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IN MEMORIAM
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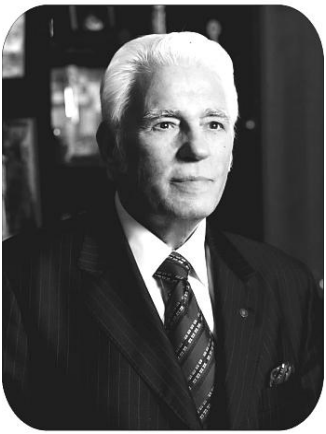
PRESIDENT-FOUNDER AND RECTOR OF THE ROMANIAN-AMERICAN UNIVERSITY



Phd. Ion Smedescu founded the Romanian-American University in 1991, with the purpose“ to promote the educational values of the American higher education on the background of the outstanding results of the Romanian higher education”, a national project which His Excellency defined as follows: ”Romanian-American University means everything to me: home , family, profession, leisure time.”

The academic community from the Romanian-American University lost not only the professor which has guided its steps wisely, skillfully and clearly, for 18 years, but also the MAN which stood by it, understood its worries, anxieties, encouraged and urged it permanently to surpass itself.

FOREWORD

In 1991 the Romanian-American University was established in Bucharest, Romania, an institution entirely committed to promoting the values of American academic education on the background of the rich traditions of the Romanian education well-known abroad.

The initiator and founder of this university is Professor Ion Smedescu Ph.D., Rector of the Romanian American University, President of the Romanian American Foundation for the Promotion of Education and Culture, active member of the New York Academy of Sciences.

The university comprises six Faculties, whose number of students is more than 15.000:

- The Department of Studies for European Economic Integration;
- The Department of Management - Marketing;
- The Department of Domestic and International Commercial Financial - Banking Relations;
- The Department of Domestic and International Economy of Tourism;
- The Department of Computer Science for Business Managemnent;
- The Law School.
- We also have approximately 2.000 students enrolled in graduate programs. Our main focuses are business and law.

The university has been accredited through Law nr. 274 as of May 15, 2002, and operates as a higher education institution enjoying its full rights, as well as facing its due responsibilities. The university is a statutory warrant for its students, as well as a guarantee of stability, promotion and increased performance of its academic body.

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Starting with the academic year 2002-2003, the Ministry of Education and Research gave the Romanian-American University from Bucharest the approval to organize Master's Degree programs. There are currently 9 ongoing Master's Degree programs organized by majors and coordinated by the respective departments in the University.

The students enrolled in the Computer Science in Economics MS program present the results of their research activity in the "INFORMATION SYSTEMS & OPERATIONS MANAGEMENT" workshop. Each of the six editions of this workshop, which took place

during the semesters of each academic year, have been honored by students from abroad enrolled in the BRIE MA Program organized by the Academy of Economic Studies and in the "Computer Science" Program organized by the University "Politehnica" Bucharest. The first number of the "JOURNAL OF INFORMATION SYSTEMS & OPERATIONS MANAGEMENT" contains the representative papers selected from the six editions of this workshop.

We express our thanks to participants, to our colleagues from the Romanian- American University, Academy of Economic Studies and University "Politehnica" Bucharest, whose efforts, skills and understanding contributed to the welfare of the workshop. We would also like to thank the authors of these projects for presenting their research. In particular, we thank the chairmen of the different sections for their continuous support, our gratitude to Professor Ion Ivan and Professor Ion Bucur, two of the initiators of this project. We also like to thank our Assistant Professor Gabriel Eugen Garais and Assistant Professor Mariana Coancă for their diligence in preparing the final version of the projects.

Bucharest, December, 2008

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Properties of the Collaborative Systems Metrics

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Abstract. The paper describes the key properties of the collaborative systems. There are presented main quality characteristics for the collaborative systems. The paper analyzes different types of indicators. They represent the base for further metrics definition. There are described the indicators most important characteristics as sensitivity, non catastrophic, non compensatory and representatives.

1. INTRODUCTION

A collaborative system is one where multiple users or agents are engaged in a shared activity, usually from remote locations. In the large family of distributed applications, collaborative systems are distinguished by the fact that the agents from the system are working together towards a common goal and have a critical need to interact closely with each other.

The informatics collaborative system is like a distribution firm that has the objective to sell more and more quantities of their products and for that has commercial agents, which go to various retail shops in order to convince them to close a distribution contract.

The properties of the collaborative systems are an important subject of our days, and an important part of the human activities is involved in this problem. The complexity of this subject, but also the huge number

of the applications makes impossible to have a large presentation in a note, but we would underline some of the main aspects.

Collaborative systems represent a new interdisciplinary domain at the intersection of economics, computer science, management, sociology, etc. From the implementation viewpoint, the collaborative systems represent software entities that are developed during a life cycle process that starts with the problem analysis and ends with the implementation of a fully functional software system. Implementing a collaborative system is accomplished using software instruments that allow the development of distributed software applications.

Science has great impact on the development of different types of collaborative systems from various activity fields. The medical field in which modern communication technologies allow doctors from around the world to work on the same patient gives one important domain that was one of the first fields presenting great interest in implementing complex collaborative systems. In a chirurgical operation each person from the group of doctors has distinct roles. In this example it is analyzed a collaborative system model representing a training on different chirurgical activities that is done in a virtual medium. The training is based on the scenario in which the instructor and the trainee are on different locations. The instructor and the trainee share a common virtual space that contains various three-dimensional anatomical models. Each person interacts with the other one through the virtual space and a medical simulation engine describes the physical and logical behavior of objects present on the virtual scene. The interaction is maintained by a multi-modal interface that uses visual 2D and 3D data, voices and audio simulation. Each person is in front of a working table that has a monitor and stereo active pair of glasses. All of these generate a three-dimensional desktop. For collaborative use, it has been implemented a mini broadband system that allows creating a videoconference between persons.

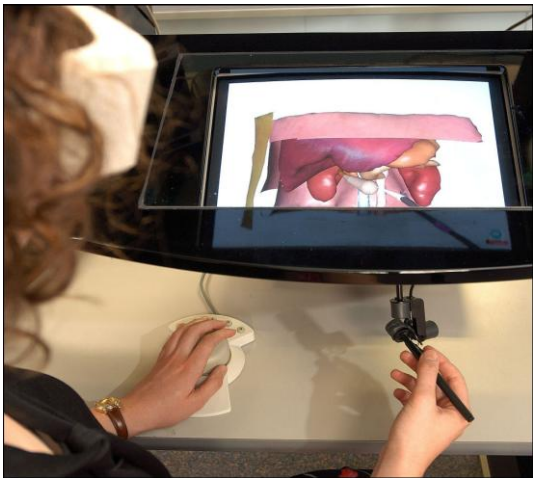

Fig. 1. Collaborative system model representing training on different chirurgical activities *[STEV05]*

The interaction between the instructor and the trainee is based on voice, gestures and chirurgical demonstrative actions, step-by-step tutorial and simultaneous actions.
The chirurgical training from this example, suppose a high level of interaction between the two persons. In opposition with training systems developed only for chirurgical dexterity, this process is concentrated also on procedures that target the understanding of the patient anatomy. The learning process is enhanced by the demonstration, the dialog and the show how activities.

2. THE QUALITY CHARACTERISTICS SYSTEM FOR COLLABORATIVE SYSTEMS

The collaborative systems represent, from the implementation viewpoint, software entities that are developed during a life cycle process that starts with the problem analysis and ends with the implementation of a fully functional software system.
The quality is a main characteristic of a collaborative system and contains the followings properties: maintainability, reliability, efficiency, usability, portability and functionality.

This characteristic may be analyzed also from the viewpoint of the length of the track the message is taking from the source component to the destination one. On this way, the system must take care the messages are not lost in the system or they aren't altered.

When for each quality characteristic $C_1, C_2, \ldots, C_n$ are established the normal areas in which are enclosed, delimited like subintervals $[b_i, 1]$ with $0 < b_i < 1$, $i=1..n$, on represent on the nomogram the standard diagram of the collaborative system functionality:

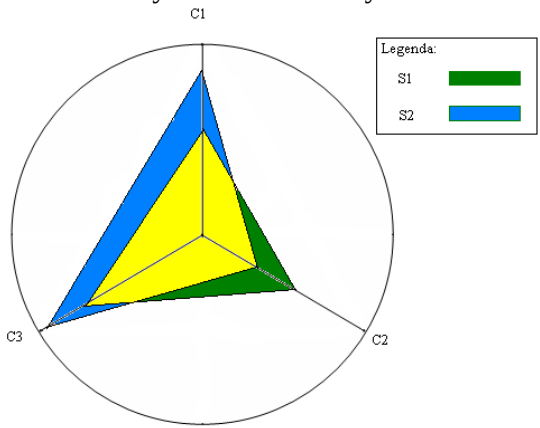

Fig. 2. The standard diagram for the functionality of a usual collaborative system

Is defined below the indicator ***HS*** like:

$HS = \frac{S_1}{S_2}$, where S_1 and S_2 are the surfaces delimited in the figure 2.

If $HS = 0$, then the collaborative system is working properly and very well and if $HS = 1$, the collaborative system is working very bad.

The most important quality characteristics for the collaborative systems are enumerated below:

C_1 – *complexity;*
C_2 – *structurability;*
C_3 – *stability;*
C_4 – *adaptability;*

C_5 *– operationality;*
C_6 *– integrability.*
All the indicators associated with these characteristics are defined with values from the interval [0;1]. Experimentally, was established the following intervals:
[0; 0,78) – the interval in which the collaborative system is working unsatisfactorily for the characteristic ***C_i, i=1..6.***
[0,78; 0,92] – the interval in which the collaborative system is working well for the characteristic ***C_i, i=1..6.***
(0,92; 1] – the interval in which the collaborative system is working very well for the characteristic ***C_i, i=1..6.***

3. THE QUALITY INDICATORS

The main quality indicators of the collaborative systems are the indicators like complexity, reliability, portability and maintainability.

The complexity is a measure for the interdependencies between components and their links and also for the diversity of different types of input and output constructions. This characteristic describes the density of fluxes between the components of the system.

The McCabe complexity was implemented with the next formula:
$CC = n_a - n_n + 2$, where:
- n_a is the number of relations between the components of the collaborative system;
- n_n is the number of collaborative system components.

The system reliability is determined by analyzing the number of problems solved by the system and the total number of specified problems.
The reliability for the software component of a collaborative system is defined like:

$$\text{I fiab} = \frac{\text{r succes}}{\text{r total}}$$, where:

- *I fiab* is the reliability indicator;
- *r succes* is the number of successfully executions of the program
- *r total* is the total number of program executions.

System reliability is a very important quality indicator because:
- it value is directly determined by the number of processes and activities that give correct and complete results;

- allows particular approaches for determining models of quality estimation; taking into consideration the hypothesis that once the causes that generates unwanted errors and system failures are eliminated it is possible to increase its levels and directly the system quality;
- its value influences the entire collaborative system project;

The portability for the software component of a collaborative system is:

$$\text{G portab} = 1 - \frac{\text{LA} + \text{LM} + \text{LE}}{\text{LI}}, \text{ where:}$$

- *G portab* is the portability degree indicator;
- *LA* represents the number of added instructions;
- *LM* represents the number of modified instructions;
- *LE* represents the number of instructions eliminated from the program;
- *LI* represent the total number of program instructions;

The maintainability of a collaborative system is defined like:

$$\text{I ment} = \frac{\text{T modif}}{\text{T dezv}}, \text{ where:}$$

- *I ment* is the maintainability indicator;
- *T modif* represent the necessary time for the realization of the modifications in the system in order to keep them in current use;
- *T dezv* is the necessary time for the system development.

The maintainability is a process particular to software products that have a complex development process and that are intended to be used for a long time, meaning more than three years. In this category are included also products like the collaborative systems.

The quality-aggregated indicator for a collaborative system is defined like:

$$I_{calit} = \frac{\min(A, B)}{\max(A, B)} * p + \frac{\min(X, Y)}{\max(X, Y)} * q, \text{ where:}$$

- *A* is the level of the planned quantity;
- *B* is the level of the realized quantity;
- *X* is the level of the planned quality;
- *Y* is the level of the realized quality;
- *p* represent the percentage of quantitative characteristics and has, generally, the value 0,4;
- *q* represent the percentage of qualitative characteristics and has, generally, the value 0,6.

4. THE INDICATORS PROPERTIES

The analytical forms of the indicators must be built such as the indicators simultaneously assure the following conditions. They must be:

- *sensitive*, that is at small variations of the influence factors the result variable has small variations; at big variations of the influence factors the result variable has big variations;
- *non-compensatory*, that is at different variation sets of the factors, small values of the result variable are not obtained;
- *non-catastrophic*, that is at small variations of the factors, big variations of the result variable have not to obtain;
- *representative*, it represents the quality to be accepted by users in analysis making assuring the significance of the results.

The analytical form of an indicator used to measured quantitative levels for collaborative systems qualitative characteristics is based on

$$y = f(x_1, x_2, \ldots, x_{nfc}),$$

where:

nfc – number of identified factors which have impact on the evolution of analyzed phenomena;

x_i – measured level for the ith influence factor of the case study;

f( ) – an analytical real form used to represent the dependency between the influence factors and result variables; it is used to describe and to study the phenomenon;

y – result variable that describe an existing situation in the phenomenon evolution.

In case of the type **I** indicators, which have analytical forms as:

$$I = \frac{A}{B},$$

the catastrophic character is the result of the very high variation of metrics value while the value of B factor is converging to zero.

The indicator $K_T = N_1 log_2 N_1 + N_2 log_2 N_2$ is sensitive, because the variations from N_1 to $N_1' = N_1 + \gamma$, respectively from N_2 to $N_2' = N_2 + \Delta$ determines:

$K_T' = N_1'\log_2 N_1' + N_2'\log_2 N_2' = (N_1+\gamma)\log_2(N_1+\gamma) + (N_2+\Delta)\log_2(N_2+\Delta) =$
$N_1 * \log_2(N_1+\gamma) + N_2 * \log_2(N_2+\Delta) + \gamma * \log_2(N_1+\gamma) + \Delta * \log_2(N_2+\Delta) > K_T + \gamma * \log_2(N_1+\gamma) + \Delta * \log_2(N_2+\Delta)$

In the case of **n** variables $\mathbf{x_1}, \mathbf{x_2}, \ldots, \mathbf{x_n}$, a generalized indicator for collaborative systems are:

$$\boldsymbol{I_n} = f(x_1, x_2, \ldots, x_n) = \frac{\min\{x1, x2, \ldots, xn\}}{\max\{x1, x2, \ldots, xn\}}$$

For this indicator, the maximal value are **1** when $\mathbf{x_1=x_2=\ldots=x_n}$, with the condition that $\mathbf{x_i>0, i=1..n}$. The sensitive property for this indicator are verified, but the non-compensatory property is not verified, because at different variation sets of $\mathbf{x_1}, \mathbf{x_2}, \ldots, \mathbf{x_n}$ factors, the $\mathbf{I_n}$ value is the same.

The indicator is sensitive in case in which the levels associated to the influence factors have a variation such as it obtains the same general type of variation for the analyzed collaborative system.

5. CONCLUSIONS

The field of collaborative systems is a domain that has many published papers and that has acquired in the last period a great volume of theoretical knowledge. This provides the methods and techniques to analyze the problem, to identify the resulting variables, the influence factors and in the end to define the model.

The properties of the collaborative systems metrics have great impact on the number of factors and as result on the scale of the model. In the end, it must be reached equilibrium between the model dimension and its capability to give significant results. The metrics must be not too complicated because it will use lots of resources when implemented and also it must be not too simple because the measured levels will loose relevance.

References

[ARBA05] Raluca ARBA – *Collaborative Electronic Marketplace*, in International Workshop „Collaborative Support Systems in Business and Education”, Cluj-Napoca, october 2005, pg. 11.

[BILL98] D. BILLSUS, M.J. PAZZANI – *Learning Collaborative Information Filters*, Proceedings of the 15th International

Conference on Machine Learning, Morgan Kaufmann, Madison, US, 1998.

[BREE98] J. BREESE, D. HECKERMAN, C. KADIE – *Empirical analysis of predicitive algorithms for collaborative filtering,* Proceedings of the Fourteenth Conference in Uncertainty in Artificial Intelligence, Madison, US, Morgan Kaufman, 1998.

[BRES05] Vasile Paul BRESFELEAN, Mihaela Antonia BURCA – *Collaborative E-learning Systems,* in International Workshop „Collaborative Support Systems in Business and Education", Cluj-Napoca, october 2005, pg. 17.

[DOBR05] Ovidiu DOBRICAN – *An Example of Collaborative System*, in International Workshop „Collaborative Support Systems in Business and Education", Cluj-Napoca, october 2005, pg. 48.

[HART04] E. HARTONO, C. HOLSAPPLE – *Theoretical foundations for collaborative commerce research and practice,* Information Systems and e-Business Management, Springer-Verlag, 2004.

[IVAN07] Ion IVAN, Cătălin BOJA, Cristian CIUREA – *Collaborative systems metrics,* ASE Publishing house, 2007.

[MICA05] Daniel MICAN – *Collaborative System in Handling Freelancer IT Projects*, in International Workshop „Collaborative Support Systems in Business and Education", Cluj-Napoca, october 2005, pg. 196.

[MOCE05] Loredana MOCEAN, Robert BUCHMANN, Ciprian-Nicuşor DRAGOTĂ – *The Proceedings of the International Workshop on COLLABORATIVE SUPPORT SYSTEMS IN BUSINESS AND EDUCATION,* October 28-29, 2005, Risoprint, Cluj-Napoca, Romania.

[MUNT05] Mihaela MUNTEAN – *Collaboration – A Business Strategy in The Global Economy,* in International Workshop „Collaborative Support Systems in Business and Education", Cluj-Napoca, october 2005, pg. 245.

[OMAH04] M. O'MAHONY, N. HURLEY, N. KUSHMERICK, G. SILVESTRE – *Collaborative Recommendation: A Robustness Analysis,* ACM Transactions on Internet Technology, vol. 4/4, 2004.

[STEV05] Duncan STEVENSON, Matthew HUTCHINS, Chris GUNN, Matt ADCOCK, Alexander KRUMPHOLZ – *Multiple approaches to evaluating multi-modal collaborative systems,* CSIRO ICT Centre, Australia, 2005.

COMPETITIVE ADVANTAGE BY INTEGRATED ERP-ADONIS IN MASTER PROGRAMMES CURRICULA

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Abstract

This paper present ERP-ADONIS package (overview, structure, documentation) and conceptual framework for the development, integration and evaluation of this package into teaching education program. ERP-ADONIS was specifically designed for the particular needs of financial services organizations and provides functionality primarily for the following application areas: Business Process Optimization; Quality Management, Process Costing, Personnel Management, Organization Management, Information Management, Creation of electronic handbooks which can be made available over an intranet with the use of powerful multi media functionality, Evaluation of Business Processes etc. ERP-ADONIS is a client/server multi-user system, which has an object-oriented structure.

1. The place and role of ERP-ADONIS in the promotion of a sustainable Information Society

Successful and dynamic enterprises can realized decisive competitive advantage through the ability to adapt their Business Processes quickly to the changing market conditions and through the active arrangement of their core competencies. The increasing dynamic, globalization and increasing competition makes efficient Business Process Management an essential goal. To enable this, the procedural Modeling, Analysis, Simulation and Evaluation of Business Processes is an authoritative success factor. The goals of Business Process Management are the optimization of both the processes of an enterprise as well as the resources and technology which execute those processes.
ERP-ADONIS offers a wide-range of various functionalities – in the following operational areas:

E-Business:
E-business application development, as well as a constant and integrated Modeling of business models, Business Processes, products, IT systems and IT infrastructures.

Business process management:
Acquisition, Modeling, Analysis, Simulation, Evaluation, documentation and realisation of Business Processes.

Process-based application development:
Application development with workflow, CASE, groupware and object technology as well as process-based introduction of standard software.

Process Warehouses:
Operational data management and Evolution based on business process and integrated solutions with different workflow products.

Knowledge management – Training and Learning:
Production and training supports through graphics models and process oriented knowledge management.

ERP-ADONIS is a client/server multi-user system, which has an Object Oriented Design structure. Additionally, ADONIS has a remarkable adaptation possibility, so it can be configured accordingly to needs and developed following requirements ("ADONIS -CUSTOMING").
ERP-ADONIS was specifically designed for the particular needs of financial services organizations and provides functionality primarily for the following application areas:

- Business Process Optimization/ Business Process Re-engineering (BRP)
- Quality Management/ ISO9000 Certification and Maintenance
- Controlling (Process Costing)
- Personnel Management (Personnel and Resources planning)
- Organization Management (Enterprise documentation, job description etc.)

- Information Management (Creation of technical concepts for IT systems, Interfaces to Workflow and CASE systems, Introduction of ERP Systems)
- Creation of electronic handbooks which can be made available over an intranet with the use of powerful multi media functionality
- Evaluation of Business Processes (Benchmarking, Monitoring, "Should-be" comparison)

2. ERP-ADONIS Components

ADONIS, as tool for business process management and optimization complies with the Requirements for Software ergonomics, can be configured to optimally suit the particular requirements of any user. The ADONIS Business Process Management toolkit consists of the following components:

Acquisition

Information acquisition supports in gathering information, which is important to successfully model your Business Processes and Working Environments. One of the methods provides is the use of the acquiring tables or Homer component, which runs through a link to Microsoft Excel. Data can be entered in these tables (excel sheets) and this data can be then be exported to an ADL file and imported into ADONIS Business Process Management toolkit.

