reflexive and transitive closure of Kleene.

Definition 5.1.7 (Omomorfism) *Let two alphabets* $\mathcal{Z}_1, \mathcal{Z}_2$ *one function*

$$\psi : \mathcal{Z}_1^* \to \mathcal{Z}_2^*$$

represent a omomorfism if:

$$\forall \xi_1, \xi_2 \in \mathcal{Z}_1^* : \psi(\xi_1 \cdot \xi_2) = \psi(\xi_1) \cdot \psi(\xi_2).$$

Definition 5.1.8 (Language $\mathcal{L}_{sql}$ ***of phrase structure - SQL)*** *If* $\mathcal{G}_{sql} = \langle \mathcal{V}, \mathcal{Z}, \mathcal{P}, \sigma \rangle$ *phrase structure grammar,* $\mathcal{L}_{sql} \subseteq \mathcal{L}^*$*, with:*

$$\mathcal{L}_{sql} = \mathcal{L}_{sql}(\mathcal{G}_{sql}) = \{w \in \mathcal{L}^* | \sigma \Rightarrow w\},$$

is named ***language of phrase structure SQL****,*

$$\mathcal{L}_{sql} = \mathcal{L}_{sql}(\mathcal{G}_{sql}),$$

language generated by the grammar $\mathcal{G}_{sql}$*.*

Lema 5.1.1 (Translators - SQL) *For phrase structure grammar - SQL (Comes et all., 2008b), (Comes et all., 2008a), (Comes et all., 2006a)*

$$\mathcal{G}_{sql} = \langle \mathcal{V}, \mathcal{Z}, \mathcal{P}, \sigma \rangle$$

we have a phrase structure- SQL, $\mathcal{G}'_{sql} = \langle \mathcal{V}', \mathcal{Z}, \mathcal{P}', \sigma \rangle$ *so:* $\mathcal{L}_{sql}(\mathcal{G}'_{sql}) \equiv \mathcal{L}_{sql}(\mathcal{G}_{sql})$ *and all rulles from* $\mathcal{P}$ *is:* $\alpha \to \beta, cu \alpha \in (\mathcal{V} - \mathcal{Z})^+, \beta \in (\mathcal{V} - \mathcal{Z})^*$ *or* $\psi \to a, with \psi \in (\mathcal{V} - \mathcal{Z}), a \in \mathcal{Z}$*.*

Demonstration 5.1.1 (Translators - SQL) *We consider (Comes et all., 2008b)* $\mathcal{G}_{sql} = \langle \mathcal{V}_{sql}, \mathcal{Z}_{sql}, \mathcal{P}_{sql}, \sigma_{sql} \rangle$ *a source grammar* $\mathcal{S}_{sql}$*. We define application* $\varphi : \mathcal{V}_{sql} \to \mathcal{V}'_{sql}$*, so* $\varphi(\psi) = \psi$*, if* $\psi \in (\mathcal{V}_{sql} - \mathcal{Z}_{sql})$*,* $\varphi(\psi) = \psi_a$*, if* $a \in \mathcal{Z}_{sql}$*,*

We extend ψ *to a omomorfism;*

If we consider the grammar target $\mathcal{G}'_{sql} = \langle \mathcal{V}_{sql}, \mathcal{Z}_{sql}, \mathcal{P}_{sql}, \sigma_{sql} \rangle$ *with* $\mathcal{T}_{sql}$*, determinable, where* $\mathcal{P}'_{sql} = \{\psi(\alpha) \to \psi(\beta) | \alpha \to \beta \in \mathcal{P}_{sql}\} \cup \{\psi_a \to a | a \in \mathcal{Z}_{sql}\}$*, then* $\mathcal{L}_{sql}(\mathcal{G}'_{sql}) \equiv \mathcal{L}_{sql}(\mathcal{G}_{sql})$*.*

Definition 5.1.9 (Language $\mathcal{L}_{pl/sql}$ ***of phrase structure grammar - PL/SQL)*** *If* $\mathcal{G}_{pl/sql} = \langle \mathcal{V}, \mathcal{Z}, \mathcal{P}, \sigma \rangle$ *is a phrase structure grammar,* $\mathcal{L}_{pl/sql} \subseteq \mathcal{L}^*$*, with:* $\mathcal{L}_{pl/sql} = \mathcal{L}_{pl/sql}(\mathcal{G}_{pl/sql}) = \{w \in \mathcal{L}^* | \sigma \Rightarrow w\}$*, we call* ***language of phrase structure grammar PL/SQL****,* $\mathcal{L}_{pl/sql} = \mathcal{L}_{pl/sql}(\mathcal{G}_{pl/sql})$*, the language generated by* $\mathcal{G}_{pl/sql}$*.*