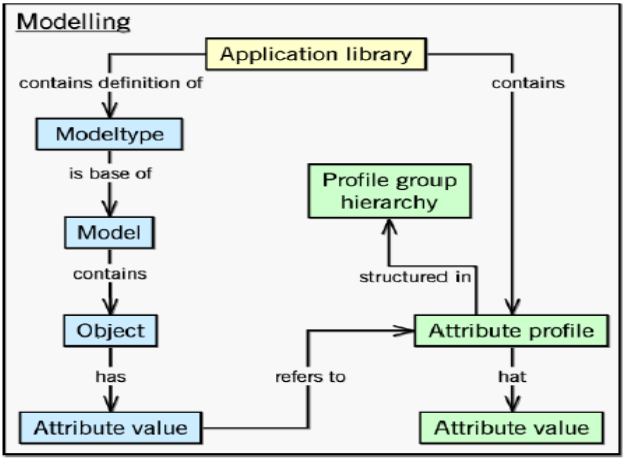

Fig.1: Attribute profiles in Business Process Management toolkit

Modeling

The Modeling component is the heart of the ADONIS Business Process Management toolkit. The Modeling components allows you to build the models you require. It can create ERP-ADONIS is a client/server multi-user system, which has an Object Oriented Design structure and can amend your Owen models using the graphical editor (model editor) provided. Additionally, it is possible to input attribute value through a tabular view of the model. Some basic tips to ensure the clarity and quality models can be found in " Fundamentals of Modeling".

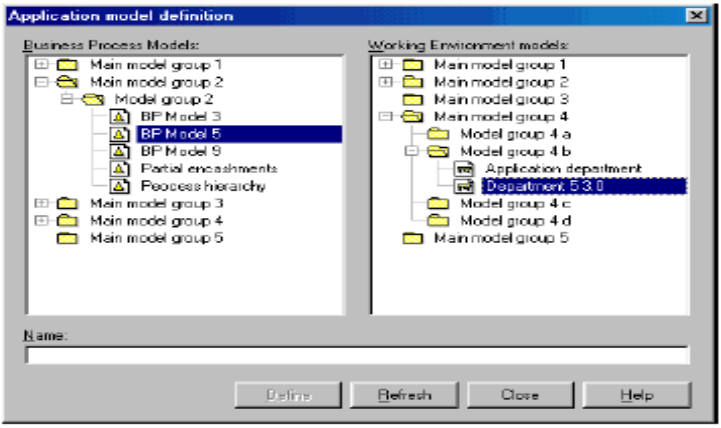

Fig. 2: Add application models

Analysis

Within the Analysis component, queries on your ADONIS models can be run and relation tables or predefined charts can be produced. The query language in ADONIS is AQL (ADONIS Query Language). The results of the query can be displayed either as a table or graphically. The results can be exported to an ASCII file and can be use in another application.

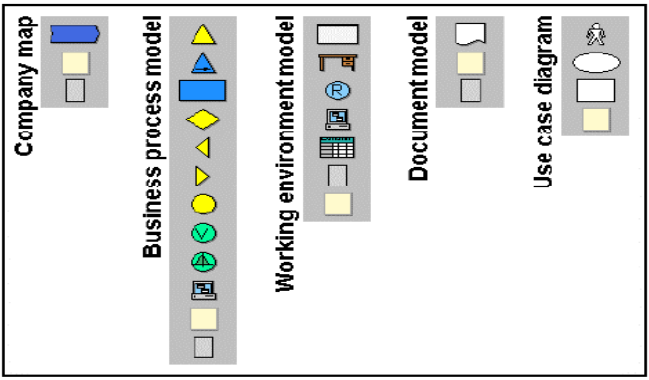

Fig. 3: Class panel of the ADONIS Standard Application Library

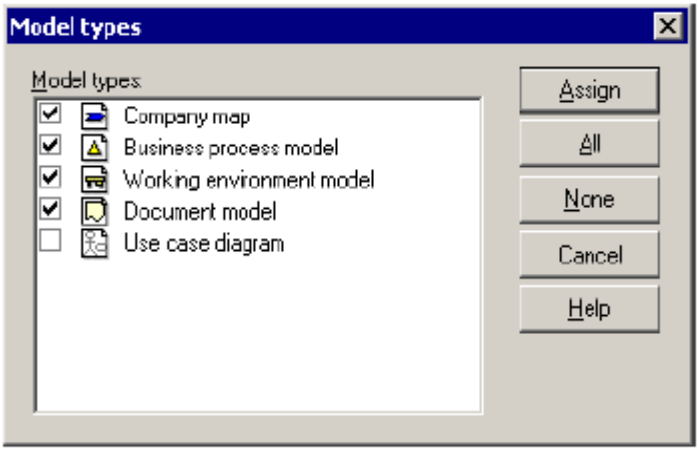

Fig. 4: Model types of the ADONIS standard library

Evaluation

The Evaluation component offers mechanisms for the Evaluation of "should-be" models as real running processes. The Evaluation component provides the following areas of functionality comparative representation of results. Evaluation of real-time audit trails of the workflow management system MQ Series Workflow (IBM) and pre-defined Evaluation queries. In the ADONIS Process Costing component can be integrated dynamic Evaluation modules with the toolkit. Dynamic Evaluation modules, based on the Simulation algorithm "capacity Analysis", enable the period-related Evaluation.

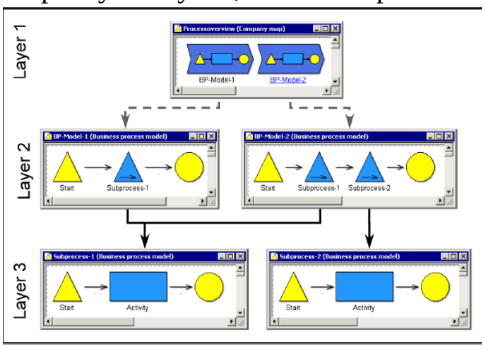

Fig: 5: Example of reference tree

Import/Export

The Import/Export component provides the possibility of exporting ADONIS models, model groups an application models into ADL files as well as importing them into an ADONIS database from ADL files. ADL stands for ADONIS Definition Language. With the help of ADL-import and ADL-export, you can transfer ADONIS models, model groups and application models into a different ADONIS databases. Additionally, ADL-Export can serve as a back-up mechanism for your models, model groups and application models.

The Documentation component provides you the possibility to transfer your ADONIS models into an electronic model documentation (e.g. HTML, XML data) or in a paper documentation (e.g. RTF data for MS Word). In this way it is possible to distribute the contents of your models either in document format (through a word processing program) or over an Intranet.

3. ADONIS Overview

Modeling Component:

- Graphical modeling editor;
- Tabular input of information into the notebooks;
- References to external programs;
- Model comparison, model administration via model attributes;
- Views and modes;
- Macro language to specify user-definable commands.

Analysis Component:

- AQL : ADONIS Query Language:
  - pre-defined queries;
  - ad-hoc queries (user-defined).

Used for specific evaluation purposes as well as for completion control

Simulation Component:

- Path Analysis;
- Capacity Analysis;
- Workload Analysis;

- Activity-based Costing;
- Call Center Simulation

- **Results:**

- Critical Process Path
  - Capacity Profiles
- Manpower Requirements
  - Workloads of Roles
  - Dynamic Waiting and Cycle Times
  - Process Costs
  - Needed Skill

Documentation Component:

- SP Expertise

4. Using the ERP - ADONIS Manuals

There are three different user groups who use ADONIS :

- **System Administrators: Installation and Database administration manual**
- **ADONIS Administrators:**
  - Administration manual
  - Method manual
- **ADONIS Users.**
  - Introduction
  - User manual
  - Method manual

The System Administrators install ADONIS and create the ADONIS databases. Additionally you can save and restore ADONIS database. To administrate your databases use ADONIS Database Administration.

ADONIS Administrators are relevant for the configuration of ADONIS as well as for the administration of users, libraries, models and components.

ADONIS Users work with the ADONIS Business Management toolkit. They acquire information, model and document their Business

Processes and Working Environment (Organizational structures). In addition, the Business Process and Working Environment models constructed can be analyzed, simulated, evaluated an if necessary transformed into an operative basis.

4. References

- Prof. Dr. Dimitries Karagiannis - ADONIS for UNIVERSITIES, University of Vienna, 2007
- *** - ADONIS - User's Manual
- *** ADONIS - Installation and Database Manual
- www.dke.univie.ac.at
- www.microsoft.com/Business Solution

B2B oriented on-line applications generator

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Abstract

B2B applications are presented. Quality characteristics of B2B applications are defined. B2B application structure is defined. The application for contracts is developed. The advantages are identified.

Key words: B2B, quality, structure, efficiency.

1. B2B application types

A distributed system is a collection of interdependent computers forming a computer network looks as a single computer to the users.

Middleware is a software component that connects software components or applications. It allows interaction between processes running on different computers through a network.

There are many definitions for distributed applications.
According to [SUND08] a distributed application is made of different components that run in different environments, on different platforms connected through a network.
According to [CONE08] a distributed application is an application formed by different components that interact and are physically localized on different computers from a network.
According to [IBMX08] a distributed application is defined as being composed of different components physically localized on different computers connected by a network.

A distributed application is therefore characterised by:

- it is composed by many distinct components;
- components running on different computers;
- running computers connected by a network.

Distributed applications are classified into:

- two-tier with two components out of witch one is the client and the other is the server;
- three-tier formed by three components out of witch one is the client, the second is the middleware and the third is the server;
- multi-tier are applications formed by many middleware and server components and one client component.

Client – server architecture separates the client from the server. This architecture is always implemented on a network. Each client is connected to at least one server. The client sends requests to the server, the server processes them and then sends the reply to the client from whom it received the request.

Three-tier and multi-tier architectures are client – server architectures for witch the user interface, the functional process logic, data storage and data access are developed and maintained as independent modules, most often on different platforms.

Modularization allows independent administration, developing and modifying of modules.

Distributed applications are usable in domains where the processing power of a single computer is overwhelmed by the needed processing power, where users are distributed over a large area, or when they must access simultaneously the system, or when the same data are simultaneously used and updated.

2. Quality characteristics for B2B applications

Scalability – represents the software application's capacity of supporting more and more users with the increase of hardware equipment. If the maximum supported number of users is reached, the increased number of computers within the network leads to augumentation of the maximum supported users without any further application modifications. If, by increasing the number of computers on witch the application runs, it does not allow the increase of the supported users number, then the application is not scalable.
Applications are scalable if the indicator NrUSA –number of users supported by the application, is defined by the following relation:

$$NrUSA = NrS*NrUSS$$

where:

NrS - number of servers within the network;

NrUSS - number of users each server supports;

The *reliability* of the distributed application – shows the measure in witch the application processes without any problems the users requests. A reliable application, assuming a computer breaks, continues its activity without any problems, recording only a drop in performance. The distributed application's reliability depends on the number of servers on witch it runs, on the distribution method, on the number of copies of the data and on resource accessing frequency.

The PNMD indicator – performance obtained provided that NMD computers of the network are broken, is defined by:

$$PNMD = PM - NMD/NTMR*PM$$

where:

PM - maximum performance obtained when all the computers within the network are working;

NMD - number of broken computers;

NTMR - total number of computers within the network;

If, provided that a number of computers within the network are broken, the application's performance is given by the above formula, then the application is reliable.

Efficiency – is the report between the number of useful operations and the total number of operations. The closer the value is to 1, the more efficient the application is, the closer to 0, the more inefficient the application is.

The efficiency indicator, IE, is given by the following relation:

$$IE = NOU/NOR$$

where:

NOU - number of useful operations;

NOR - total number of operations;

Classification of distributed applications regarding the value of the efficiency indicator

IE value	Application's efficiency
IE>0,75	Very efficient
0,5<IE<0,75	Efficient
0,25<IE<0,5	Somewhat efficient
IE<0,25	Inefficient

Correctness of the distributed application supposes a correct processing of the input data for right outputs. Data processing also supposes that it is thoroughly cheked. For correct data input the application's reply will be the data processing result, and for incorrect data input the application's reply will consist in messages regarding incorrect data and their flaws.

Maintainability is the quality characteristic regarding the effort of modifying the application to reflect the real world changes. If the effort needed for modifying is greater than the effort required for the application's total development process, the maintaining process is suspended. The maintainable application must allow modifications with minimum effort so that, during running time the updates are not an impediment.

3. Applications generator

Applications generator is a software product that automatically develops applications starting from the problem's description and not through traditional programming. Based on the problem's description, using an adequate programming language, the software product creates instruction sequences and modules used in the source texts needed for solving the problem. The generator is software that develops software with a certain fixed structure. The complexity level of the created

software is below the generator's complexity level. The applications generator is easier to use than the high level programming languages.

A great disadvantage is the fact that the resulting application is very slow or some of the functions can't be implemented.

Applications generators are characterised by:

- generated products have a lower complexity than the generator;
- for the same input it is always generated the same output;
- generation algorithms depend of those projecting the generator.

As users vary so do the reports that they need and the input data they supply.

The acquirement of a very complex application generates a high level of uselessness of the components leading to the idea that for every user, the distributed application's version he needs,must be generated .

Even though the effort for the development of this product is greater than for developing a single application, it is by far smaller than the effort needed for developing all the applications that are afterwards generated.

If more than one application is written for solving the same problem, each of them having to be tested, the cumulated effort is greater than the effort of testing the applications generator.

4. Application for contracts

The objective of the application is to facilitate the contract's signing between the contracting parts through Internet. The need of developing a signing method that is fast, secure and easy to use is given by the increasing number of contracts companies sign as they grow stronger and stronger. Using the Internet network assures the rapidity, security and the ease of use of the application.

The application allows:

- the visualization of the transactions participants;
- signing contracts;
- the visualization of the contracts signed on an anterior date;
- signing in into the database in order to be able to use the system;

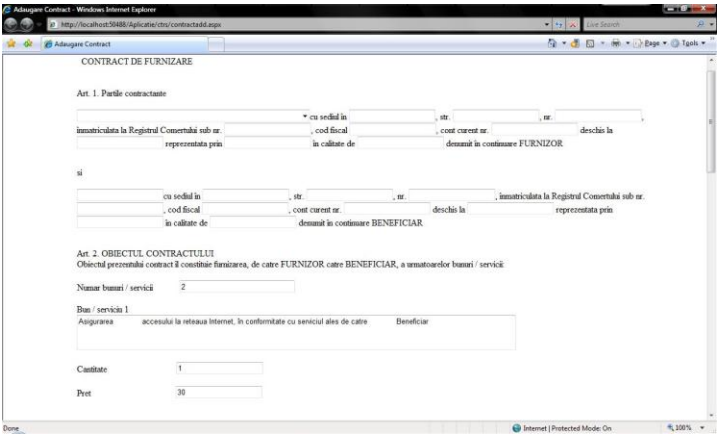

Fig. 1 - Application generates contract

The target group consists of companies that want to minimize the time and costs allocated to signing contracts with the partner companies. The number of users will be of thousands order and daily using.

The steps in developing the application are:

- *specification requests* supposes the description of the input data, the operations that are to be applied and the results for each request;
- *database projecting* supposes defining the tables, their structure and the relations between them, setting the domain and integrity restrictions;
- *developing the user interface* that must be friendly, intuitive and easy to use. The interface will not be overcrowded only necessary info being displayed.
- *operations implementation* supposes besides the data processing procedures, building data input validation procedures and procedures for displaying messages.
- *application testing* bases on input datasets for witch the results are already known; If differences occur between the final results from the specifications and the processed results, corrections are made and then the testing is repeated.

The contracts are generated according to the chosen parts and the user supplied parameters.

5. Experimental results

Testing is done by using as input the SD1, SD2, …, datasets, for witch results exists in specifications and comparing the results obtained with those in the specifications.
Each dataset has the contracting parts, the contract's elements (goods, quantities), the prices of the contracted goods or services and the decisions that are taken during negotiations.

After using all available input test datasets and following the specified decisions, no errors were found, neither correctness errors, nor errors in the validation procedures. The generated results were totally correct.

The tests, that the application was subject to, revealed that the application meets the described quality characteristics, being an application with a high degree of correctness and maintainability.

The further development of the application will maintain or possibly improve the quality characteristics of the B2B applications.

6. Conclusions

The information and communications technology development has been the support on witch distributed applications were developed. As the nature of certain problems imposes a data or users distribution, the distributed applications meet a fast development and great interest from software developers.

Even though the distributed applications' development level of complexity is greater than the one of the local applications, the distributed applications have great advantages:

- support a great number of simultaneously users;
- solves problems impossible to solve by local applications;
- risk of losing data provided an error occurs drops significantly;
- updating distributed applications affects all the users regardless of their geographical location;

- generally the requested resources from the user side are smaller compared to the local applications;
- scalability;
- lower costs for companies;
- many users use the same data leading to saving space;
- used data is frequently updated.

Taking into consideration the great variety of applications requested by users, the generator proves its utility by generating a great part of them. The generator has many advantages:

- it allows the rapid development of applications;

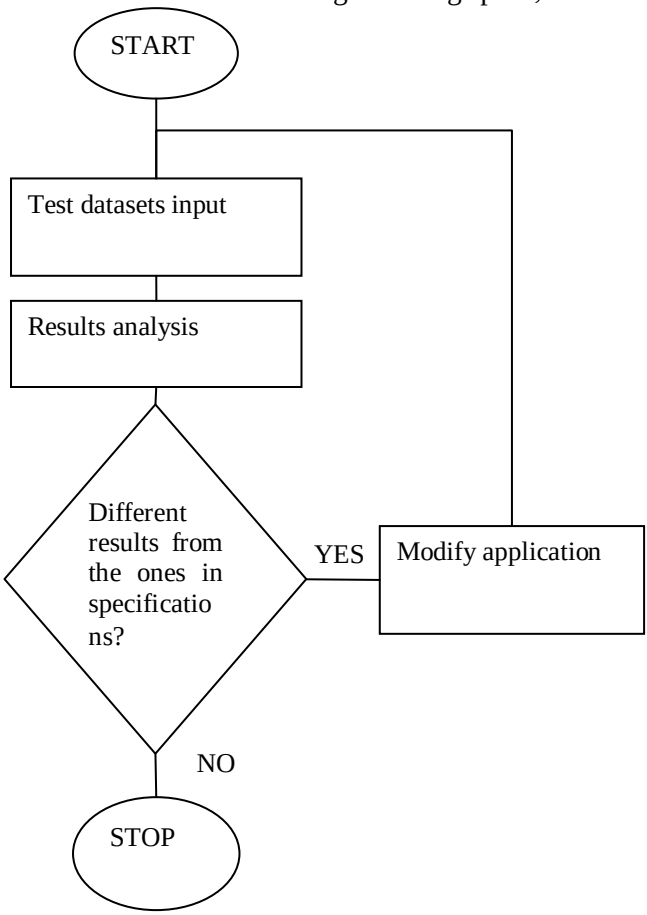

Fig. 2

Application testing

- it is used by users without advanced knowledge;
- functionality is easily extendable;

In the future, the development of the generator seeks a greater variability of the results obtained through its use. For attaining this, the increase of the input parameters number is required.

As with the development of the information and communications technologies a tendency of giving up the local applications and heading towards the distributed applications is becoming visible.

Bibliography

[MACD03] Matthew MACDONALD – Microsoft® .NET Distributed Applications: Integrating XML Web Services and .NET Remoting, Editura Microsoft Press, 2003, ISBN 0-7356-1933-6, 752pg.

[TANE95] A.S. TANENBAUM – Distributed Operating Systems, Editura Prentice Hall, New York, 1995

[IVAN99] Ion IVAN, Paul POCATILU – Testarea Software Orientat Obiect, Editura INFOREC, Bucureș ti, 1999, ISBN 973-98508-0-4

[IVAN00] Ion IVAN, Paul POCATILU, Panagiotis SINIOROS – Testarea aplicaț iilor e-business, SIMPEC 2000 – BRAȘ OV: Lucrările Simpozionului de Ș tiinț e Economice organizat de Facultatea de Ș tiinț e Economice Vol. 2 , Universitatea Transilvania din Braș ov, Editura Infomarket, 2000, ISBN 973-8204-00-3 ISBN 973-8204-02-X (Vol.2), pp. 172-176

[ȘOAV00] Georgeta ȘOAVĂ – Arhitecturi client/server, SIMPEC 2000, BRAȘOV Vol. 2, Editura Infomarket, 2000, ISBN 973-8204-00-3 ISBN 973-8204-02-X (Vol.2), pp. 224-227

[ROȘC03] Ion Gh. ROȘCA, Floarea NĂSTASE, Cristina BUCUR, Mirela VIȘEAN, Carmen TIMOFTE, Octavian PAIU – Cercetări privind proiectarea ș i realizarea aplicaț iilor de e-business. Sisteme de plată în tranzacț iile generale de e-business, Economia,

Seria Management, Editura ASE, Bucureș ti, 2003, ISSN 1454-0320, pp. 11-18

[IVAN03] Ion IVAN, Marius POPA, Bogdan FLORESCU, Doru UNGUREANU – *Juridical Aspects of the Program Generators Cloning*, The 34th International Scientific Symposium – Military Equipment and Technologies Research Agency, Proceedings, vol.1, Bucureș ti, 29-30 mai 2003, pg 283 - 288

[CONE08] http://en.csharp-online.net/Glossary:Definition_-_Distributed_application, 05.04.2008

[SUND08] http://java.sun.com/j2ee/1.4/docs/glossary.html, 09.04.2008

[IBMX08] http://publib.boulder.ibm.com/infocenter/adiehelp/index.jsp?topic=/com.ibm.wsinted.glossary.doc/topics/glossary.html, 09.04.2008

http://www.ici.ro/ici/revista/ria2008_1/art07.html, 05.04.2008

http://www.ici.ro/ici/revista/ria2007_4/art03.html, 05.04.2008

http://jaqm.ro/issues/volume-2,issue-1/pdfs/dumitrascu_popa.pdf, 05.04.2008

http://www.pcmag.com/encyclopedia_term/0,2542,t=application+generator&i=37909,00.asp, 05.04.2008

On the Borda Method for Multicriterial Decision-Making

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Abstract

The present paper discusses two issues with multicriterial decision-making methods of Borda type (when scores such as *n, n-1,…, 2, 1* are given to the objects to be ranked and the hierarchy is obtained based on the totals of these scores). The first issue is related to the influence on the result of various transformations of the scores. We show that a linear transformation of the scores does not change the final ranking and that (almost) any polynomial of second degree or more, with positive coefficients, can alter the solution (ranking). The same happens if one changes the scores by employing the logarithm, exponential, or square root functions. In the second part of the paper we consider an iterated version of the Borda method. We show that this method is not robust: there are cases when different solutions are returned at different iterations.