Lema 5.1.2 (Translators - PL/SQL) *For phrase structure grammar - PL/SQL (Comes et all., 2008b), (Comes et all., 2008a), (Comes et all., 2006a)* $\mathcal{G}_{pl/sql} = \langle \mathcal{V}_{pl/sql}, \mathcal{Z}_{pl/sql}, \mathcal{P}_{pl/sql}, \sigma_{pl/sql} \rangle$ *exist a phrase structure grammar - PL/SQL,* $\mathcal{G}'_{pl/sql} = \langle \mathcal{V}'_{pl/sql}, \mathcal{Z}_{pl/sql}, \mathcal{P}'_{pl/sql}, \sigma_{pl/sql} \rangle$ *so:* $\mathcal{L}_{pl/sql}(\mathcal{G}'_{pl/sql}) \equiv \mathcal{L}_{pl/sql}(\mathcal{G}_{pl/sql})$ *and for all rulles in* $\mathcal{P}_{pl/sql}$ *has the form:* $\alpha \to \beta, with \alpha \in (\mathcal{V}_{pl/sql} - \mathcal{Z})^+_{pl/sql}, \beta \in (\mathcal{V}_{pl/sql} - \mathcal{Z})^*_{pl/sql}$ *or* $\psi \to a, cu \psi \in (\mathcal{V}_{pl/sql} - \mathcal{Z}_{pl/sql}), a \in \mathcal{Z}_{pl/sql}$*.*

Demonstration 5.1.2 (Translators - PL/SQL) *We consider (Comes et all., 2008b)* $\mathcal{G}_{pl/sql} = \langle \mathcal{V}_{pl/sql}, \mathcal{Z}_{pl/sql}, \mathcal{P}_{pl/sql}, \sigma_{pl/sql} \rangle$ *a source grammar* $\mathcal{S}_{pl/sql}$*. We define:* $\varphi : \mathcal{V}_{pl/sql} \to \mathcal{V}'_{pl/sql}$*, so* $\varphi(\psi) = \psi$*, if* $\psi \in (\mathcal{V}_{pl/sql} - \mathcal{Z}_{pl/sql})$*,* $\varphi(\psi) = \psi_a$*, if* $a \in \mathcal{Z}_{pl/sql}$*, we extend* ψ *până to a omomorfism; If we consider the grammar target* $\mathcal{G}'_{pl/sql} = \langle \mathcal{V}_{pl/sql}, \mathcal{Z}_{pl/sql}, \mathcal{P}_{pl/sql}, \sigma_{pl/sql} \rangle$ *with source* $\mathcal{T}_{pl/sql}$*, determinable, where* $\mathcal{P}'_{pl/sql} = \{\psi(\alpha) \to \psi(\beta) | \alpha \to \beta \in \mathcal{P}_{pl/sql}\} \cup \{\psi_a \to a | a \in \mathcal{Z}_{pl/sql}\}$*, then* $\mathcal{L}_{pl/sql}(\mathcal{G}'_{pl/sql}) \equiv \mathcal{L}_{pl/sql}(\mathcal{G}_{pl/sql})$*.*

Definition 5.1.10 (Context-free grammars - SQL) *A phrase structure grammar of SQL, (Comes et all., 2008b)* $\mathcal{G}_{sql} = (\mathcal{V}, \mathcal{Z}, \mathcal{P}, \sigma)$ *is independent of context SQL -* GDC_{sql}*, if for any production of the form* $x\psi y \to x\xi y$*, where* $\psi \in (\mathcal{V} - \mathcal{Z}), x \in (\mathcal{V} - \mathcal{Z})^*, y \in \mathcal{V}^* - \epsilon$*.* $\mathcal{L}_{sql}$ *is an independent language SQL context if* $\mathcal{L}_{sql} = \mathcal{L}_{sql}(\mathcal{G})$ *is independent of context* $\mathcal{G}$*.*