1. Introduction

It is well-known that most decisions (either personal, social, or economic) are multicriterial: several possibilities of action (objects) are taken into account given several criteria, or are considered by several decision-makers. The goal is to select a particular course of action (a unique object), which is often times the one at the top of a synthesis ranking of objects. There are numerous methods to address this problem – the reader is guided towards Andraşiu et al. (1986) and the references it provides.

In the 18th century, the French mathematician Jean-Charles de Borda has proposed a method which is still widely used. In short, the method requires that, using a pre-defined scale, points be allocated to

objects that are to be ranked, and that these points be summed; the synthesis hierarchy is obtained by sorting in decreasing order these "scores". The points that are allocated can decrease in constant steps (for instance, the object on the ith place in a departing hierarchy may receive $m - i + 1$ points, where m is the number of objects to be ranked), or they can belong to a specific set (for example, Onicescu (1970) proposes that $1, ½, ¼, \ldots, ½^{i}, \ldots, ½^{m-1}, ½^{m}$ be the points allocated to objects on the $1^{st}, 2^{nd}, \ldots, i^{th}, \ldots, m^{th}$ place in a departing hierarchy).

It has been shown that such ranking methods contradict one of the main rationality conditions of the Arrow theorem[1]: *independence*. In short, a multicriterial decision-making method (a method which aggregates the departing hierarchies) satisfies the independence property if the final ordering of any two objects does not depend on the presence (or absence) of a third object. For instance, let us employ the example from Păun (1987, p. 30), who considers five decision-makers who need to rank three objects. The departing hierarchies are

$$(a_1, a_2, a_3), (a_1, a_2, a_3), (a_3, a_1, a_2), (a_2, a_3, a_1), (a_2, a_3, a_1).$$

If we allocate three points to the first object in a hierarchy, two points to the second object and one point to the third, we obtain the following scores:

$$a_1 \rightarrow 10, a_2 \rightarrow 11, a_3 \rightarrow 9,$$

leading to synthesis hierarchy (a_2, a_1, a_3). However, if we eliminate object a_2 from all departing hierarchies, and thus have the five decision-makes indicate

$$(a_1, a_3), (a_1, a_3), (a_3, a_1), (a_3, a_1), (a_3, a_1),$$

then, in a similar manner as above, a_1 obtains 7 points while a_3 obtains 8 points, and thus the synthesis hierarchy is (a_3, a_1). Clearly, the relationship between a_1 and a_3 is opposite now to the one obtained when a_2 was present.

[1] For an exhaustive view, the reader is guided towards the seminal work of Arrow (1963).

Another weakness of many methods for hierarchy aggregation is the possibility to manipulate the final result by adjusting some individual hierarchies (votes). This point has been emphasized in the early '70s – see Gibbard (1973) and Satterthwaite (1975). One way to counter this possibility is to make the method more complicated, so that forecasting and influencing the result are less likely. A classic example is the Copeland method, thoroughly presented by Nurmi (1989). The first degree Copeland method is in fact a Borda method: the object on the ith place is allocated $m - i$ points (and not $m - i + 1$ as above). The method can be manipulated in polynomial time. The second degree Copeland method is more evolved. After the first step, in which objects receive points as described above, in the second step the total score for each object is obtained by summing the first step points of those objects dominated by this particular object. Manipulation of this method is significantly more difficult; this has been shown to be a NP-complete problem.

The idea to iterate a Borda-like method further appears naturally. However, this raises two important issues:

- First, total scores at each step increase rapidly, which may lead to difficulties when implementing large, real-life applications on computer. A usual solution in such cases is data "normalization", obtained by applying a specific transformation on the initial figures. We will prove that such transformations may alter the final result, and so this should be avoided. Precisely, we show that a linear transformation does not alter the result, but some polynomial transformations do change the hierarchy. A similar situation is found when one uses the exponential, logarithmic, or square root transformations.
- Second, a desirable feature of iterated methods is that hierarchies at different iterations remain unchanged. A numerical example will show that this goal is sometimes missed.

2. Notation

In what follows, n will always represent the number of decision-makers (or the number of criteria), which we denote $d_1, d_2, \ldots, d_n$, and m will represent the number of objects to be ranked,

denoted $o_1, o_2, \ldots, o_m$. Each decision-maker conveys a hierarchy of objects (a total, linear order) and objects in these departing hierarchies are allocated points according to their position in the hierarchy (more points being allocated to objects ranked higher). Let $p(d_i, o_j)$, where $1 \leq i \leq n$, $1 \leq j \leq m$, denote the number of points received by object o_j in decision-maker's d_i hierarchy.

We can now define the quality of an object:

$$Q(o_j) = \sum_{i=1}^{n} p(d_i, o_j).$$

Let us consider a function $f : \boldsymbol{R} \rightarrow \boldsymbol{R}$. If the objects are allocated points such as $f(p(d_i, o_j))$, hence transformed by applying function f, then the corresponding quality of an object will be denoted $Q_f(o_j)$.

3. The sensitivity of the Borda method to point transformations

Lemma 1. (The additivity lemma) Let $f_1, f_2 : \boldsymbol{R} \rightarrow \boldsymbol{R}$ be two functions. Let us assume we have a multicriterial decision-making problem such that, for two objects o_j, o_k, we have

$$Q_{f_1}(o_j) > Q_{f_1}(o_k), Q_{f_2}(o_j) > Q_{f_2}(o_k).$$

Let function $f(x) = a_1 f_1(x) + a_2 f_2(x) + a_3$, where a_1 and a_2 are two positive numbers. Then,

$$Q_f(o_j) > Q_f(o_k).$$

Proof.

$$\begin{aligned} Q_f(o_j) &= \sum_{i=1}^{n} (a_1 f_1(p(d_i, o_j)) + a_2 f_2(p(d_i, o_j)) + a_3) \\ &= a_1 \sum_{i=1}^{n} f_1(p(d_i, o_j)) + a_2 \sum_{i=1}^{n} f_2(p(d_i, o_j)) + a_3 n \\ &= a_1 Q_{f_1}(o_j) + a_2 Q_{f_2}(o_j) + a_3 n, \\ Q_f(o_k) &= a_1 Q_{f_1}(o_k) + a_2 Q_{f_2}(o_k) + a_3 n. \end{aligned}$$

Clearly, $Q_f(o_j) > Q_f(o_k)$. □

The following example will be used several times below. We consider four decision-makers who have to decide on five objects, and let the departing hierarchies be:

	d_1	d_2	d_3	d_4
1st place	o_3	o_2	o_3	o_2
2nd place	o_1	o_4	o_1	o_1
3rd place	o_5	o_1	o_2	o_4
4th place	o_4	o_5	o_4	o_3
5th place	o_2	o_3	o_5	o_5

If we allocate 5 points to the object on the first place, 4 to the object on the second, and so on, 1 point to the fifth placed object, then the total scores the five objects obtain are 15, 14, 13, 11, 7 and thus the Borda hierarchy is $(o_1, o_2, o_3, o_4, o_5)$.

Lemma 2. Given the previous example, for any function $f(x) = x^k$, with $k \geq 2$, we obtain $Q_f(o_2) > Q_f(o_1)$.

Proof. It is obvious that

$$Q_f(o_1) = 3 \cdot 4^k + 3^k,$$
$$Q_f(o_2) = 2 \cdot 5^k + 3^k + 1.$$

It suffices to show that $2 \cdot 5^k > 3 \cdot 4^k$. We can write $5^k = (4 + 1)^k$ and use the Newton binomial series. Then,

$$\begin{aligned} 2 \cdot (4+1)^k &= 2 \cdot (C_k^0 4^k + C_k^1 4^{k-1} + \ldots + C_k^{k-1} 4^1 + C_k^k 4^0) \\ &= 2 \cdot 4^k + 2 \cdot k \cdot 4^{k-1} + \alpha, \end{aligned}$$

where α is a strictly positive number. Since $k \geq 2$, we obtain $2 \cdot 4^k + 2 \cdot k \cdot 4^{k-1} \geq 3 \cdot 4^k$, which means that $2 \cdot 5^k > 3 \cdot 4^k$.

Observation 1. In the previous setup, it can be shown that for $k \geq 3$ an even stronger result emerges: $Q_f(o_3) > Q_f(o_1)$. The inequality is clearly true for $k = 3$ while, for k greater than 3, it can be proved by induction and by relying once again on the Newton binomial series. We can now demonstrate the main result of this section.

Theorem 1. (i) A linear transformation, with positive coefficients, of the allocated points does not alter the ranking produced by the Borda method. (ii) Let us consider a polynomial of second degree or more, with positive coefficients, such that the coefficient of the first degree term is either zero or equal to the coefficient of the second degree term. For any such polynomial $f(x)$, there are multicriterial decision-making problems for which the solution obtained by the Borda method is altered if one applies the $f(x)$ transformation.

Proof. The Borda method obtains the synthesis hierarchy by ordering $Q(o_j) = \sum_{i=1}^{n} p(d_i, o_j)$, $1 \le j \le m$. A linear transformation $f(x) = ax + b$, with $a \ge 0$, leads to $Q_f(o_j)$ which, according to Lemma 1, will keep the hierarchy unchanged[2].

Let us consider a polynomial $f(x) = a_1x^k + a_2x^{k-1} + \ldots + a_kx + a_{k+1}$, with $a_i \ge 0$, $1 \le i \le k + 1$, and either $a_k = 0$ or $a_k = a_{k-1}$. If we denote $f_i(x) = a_ix^{k-i+1}$, $1 \le i \le k + 1$, we have $f(x) = f_1(x) + f_2(x) + \ldots + f_{k-2}(x) + f_{k+1}(x) + (f_{k-1}(x) + f_k(x))$. According to Lemma 2, for any $i = 1, 2, \ldots, k - 2$, we have that $Q_{f_i}(o_2) > Q_{f_i}(o_1)$. Using Lemma 1 repeatedly, we get that $Q_g(o_2) > Q_g(o_1)$, where $g(x) = f_1(x) + f_2(x) + \ldots + f_{k-2}(x) + f_{k+1}(x)$.

Let us analyze separately the case of transformation $h(x) = x^2 + x$. Using this function, 30 points are allocated to the object on the first place, 20 to the object on the second place, 12 to the third placed object, 6 to the object on the fourth place and 2 points to the last object in a hierarchy. Using the previous example of departing hierarchies, $Q_h(o_1) = 72 < Q_h(o_2) = 74$. According to Lemma 1, the same is the case if we apply transformation $g'(x) = a_{k-1} \cdot g(x)$. We employ Lemma 1 once again for functions $h(x)$ and $g'(x)$, which, by addition, lead precisely to polynomial $f(x)$. □

Observation 2. The condition we imposed on the coefficients of the first and second degree terms of the polynomial is needed in the above proof, given the particular example we were working with. Indeed, let us consider the polynomial $f(x) = x_2 + 4x$. The points to be

[2] This is a particular case of Lemma 1, in which $f_1(x) = x$, $f_2(x) = x$, $a_1 = a_2 = a/2$, and $a_3 = b$.

allocated to objects are now 45, 32, 21, 12, and 5. Accordingly, $Q_f(o_1) = 117 > Q_f(o_2) = 116$, so the order of the two objects in reversed. As expected, other nonlinear transformations also change the hierarchy.

Theorem 2. Let us consider transformations $f_1(x) = 2^x$, $f_2(x) = \ln x$, and $f_3(x) = x^{1/2}$. There are multicriterial decision-making problems for which the solution obtained by the Borda method is altered if one applies these transformations.

Proof. If we consider the previous example and transformation $f_1(x) = 2^x$, then the points to be allocated are 32, 16, 8, 4, and 2, which leads to

$$Q_{f_1}(o_1) = 56, Q_{f_1}(o_2) = 74, Q_{f_1}(o_3) = 70, Q_{f_1}(o_4) = 28, Q_{f_1}(o_5) = 16,$$

and thus to hierarchy $(o_2, o_3, o_1, o_4, o_5)$. This is completely different from the hierarchy obtained when 5, 4, 3, 2, 1 points were allocated.

For transformation $f_2(x) = \ln x$ we consider the example below:

	d_1	d_2	d_3	d_4	points
1st place	o_1	o_3	o_5	o_4	1.61
2nd place	o_2	o_1	o_1	o_3	1.38
3rd place	o_5	o_2	o_2	o_2	1.09
4th place	o_3	o_4	o_4	o_5	0.69
5th place	o_4	o_5	o_3	o_1	0

For this example, the Borda method, using the "standard" points 5, 4, 3, 2, 1, leads to hierarchy $(o_1, o_2, o_3, o_5, o_4)$. We now allocate ln 5, ln 4, ln 3, ln 2, and ln 1 points (using the approximate values we have listed in the above table), which leads to total scores of 4.37, 4.65, 3.68, 2.99, and 3.39 and thus to hierarchy $(o_2, o_1, o_3, o_5, o_4)$, different from the previous one.

Lastly, for transformation $f_3(x) = x^{1/2}$ we consider the following example:

	d_1	d_2	d_3	d_4	$d5$	points
1st place	o_1	o_3	o_3	o_4	o_4	2.236
2nd place	o_2	o_1	o_1	o_5	o_5	2
3rd place	o_5	o_2	o_2	o_3	o_3	1.732
4th place	o_4	o_4	o_4	o_2	o_2	1.414
5th place	o_3	o_5	o_5	o_1	o_1	1

The Borda method using the "standard" point system leads to hierarchy $(o_3, o_4, o_1, o_2, o_5)$. By transforming the points to be allocated using function f_3 (see the approximate values in the table above), the five objects get the scores 8.236, 8.292, 8.936, 8.714, and 7.732, which leads to hierarchy $(o_2, o_1, o_3, o_5, o_4)$, different from the previous one.

□

4. Iterating the Borda method

As mentioned in the introduction, the Copeland method of second degree is a two-step procedure: in the first step points are allocated to objects in a similar fashion to the Borda method, while in the second step the total for each object is obtained by summing the first step points of the objects that particular object dominates. We now proceed to iterate this procedure further.

Formally, for a multicriterial decision-making problem of the type we have analyzed so far, where objects' quality is evaluated by $Q(o_j)$, with $1 \leq j \leq m$, we define $Q_i(o_j)$, with $i \geq 0$, in this manner:

$$Q_1(o_j) = Q(o_j),$$

$$Q_{i+1}(o_j) = \sum_{k=1}^{n} \sum_{l \in D_k(j)} Q_i(o_l), i \geq 1,$$

where $D_k(j)$ is the set of objects in decision-maker's d_k hierarchy which are dominated by object o_j. Then, at each step i, the decreasing order of $Q_i(o_j)$, with $1 \leq j \leq m$, indicates the hierarchy at that particular iteration.

Naturally, the question is whether, given a particular problem, hierarchies remain unchanged at various steps. If so, this would mean the procedure is robust, and thus full confidence should be placed on that (constant) hierarchy. Unfortunately, this is not always the case, and we will demonstrate this by employing a numerical example. Four decision-makers need to rank five objects, and their departing hierarchies are provided in the table below:

	d_1	d_2	d_3	d_4
1st place	o_1	o_2	o_1	o_4

2nd place	o_3	o_4	o_5	o_2
3rd place	o_2	o_1	o_2	o_1
4th place	o_4	o_3	o_4	o_3
5th place	o_5	o_5	o_3	o_5

Given the above, the results of the first ten iterations (returned by a simple computer program) are the following:

Scores at iteration 1: 12, 11, 5, 9, 3
Hierarchy at iteration 1: $(o_1, o_2, o_4, o_3, o_5)$

Scores at iteration 2: 72, 75, 29, 59, 25
Hierarchy at iteration 2: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 3: 484, 483, 209, 381, 163
Hierarchy at iteration 3: $(o_1, o_2, o_4, o_3, o_5)$

Scores at iteration 4: 3216, 3227, 1353, 2567, 1073
Hierarchy at iteration 4: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 5: 21292, 21411, 9013, 16937, 7147
Hierarchy at iteration 5: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 6: 141336, 141875, 59789, 112475, 47361
Hierarchy at iteration 6: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 7: 937300, 941547, 396433, 745997, 314139
Hierarchy at iteration 7: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 8: 6217376, 6244307, 2629961, 4947836, 2083977
Hierarchy at iteration 8: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 9: 41240092, 41420155, 17444101, 32820873, 13822131
Hierarchy at iteration 9: $(o_2, o_1, o_4, o_3, o_5)$

Scores at iteration 10: 273546984, 274741499, 115707421, 217699035, 91685129

Hierarchy at iteration 10: $(o_2, o_1, o_4, o_3, o_5)$

As indicated above, hierarchies at the first four steps alternate (o_1 and o_2 switch their places). From the fourth step on the hierarchy remains constant (however, we have not explored past the 10th iteration).

5. Concluding remarks

The two main results of the present paper are:

(1) Transforming the initial points allocated to objects in a multicriterial decision-making problem solved by the Borda method may alter the final result. This is the case for many of the usual nonlinear functions one may employ: polynomial of second degree or more (with some restrictions placed on coefficients), logarithm, exponential, square root. The hierarchy is not modified if one employs a linear transformation of the initial points.

(2) Iterating the Borda method may lead to different hierarchies at different iterations.

We need to emphasize once again that Borda-like methods are the most commonly used for multicriterial decision problems. Then, the significance of the above results is obvious. First, caution should be exerted when modifying the initial data (by normalization or other operations imposed, for instance, by limitations of computing capacity). Also, one should always bear in mind that the final result may depend on the actual method employed, or even on the version of that particular method.

References

Andraşiu M., Baciu A., Pascu A., Puşcaş E., Tasnadi Al. (1986) *Metode de decizii multicriteriale*, Editura Tehnică, Bucureşti

Arrow K. (1963) *Social Choice and Individual Values*, John Wiley, New York

Gibbard A. (1973) "Manipulation of Voting Schemes: A General Result", *Econometrica*, 41, 587 – 601

Nurmi H. (1989) "Computational Approaches to Bargaining and Choice", *Journal of Theoretical Politics*, 1, 407 – 426

Onicescu O. (1970) "Procedee de estimare comparativă a unor obiecte purtăatoare de mai multe caracteristici", *Revista de Statistică*, 4

Păun Gh. (1987) *Paradoxurile clasamentelor*, Editura Ştiinţifică şi Enciclopedică, Bucureşti

Satterthwaite M. (1975) “Strategy-Proofness and Arrow's Conditions”, *Journal of Economic Theory*, 10, 187 – 217

OPTIMAL AREA AND PERFORMANCE MAPPING OF *K*-LUT BASED FPGAS

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FPGA circuits are increasingly used in many fields: for rapid prototyping of new products (including fast ASIC implementation), for logic emulation, for producing a small number of a device, or if a device should be reconfigurable in use (reconfigurable computing). Determining if an arbitrary, given wide, function can be implemented by a programmable logic block, unfortunately, it is generally, a very difficult problem. This problem is called the Boolean matching problem. This paper introduces a new implemented algorithm able to map, both for area and performance, combinational networks using k-*LUT based FPGAs.*
Keywords: *k*-LUT based FPGAs, combinational circuits, performance-driven mapping.

1. Introduction

The Field Programmable Devices (FPDs) have been widely used for implementation of small to medium size digital circuits.
There are two major types of FPDs - Field Programmable Gate Arrays (FPGAs) that usually consist of small programmable logic cells, such as *k*-input single-output lookup tables, and Complex Programmable Logic Devices (CPLDs) that are based on multiple-input and multiple-output PLA-like logic cells. Both of FPGAs and CPLDs have been widely used [1], [2], [3], and [4].
The programmable gate array technology was introduced in the mid-1980s as a lesser-cost substitute for the implementation of application-specific integrated circuits (ASICs).

Main difference between the mask-programmable gate array technology and the cell library technology for ASICs, and FPGA is that the last one does not need to go through the fabrication process for circuit implementation and is field programmable and often field reprogrammable (LUT based ones).

Although the FPGA in general has a lower gate density and slower circuit speed, its advantages of programmability, shorter design turnaround time, and lower initial nonrecurring engineering cost (good for low to medium volume production) often offset its disadvantages.

FPGA circuits are increasingly used in many fields: for rapid prototyping of new products (including fast ASIC implementation), for logic emulation, for producing a small number of a device, or if a device should be reconfigurable in use (reconfigurable computing).

FPGAs consist of three kinds of programmable elements: programmable logic blocks (PLBs), routing resources, and input–output (I/O) blocks. Each logic block contains combinational components such as multiplexers (MUXs), simple gates (e.g., OR and AND), programmable lookup tables (LUTs), and sequential components such as flip-flops [5], [6], [7], and [8].

Routing resources include segmented interconnects and switching blocks. The segmented interconnects connect to the inputs and outputs of logic blocks while the switching blocks link the segments to form long routing tracks to implement routing topology.

The I/O blocks can be programmed to become the primary inputs (PIs) or primary outputs (POs) of the circuits on FPGAs.

Most commonly used FPGAs are based on *k*-input single-output lookup tables (*k*-LUTs). LUTs are the basic logic blocks in many FPGAs today. A *k*-input LUT (*k*-LUT) consists of static random access memory (SRAM) cells that can store the truth table of an arbitrary *k*-input function [5], [9], and [10].

Every *k*-LUT can implement any function with no more than *k* inputs. In practice, *k* is usually small, for example, 4-LUTs are widely used in commercial FPGAs, as the area of a *k*-LUT grows exponentially with large *k*. It was showed [30], and [24] that 4-input, single-output LUT cell yields the smallest FPGA area of any *k*-LUT cell for a wide range of programming technologies and routing pitches.

Most of actually commercially available FPGAs are using, indeed, LUTs of input size of 4 or 5 ([10], [11], and [12]). In many FPGAs,

small LUTs are connected by fast local connections to form a programmable logic block (PLB) for implementation flexibility, better performance, and proficient utilization of silicon area. A PLB can often implement one arbitrary *k*-input function, where is determined by the PLB architecture or some *large* function of more than *k* inputs [13], [14], [15], [16], [17], and [18].

Determining if an arbitrary, given wide, function can be implemented by a PLB, unfortunately, it is generally, a very difficult problem. This problem is called the *Boolean matching* problem.

Most of existing technology mapping algorithms first produce a *k*-LUT mapping solution, and then pack LUTs into PLBs [9], [10], [11], [19], and [20]. An ample survey of representative FPGA technology mapping approaches can be found in [10] and [26].

While placement and routing is strongly connected with the detailed architecture inside of the chip and mostly managed by the commercial FPGA software, the optimization and mapping can be more influenced by the user [21], [22], [23], [24], and [25].

Recent innovations in field-programmable gate array (FPGA) architecture has led to the development of *heterogeneous FPGA* families [23] that combine diverse sets of logic resources on the same silicon substrate, having heterogeneous blocks, similar to Apex20KE [3].

To support wide fan-in, low logic density sub-circuits, such as finite state machines, some contemporary FPGA architectures [20] contain SRAM-configurable PLAs. Unlike fine-grained LUTs, PLAs can implement sets of logic functions with minimal interconnect, the most area expensive resource in contemporary FPGAs. For *m* terms based PLA structures, this area efficiency often comes at the cost of increased minimum delay for PLA paths versus corresponding LUT paths, requiring resource balance. When coupled with fine-grained LUTs, PLAs provide an integrated programmable resource that can be used in many digital system designs to support non-critical-path control logic for LUT-based data paths [27], [28], [29], [30], [31], [32] and [33].

In order to maximize performance and device utilization, recent generations of FPGAs take advantage of speed and density benefits resulting from *heterogeneous* FPGAs, which provide either an array of homogeneous PLBs, each configured to implement circuits with LUTs of different sizes, or an array of physically heterogeneous LUTs.

The PLBs in FPGAs made by Xilinx, XC4000 series [34], Lucent, ORCA2C series [25], and the recently announced Vantis, VF1 [2], can be configured to have heterogeneous LUTs, as examples of versatile heterogeneous FPGAs. These heterogeneous FPGAs do not have limitations on the availability of LUTs of specific configurable sizes (as long as within the chip capacity) due to their PLB configuration flexibility.

The field programmable gate-array appeared last decade of previous millennium as alternative to application-specific integrated circuit (ASIC) projects. Static random-access memory (SRAM) is dominant FPGA technology in which programmability is realized by using SRAM cells to implement both programmable logic blocks and control programmable routing resources.

Basic reported algorithms and techniques used for mapping *k*-LUT based FPGAs circuits are summarized, compared and evaluated using only delays minimum criteria. We designed and developed one of these algorithms.

2. Model used

A Boolean network N can be represented as a directed acyclic graph (DAG) where each node represents a logic gate, and a directed edge (i,j) exists if the output of gate i is an input of gate j. Primary input (PI) nodes have no incoming edge, and primary output (PO) nodes have no outgoing edge. It is used *input(v)* to denote the set of fanins of gate v.

Given a subgraph H of the Boolean network, let *input(H)* denotes the set of *distinct* nodes outside which supply inputs to the gates in H.

For a node v in the network, a *k-feasible cone at v*, denoted C_v, is a subgraph consisting of and its predecessors (u is a predecessor of v if there is a directed path from u to v), such that $|input(C_v)| \leq k$ and any path connecting a node in C_v and v lies entirely in C_v.

The *level* of a node is the length of the longest path from any PI node to v. The level of a PI node is zero. The *depth* of a network is the largest node level in the network [33]. A Boolean network is *k-bounded* if $|input(v)| \leq k$ for each node in the network.

In this paper, the primary considered objective is to minimize the circuit mapping delay under the LUT-delay model through technology mapping. Therefore, a mapping solution is said to be *optimal* if the

mapping delay is minimized. The secondary objective is to reduce the area used in the technology mapping solution.

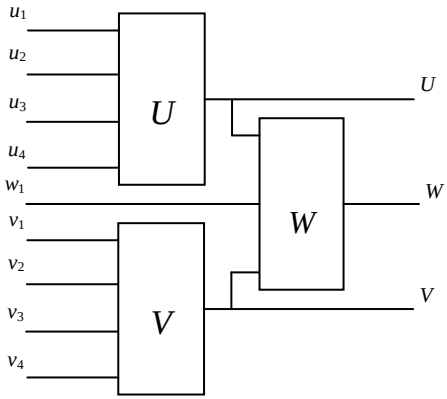

Fig. 1. Schematic Block Diagram of Xilinx 4000 CLB.

3. Logic optimization

A logic block (XC4000 CLB) contains three LUT's noted *U*, *V* and *W* as shown in figure 1. Four independent inputs (u_1, u_2, u_3, and u_4) and (v_1, v_2, v_3, and v_4) are provided for each of two 4-input LUT's *U* and *V*. The LUT *W* has internal inputs from *U*, *V* and a third input from outside the block (w_1). With this design, a XC4000 CLB (as an example) can be used to implement

(i) Any two functions of up to four variables, or
(ii) Any single function of five variables, or
(iii) Any function of four variables together with some function of five variables, or
(iv) Some function of up to nine variables.

The flexibility provided by XC4000 CLB, however, also creates a great deal of difficulty to have efficient use of all resources [34]. To implement a Boolean network on XC4000 FPGA's, the common approaches is to first map the network into a k-LUT network and then pack the *k*-LUT network into XC4000 CLB's.

Parameter *k* can be set to either 4 or 5. If one set $k = 4$, then *U* and *V* LUT's in a XC4000 CLB can implement every two 4-LUT's in the mapping solution, but the *W* LUT is left unused.

From a functional decomposition point of view, a XC4000 CLB can implement any function of the form $g\ (y_1(X_1), y_2(X_2), x_n)$, where:
$X = \{x_1, x_2, \ldots x_n\}$, $n \leq 9$, $X_1, X_2 \subset X$, $|X_1| \leq 4$, and $|X_2| \leq 4$.
Given function $f\ (X)$, it can be implemented by a XC4000 CLB, if $f\ (X)$ can be transformed into the XC4000-CLB form. For example, when n =5, the Shannon expansion:

$$f(X) = x_5 f(x_5 = 1) + \bar{x}_5 f(x_5 = 0) \tag{1}$$

It transforms $f(X)$ into the XC4000-CLB form, where $f(x_5 = 1)$ and $f(x_5 = 0)$ correspond to y_1 and y_2 respectively and $g\ (y_1, y_2, x_5)$ has the functionality of a 2-input multiplexer.
There are several criteria to distinct basic design techniques focusing on k-LUT FPGA based circuits. One could recognize a first approach named logic optimization, which transforms the gate level network into another equivalent gate-level network more suitable for the subsequent step.
Other approach is technology mapping, which transforms the gate-level network into a network of cells targeting specific technology by covering initial network with the specific cells.
This classification is used, in general, in logic design domain as alternatives to the same two main low-level design approaches.
First approach is making technology independent optimization based on given network particularities, and is generally known as *logic optimization*. Logic optimization operates using mainly knowledge of gates and network functionality and tools are Boolean optimization techniques.
Given a multilevel network of logic gates, combinational logic synthesis transforms it into a network of look-up tables, each of no more than k inputs, where parameter k is determined by the FPGA technology.
The second approach, named *technology mapping*, ignores any independent optimization, following only structural information of the network, specific technology optimization, and uses only combinatorial optimization techniques. It's essential to outline that these approaches are using different techniques having distinct characteristics.

However many reported synthesis algorithms and systems are using both approaches. In many synthesis systems dedicated to *k*-LUT based FPGAs circuits, a separate mapping or coverage step doesn't exit because a gate-level network *k*-bounded gate input can be considered an a *k*-LUT network.

4. Optimization targets and optimality

There are several optimization targets for *k*-LUT Based FPGAs. Among them the most used are:

- The delay minimization objective is to minimize the delay from primary inputs to primary output in FPGA implementation.
- The area minimization objective is to use the minimum chip area in order to implement the circuit.
- The routability objective is to make the *k*-LUT network more routable in the subsequent placement and routing steps.
- The power minimization objective is to minimize the power dissipation of the implementation.

Accurate measurement of these objectives requires information that's available only after layout synthesis. That's the reason most of the reported specific applications are using either estimation using function cost models or quick layout synthesis.

Delay of a *k*-LUT network is measured by the length of the longest path from primary input to a primary output, where the length is the computed by the accumulation of delays of nodes and edges along the path.

For a given technology the *k*-LUT delay is approximately a constant. Various delay models focus mostly on the internal various connections delays. The most commonly used model is the unit delay model, assuming each net has constant delay. This assumption involves that delay minimization is equivalent to depth minimization.

Area of a *k*-LUT network is usually estimated by the number of *k*-LUTs, or any actual logic elements used in a specific FPGA architecture.

Routability is usually modeled by interconnection complexity, more specific, the size and the terminal distribution of the net.

Simplified estimations, currently used, are the pin-to-net ratio and the pin-to-cell ratio.
Power consumption minimization is of relative new interest in logic synthesis. Power consumption can be estimated based on the output load capacitance and transition frequency of *k*-LUT and primary inputs. Load capacitance changes dynamically with the mapping process.
Optimization objectives may be mutually less-suitable. Minimization the number of *k*-LUTs may lead to a larger delay. It involves necessity of finding a proper balance among different objectives.

5. Related work

A number of technology mapping algorithms have been proposed which optimize for area and performance in lookup table-based FPGA designs. Some of these efforts are described below.
The *chortle* program, one of the earliest mapping algorithms [16] divides the Boolean network into a forest of trees and determines an optimal mapping of each tree using the dynamic programming techniques.
It does not exploit the relationship among nodes across the trees. *Chortle-crf* [18] *chortle*'s successor employs bin-packing heuristics for gate-level decomposition and technology mapping, achieving significant improvement over the previous algorithm in the solution quality as well as in run-time efficiency.
As a result, it reduces the area by 14% when compared with the original Chortle algorithm. *Chortle-crf* is optimal for $K \leq 5$. It also exploits reconvergent paths and replication at multi-fan out nodes, but if there are too many reconvergent paths terminating at a node then it tends to lose its run-time efficiency.
The idea in *Chortle-crf* was then extended to depth (delay) minimization in the *Chortle-d* algorithm [17]. In addition, it minimizes area as a secondary objective by using area-optimal node decomposition along critical path, as well as predecessor packing. Mapping solutions of *Chortle-d* use an average of 35% fewer levels of LUTs than those of *Chortle-crf*, at the cost of an average of 59% larger area. Both *Chortle-crf* and *Chortle-d* have very efficient implementations. Chortle algorithms have solved the optimal mapping problem for an un-

bounded tree, but a prior tree partitioning often could compromises the mapping quality.

Another early algorithm was the original *MIS-pga* [27] was an extension of the UC Berkeley *MIS-II* logic synthesis system [6]. This system evolved finally in SIS-1.2. It is applicable to general networks for *area minimization*. The algorithm has two close related steps, logic optimization and technology mapping. It's the first implemented algorithm pointing out the importance of the logical optimization of the network before technological mapping.

First step uses partial implemented Roth-Karp decomposition [31] kernel extraction (multilevel optimization) and AND-OR decomposition to make network transformation into a *k-bounded* one. Last part of the first step proceeds by collapsing nodes into their fan-outs, while maintaining it *k-bounded*. Nodes are collapsed is a heuristically order.

Technological mapping step uses node covering based enumeration. This synthesis application had an improvement named *MIS-pga(new)* [29] where first step was substantially enhanced with three other decomposition techniques: *cube partitioning*, *cofactoring* and *cube-packing*. All decomposition methods are tried and best result is kept. This enhancements and many other did lead to area reduction by 28.2% compared to the old version.

Other version of this application was *MIS-pga*(*delay*) [28] targeting *delay minimization*. Algorithm, proceeds by collapsing each critical node, in the network, into its critical fan outs. Such collapsing proved successful, *i.e.* keeping network *k-bounded* or nodes not satisfying this condition are re-decomposed according to a cube-packing based quick estimation procedure, will not increase delay in circuit and will reduce cost area. This procedure is re-iterated until no more collapsing is possible. Best solution for technological mapping is computed using heuristic binate covering.

Notable progress in *k-LUT* based FPGA synthesis was development of delay-optimal technology mapping algorithms based on *DAGMap* algorithm [8].

This was the first polynomial-time depth-optimal mapping algorithm for general *k-bounded* circuits. *DAGMap* transforms a general network into a depth-minimum 2-*bounded* simple gates network using AND-OR and Huffman tree decomposition.

Mapping section is performed using *dag-map* algorithm. Obtained solution is improved using two post-processing operations.
This algorithm evolved in *FlowMap* algorithm [9]. It uses same logic optimization as *DAGMap* but has an improved procedure for technological mapping, named *FlowMap*, and post processing uses one new step named *flowpack*. *FlowMap* is computing one minimum height *k-bounded* cone rooted in each internal node of the network. This feature guarantees depth-optimal mapping for general *k-bounded* networks.
However, if there are more than one such *k-bounded* cone rooted in each internal node of the network, it is ignored, narrowing solutions space. The used *MinCut-MaxFlow* procedure implies this feature. Mapping results proved is superior to *Chortle-d* and *MIS-pga*(*delay*) because these algorithms use 9 – 50% more LUTs with up to 7% larger depth on average compared to *FlowMap*.

6. Implemented solution

We recently introduced algorithm named *minDepth* [5]. It proceeds using similar approach as *FlowMap* and *MIS-pga*(*delay*). Logical optimization is done with typical procedures implemented with structure and routine in *SIS*-1.2 [32].
MinDepth is designed to compute *all k-bounded cones rooted in each internal node of the network.* This feature provides more freedom degrees in building-up technological mapping solutions.
Generation of all *k*-feasible cones rooted in every node of a node in network has to be considered in the context of network model.
Let N be a *k*-bounded network, and u a node of N. Then, a *k*-feasible cone of the node u, noted $C(u)$ could be identified by the set:

$$input(C(u)) = \{v_1, v_2, \ldots, v_m\},\ m \leq k. \qquad (2)$$

Such a set can be represented as the product (conjunction) of the elements (literals) of the set $p = v_1 v_2 \ldots v_m$. The set of all feasible cones of node u, noted $cones(u)$, can be represented as the sum (reunion) of each of the product (cube) representing the respective cone:

$$cones(u) = \bigcup_i input(\mathrm{C}_i(u)) \qquad (3)$$

Representing each *k*-feasible cone of the node u as a conjunction, in

above relation, it becomes:

$$cones(u) = \bigcup_i v_{i1} v_{i2} \cdots v_{im} \tag{4}$$

Then it holds:

Lemma1. Given a node u having as immediate predecessors $input(u)$ = $\{v, w, \ldots, z\}$, each predecessor having already computed the set of all k-feasible cones, respective $cones(v)$, cones(w), …, $cones(z)$, than the set $cones(u)$, of all the k-feasible cones of node u, is included in the set:

$$\{ v \cup (cones(v)) \cap (w \cup \text{cones}(w)) \cap \ldots \cap (z \cup cones(z))\} \tag{5}$$

Proof the Lemma1 is exposed in [4].It was proved that this algorithm computes all possible mapping solution for each node (all details of the implemented algorithm are exposed in [4]).

Computing the sum-of-products (SOP) form of the expression (5), and eliminating (as soon as possible) all the products having more than k literals, one can determine $cones(u)$, the set of all k-feasible cones of the node u.

It is not difficult to remark that there is only polynomial number of k-feasible cones in the predecessor's maximum transitive cone of the node u, since the total number of possible combinations of k or fewer nodes is $O(n^k)$, where n is the number of nodes in the predecessor's maximum transitive cone of the node u.

7. Results

Measurements, made using *minDepth* on MCNC91 benchmark circuits, are presented in Table 1. Most of these well-known benchmark circuits are currently used in order to evaluate technological mapping algorithms.

Results of *minDepth* algorithm are compared with published homologues results of *FlowMap* algorithm.

Mapping results proved it is superior to *FlowMap*, because this algorithm uses 19% more LUTs with up to 25.8% larger depth on average, compared to *minDepth* algorithm.

Table 1

Experimental results.

	FlowMap		*minDepth*	
Circuit	Delay	Area	Delay	Area
5xp1	3	24	2	19
9symml	5	61	3	7
C499	5	154	4	65
C5315	-	-	8	498
C880	8	232	7	126
alu2	8	162	5	120
alu4	10	268	5	546
apex6	4	257	4	221
apex7	4	89	4	67
count	3	76	3	74
des	5	1308	5	1010
duke2	4	187	4	151
misex1	2	15	2	21
rd84	4	83	3	14
rot	6	268	6	209
vg2	4	45	3	35
z4ml	3	13	2	5

8. Conclusions and future work

Internal potential of *minDepth* algorithm makes it suitable for technological mapping refinements. It was tested flexible delay mapping with optimal area targeting different delays (greater than *minimum* possible but with *less* LUT count) for each primary output. Such solution is useful in practical environment because designer could tailor more appropriate solutions involving not-necessary best delay (seldom used in practice) but an optimum equilibrium between delay, on one side, and LUT count (area), on other side, in order to satisfy particular design features.

Latest version of this algorithm, named *minLevelMapIII* was released for technological mapping using clusters partitions of circuits in order to achieve best solutions using signal flow in networks. Such an approach will make this algorithm more compliant with balanced usage of connecting and I/O resources in mapping FPGAs circuits.

R E F E R E N C E S

1. Altera Corp., Programmable Logic Devices Data Book, 1998.
2. AMD, Vantis VF1 FPGA Data Sheet, 1998.

3. Apex20KE Data Sheet, Altera Corporation, San Jose, CA, 1999.
4. *I. Bucur*, "Performance Mapping of *k*-LUT based FPGAs", in Scientific Bulletin of University Politehnica of Bucharest, Series C: Electrical Engineering,Vol 69,Number 2, 2007, pp. 49-60.
5. *I. Bucur, Al. Susu*, "Mapping Large Combinational Circuits with *k*-LUT Based PFGAs Using Dominating Cones", in Control Engineering and Applied Informatics,Vol. 8, Number 3, 2006, pp. 364-368.
6. *R.K. Brayton, R. Rudell, A.L. Sangiovanni-Vincentelli, and A.R. Wang*, "MIS: A multiple-level logic optimization system", in IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, **Vol. 6**, No. 6, 1987, pp. 1062-1081.
7. *G. Chen, and J. Cong*, "Simultaneous logic decomposition with technology mapping in FPGA designs", in the Proceedings of the 2001 ACM/SIGDA ninth International Symposium on Field Programmable Gate Arrays, 2001, pp. 48-55.
8. *J. Cong, and Y. Ding*, "An optimal technology-mapping algorithm for delay optimization in lookup-table based FPGA designs", in *Proceedings of the IEEE International Conference on Computer-Aided Design*, 1992, pp. 48-53.
9. *J. Cong, and Y. Ding*, "FlowMap: An Optimal Technology mapping algorithm for delay optimization in lookup-table based FPGA designs", in IEEE Transactions on Computer-Aided Design and Integrated Circuits and Systems, **Vol. 13**, No. 1, January 1994, pp. 1-12.
10. *J. Cong, and Y. Ding*, "Combinational Logic Synthesis for LUT Based Field Programmable Gate Arrays (Tutorial and Survey Paper)", in ACM Transactions on Design Automation of Electronic Systems, **Vol. 1**, No. 2, April 1996, pp. 145-204.
11. *J. Cong, and Y-Y. Hwang*, "Boolean Matching for LUT-Based Logic Blocks With Applications to Architecture Evaluation and Technology Mapping", in IEEE Transactions on Computer-Aided

Design of Integrated Circuits and Systems, **Vol. 20**, No. 9, 2001, pp. 1077-1090.
12. *J. Cong, and S. Xu*, “Performance-Driven Technology Mapping for Heterogeneous FPGAs”, in IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, **Vol. 19**, No. 11, November 2000, pp. 1268-1281.
13. *J. Cong, and C. Wu*, “An Efficient Algorithm for Performance-Optimal FPGA Technology Mapping with Retiming”, in IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, **Vol. 17**, No. 9, September 1998, pp. 738-748.
14. *E. Detjens, G. Gannot, R. Rudell, A. Sangiovanni-Vincentelli, and A.R. Wang*, “Technology Mapping in MIS”, in Proceedings of the IEEE International Conference on Computer-Aided Design, 1987, pp. 116-119.
15. *R.J. Francis*, "A tutorial on logic synthesis for lookup-table based FPGAs” in Proceedings of the IEEE International Conference on Computer-Aided Design, 1992, pp. 40-47.
16. *R.J. Francis, J. Rose, and K. Chung*, “Chortle: A technology mapping program for lookup table-based field gate arrays”, in *Proceedings of the ACM/IEEE Design Automation Conference*, 1990, pp. 613-619.
17. *R.J. Francis, J. Rose, and Z.G. Vranesic*, “Technology mapping of lookup table-based FPGAs for performance”, in Proceedings of the IEEE International Conference on *Computer-Aided Design*, November 1991, pp. 568-571.
18. *R.J. Francis, J. Rose, and Z.G. Vranesic*, “Chortle-crf: Fast technology mapping for lookup table-based FPGAs”, in Proceedings of the ACM/IEEE Design Automation Conference, June 1991, pp. 227-233.
19. *J. He, and J. Rose*, "Advantages of Heterogeneous Logic Block Architectures for FPGAs," IEEE Custom Integrated Circuits Conf. 1993, (CICC 93), May 1993 pp. 7.4.1 - 7.4.5.
20. *F. Heile, and A. Leaver*, “Hybrid Product Term and LUT Based Architectures Using Embedded Memory Blocks”, in Proceedings of the 1999 ACM/SIGDA seventh international symposium on Field Programmable Gate Arrays, February 1999, pp. 13–16.
21. *U. Hinsberger, and R. Kolla*, “Boolean Matching for Large Libraries”, in Design Automation Conference, 1998, pp. 206-211.