Definition 5.1.11 (Context-free grammars - PL/SQL) *A phrase structure grammar of PL/SQL (Comes et all., 2008b)* $\mathcal{G}_{pl/sql} = (\mathcal{V}, \mathcal{Z}, \mathcal{P}, \sigma)$ *is independent of context PL/SQL -* $GDC_{pl/sql}$*, if for any production of the form* $x\psi y \to x\xi y$*, where* $\psi \in (\mathcal{V} - \mathcal{Z}), x \in (\mathcal{V} - \mathcal{Z})^*, y \in \mathcal{V}^* - \epsilon$*.* $\mathcal{L}_{pl/sql}$ *is an independent language PL/SQL context if* $\mathcal{L}_{pl/sql} = \mathcal{L}_{pl/sql}(\mathcal{G})$ *is independent of context* $\mathcal{G}$*.*

5.2 PL/SQL Migration

Database servers in a first phase only known SQL (SQL dialects in more than 86 SQL-89, SQL-92, SQL: 1999, SQL: 2003, SQL: 2008) - declarative language, developed at Donald D. Chamberlin IBM and Raymond F. Boyce in the neighborhood of 1970, the need for an imperative language allowed after its creation procedural extensions in Table 5.1 - the three components:

1. DDL - Data Definition Language(CREATE..., ALTER..., DROP...);
2. DML - Data Manipulation Language(INSERT..., UPDATE..., DELETE, plus SELECT ...);
3. DCL - Data Control Language(GRANT..., REVOKE...);

High languages like (C, C + +, Delphi, Java) in integrated development environment - IDE (Integrated Development Enviroment) needed an intermediary component equipped with an appropriate interface API (Application Programming Interface) brought on stage IT a new actor ODBC (Open Data Base Connectivity)

Soft House	Name	Description
IBM	SQL PL	SQL Procedural Language
Teradata	SQL SP	SQL Stored Procedures
ANSI/ISO Standard	SQL/PSM	SQL/Persistent Stored Modules
Oracle	PL/SQL	Procedural Language/SQL
Microsoft/Sybase	T-SQL	Transact-SQL
PostgreSQL	PL/pgSQL	Procedural Language/PostgreSQL Structured Query Language
MySQL	SQL/PSM	SQL/Persistent Stored Module

Table 5.1: Procedural extension to SQL, Source: author

5.3 Steps to migrate PL/SQL

Migrating stored procedures from the database to a server with a language $SGBD_S$ with SQL_S and over SQL procedural language PL/SQL_S to a database server $SGBD_T$ with SQL_T language and procedural language than $SQLPL/SQL_T$ consider the following methodology .

1. Walker step involves developing grammar files with SQL and PL / SL for source S and destination T, its correctness;
2. The first step check if the file containing the source SQL_S and PL/SQL_S is valid as vocabulary, syntax, semantics of grammar source S;
3. The second step involves translating source to source from source to destination;
4. The last step check if the file/files that contain / contains source SQL_T and PL/SQL_T is / are valid as vocabulary, syntax, semantics of grammar source T.

5.4 Migration management stored procedures

MANAGEMENT migration process has undergone many metamorphoses under Chapter 4 they permeated its way. Pharmaceutical industry in Romania was a form the disc slices of each geographical area on the map production received different color stains drugs, pharmaceutical flasks entities were not concentric nationwide there was a total disjunction. Pharmaceutical market in our country had and still has an ascending line processes are well defined quality human resource which is aroused attention multinational companies.

5.5 Migrating Data

Datelelor migration requires a file or several files containing SQL and PL/SQL RDBMS software from source S, ie the target RDBMS T. To achieve the migration process we defined grammar RDBMS's corresponding source S, that target T.

5.5.1 Configurable components of the lexical analyzer

The"**lexer**" type SQL $\mathcal{G}_{SQL}$ has the components:

- literals;
- binar operators;
- numerical data, string data;
- remarks;
- blanks.