22. *A. Kaviani, and S. Brown*, “The Hybrid Field-Programmable Architecture”, in IEEE Design and Test of Computers, **Vol. 16**, No. 2, April 1999, pp. 74–83.
23. *A. Kaviani, and S. Brown*, “Technology Mapping Issues for an FPGA with Lookup Tables and PLA-like Blocks”, in *Eighth International ACM Symposium on Field-Programmable Gate Arrays* (FPGA'00), February 10 - 11, 2000, pp. 60-66.
24. *J.L. Kouloheris, and A. El Gamal*, “PLA-based FPGA Area versus Cell Granularity”, in Proceedings of the IEEE Custom Integrated Circuits Conference, 1992, pp. 4.3.1 - 4.3.4.
25. *Lucent Technologies, Inc.*, "ORCA OR2C-A/OR2T-A Series FPGAs Data Sheet", 1996.
26. *H-G. Martin, and W.A. Rosenstiel*, “A Comparing Study of Technology Mapping for FPGA”, in Design Automation and Test in Europe (DATE '98) February 23 - 26, 1998, pp. 939-944.
27. *R. Murgai, Y. Nishizaki, R.K. Brayton, and A. Sangiovanni-Vincentelli*, “Logic synthesis algorithms for programmable gate arrays”, in Proceedings of the ACM/IEEE Design Automation Conference, June 1990, pp. 620-625.
28. *R. Murgai, N. Shenoy, R.K. Brayton, and A. Sangiovanni-Vincentelli*, “Performance directed synthesis for table look up programmable gate arrays”, in Proceedings of the IEEE International Conference on Computer-Aided Design, November 1991, pp. 572-575.
29. *R. Murgai, N. Shenoy, R.K. Brayton, and A. Sangiovanni-Vincentelli*, “Improved logic synthesis algorithms for table look up architectures”, in Proceedings of the IEEE International Conference on Computer-Aided Design, 1991, pp. 564-567.
30. *J. Rose, R.J. Francis, D. Lewis, and P. Chow*, “Architecture of Field Programmable Gate Arrays: The effect of Logic Block Functionality on Area Efficiency” in IEEE Journal of Solid State Circuits, **Vol. 25**, No. 5, October 1990, pp. 1217-1225.
31. *J.P. Roth, and R.M. Karp*, “Minimization over Boolean graphs”, in IBM J. Res. Dev., April 1962, pp. 227-238.
32. *E. Sentovich, K. Singh, L. Lavagno, C. Moon, R. Murgai, A.*

Saldanha, H. Savoj, P. Stephen, R.K. Brayton, and A.

Sangiovanni-Vincentelli, “SIS: A System for Sequential Circuit Synthesis”, University of California, Berkeley, CA, Tech. Rep. UCB/ERL M92/41, 1992.

33. *K.J. Singh, A.R. Wang, R.K. Brayton, and A. Sangiovanni-Vincentelli*, “Timing optimization of combinational logic”, in Proceedings of the IEEE International Conference on Computer-Aided Design, 1988, pp. 282–285.
34. *Xilinx*, “The Programmable Logic Data Book”, 1997.

The development of computer science oriented towards the citizen

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Abstract: The concept of informational application oriented to the citizen is defined. The quality characteristics for the informational applications developed under the conditions of computer science oriented towards the citizen are settled and the structure of the development cycle for these applications is presented. The conditions of existence for applications oriented towards the citizen are defined. Strategies on medium and long term are structured.
Key words: distributed applications, metric units, orientation towards the citizen, strategies.

1. Computer science applications orientated towards the citizen

The computer science applications orientated towards the citizen present characteristics which recommend the application to be used by simple users:

- contain computer science applications without operator; the entering data is introduced only by the citizens in the society and the executors from organizations;
- the persons in the management have the decision role, concretized through variant selection and signing of decided variant;
- the information in the databases are the ones that generate activities within the organizations, performing personalized products and services, offered to the ones that requested them.

The computer science orientated towards the citizen presumes data collection in order to create patters and the adaptation of robotized equipment. Among the advantages on the citizen's level we remind: the product is exactly for him, good acquisition price, delivery on term,

quality and personalization of the product. On the level of organization appear advantages regarding customized products requested by the customers, products that have buyers among the citizen. The markets are influenced by shop reorganization and their decreasing role. At the moment, the steps needed for creating software for sale are:

- problem definition identifies the characteristics of the studied problem;
- specification elaboration, existing environment investigation are analyzing the problem;
- solution elaboration sets the ways to solve the problem;
- code writing correlates the theoretical solutions with the practical ones, implemented using a programming language;
- testing assume checking the application functionality;
- documentation elaboration assure information needed for using the application;
- implementing includes all operation performed in order to install the product;
- maintenance is the process which characterize the software products which are used more than 3 years; due to the evolution of technology, legislation, collectivity the software products must be update it.

The existing applications subordinate user to obtaining the inputs for organization. In these applications:

- the operators introduce data;
- the quality is orientated towards the beneficiary organization;
- the citizens receive the outputs from the application;
- the citizens authenticate and introduce data, but the problem solving depends on the organization owner of the application.

This optic must be radically changed in order to help users to solve their problems on-line. For that, there are some steps to be follow:

The target group is defined as number of persons, structure, characteristics, qualification, age, aptitudes to work on a computer. The dimension of the sample is settled starting from estimations. The problems that the persons in the target group wish to solve on-line are identified. The beginning is made from defining the problems of the citizens and not from the organization. Specifications are elaborated beginning from the citizen’s exigencies, and the organization owner of the computer science application is actually supplying services to the

citizen. Its advantages result as a percentage part of the citizens' advantages. The developing cycle of the computer science applications oriented to the citizen contains:

- target group definition;
- problem definition for the target group;
- the elaboration of the specification to satisfy the exigencies of the target group;
- the elaboration of a solution to produce economy and satisfaction to the persons in the target group;
- code elaboration that allows the processing and acquisition of different sets of data of the persons without operators;
- the testing for the application to be correct, fast;
- the implementation for the citizen;
- the assistance for citizens and corrective maintenance in real time;
- friendly interfaces making;
- insuring the structure continuity, consecrated interfaces and vocabulary.

Respecting the criteria from above contributes at creating applications oriented towards the citizen.

2. Quality characteristics of applications orientated towards the citizen

Unlike the classic computer science applications in which the owning organization but also the developer accept the quality of a computer science application distributed as being the totality of technical, economical and social features, for the computer science applications orientated towards the citizen, the quality has a new content as these applications are or not good depending on the degree of satisfaction offered to the citizens.

The citizens are not simple users of the computer science application in the meaning that they dictate data to the operators or identification elements and a few variable fields in order to start acquisitions, payments or to perform services (testing, documentation, architecture projects). In the new created context, the citizens introduce data, start selected actions, and start processes.

This is why the computer science applications orientated to the citizen must respect conditions like:

- be easy to understand, the type open and work directly;
- have minimum flows, very few selections until it reaches what it has to solve ;
- maximize the reuse degree for the data.

The technical characteristics of software product are: functionality, reliability, use, efficiency, maintenance and portability.

A software product is **functional** if the transformations it makes lead to the acquisition of results that quantitatively and qualitatively correspond to the product's specifications. The evaluation of the functionality is performed by successive tests of the software product by involving a group of target citizens and by verifying the associated source text and used components.

The **use** appreciates the necessary effort for the use and individual estimation of each use by a target users group. In insuring the usability, an essential role has the citizen's point of view representing the final user and less the developer's point of view.

The **efficiency** refers to the relation between the performance level of the product and the quantity of resources used under settled conditions. A software product is efficient when there is an optimum report between the consumed resources and the complexity of the problem that is solved. The financial effort which the citizen has to bear by using the software product must be correlated with the satisfaction it offers. All the same, the hardware and software resources necessary for using the product must be available for the citizen: medium computers as performance criteria, popular software, no restrictions related to the internet connection speed.

The **reliability** refers to the capacity of the software product to maintain its level of performance under settled conditions for a determined period of time or the probability of apparition of an interruption of the product's execution under the specific using conditions. It is accentuated by the software product's behavior, more precisely, the error tolerance. The estimation of reliability is performed through direct measurement or based on information related to the development of the product. Non-reliability regards the effects the interruption of execution has over the citizen and the volume of compensations which the organization has to offer.

In the old approach the processing of the non-reliability was seen through effects on the level of the application's owner. Now the owner

is serving the citizen. He has profit from the citizen but pays the citizen if he is not content.

The **maintenance** is based on a set of indicators that measure the effort necessary for the specific modifications. A product can be maintained if it offers the possibility of an easy and fast update, having as object the performance of processing functions under superior conditions, as well as the implementation of new processing functions. The computer science orientated towards the citizen imposes a high maintenance in order to respond to the divers requests of modification and adding of services. If the organization does not answer affirmatively in a reasonable period of time, normally in a competition economic environment, the citizen will go straight for competition to solve the problems.

The **portability** is a characteristic that appreciates the software product's capacity to function without modifications on diverse hardware and software platforms. The organization cannot impose the citizen to use a certain hardware/software platform. Still, if it makes it, it must undertake certain negative consequences that arise from the orientation of a part of the target group to other software products that are less restrictive in this meaning.

The social characteristics manifest through effects determined by the product in large collectivities of users through the role it has in solving their requests. These characteristics are reflected in the effort the users depose to get used to the specific working mode of this, but also how much the program responds to expectancies.

The quality of a software product is influenced by the quality of the entering data. The extend to which it responds or not to the citizens' requests cannot be evaluated regardless of the completeness, correctitude of the entering data, redundancy and their comparability.

3. Types of computer science applications orientated towards the citizen

Computer science applications with integrated data bases presume the solving of a problem in which the citizen always supplies his personal number and the owner of the application will access all the databases necessary for solving the problem playing their owners without obliging the citizen to financial efforts.

The old variant: in order to create a bank account, the citizen presents to the bank with a lot of documents and money.
The new variant: the citizen provides his personal number to the bank and says what type of account he wants. The bank accesses the database of the population, the database of the diplomas, the databases of the revenue office, and the databases of the citizen's work place and builds a registry with points and gives him or not an account.
The driver's license application, flow of operations:

I. the citizen introduces his personal number;
II. the software product accesses the databases of population evidence and fills in the registration certificate with the data taken from this database, including the citizen's photo;
III. the citizen verifies the data in the form and if it is correct approves the passing to the next step;
IV. the citizen is proposed a programming to the psychological evaluation;
V. after the positive evaluation, the citizen reenters into the application and reintroduces his personal number to start a programming to the written test;
VI. if he passed the written test, also based on his personal number he will obtain a programming for practical evaluation;
VII. if he passed the previous step, at a new entering into the system he will pay on-line the taxes afferent to the issuance of the driver's license;
VIII. if the payment has been accepted he will receive his driver's license by postal service with receipt confirmation.

The same data is used for distance diagnosis. There are equipments for pulse measurement, blood pressure, public computerized tomography and the data are transmitted to the specialists.

4. Medium and long term strategies

The industrial revolution of past centuries was based on the power of the steam, the physical force of man and money capital. The wealth and power of our century will come with priority from the intangible intellectual resources, from the knowledge capital. The revolution of knowledge and the passing to the economy based on knowledge is a

process that generates changes in all the components of the economic activities.

The profound changes that produce in the economy, companies and management based on knowledge must be reflected in new approaches of the organization's strategy. Thus the knowledge and the organization's capacity to learn become very important.

Therefore, the organization goes on the market with knowledge products and services, in the general context of continue innovation. The strategy on medium term provides:

- the classification of the types of citizens problems;
- priority definition;
- the creation of infrastructure in order to allow the citizens the access the resources of the distributed computer science applications;
- the creation of advantages for the citizen to solve the problems by accessing the distributed computer science applications.

The strategy on long term regards:

- the increase in the diversity of means of purchasing the personal data from citizens;
- the generalization of resources allocation by accessing the distributed applications, like the ones used for tickets reservations;
- the work in regime of subscription, like accountancy application; now every organization has its own software, but in the future there will be a server which will grant the access to the accountancy software, based on a monthly subscription.

There will be eliminated the use in excess of traditional ways of working, paper filling in. All activities will be executed using an accessing card to the services and a password attached to the card.

5. Conclusions

Computer science oriented towards citizen offers solutions for a society based on knowledge. Services and products are bought using applications which control both buyers' identification data and services provider data. Knowledge societies are based on large databases interconnected which assure citizen identification and their access to services.

Passing from the classical computer science to the one oriented towards the citizen is a necessity. It requires new technologies, new metric units,

another endowment degree, very good software products and databases interconnected used to control all data which assure the orientation of the application towards citizen.

Bibliography

[IVAN 02]	Ion Ivan, Adrian Pocovnicu, QSPM – Software pentru managementul calității proiectelor, Informatică Economică, vol. 6, nr. 4, 2002
[IVAN 03]	Ion IVAN, Cristian TOMA – Aplicații informatice orientate către utilizatorii finali, Informatică Economică, vol. 7, nr. 4, 2003
[IVAN 97]	Ivan Ion, Sinioros P., Popescu M., Simion F. – Metrici Software, Editura Inforec, București, 1997
[IVAN 06]	Ion IVAN, Gheorghe NOSCA, Marius POPA – Managementul calității aplicațiilor informatice, Editura ASE, București, 2006
[ROŞCA 06]	Ion Gh. Roşca – Informatică: Societatea Informațională, E-serviciile, Editura Economică, Bucureşti, 2006
[GHILIC 04]	Bogdan Ghilic Micu, Marian Stoica – Organizația virtuală, Editura Economică, Bucureşti, 2004
[GHILIC 01]	Ghilic-Micu B., Stoica M., *e-Activities in Information Society*, Ed. Economică, Bucureşti, 2001

Corruption and Taxation in the New European Union Member States

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ABSTRACT

This paper analyzes tax capacity and tax effort in new European Union member countries and (potential) candidate member countries. In addition, the paper explores the hypotheses of negative relationships between corruption and tax effort and between corruption and foreign direct investments. However likely these hypotheses are, the paper finds only very weak empirical evidence supporting them.

Keywords: corruption, tax effort, foreign direct investments, European Union

1. INTRODUCTION

In December 2002, the European Council closed negotiations with ten candidate member countries. As a result, they joined the European Union on May 1, 2004 and the European Union's membership increased from 15 to 25 countries. Eight of the new member countries are former East Bloc states including three former Soviet Republics (Estonia, Latvia and Lithuania) and five countries in Central and Eastern Europe (Hungary, Poland, Slovenia, Slovakia, and the Czech Republic). The other two countries that joined the European Union are mini-states in the Mediterranean (Cyprus[3] and Malta).

[3] Since Turkey occupied the north of the island in 1974, Cyprus is divided in Turkish Cypriot and Greek Cypriot communities. The Turkish Republic of Northern Cyprus is only recognized by Turkey. Officially, Cyprus joined the European Union as one country. Effectively, however, only the Greek Cypriot community joined.

Accession negotiations with Bulgaria and Romania continued and resulted in their accession on January 1, 2007. In addition, there are three candidate member countries (Croatia, Macedonia and Turkey). Two of them (Croatia and Turkey) have already begun accession negotiations.

2. ACCESSION AND ECONOMIC CONDITIONS

Approximately half of the new member states cope with budget deficits that exceed 3% of GDP (the Maastricht criterion). Figure 1 shows the budget deficits in the period 1991-2007 in the three regions that the European Bank for Reconstruction and Development (EBRD) discerns: Central and Eastern Europe and the Baltic States, South Eastern Europe, and the Commonwealth of Independent States.[4]

In the first years after the collapse of the Soviet Union budget deficits increased to high levels. The highest level was reached in the Commonwealth of Independent States, it was somewhat less high in South Eastern Europe and the relatively lowest level was reached in Central and Eastern Europe and the Baltic States. From the mid-1990s, deficits came more and more under control. Notably, from 2000 a kind of role reversal emerged. Deficits are now at the highest level in Central and Eastern Europe and the Baltic States and at the lowest level in the Commonwealth of Independent. However, the average deficit in the Commonwealth of Independent States is heavily influenced by the large surpluses in oil-rich countries like Russia (8.1% in 2005) and Kazakhstan (5.3% in 2005).

There are also considerable differences in attractiveness of the new member states for foreign investors. Table 1 displays the cumulative inflows of foreign direct investments since the fall of the Berlin Wall in each of the new member states in Central and Eastern Europe and the Baltic States as well as in the candidate member

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[3] Central and Eastern Europe: Czech Republic, Hungary, Poland, Slovakia and Slovenia.
South Eastern Europe: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania and Serbia.
Baltic States: Estonia, Latvia and Lithuania.
Commonwealth of Independent States: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

countries in South Eastern Europe. Given the differences in population size the table does not contain the total amounts of foreign direct investments, but rather the amounts per capita. Obviously, the Czech Republic is the foreign investors' darling. Contrary to Poland's image this country has attracted a mediocre amount of foreign direct investments in the period 1989-2006. On average, Central and Eastern Europe and the Baltic States have attracted $3,030 per capita in the period 1989-2006, which is nearly two times as much as South East Europe's average ($1,658).

3. TAX CAPACITY AND TAX EFFORT

Since most countries in the region cope with continued budget deficits, as Figure 1 illustrates, the question arises as to how these countries can tackle their deficit problems. In principle, governments have a choice between two strategies: increasing revenues or cutting expenditure. It goes without saying that a combination of both strategies is also possible. The question arises on what basis a government can make a choice. In other words, at what point should the emphasis be placed on cutting expenditure rather than raising revenues?

Answering this question involves evaluating a country's tax capacity and tax effort. *Tax capacity* is defined as the ability of a government to raise tax revenues based on structural factors including the level of economic development, the number of "tax handles" available, and the ability of the population to pay taxes (Chelliah, 1971, p. 293). *Tax effort* is defined as a measure of how well a country is using its taxable capacity, that is tax effort is the ratio of actual tax revenues to taxable capacity (Bahl, 1971, p. 582). Indices of tax effort provide a tool for measuring differences between countries in how effectively they are using their potential tax bases. These indices may indicate the appropriate policy for dealing with budget deficits. For example, countries with a high tax effort index may need to look at reducing expenditure rather than raising taxes (Stotsky and WoldeMariam, 1997).

Figure 2 shows general government revenue as a percentage of GDP over the period 1996-2004 in the three regions, while it includes as benchmarks the USA and the EU-15 (the European Union of 15 member states as it existed before May 1, 2004). In Central and Eastern

Europe and the Baltic States, the tax burden is comparable to that of the EU-15 and, thus, well above the level of the USA. In the mid-1990s, South Eastern Europe's tax burden was well below the level of the EU-15 and even lower than the level of the USA, but it increased in the late 1990s. From the turn of the century tax levels in Central and Eastern Europe and the Baltic States and South Eastern Europe are on average within the range of European Union countries, which is roughly 30-55% of GDP (van der Hoek, 2003, p. 22).

In the Commonwealth of Independent States the situation with regard to the tax burden is the reverse. As can be expected, these countries face the greatest taxation problems. They have been under communist rule for over sixty years. The state financed itself through state-owned companies rather than taxation, so the countries in this region have little experience with taxation and markets. No wonder that they are the only of the three regions where the total tax level is clearly below the range of tax burdens in the member states of the European Union.

4. APPROACHES TO TAX CAPACITY

It seems relevant to know how well the new European Union member states are utilizing their tax capacity. Musgrave (2000) identifies three factors that determine a country's taxable capacity:

- The stage of development, often measured by per capita income.
- The existence and extent of "tax handles".
- Efficacy of tax administration.

Each of these factors contributes either to a country's potential taxable base (for example the greater the level of economic development the higher the income tax base) or contributes to the accessibility to that tax base by the government. For example, an economy with a sizeable and established manufacturing sector has more easily identifiable and accessible taxpayers than an economy that is largely agricultural or comprised of many small traders. A well-developed manufacturing sector points to the existence of a "tax handle."

A simple measure of tax effort across countries might compare countries' tax/GDP ratios, but such comparisons would ignore differences in tax capacity across countries. Countries differ with respect to their economic situations, for example per capita income, economic

structure, resources, and other factors. These differences must be accounted for when measuring tax effort. Another approach, therefore, is using regression analysis across countries to predict a country's tax/GDP ratio (Bahl, 1971; Chelliah, 1971; Stotsky and WoldeMariam, 1997; Tait, Gratz, and Eichengreen, 1979; Tanzi 1968; Tanzi, 1992).

A tax effort index can be developed as the ratio of actual tax share to the predicted tax share. An index of 1 means the country's tax effort is at the "expected" level, given the structural factors of that country. In other words, the country is using its taxable capacity at a level consistent with the average of the other countries in the sample. By comparing tax effort across similar countries, it may be possible to identify countries that have the potential to increase tax revenues through increased tax effort. Alternatively, countries may be identified where tax effort is already relatively high and it would be more obvious to closely examine the expenditure side of the budget in order to reduce the budget deficit.

- A study by Mertens (2003) uses a regression approach covering the period 1992-2000 and including data for ten countries in Central and Eastern Europe and South Eastern Europe: Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Macedonia, Poland, Romania, the Slovak Republic, and Slovenia. A very interesting dimension of this study is that it presents a ranking based on each country's deviation between its actual and predicted tax/GDP ratio. Table 2 summarizes the results. The value of –14.9% for Romania in 2000 means that the country's actual revenue share was 14.9 percent lower than that predicted by the model. To my knowledge there are no comparable data available for the "old" member states of the European Union. To obtain them would require a separate research study because they will have to be calculated on the basis of a regression analysis.

The results of the Mertens study suggest that in several Central and Eastern European and South Eastern European countries - especially Bulgaria, Poland, Romania and Slovakia - deficit reduction is possible through increasing tax effort. The European Commission may use this kind of information to assess to what extent these countries prepare themselves for membership of Economic and Monetary Union.

5. FUTURE RESEARCH

The study cited above (Mertens, 2003) points out some possible avenues for further research. Countries in Central and Eastern Europe and South Eastern Europe have had myriad tax law changes as well as major tax reform efforts during the 1990s. Reviewing these events may shed light on what is happening with tax effort in Central and Eastern Europe and South Eastern Europe. For example, Slovenia and Croatia consistently have tax effort indices above one, while both have positive deviations from predicted tax shares for each year. These two countries have many factors in common, including a steady approach to tax reform. Because tax administration is an important component of tax effort, further examination of these relationships is warranted.

However, there is another factor that warrants further examination: corruption. Though it is a phenomenon that is not easy to study, data are available about perceived corruption levels in a large and growing number of countries. Transparency International, a Berlin based institution, publishes an annual Corruption Perceptions Index for a growing number of countries. Table 3 shows the amount of perceived corruption over time in selected countries. In 2006, Finland was perceived as the cleanest country and Haiti as the most corrupt. Table 3 includes new European Union member states (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) as well as two candidate member countries (Croatia and Macedonia). In addition, it includes Russia, several large western countries (Australia, Germany, UK and USA), the two most corrupt "old" European Union member states (Greece and Italy) and a potential candidate member state (Albania).

The low scores for countries in Central and Eastern Europe, the Baltic States and South Eastern Europe – with Estonia and Slovenia as notable exceptions - indicate that doing business in these countries is not only subject to normal business risks, but also to additional risks resulting from corruption. Negative relationships seem plausible between corruption and tax effort on the one hand and corruption and foreign direct investments on the other hand. Corrupt tax inspectors fill their private pockets rather than the public purse, while corrupt officials make foreign direct investments more risky.

However plausible these hypotheses are, I have found only very weak empirical evidence supporting the hypotheses of negative relationships between corruption and tax effort and between corruption and foreign direct investments. Figure 3 displays how the data pertaining to the Corruption Perceptions Index and tax effort were related in 1998/1999. This figure suggests there is no relationship at all. Figure 4 shows how the averages of the data pertaining to the Corruption Perceptions Index in the period 1996-2006 relate to the average foreign direct investments data in the period 1989-2006. This figure suggests there might be some weak relationship between the two variables. Therefore, it seems worth doing more research in this area in future to unravel a possible relationship between foreign direct investments and the extent of corruption.

REFERENCES

[1] Bahl, R.W. (1971). "**A Regression Approach to Tax Effort and Tax Ratio Analysis**," *IMF Staff Papers*, 18(3): 570-612.

[2] Chelliah, R.J. (1971). "**Trends in Taxation in Developing Countries**," *IMF Staff Papers*, 18(2): 254-331.

[3] European Bank for Reconstruction and Development. (Various years). *Annual Transition Report*, London: EBRD.

[4] Mertens, J.B. (2003). "Measuring Tax Effort in Central and Eastern Europe," *Public Finance and Management*, 3(4): 530-563.

[5] Musgrave, R. (2000). "**Tax Reform in Developing Countries**." In: *Public finance in a democratic society. Volume 3. The foundations of taxation and expenditure*, Cheltenham en Northampton: Elgar, pp. 467-490.

[6] Organisation for Economic Co-operation and Development. (2006). *Revenue Statistics 1965-2005*, Paris: OECD.

[7] Stotsky, J.G. en WoldeMariam, A. (1997). *Tax Effort in Sub-Saharan Africa*, Washington: IMF.

[8] Tait, A.A., Gratz, W.L.M. en Eichengreen, B.J. (1979) "International Comparisons of Taxation for Selected Developing Countries, 1972-76," *IMF Staff Papers*, 26(1): 123-156.

[9] Tanzi, V. (1968). "**Comparing International Tax 'Burdens': A Suggested Method**," *Journal of Political Economy*, 76(5): 1078-1084.

[10] Tanzi, V. (1992) "**Structural Factors and Tax Revenue in Developing Countries: A Decade of Evidence**." In: I. Goldin and L.A. Winters (eds.) *Open Economies: Structural Adjustment and Agriculture*, Cambridge, New York en Melbourne: Cambridge University Press.

[11] Transparency International. (Various years). *Corruption Perceptions Index*, Berlin: Transparency International.

van der Hoek, M.P. (2003). "**Tax Harmonization and Competition in the European Union**," *eJournal of Tax Research*, 1(1): 19-36.

STRATEGIES ON SOFTWARE INTEGRATION

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ABSTRACT
The strategy represents in a general way "a well-defined and structured set of fundamental long-term objectives, together with allocated resources and the ways these can be used effectively in accordance with established goals, in order to obtain better competitive results." Software integration is not a new concept as it has been addressed from the moment the companies had no more than two systems and a network connection. The problem of integrating applications at company level has become very important, with direct effects on the work of any economic society. As such, the specialists in the field developed true strategies for addressing and solving the integration of information systems.

Keywords: Integration software, Vertical integration, Horizontal integration, Integration mixed, Business Process Oriented.

1. APPLICATIONS INTEGRATION. GENERAL FEATURES.

Applications integration is a strategic approach to unify multiple systems, both at the level of services and level of data. It offers the opportunity to set up data exchange between systems and reuse business processes in real time. Although it seems to be a purely technological issue, resulting stream of data and processes provide businesses a strategic advantage: the ability to run businesses in real time, in an environment based on events, with low latency, reusing their IT resources in optimal conditions.

Integration of existing applications for different departments or companies can take 3 paths:

a). Vertical integration, including the achievement of adaptative services to connect existing applications and data with other new applications, platforms and services such as Web services.

b). Horizontal integration, which involves the construction of adaptative services to connect together existing applications and data.

c). Mixed integration, involving both the integration of existing applications, as well as some other new applications.

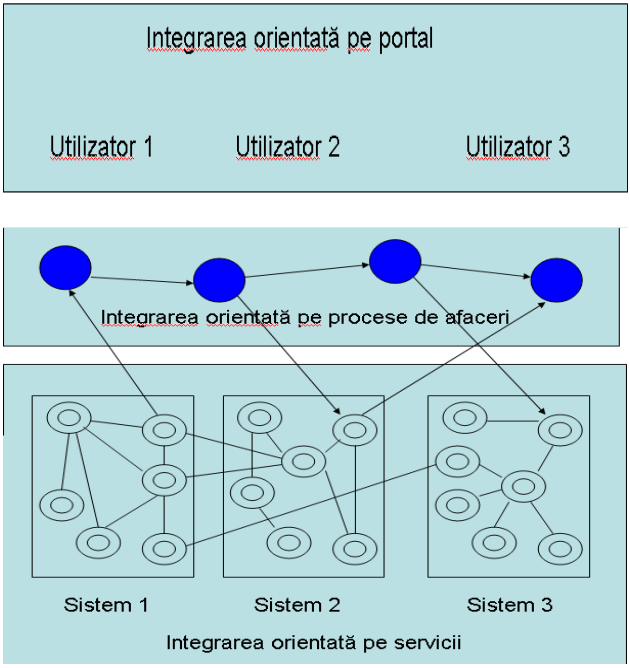
All these techniques need to respond to requests related to the preservation of consistent data, the data visibility and the need to ensure their security.
Among the existing types of applications integration we can find:
• Data integration technologies
• Application integration technologies at organizational level of domestic nature (Enterprise Application Integration)
• Integrated software packages (Enterprise Resource Planning - ERP)
• Business process integration technology of external nature (Business to Business Application Integration).
Although any form of integration uses relatively different technologies, both the integration of intra and inter - companies contain a set of common models.
Today, software integration is a real necessity in order to make possible the data and services integration that are included in the internal systems of companies.
Techniques used in order to integrate applications have evolved from technology-oriented exchange of data, the technology-based services.
Integration-oriented exchange of data (information oriented) provides a simple mechanism for the integration of applications, avoiding the modification of the latter.
Service-oriented integration (service based application integration) approach is not a new way: tools for creating the link between application-level services have been designed and are used for a good period of time (frames, transactions and distributed objects)

The new concept based on web services introduced by Microsoft .NET strategy and supported on J2EE by IBM in the beginning and then by all the significant names of IT industry, means nothing else than defining a system that allows the use of the Internet to provide remote access to the application services through well designed interfaces and an index of available services.

There are many ways to use of this type of integration, because it offers the possibility to create new applications that contain processes and data from several applications.

Service level integration offers long-term strategic advantages, but also presents some disadvantages. One of the disadvantages lies in the need to modify both the applications that must provide services and applications that will use these services.

The following presents the main types of integration



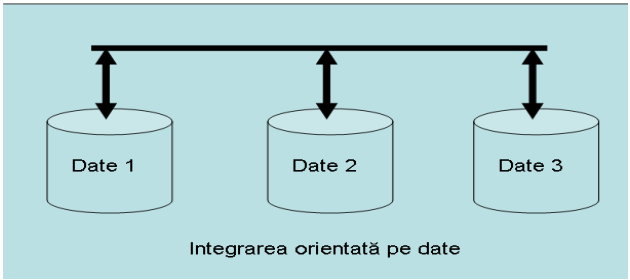


Fig 1 Strategies for integrating applications

Consequently, the data level integration is less costly because it has a reduced impact on applications, but it is also less powerful in terms of reusing the business logic of the company. For the adoption of services oriented integration one can choose " small steps policy", with reduced risks, through publication and use of a growing number of services, thereby enhancing in time a true "service court" of the company.

2. DATA ORIENTED INTEGRATION

Systems integration involves data processing, a process that is based on procedures such as:
- Change in data format
- Rules for replacing the missing values
- Rules to ensure consistent data
- Rules to ensure data integrity
- Methods of filtering and combining data
- Data history
- Algorithms for data aggregation or disaggregation
- Algorithms for getting derived data, etc.

Integration at data level consists of integration at database level, either through data migration from one system to another, either through the creation of common data warehouses to be operated by more systems. Solutions based on data integration can be classified into three categories: data replication, the federalization of data and interface processing.

a). Data replication - consists in duplication of data from two or more databases. Replication is used in the case of spatial distributed enterprises. Data from the central database needed for a specific service

are locally replicated and then the local upgrades are transmitted to the central node. The source and destination database may belong to the same or more producers and can have homogeneous or heterogeneous database management systems with different data models. For data integration were developed middleware solutions that provide replication by installing a software level between two or more databases. The data is extracted from sources and it is entered in the destination database.

Frequent updates of data require a replication server. It may be of different types: many to many, 1 to many, many to 1 or 1 to 1. Depending on the type of network design, replication typology can be: star, circle or hybrid.

Some of these solutions provide services for processing data for normalization of the schemes of the two databases. The advantages of these solutions consist of the ease of implementation and their default low cost. If the requirements of integration issue require both the integration of logic and methods of data processing, then integration solutions based on services have to be adopted.

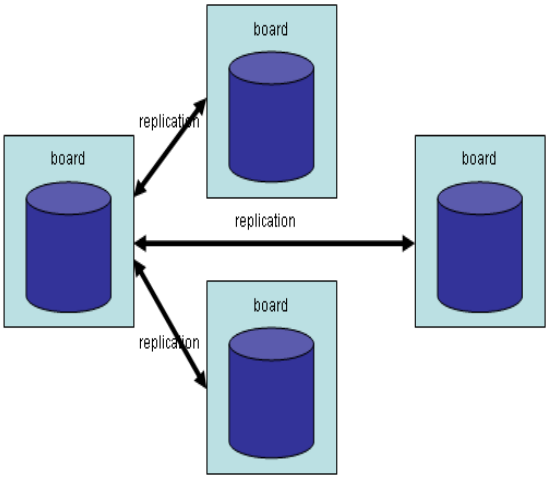


Fig 2 Replication process. Overview

b). Data federalization - consists of the integration of multiple databases and data models into a single unified data view.

Federalization involves development of a middleware level between different physically distributed databases and applications using these databases. This level is connected to the database using available interfaces and achieves an integration at a virtual database of existing databases. The advantage of data federalization is the possibility to group together different types of data in a unified model to support the exchange of data. The advantage of this model consists in the fact that it does not require changes to the source or destination applications. Yet small changes have to be done at application level in order to support federalization software, because each data model has different interfaces.

c). *interface processing* - these are well defined solutions for software packages or client applications integration. The Interest in ERP applications (SAP, PeopleSoft, Oracle applications) made the integration hub sites to support solutions for interface processing providing adapters for application packages integration or client applications. Integration of several types of applications represents the main advantage for this type of integration. It allows two synchronized systems that can use each other's applied logics.
The advantage of the method consists in the fact that in a long-term vision, the products from this category will be able to provide this type of access in an services-oriented vision.

3. INTEGRATION AT APPLICATION LEVEL

Applications integration involves several levels of integration: service-oriented integration, business process - oriented integration and portal - oriented integration.
a). service-oriented integration
Service-oriented integration allows applications to bring to a common denominator the business logic, allowing the exposure of functionality activities. It can integrate applications functionality in two ways: through creating new features that are technologically already available to be used as a services (or as integrated services), or through adopting an infrastructure that allows presentation as services for already existing functionalities.

Service integration is a concept identified in the client-server multi-level architecture (n-tier) or more recent ones, distributed in the form of a set of re-usable software modules. Recently a uniform mechanism for access to these services can be provided. The existence of a set of services, easily accessible, containing business logic, allows reusing of business logic thus considerably reducing the number of redundant services and applications.

Using the infrastructure that allows the use of these services not only applications are integrated with the aim of data integration (information sharing), but it provides the infrastructure for reusing the business logics within cross-company processes (through a business-oriented process .

b*). Business Process Oriented integration*

Business Process Oriented integration is the mechanism for data and processes management in the correct way in order to support the management and implementation of common processes between applications. Business Process Oriented integration provides another layer of easily defined and managed centralized processes, that include within a structured set of subprocesses, processes and data in a lot of company applications. The aim is to bring together the important processes in a company or a number of companies to get the maximum added value, supporting the flow and logic control between these processes. Products from this category use middleware integration and provide easy to use visual interfaces for representation, composition and management of these processes.

In fact, solutions for integrating business processes are a supplemental level added to the existing integration solutions like: server integration, applications server, distributed objects and middleware levels. Integration based on business processes provide a tool to link separate processes and to develop process to process solutions. Business Process Oriented integration is a strategy, but at the same time a technology that increases the ability of companies to interact with different applications, integrating complete business processes, both inside and outside the company.

c). *Portal oriented integration*

Portal oriented integration allows viewing several systems, both internal and external, through a single user interface. It adapts the

interface of each system to a common user interface (UI aggregate) which is very often a web browser.
As a result, all participating systems are integrated through the browser, even if the applications are not directly integrated inside or outside the enterprise. If other types of integration manage real time information exchange or by joining a model of joint processes and systems between companies, Portal oriented integration is trying to present data from a variety of systems through a single application or user interface. For these reasons this approach is not always considered as a strategy for integrating applications.

4. CONCLUSIONS

With the increasing number of applications that needed to be integrated, as well as cost and time of execution and maintenance, the implication of specialists in this field have been intensified, generating new techniques and technologies. Thus integration brokers appeared, developed as hub-spoke systems where the broker product represents the core and the spokes are applications that need to be integrated. Integration brokers have been developed including various models of communication and components such as: Business Process Management - BSM, work flow diagrams, support for Web services. They allow interaction with users outside the system. XML stood up as a standard for integration, allowing communication of data between heterogeneous databases and ensuring an integrated management of documents and processes, integration with existing applications and management of storage of XML files.

5. REFERENCES

[1] Luis Camarinha-Matos *"***Virtual enterprises and collaborative networks**", Ed Springer, ISBN 1402081383,2004
[2] Cornelia Paulina Botezatu, Cezar Botezatu,
George Căruțaşu, "**Virtual enterprise information system Requirements***",* Electronic copy of this paper is available at: http://ssrn.com/abstract=931110
[3] http://www.apache.org

[4] http://www.gridcomputing.com
[5] http://www.oracle.com

STANDARDS IN CONTROL AND PROTECTION TEHNOLOGY FOR ELECTRIC POWER SYSTEMS

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The features of the standard IEC 16850 with respect to intelligent applications in substations are summarized. It is shown how modeling of functions independently from its allocation to devices allows optimizing existing applications and opening up for future intelligent applications. The data model provides all information in a substation needed not only for control and protection functions but also about the IEDs and the switchgear configuration.

1. Overview

The task of protection and control in substations and in power grids is the provision of all technical means and facilities necessary for the optimal supervision, protection, control and management of all system components and equipment in high and medium-voltage power systems.

The task of the control system begins with the position of the HV circuit-breaker and ends in complex systems for substation automation, network and load management as well as for failure- and time based maintenance. For all of these functions the data acquisition at the switch yard and – if applicable – the command execution at the switch yard are part of the network control and management.

Figure 1 provides an overview of the functions and subsystems that make up the control technology in the context of electric power transmission and distribution. The purpose of these secondary systems is to acquire information directly at the high- and medium-voltage apparatus in the substations and to allow their safe on-site operation, including the secure power supply of all their parts.

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Modern automation technology provides all the means necessary for processing and compressing information at the actual switchgear locations in order to simplify and secure normal routine operation. This allows more efficient use of existing equipment and quick localization and disconnection of faults in case of troubles, thereby also reducing the load on the communication links and in the network control centers.

Protection devices are required to safeguard the expensive power equipment and transmission lines against overloads and damages. Therefore, they have to switch off very quickly short circuits and earth faults and to isolate very selectively the faulted or endangered parts in the power system. They are thus a major factor in ensuring the stability of the power system.

The purpose of the power system control as a subdivision of power system management is to secure the transmission and distribution of power in the more and more complex power systems by providing each control centre with a continually updated and user friendly overall picture of the entire network.

All important information is transmitted via communication links from the substations to the control centre, where it is instantly evaluated and corrective actions are taken.

The growing amount of data acquired, the increasing communication bandwidth and the performance and memory capacity of modern computers have resulted in replacement of conventional mosaic panels for direct process control by computer based control systems with screens video based displays. In a few cases, conventional mimic panels are still kept for power grid overview.

Load management is directly influencing the system load, e.g. with the help of ripple control communication via power network. It is selectively disconnecting and reconnecting consumers or consumers groups. On the basis of actual and forecasted load figures it is possible to level out load curves, to make better usage of available power resources, or to buy or sell energy on the market.

Due the increase of automation functions, the more complex protection concepts and the least partial integration of the protection into the control systems, the overall system of control, monitoring and protection functions is called substation automation system. The terms ‘digital’ and ‘numerical’ apply for all microprocessor based devices with identical meaning.

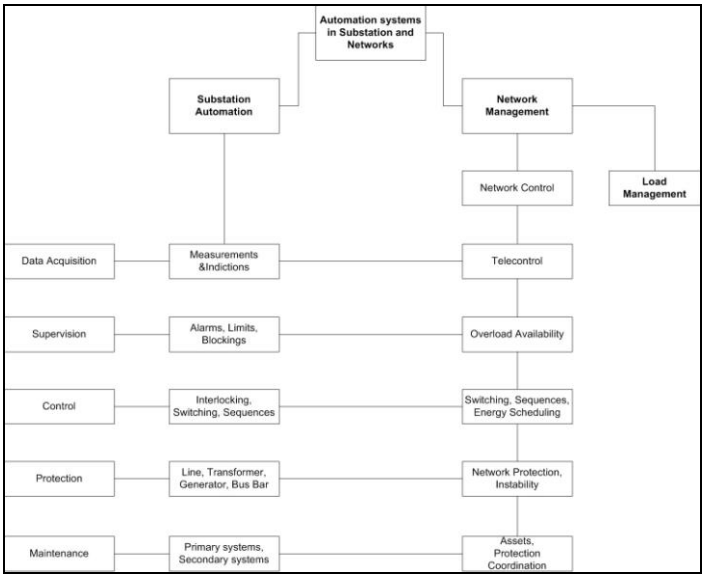

FIGURE 1. FUNCTIONS AND SUBSYSTEMS OF AUTOMATION IN SUBSTATIONS AND NETWORKS

2. Protection

Various protection devices in power systems with rated voltages > 1kV are available to protect generators, transformers, cables, busbars and consumers. The purpose of these devices is to detect faults and to switch off and isolate these selectively and quickly from the network as a whole so that the consequences of the fault are limited as much as possible. With today's high fault current levels and highly integrated networks, faults have far-reaching consequences, both direct (damaged equipment) and indirect (loss of production). Protection relays must therefore act very fast with the greatest possible reliability and availability, however also very selectively, to not switch off parts where it is not needed…

Relays can be divided into various categories.