the literals for $\mathcal{G}_{SQL}$, $\mathcal{S}$, or $\mathcal{T}$ have the representation in Oracle 10g:

```
ACCESS     {return ACCESS};
ACCOUNT    {return ACCOUNT};
ACTIVATE    {return ACTIVATE};
...      ... ...
TRANSITIONAL   {return TRANSITIONAL};
TRIGGER  {return TRIGGER};
...      ... ...
{RETURN CUVINTE_CHEIE;}
```

unar operators in Oracle 10g are:

```
...
"=" |
"<>"  |
"<" |
">" |
"<=" |
">="
{RETURN REL_ECHIV_REL_ORD;}
...
```

binar operators in Oracle 10g are:

```
...
[-+*/]
...
{RETURN OPERATOR;}
```

Identificators

```
...
[A-Za-z][A-Za-z0-9_]*
{RETURN SIR_CARACTERE;}
...
```

numbers in Oracle 10g are:

```
...
[0-9]+ |
[0-9]+"."[0-9]* |
"."[0-9]* {RETURN D_INTREG; }

[0-9]+[eE][+-]?[0-9]+ |
[0-9]+"."[0-9]*[eE][+-]?[0-9]+ |
"."[0-9]*[eE][+-]?[0-9]+
{RETURN DATA_VM;}
...
```

In the form of a finite state automaton equivalent relations corresponding binary operators = or order < is represented for in Oracle 10g.

Regular expression for comments is represented in grammar $\mathcal{G}_{SQL}$ Oracle 10g IS:

```
...
"--".*$
{RETURN REMARKS;}
...
```

Spaces are defined as:

```
...
[ \t\r]+
{RETURN SPATIU;}
...
```

These regular expressions are useful for identifying atoms in lexical analysis phase component of zDB that, after lexical analysis phase follows the syntactic analysis phase.

5.5.2 Functions and Procedures

We define the grammar rule for stored procedures $\mathcal{G}_{PL/SQL}$ Oracle 10g:

```
sql_orcl_10_procedura_stocata
: schema_procedura_stocata_sql_orcl_10 ;
```

Rule for setting a function, i.e. the procedure for grammar $\mathcal{G}_{PL/SQL}$ Oracle 10g:

```
schema_procedura_stocata_sql_orcl_10
: schema_procedura_stocata_sql_orcl_10
| schema_functie_stocata_sql_orcl_10 ;
```

Invoking the function, procedure:

```
schema_procedura_stocata_sql_orcl_10
: CREATE sql_invoc_procedura_sql_orcl_10
| CREATE sql_invoc_functie_sql_orcl_10 ;
```

Appropriate procedures for the grammar rule $\mathcal{G}_{PL/SQL}$ Oracle 10g:

```
sql_invoc_procedura_sql_orcl_10
 : PROCEDURE
indentificator_sql_orcl_10
parametri_sql_orcl_10
rutine_sql_orcl_10
```

Appropriate rules for grammar functions $\mathcal{G}_{PL/SQL}$ Oracle 10g:

```
sql_invoc_functie_sql_orcl_10
: specificatie_functie
rutine_sql_orcl_10
```

5.5.3 Triggers

Triggers are stored procedures that run by default before - before or after - AFTER an action DML (INSERT, UPDATE, or DELETE) without the need for speed. Grammar rules that describe appropriate shutter $\mathcal{G}_{PL/SQL}$ Oracle 10g is:

```
trigger_sql_orcl_10  :
CREATE TRIGGER  identificator_sql_orcl_10  trigger_actiune_sql_orcl_10  trigger_ev_sql_orcl_10
ON table_name  ( REFERENCING old_sau_new_sql_orcl_10  )
trigger_actiune_sql_orcl_10
;
```

```
trigger_actiune_sql_orcl_10 :
BEFORE
| AFTER
;

trigger_ev_sql_orcl_10 :
INSERT
| DELETE
| UPDATE
( OF trigger_col_sql_orcl_10);

trigger_col_sql_orcl_10 :
  coloana_sql_orcl_10
;

...

sterg_trigger_sql_orcl_10 :

DROP TRIGGER identificator_sql_orcl_10;
```

5.6 Economic efficiency of the prototype

Economic efficiency of data stored in Database servers that use NoSQL methodology is related to horizontal scalability, scalability vertical data effectively achieved through relational databases - financial accounting modules: FI, CO, PP production planning, distribution SD need well-structured data that meets the specifications ACID relational model. Research and Development R&D department, that the Quality Management - QM is able to use elements NoSQL - Not only SQL to ensure rules of good practice GMP requirements in the pharmaceutical sector, which has a batch processing products. To manage a lot of products in all intermediate stages from raw material produced in progress, finished product, follow it on the market that guarantees management practice GMP exhibit diverse and exponential demand for resources stored data: structured and semi-structured .