A basic distinction with respect to function is made between switching (contactor) relays and measuring relays.

The relays used for protection purposes, together with supervisory relays, fall into the category of measuring relays and appeared according to their technology first as electromechanical and later as solid-state measuring relays. Today new protection relays are nearly exclusively numerical relays, i.e. based on software running in microprocessors. Therefore, more and more the term protective device is used instead of protection relay. More precisely, there are protection functions which are implemented in devices singly or in combination with other functions. Protection functions supervise dedicated values of the power system or of its components and respond very quickly and selectively if critical limits are exceeded.

There are also protective devices for direct current (DC), but in the context of this paper, only the protection of circuits with alternating current (AC) is described. Important for measurements in multi-phase systems, common is the three-phase system, is that values may be single-phase or three-phase related. In addition, the sinusoidal voltages and currents are shifted against each other by the so-called phase angle. The sinusoidal values may be also represented as rotating phasors with amplitude and angle facilitating a lot of protection algorithms.

Nearly all protective devices are today integrated in some kind of systems requesting information like start and trip events from the protection function(s) and providing access to these e.g. for changing parameter sets. Numerical relays provide often also disturbance recording and, therefore, disturbance recorder file transfer over a serial link. All this information has to be exchanged over the so-called station bus according to IEC 61850 or one of the older proprietary protocols.

At the output of protective devices, there are switching relays which open e.g. the circuit breaker by closing the trip circuit. These relays act normally also as galvanic separation between power system equipment (primary technology) and the substation automation system including protection (secondary system). It is important that the output (trip) relays are able to switch the applied high currents and to not stick together. Because of their importance for the protection function, they are supervised in most cases.

An alternative not commonly used up to day are electronic components like thyristors for switching the trip circuit.

If not only the values from the instrument transformers but also the trip commands are transmitted serially via the so-called process bus to some

breaker electronics integrated e.g. in the drive, then no such switching relays exist anymore. Supported by the communication standard IEC 61850 such solutions will dominate the future, especially since they allow also transmitting current and voltage samples both from non-conventional and conventional instrument transformers.

2.1. Advantages of numeric relays

The numerical relays mentioned above with up-to-date microprocessors (μP) provide a lot of important benefits:

Analog variables are digitized (A/D conversion) at the input card of the device and preprocessed if applicable. The trip decision is made in the microprocessor and, therefore, allows considering any complex conditions needed by the protection function. The resulting protection is much more adaptive regarding the power system conditions as any previous protection technology.

Parameters determining the behavior of the protective device are loaded and changed from outside via communication interface. Also dynamically self-adapting protection is feasible.

Several protection functions can be combined in a single device and executed in parallel (multi-functional devices). Functions from build-in libraries may be activated or downloaded from external libraries.

Numerical devices have a continuous self-supervision. Details depend on implementation.

Configuration and setting of the devices may be done over communication interface either locally by a laptop or from the remote workplace of the protection engineer. Consistency and plausibility checks support this work.

Opto-coupler inputs allow the potential-free input of external signals.

Serial interfaces support both the integration into substation automation systems andthe connection of properly equipped process devices like instrument transformers and switchgear. A manual or automatic transmission of events and disturbance recorder files is possible. The standard for all this serial communication is IEC 61850.

In substation automation systems all events and alarms may be displayed in dedicated lists at the screen of the operator, and archived for later analysis.

Events and disturbance recorder files may be transmitted to a remote, centralized workplace for a comprehensive fault analysis.
Storage facilities for events and disturbance files allow to buffer data so that these are not lost in case of a communication interrupt. They provide also the transmission of data on request only.
Besides protection functions the same numerical device or devices out of the same device family allow performing also control and monitoring functions. In most distribution substations, a single device comprises already all protection and control functions needed in one bay.

3. Control, measurement and regulation (secondary systems)

Secondary systems are all those facilities needed to ensure reliable operation of the primary system, e.g. of the HV substation. They cover the functions of controlling, interlocking, signaling, monitoring, measuring, counting, recording and protecting. The power for these auxiliary functions is taken from batteries, so that they continue to work also in the event of network faults. Whereas in the past conventional techniques were used for decentralized control, e.g. from a local panel, this can now be done using computer based substation control techniques, often called ‘substation automation’, with or without protection.
The interface that this necessitates, is moving ever closer to the process, i.e. to the primary system. How near this interface can be brought to the process depends, forexample, on how practical and reliable it is to convert from electromechanical methods to electronic (numerical) techniques, or whether the information to be transmitted can be provided by the process in a form which can be directly processed by the electronics. The communication standard IEC 61850 even defines a serial interface to the process, which provides sampled analog values of voltage and current from the instrument transformers or sensors.
Today, overall network management is undertaken by computer-assisted systems based at regional or supra-regional control centers and load-dispatching stations. The conventional means to connect these to the substation is via remote terminal units (RTU). If however a computer based substation automation system exists, the RTU can be reduced to a protocol converter to the SA system. The trend to use the IEC61850 up to the network control can reduce this even further to a data filtering and concentrating unit.

3.1. Microprocessor and conventional secondary systems compared

With conventional secondary systems, the various functions are performed by separate devices (discrete components) which mostly work on hardwired and analogue principles and represent different technologies.

The resulting situation is as follows:

- Each task is performed by devices using different technologies (electromechanical, electronic, solid-state or microprocessor-based).
- These discrete devices may require many different auxiliary voltages and power supply concepts.
- The connections between the devices and with the switchgear require a great deal of wiring or cabling and means of matching.
- The data from the switchyard equipment has to be supplied several times, i.e. dedicated for the inputs of protection, control, interlocking etc., making the supervision of interfaces difficult .
- Checking the performance of the individual devices is accompanied by complex verification of the overall performance.

With the new automation technology for substations, the focus is on the system and its function as a whole.

Numerical methods are employed for process-near functions using programmable modules based on microprocessors.

The distinguishing features of the new automation technology are:

- Use of the same microprocessor-based platform for the implementation of all functions, either single or in many combinations.
- Standardized power supply and common supply concept facilitating the system layout.
- Serial data transfer (bus technique) minimizing wiring.
- Fiber optic cables are used in the substation reducing the cost of established adequate electromagnetic compatibility.
- Multiple use of the data from the switchgear.
- Self-diagnosis with continuous function check reducing the periodic testing of overall system and subsystems.
- No dedicated effort for recording events in the correct time order with a resolution of about 1 ms.
- Reduced space requirements.

Another major innovation of the new approach is the screen based human-machine interface (HMI). While the access interface to

conventional secondary technology is focused on switch or mimic control panels with switches, buttons, lamps and analogue instrumentation, access to the new automation systems is usually given by a display at bay level and by screen-based operator places all with a keyboard and a mouse. This is valid both for the station level in the substation and the network control level. Operation is mostly application near and menu-guided, no programming or ccomputer skills are necessary.

3.2. IEC 61850 – the communication standard within electrical substations

Each new substation automation system should use IEC 61850 – mentioned already many times above - as its communication protocol. This only globally recognized communication standard is based on Ethernet, allows direct communication between any of the connected devices, and supports communication within the system hierarchy levels as well as between the hierarchy levels, as well as process near applications. To guarantee real time performance, classical Ethernet busses have not to be used, but only switched Ethernet networks. Further the priority handling and VLAN features as defined in the Ethernet standard have to be supported by the switches. For availability reasons the networks are mostly ring based instead of tree based. The point – point connection between devices can be electrical for short distances within a screened environment, otherwise optical as described already above.

IEC 61850 offers much more than just a communication protocol to connect devices of different manufacturers. Its uniform data model with standardized semantics and the standardized description of substation automation configurations including their functional connection to the switchyard (Substation Configuration description Language) supports uniform maintenance of all secondary devices, provides long life time of engineering data within a system configuration, supports the exchange of engineering data between the engineering tools of different manufacturers, und reduces the effort for engineering and maintenance.

Because of its flexibility and comprehensive features there are further standardization efforts going on to use IEC 61850 also for communication to the network control centre and between protection

devices in different substations. Data model extensions for hydro power plants and distributed energy resources are in work also.

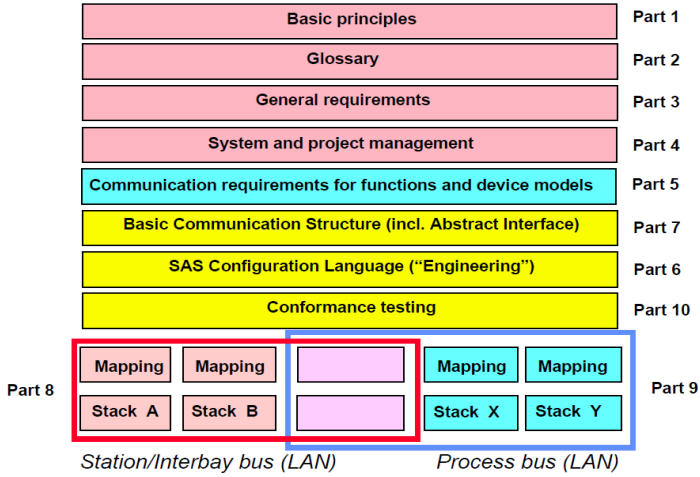

FIGURE 2.STRUCTURE OF THE STANDARD IEC61850 "COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS" [6]

3.3. IEC 61850 Substation Model

At the "process" layer, data from Optical/Electronic Voltage and Current sensors as well as status information will be collected and digitized by the Merging Units (MUs). MUs could be physically located either in the field or in the control house. Data from the MUs will be collected through redundant 100MB fiber optic Ethernet connections. The collection points will be redundant Ethernet switches with 1GB internal data buses and 1GB uplinks that support Ethernet priority and Ethernet Virtual LAN (VLAN). VLAN allows the Ethernet switch to deliver datasets to only those switch ports/IEDs that have subscribed to the data. In migrating to Process Bus implementations, manufacturers will need to provide the ability to integrate data from existing CTs and PTs with the data from the newer Optical/Electronic sensors. A redundant synchronization clock architecture will also have to be addressed. In this architecture, upon detection of failure of Clock 1,

Clock 2 will have to automatically come on line and continue providing sampling synchronization.

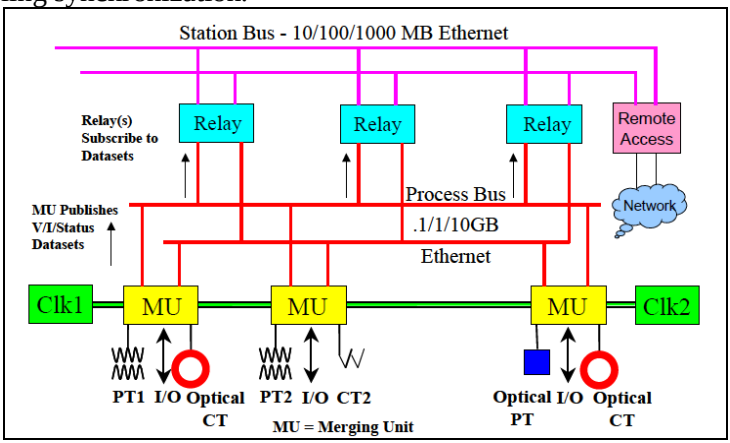

FIGURE 3. IEC SUBSTATION MODEL

At the substation level, a Station Bus will exist. Again, this bus will be based today on 10MB Ethernet with a clear migration path to 100MB Ethernet. The Station Bus will provide primary communications between the various Logical Nodes, which provide the various station protection, control, monitoring, and logging functions. Communications will operate on either a connection oriented basis (e.g. – request of information, configuration, etc.) or a connection-less basis (IEC Generic Object Oriented Substation Event - GOOSE). Again, a redundant communication architecture is recommended as application of IED to IED data transmission puts the communication system on the critical path in case of a failure.

Finally, this architecture supports remote network access for all types of data reads and writes. As all communication is network enabled, multiple remote “clients” will desire access the wide variety of available information. Typical clients would include local HMI, operations, maintenance, engineering, and planning. The remote access point is one logical location to implement security functions such as encryption and authentication. This implementation un-burdens the individual IEDs from performing encryption on internal data transfers but still provide security on all external transactions.

3.4. Conclusions

IEC 61850 is now released to the industry. This standard addresses most of the issues that migration to the digital worls entails, especially, standardization of data names, creation of a comprehensive set of services, implementation over standard protocols and hardware, and definition of a process bus. Multi-vendor interoperability has been demonstrated and compliance certification processes are being established. Discussions are underway to utilize IEC61850 as the substation to control center communication protocol. IEC61850 will become the protocol of choice as the utilities migrate to network solutions for the substations and beyond.

REFERENCES

[1] Mihoc, D, Iliescu, St. S, Făgărăşan Ioana, Automatizarea sistemelor electro- si termoenergetice, Editura Printech, Bucureşti, 2008

[2] Mihoc D, Făgărăşan Ioana, Onița Calotă, Protecții prin relee, Editura Printech, Bucureşti, 2007

[3] ***, ABB Switchgear Manual 11th revised Edition, Edited by Hennig Gremmel for ABB AG, Mannheim, 2006

[4] Brand K-P, Lohmann V, Wimmer W., Substation Automation Handbook, Utility Automation Consulting Lohmann, Bremgarten, UAC 2003, (www.uac.ch)

[5] Brand K-P, The Standard IEC 61850 as Prerequisite for Intellingent Applications in Substations, Power Engineering Society General Meeting, 2004. IEEE Volume , Issue , 6-10 June 2004 Page(s): 714 - 718 Vol.1(http://ieeexplore.ieee.org/iel5/9451/30010/01372909.pdf)

[6] Andersson L, K-P Brand, The Benefits of the Coming Standard IEC 61850 for Communication in Substation, Southern African Power System Protection Conference,2002

[7] Grimoni J A B, Lopes V J S, Nakao O S, Using LabVIEW in a Mini Power System Model Allowing Remote Access and New Implementations, International Conference on Engineering and Education 2007, (http://icee2007.dei.uc.pt/proceedings/papers/278.pdf)

[8] Le Kim Hung, Thach Le Khiem, De Mesmaeker I, The Advantage of Standard IEC61850 in Protection and Substation Automation Systems, International Symposium on Electrical & Electronics Engineering, HCM City, Vietnam,2007

[9] IEEE PES-PSRC WG I16 Report, Understanding Microprocessor-Based Tehnology Applied to Relaying, 2004
[10] Mason, C. Russel, The Art and Science of Protective Relaying, (http://www.geindustrial.com/pm/notes/artsci/index.htm)
[11] Drew Baigent, Adamiak M, Mackiewicz R, IEC 61850 Communication Networks and Systems In Substations: An Overview for Users
[12] G. Brunello, Microprocessor-based relays - an enabler to Scada integration, Electricity Today, Issue 4, 2003, page 10-1, disponibil la http://www.electricity-today.com/et/issue0403/microproc_based_relays.pdf
[13] Costianu D, Fagarasan Ioana, Iliescu S, Evoluția sistemelor de protecție a instalațiilor energetice. Avantajele noului protocol de comunicație IEC 61850, Sesiunea de Comunicări Ştiinţifice Studenţeşti – Mai 2008

System Requirements Analysis for e-learning systems using grid

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Abstract: Until recent years network-based education and grid technologies were two distinct areas. But e-learning systems have been increasingly addressing learning resources sharing (text, images, video, on-line data, etc.) and reuse, interoperability and other more different modes of interactions. E-learning systems consist of complex activities and most of them have been designed based on client-server or peer to peer, and recently web services architecture. These systems have major drawback because of their limitations in scalability, availability, distribution of computing power and storage systems, as well as sharing information between users that contribute to these systems. In this context the use of grid technology reveals its utility and availability, as scalable, flexible coordinated and secure resource sharing among geographically distributed individuals or institutions, in the perspective of e-learning.

Key-words: networked-based, education, grid technologies, e-learning systems,resouce sharing, interoperability, standardisation.

1. Introduction

This paper presents a system's approach aimed at establishing an arhitecture for e-learning systems based on a grid technology. Adoption of GRID technology for e-learning is possible only through analysis of the components of the e-learning system and how they fit to common GRID properties.

Initially a simplified and idealized description of an e-learning model of the system will be discussed. From the user point of view it contains some material presentation of components, typically html pages with

different contents, followed by the task or activity to be performed by learner, tutor or administrator. That could be, for instance, interactive simulation program, assessment test, or any reality based learning application.

From application design perspective, as it is intended to be used on a grid, we assumed that both web page and activity software are realized as interconnected Learning Objects (LO) supplied with metadata headers according to the standards. LO may reside on different servers, moreover, activity could be executed on the particular server on which the LO is stored or on another server.

In the following sections a system requirement analysis will be presented based on e-learning system characteristics and grid technology characteristics. In conclusion the advantages and disadvantages of the proposed architecture will be argued.

2. Current Approaches

In order to make a state-of-art analysis on e-learning systems, an empirical analysis could be done by analysing the features, tools and potentialities provided by differnt systems.

Several solutions to support e-learning was analysed. Most of them are content-centered neglecting some important educational issues.

From the comparison of commercial and freeware/open-source platforms the conclusion indicates that the commercial ones have more difficulty integrating with other systems and supporting different kinds of pedagogies and of course in terms of costs.

Some strong points and weaknesses have been found. The strong points are related to the communication tools, administrative and management tools, compliance with standards implementation level and documentation or possibility of hierarchical organization. On the other hand the weaknesses are linked to resource management & portability, adaptability and personalization, quality of resources, development of new components, diversity of pedagogies and applications and costs, especially for comercial plataforms.

These weaknesses are mainly traced to problems regarding interoperability, reusability and quality of resources, learning domain independence, extensibility of the platforms, and meeting some of our goals already presented. In order to solve these problems a proper system requirements analysis will be proposed.

3. System Requirements Analysis

Experience in recent decades indicades that a properly functioning and competitive systems could not be reached without application of systems life cycle engineering and analysis (Figure 1). The life cycle begins with the identification of a need and extends through conceptual and preliminary design, detailed design and development, production and/or construction, product utilisation, phase-out and disposal.

Design within the system life cycle is different from design in the ordinary sense. Life-cycle focused design is simultaneously responsive to customer needs and to life-cycle outcomes. Design should not only transform a need into a product/system configuration but should ensure the design's compatibility with related physical and functional requirements.

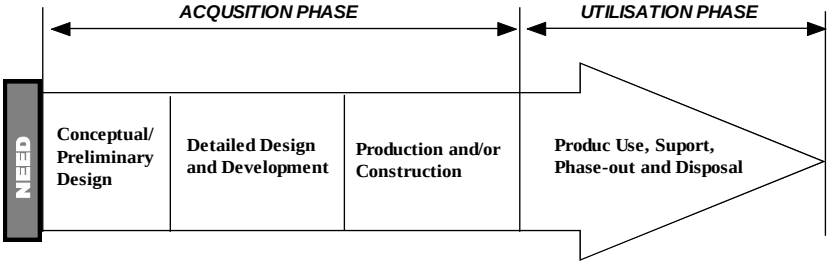

Figure 1. The product/system life cycle

The conceptual is the first and the most important phase of the system design and development process. The major objective in conceptual design of the system is the system requirements definition (Figure 2) of the process and it suppose the next subprocesses: problem definition and identification of need; requirements analysis; operational requirements; maintenenace and support concepts; evaluation of feasible technology applications; selection of technical approach; functional definition of the system.

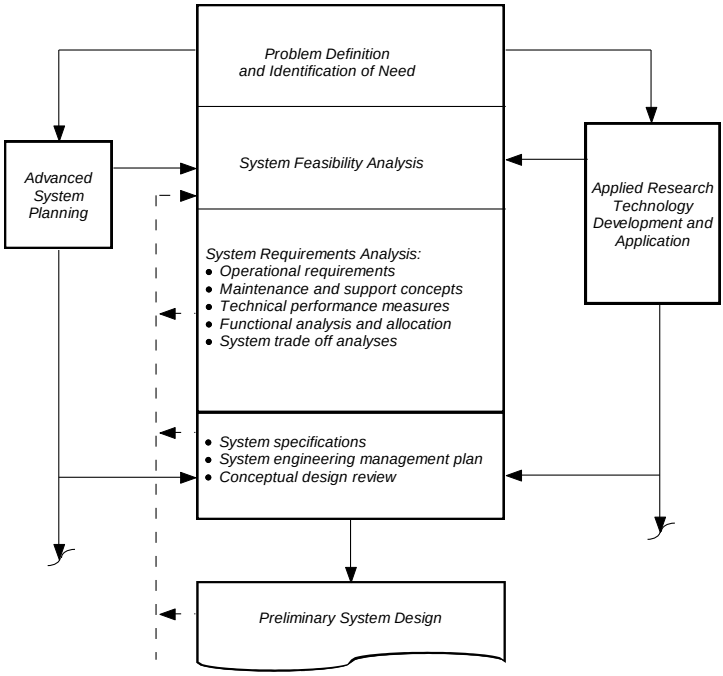

Figure 2. Major steps in the system requirements definition process

The phase of system requirments and design analysis could be based on the already existing international standards and specifications that have been developed in order to structure content and information on e-learning systems in order to promote interoperability between systems and to obtain a greater quality of teaching.

The most technological educational standards and specifications are more focused on the course design and structuring all the processes of teaching/learning. IMS Specifications [2], AICC [3], SCORM [1] and DublinCore [5] was analysed [13]

Standards like Sharable Content Object Reference Model (SCORM) [1], a project from Advanced Distributed Learning (ADL), that becomes more of a standard integrator than a standard by itself, what makes it dependent of the other standards it integrates, and it doesn't consider the evaluation and characterization of students. Another specification, the IMS, is used as a guide for structuring contents, developed by the

IMS consortium that began its activity with the definition of specifications for instructional structure, to become the standard it is today. It bases its metadata specification on the IEEE LOM [8] standard and includes specifications to structure the learning process, the learning objects and their metadata, to design units of learning and courses, to evaluate and characterize the users, among others, storing them in XML files [4].