5.6.1 Advantages and disadvantages of NoSQL

NoSQL uses memory and processor speed to maximum implying a speed of accessing and processing high compared with a database that uses relational model and implementing strict specifications of

ACID. Specificity pharmaceutical industry require the use of standard operating procedures conducted by human factors which oversees equipment managed computing resources (HW and SW) and programmable controllers (PLC). Semistructured data acquisition that provides horizontal scalability show a NoSQL model increased efficiency due to high volume of multimedia data. Using data multimidia, acquisition from different angles of image sequences as movies in various formats, HD, HDMI processes taking place at the level of raw material processing equipment, products in progress, or finished products.

Chapter 6

CONCLUSIONS AND CONTRIBUTIONS

PLANNING in an enterprise in terms of the researcher is a topic approved by optimizing processes within an organization, information systems that shape under ERP are complex nature of : analysis, design, implementation and continual maintenance involves allocating special physical and logical resources, multinationals by organizational culture require effective management at all levels of logical and physical control over them through endogenous and exogenous factors preventing what may disturb homeostasis.

6.1 Dissemination of results the author

Scientific activity between 1 October 2000 - 1 October 2012 was conducted on three levels: thorough analysis of the results of students using methods such as DEA (Comes et all., 2010), Data Mining in (Breşfelean et all., 2008), respective EFI ROM (Tripon and Comes, 2005), Lotka-Volterra equation (Comes, 2012b), stochastic calcullus (Comes, 2012a) in România: Tulcea 2010, Dubrovnik - Croatia 2008, Chania - Greece 2005, Valencia - Spain 2007, 2008, Athena - Greece 2006, Bratislava - Slovakia 2011, Siauliai - Lithuania 2012:

- **Comes C.A.**, *Credit crunch: Stochastic model*, Proceedings of EMQFB212, Procedia Economics and Finance, Elsevier, 2012, accepted, **ISI Proceedings**;
- **Comes C.A.**, *Banking System: Three level Lotka-Volterra model*, Proceedings of EMQFB212, Procedia Economics and Finance, Elsevier, 2012, accepted, **ISI Proceedings**;
- **Comes C.A.**, *Endogenous and Exogenous benefits of grid in Financial Markets*, in 7^{th} International Workshop Grid on Computing for Complex Problems, GCCP 2011, October 24 - 26, 2011 pp. 102–106.

- **Comes C.A.**, Rus I., Munteanu A., Nistor P., Tripon, A., *DATA ENVELOPMENT ANALYSIS METHOD IN HIGHER EDUCATION*, Proceedings of 6^{th} International Seminar on the Quality Management in Higher Education 2010, Tulcea, ROMANIA pp. 39–42, **ISI Proceedings**;

- Breşfelean V. P., Breşfelean M., Ghişoiu N., **Comes C.A.**, *Determining students academic failure profile founded on data mining methods*, PROCEEDINGS OF THE ITI 2008 30^{TH} INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY INTERFACES, Dubrovnik, Hrvatska, IEEE Explorer,2008, **ISI Proceedings**;

- Tripon A., **Comes C. A.**, *Innovative holistic aspects of the activities in a continuous educational center*, 4^{th} International Conference on Management of Technological Changes, Chania, Greece, 2005, **ISI Proceedings**;

- Breşfelean V.P., Breşfelean M., Ghişoiu N., **Comes C.A.**, *Development of universities' management based on data mining researches*, INTED 2008, International Technology, Education and Development Conference, March 3-5 2008 Valencia, Spain;

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- Breşfelean V.P., Breşfelean M., Ghişoiu N., **Comes C.A.**, *Continuing education in a future EU member, analysis and correlations using clustering techniques*, Transactions on Advances in Engineering Education, Issue 11, Volume 3, November 2006, p.1016-1021 **Index British Library**

Modeling the relational database stored procedures is another research direction manifested by attending conferences or published in the Proceedings of Hangzhou - China 2008 (Comes et all., 2008b), Barcelona - Spain, 2008 (Comes et all., 2008a), Tenerife - Spain 2006 (Comes et all., 2006a), Athena - Voulagmeni - Greece, 2007 (Comes et all., 2006b), (Comes and Ghişoiu, 2006):

- **Comes C.A.**, Spătăcean I. O., Ştefan D., Ştefan B.A., Savu L. D., Breşfelean V. P., Ghişoiu N., *Universal symbolic translator for procedural language over SQL*, ADVANCES ON APPLIED COMPUTER AND APPLIED COMPUTATIONAL SCIENCE, Hangzhou, China, 4-11 April, 2008, **ISI Proceedings**;

- **Comes C.A.**, Spătăcean I. O., Ştefan D., Ştefan B.A., Savu L.D., Breşfelean V.P., Ghişoiu N., *SCHEMA MAPPING FOR RDBMS*, 10^th International Conference on Enterprise Information Systems 12 - 16, June 2008, Barcelona, Spain, **ISI Proceedings**;

- **Comes C.A.**, Ghişoiu N., Breşfelean V.P., Rus I., *Entity Relationship Stored Procedure*, TRANSACTIONS on COMPUTERS, Tenerife, Spania, 16-18 Decembrie, 2006, **index BDI**;

- **Comes C.A.**, Ghişoiu N., Breşfelean V.P., Rus I., *Entity Relationship Stored Procedure Language*, TRANSACTIONS on COMPUTERS, ISSN-2750, Press: Athens, 17-23 Ag I.Theologu, 15773, Athena, **index BDI**;

- **Comes C.A.**, Ghişoiu N., Breşfelean V.P., Rus I., *Entity Relationship Stored Procedure Language*, TRANSACTIONS on COMPUTERS, ISSN-2750, Athens, 17-23 Ag I.Theologu, 15773, Athena.

Reserved tier modeling processes in organizations is represented by models for analysis Cost-Volum-Profit (Stefan et all., 2008) Neringa - Lithuania 2008, with UML (Object Management Group, 2010) Montego Bay Jamaica 2005(Comes and Ghişoiu, 2005), Genoa Italia 2006 (Comes et all., 2006c) (Comes, 2006), (Comes, 2005):

- Ştefan D., Ştefan B.A., Savu L.D., Şumandea R., **Comes C.A.**, *A Cost-Volume-Profit model for a multiproduct situation with variable production structure*, 20TH INTERNATIONAL CONFERENCE, EURO MINI CONFERENCE CONTINUOUS OPTIMIZATION AND KNOWLEDGE-BASED TECHNOLOGIES, Neringa, Lithuania, 2008, **ISI Proceedings**;

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Research grants manifested by two doctoral won the competitions organized by CNCSIS, respectively "Petru Maior" University

- Grant Director CNCSIS nr. 123 PN II RU MC/2008 UNIVERSAL SYMBOLIC TRANSLATOR FOR PROCEDURAL LANGUAGE OVER SQL, value 6 993 RON [1];

- PhD Grant - "Petru Maior" University of Tîrgu-Mureş 2005, value de 2000 RON.

Scientific prestige can be measured by citations of articles in databases BDI International, ACM, WorldCat, or ISI Web of Knowledge

[1] http://www.cncsis.ro/UserFiles/File/MC%202008/REZULTATE_FINALE_Tip_MC_Martie_2008.htm

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- **Comes C.A.**, Marian L.O., Ghişoiu N., Bircea I., *Business Process Management with Unified Modeling Language*, Transactions on Computers Issue 2, Volume 6, Febr 2007, Greece, index în SCOPUS cited by:
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6.2 Prospects for further research

Clifford algebras for discrete dynamical systems analysis for the economic phenomena at micro, macro elements interdisciplinary approach in medical, biological, economical from a holistic perspective and collaborative are prospects for further research. Doctoral envisages accessing post-doctoral

[2] http://www.enggjournals.com/ijet/docs/IJET09-01-01-03.pdf
[3] http://www.scopus.com
[4] http://www.scopus.com
[5] http://portal.acm.org

studies in Romania, namely in the EU 27, the investigating bodies which benefit from limited funds, an interdisciplinary field approach using knowledge: quantitative methods of time series AR, MA, ARMA, ARMAX , ARIMA, ARCH, GARCH environments R, S, SPSS, Stata, Gretl, or advanced knowledge in RDBMS Oracle, Informix, Teradata, MS SQL, Sybase, MySQL, Interbase on various UNIX (HP-UX, Sinix, Solaris), different colorations Linux distributions, Mac OS, namely the production of scientific articles in TEX, and LATEX.

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