The main objective of these specifications is to be as general as possible, so they can be applied to any process of teaching/ learning [9][13].

The use of a standard, helps to achieve more stable systems, reduces the development and maintenance time, allows backward compatibility and validation, increases search engine success, among many other advantages.

From this analysis it could be verified that the IMS specifications covers the most of the technical aspects needed to developed good e-learning systems.

The use of online learning content must allow three identities to interact with one another and with the learning content (Figure 3). **Authors** must be able to *build* online learning content. **Administrators** *manage* and distribute content and **Learners** *interact* with and learn from the content inside the LMS (Learning Management System).

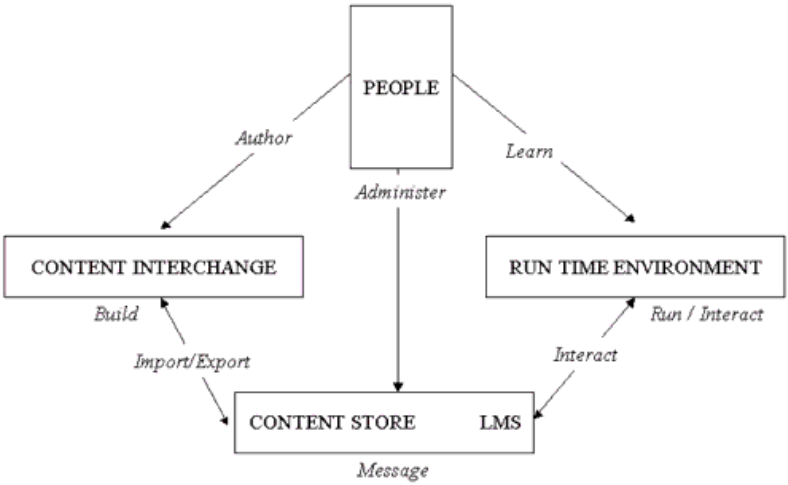

Figure 3. Content framework goals

The complete, identified scope of the content framework is large and complex. To reduce the complexity and decrease the amount of time needed to complete a first specification, the scope was broken down into three, main parts: Content Packaging, Data Model, and Run Time Environment. Each of these topics requires additional explanation and each is described in more detail in the following figure 4.

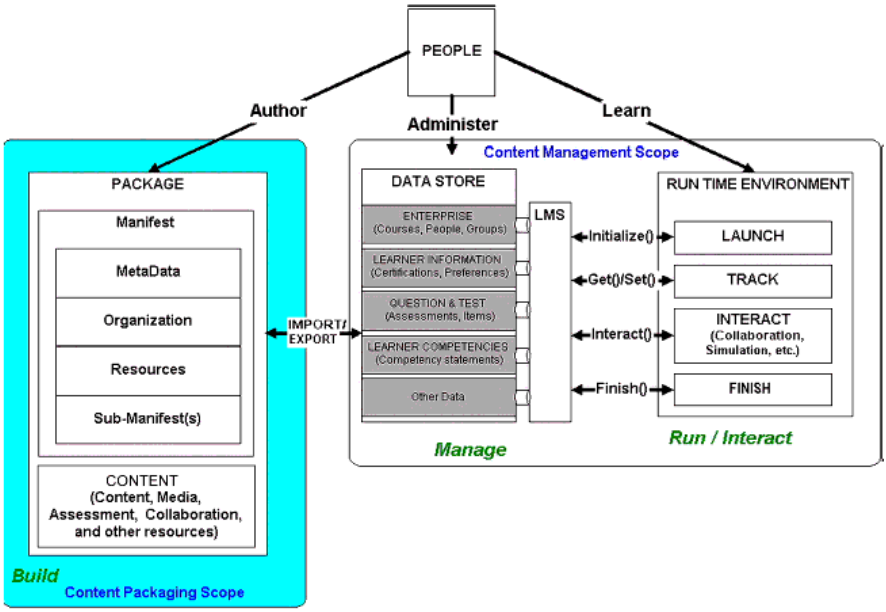

Figure 4. Content framework

Content Packaging represents the section that deals with the issues of content resource aggregation, course organization, and meta-data. The data model represents that portion of the Content framework where content is imported, stored, managed, and manipulated for instructional purposes. The definition of specification of data models first depends on LMS vendors and computer platform vendors.

The run time environment portion of the Content framework represents the point where learners will interact with the content presented to them. One of the key requirements for this portion of the specification is the identification of standard mechanisms to enable communication between a run time environment and an LMS.

4. Grid infrastructure

Grid infrastructures support the sharing and coordinated use of resources in dynamic global heterogeneous distributed environments. These include resources that can manage computers, data, telecommunication, network facilities, and software applications provided by different organizations [6]. A Grid is a collection of distributed computing resources available over a local- or wide-area network that appears to an end user or application as one large virtual computing system.

Grid computing is a service-oriented architectural approach that uses open standards to enable distributed computing over the Internet, a private network or both, providing high performance computing and large storage capacity. This approach can help academic organizations and universities aggregate disparate IT elements such as computational resources, data storage, devices, instrumentations and sensors, and filing systems to create a single, unified system and address fluctuating workload requirements.

5. Conclusion

At its core, grid computing enables devices—regardless of their operating characteristics—to be virtually shared, managed and accessed across an enterprise, consortium or workgroup. Although the physical resources that compose a grid may reside in multiple locations, users have seamless and uninterrupted access to these resources. This resource virtualization provides the necessary access, data and processing power to rapidly solve complex business problems on demand for research. Grid computing helps to promote the efficient utilization of technology resources and foster the creation of cost-effective, resilient IT infrastructures that are adaptable to change.

Actually, these implementations provide grid services delivered according to rather strict QoS requirements [14]. More challenges arise, such as resource management among different Grids, varying resource usage across Grids, different security policies, resource reservation and co-allocation by research communities in peered Grids, and, formation and management of virtual organisation (VO) in the InterGrid.

Reference:

1. ADL: Sharable Content Object Reference Model (SCORM)® 2004 3rd Edition – Overview Version 1.0. Advanced Distributed Learning (2006)
2. ADL SCORM Metadata Generator, http://www.adlnet.org (2005)
3. AICC, Aviation Industry CBT Committee, http://www.aicc.org (2005)
4. Bray, T., Paoli, J., and Sperberg-MacQueen, C.M.: Extensible Markup Languaje (XML) 1.0, 3rd Edition, W3C Recommendation (2004)
5. Dublin Core Metadata Initiative, http://dublincore.org (2005)4. Bray, T., Paoli, J., and Sperberg-MacQueen, C.M.: Extensible Markup Languaje (XML) 1.0, 3rd Edition, W3C Recommendation (2004)
6. F. Berman, G. Fox, and T. Hey, *Grid Computing-Making the Global Infrastructure a*
Reality, John Wiley and Sons Ltd., New York, 2002, pp. 9-49.
8. IEEE LTSC Working Group 12: Draft Standard for Learning Object Metadata. Institute of Electrical and Electronics Engineers, Inc. (2002)
9. IMS Specifications, IMS Global Learning Consortium, Inc. http://www.imsglobal.org/specifications.html (2005).
13. Totkov, G., Krusteva, C., Baltadzhiev, N.: About the Standardization and the Interoperability of E-Learning Resources. CompSysTech'2004 - International Conference on Computer Systems and Technologies (2004)
14. L. Ferreira, F. Lucchese, T. Yasuda, C.Y Lee, C.A Queiroz, E. Minetto, A. Mungioli, *Grid Computing in Research and Education*, IBM Redbooks, 2005.

VIRTUAL EDUCATION

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ABSTRACT

The internet economy is strongly connected with its developing modalities. A society desiring to be developed must be initially educated, in order to understand the benefits of the new modality of social integration. The practical finality of the "e" phenomenon in the educational field is the application of an eLearning system**.**

In order to have a society being able to adapt itself to the forms that have been developed by introducing the new technologies, and especially the Internet, you must educate it. The costs are quite high at the beginning, but the effort worth it. It is well known that any learning process must have a practical finality. Virtual education is a concept which requires being debated for a long time, before being taken over or transformed according to your own principles or possibilities. Distance education is not a new phenomenon in the educational field, representing a modality of teaching and learning known and practiced for at least one hundred years. Distance education comprises several types of education: by correspondence, radio, television, and internet. The internet economy is strongly connected with its developing modalities. A society desiring to be developed must be initially educated, in order to understand the benefits of the new modality of social integration. The practical finality of the "e-" phenomenon in the educational field is the application of an eLearning system**.**

That is particularly why the Internet also developed its own form of organized education: e-Learning. E-learning as an educational model requires students to engage with information presented via a computer at a location convenient to them. In comparison with traditional ways of

learning, little social interaction is possible and learning becomes a solitary experience. This is at odds with the type of working life met with in the construction industry. The new economy concentrates wealth creation on finance, knowledge and social capital. The type of working environment experienced is changing into one where interaction with others, in the form of collaborative projects, is one of the most important aspects. Production is invariably pooled, often across continents, using a varied team of people and there is less emphasis on the individual. The social intelligence needed for this type of activity arises as a natural consequence of an interactive contact teaching model, used together with modern technology, but it is more difficult to enable students to gain these skills when e-learning is used as the major delivery method. The specific particularities of e-learning technologies bring new dimensions in education, which can be complementary or alternative compared to the traditional methods in the field of education. These particularities offer the possibility to organize online education according to subjects or themes, while the traditional education is organized according to age groups/classes. E-learning is included within a new paradigm at the educational level, characterized by: fluidity of roles, curriculum orientated towards the needs of the person learning the distributed resources, virtual facilities and asynchronous lessons.

In this context, the applications of IT in the educational system represent a dynamic, fully extended field, a main point of interest both for schools and the commercial societies that are active on the education market. Although, up to a certain acceptable extend, the hardware and communication infrastructure exists, as far as high-schools are concerned, the usage of the new IT is under expectancy, people's implication to a more superior level being necessary.

The process of teaching – learning – examination acquires new dimensions and characteristics by using the e-learning technologies. The educational system in our country is directly and decisively involved in the substantiation and construction of the informational society. In limited sense, e-learning represents a type of distance education, as a planned teaching – learning experience organized by an institution which provides by mediation materials in a sequential and logical order to be assimilated by students in their own way. The mediation is performed by means of

new information and communication technologies – especially via Internet. The Internet represents both the medium of distribution of the materials, and also the communication channel between the involved actors. Functionally, for the time being, only at the level of higher education and in adults' education, the training system via Internet adapts the components of the traditional didactic method / face – to – face: planning, specific content and methods, interaction, support and evaluation. E-Learning type portals are real data storages that allow the interconnection of various types of activities in order to obtain automation and render efficiency to the decisional process. Distributed learning allows the performance of an educational process of the highest quality, substantiated by a modern education and having a great perspective, personalized depending on the individual needs that are becoming more and more exigent and complex.

Another important modification that the Internet produced is the making of a new ecosystem, in which the learning process is more and more accomplished in real time, the working spaces becoming less and less important. Thus the learning process must align to the advanced technologies, to the purposes of the organizations and institutions and to the concept of sustained development. The advantages of education via Internet are multiple: the necessity of storage spaces, the numerous personnel is eliminated, the dispatches costs are considerably reduced, there is a flexible system for each student in the sense that the student has the possibility to choose the parts to be printed and those to remain in electronic format, the dispatch in time of the material to the student – the student can access as many times as he wants, whenever and wherever the material is required, integration of some variety of learning media: text, graphics, static and animated image, sound, short films, access to materials from other hundred thousands sources, some of them by means of directs links from the origin site, integration of the connections with the tutors and with other students, by means of the web site. Thus, defined more as e-education, the semantic area of the e-learning concept interferes with and is superposed variably indefinitely upon a multitude of terms rendering the variety of the didactic experiences that can beneficiate of technological support: computer – assisted / mediated training or digital / mobile / online learning / education (digital / mobile / online education / assignment), multimedia training etc. Under the name

of didactic / educational software, a large scale of electronic materials (on digital / multimedia support) are developed in order to simplify the process of education: maps, dictionaries, encyclopedias, didactic films, presentations in various formats, books (e-books), tests, tutorials, simulations, software that forms abilities, software of practicing, didactic games, etc. The computer and the electronic / multimedia materials are used as teaching, learning, evaluation support or as communication mean (in order to accomplish certain individual tasks etc.). By comparison with the traditional education, few advantages of distance education via Internet may be pointed out: first, all the resources representing the object of the course may be accessible all the time and much more easier, the purpose of the curriculum will be more comprehensive than the current one, the curriculum offering multiple modalities for acquisitions of the highest level in all the fields of the culture, the audience is significantly increased, the distance education being able to include also students which can not attend the courses of the traditional system, the access to the local, regional and national networks connects the students from different social, cultural, economic environments and with various experiences, the learning in a personal rhythm, in a personal style is facilitated, it is possible to read or attend the courses gradually and repeatedly, the computers incorporate various soft packages that are extremely flexible, the student having maximum control of the content information, the synchronous and asynchronous interactions between the teacher and the students can be complementary. An important corollary here would be the possibility of forming a team teaching in order to transmit the knowledge to a certain domain and to involve in activities some trainers who are not currently available from different reasons. Among the difficulties faced upon implementation, which can be considered also limits of the virtual education system, please note:

- High costs of system development, including expenses with: technology (hard and soft), sending the information in the network, equipment maintenance, production of the necessary materials.
- Difficulty to sustain a consistent and permanent effort of the students, teachers, mediators providing technical support and of the administrative personnel to the system implementation.
- The need of the experience of the students in the field of computers. Maintenance of the student’s own computer will be probably one of the current responsibilities.

- The students must be extremely motivated for participation. School abandonment phenomenon is much more frequent in distance education than within the traditional education, the established inter-relations being relatively impersonal, making the option much easier for the student.
- The relative "dehumanization" of the courses up to the development of some optimum strategies of interaction and the focus especially on the student and not on the system.

But the experience of the systems that are already functional assures us of the fact that the participants to the education by means of the new technologies will familiarize themselves shortly with the virtual environment and enter relatively soon the natural rhythm of transmission and, respectively, of knowledge acquisition. During the previous presentation we noticed that the distance instruction medium has as main particularities the available resources and contact modalities between tutor and student or between students. These particularities require that both the trainers (tutors and course authors) and the students develop specific competences, namely: of communication in writing and of possessing the transmission means of the information used in the program. Graphic, textual expression is a complex phenomenon, less approached. As emission and interception process, the textual communication is subject to the same succession of preparing, elaboration, adaptation – and then interpretation - techniques of the "materials" forming the message body. But, each separate technique is more or less different, to the extent in which the graphic (respectively visual) appearance of the oral (respectively acoustic) phenomena message in communicating the same message are different. In support of the idea that the emission process is more complex that a simple articulation and the interception is more than the simple perception of certain stimuli, researchers in the psycho-linguistic field emphasize that the message is materially constructed, so that it also carries the signification, therefore the receiver also receives the productive germs of the sense. The expression initially supposes, in the pre-locutor phase, of its organization, the analysis of an ensemble – psychical content that will be found an adequate form of expression. This global, syncretic fact will have to be decomposed, analyzed and then ordered organized in its sequential expression, by resorting to the language tools (that help to operate

cuttings rather standardized, intelligible from the social point of view). Then the synthesis must be performed by choosing the necessary components and their organized grouping within a whole that will form the message. The expression, the exterior, sequential enunciation requires the choosing of the most adequate signs material in order to translate fully and intelligibly the transmitted content. The visual communication can combine the verbal stimuli with non-verbal expression modalities – iconic signs or representation index means, and at this level of analysis intervene the issues connected to the adequate decoding of the communicated content, especially when the iconicity degree, the quantity of "realism" of the representation decreases. This is why the interception represents an attempt to recreate the signification intended by the emitter, process that, in the didactic activity of transmission-acquisition of knowledge, must be provided and attentively conducted by the authors of courses and textbooks. The trainer's efficiency is strongly connected with the capacity of using all the possible interaction forms in the context of distance learning and, correlatively, with the possession of the particular technological means involved.

According to the standards generally accepted by the international scientific community from the virtual education field, **virtual education** is represented by the interaction between the teaching/learning process and the informational technologies. At the world level substantial investments are made in the training programs of the teachers in the field. The internet has already become a subject of study in many educational institutions (because of very complex technologies which involves it), but also the bibliographic and imagistic source for the presentation of the lessons or making the homework. In the commercial field an entire strategy of public education is developed in order to attract the clients by a promotion as attractive as possible of the offered services and products. Thus, there are available on the Internet guides and other types of electronic publications, promotional materials, sections of answers to the questions frequently asked by the clients, lists of discussions of subjects. There are mass-media commercial corporations providing on the Internet free training courses in various fields. Also, culture institutions are placing free courses on different sites specialized in popularizing the modern methods of education. It is obvious that the traditional education will never loose the prerogative of direct dialogue between teacher and

students, creating therefore an optimum environment for modeling the personality, maintaining the competition spirit at higher levels, but also the mutual psychological support. The internet provides, however, new opportunities of training, to which there is no need to grant exclusivity. The traditional academic institutions acquired or designed their own e-learning system, accessible not only to the students enrolled within the sections of distance learning but also to the students enrolled within full-time courses. The internet becomes, in this way, more and more striking, an auxiliary of the educative process of any field. Both managers and employees must understand that the use of hypermedia technologies is a striking characteristic of all e-learning systems. The intuitive impression and the plus of attractiveness conferred by web sites are irreplaceable. Lately, there is an accent placed more and more on the selection of open-source multimedia technologies (free source) because of the very wide public to whom the educational materials are destined. The accessibility is a major request of everything that is published on the Web, and the use of any proprietary technology limits from the start the number of beneficiaries. This is one of the major reasons for which the multimedia specialists developed languages of opened multimedia technologies. XHTML and SMIL languages are two of these technologies useful in developing the e-learning sites. XHTML and SMIL languages are adopted by many educational sites first of all for its accessibility. XHML needs the popular navigator Internet Explorer, and SMIL – as standard recommended by the Web Consortium – enjoys the attention of many implementers offering free players as for example RealPlayer. The collectives of some research centers adopted SMIL language in order to carry out the research reports under the form of multimedia presentations available on the Web. Among the facilities provided by the two languages in order to create some attractive materials in the educative field – and not only – please note: making of slide-shows; conceiving computer- assisted courses integrating voice, images, animation or other multimedia content; the presentation on an electronic trade Web site, together with the name of the products offered for sale, of their photos or video-clips, dynamically appearing on the screen simultaneously with an appropriate voice presentation; temporization of the presentations so that the slides be sequentially presented at specific periods of time, changing different properties when they become focused; the placement on the screen of some control elements by means of which musical or video

pieces are able to be launched or stopped; development of the TV on demand or TV Web; creation of conceptual art or info-entertainment.

REFERENCES

[1]. Stiglitz J., **„Information and the Change of the Paradigm in Economics”**, The American Economist, 2003

[2]. Massy J., **„When absorptive capacity meets institution and (e) learners: adopting, diffusing and exploiting e-learning in organization”**, Brussels, 2004

[3]. Roşca I.Gh. , Ţăpuş N., Cristea V., Athanasiu I, Năstase F., **„Internet and intranet: concepts and aplicații”**, Economic Publishing House, 2000

Features Concerning Competitive Performance Measurement

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ABSTRACT: Innovation and competitiveness are the main vectors of social-economic progress of every country. Starting from this general context and considering the particular context wherein Romania is, which strongly impose the growth of economic competitiveness for realize the convergence to EU countries, in this item we propose to put in evidence the kinds of competitive performance measurement. For this, we'll study from economic development point, competitiveness index contained in Global Competitiveness Report of World Economy Forum (WEF). We'll also comparatively show features linked to the index elaborated by the Institute of Management Development (IMD) in Global Competitiveness Report.

Keywords: competitiveness, innovation, creativity, competitiveness indices

1. INTRODUCTION

Many politicians make clear remarks about national competitiveness. Such remarks aren't new. What is new, is intensity and spread, response to globalization, fast economic change, economic distance decay and liberalization spread.

The view over competitiveness brought to a large industry, aiming to politicians, analysts and enterprising men. It has a different output, varying from studies of productivity or cost to specific activities and institutional analysis from national strategy documents, group studies and so on. Its well-known product is however, competitiveness index, a composed indicator that classifies the countries in rapport to selected criteria and measuring national competitive courage.

While competitiveness indices have become essential in political speeches from many developed countries, there is surprisingly less known about the foundation of their economies, how sturdy they are relied on theory and they are build in practice. Academy economists mostly ignored competitiveness "industry" and disclaimed its output: the products of the schools of businesses relied on weak or inexistent economic foundations.

Every competitiveness index must start from a measure of national competitiveness performance (variable depending on analysis) bordered by activities which imply the competition with other countries. Bordering of activities in this kind isn't easy.

Numerous economic activities clearly imply competition between nations (such as tradable industry activities, agriculture or service' ones). Others are indirectly fit in competition as inputs in trade activities (for example, parts of infrastructure, of financial or transport services, or the price of a terrain) but there is difficult to separate the relevant elements for competitiveness.

Even others don't trouble trade activities' competitiveness too (as home helping, shareholders, entertainment staff, or restorers) though ones, troubling life quality, can influence the place of investments which trouble the competitiveness.

However the theory suggests that a competitiveness index must make the difference between relevant activities and those irrelevant, this is very difficult in practice. No easy solution shows them while the aim is to measure national competitiveness as a whole.

2. COMPETITIVENESS INDICES

In the followings, we'll study, from the perspective of economic development, competitiveness index contained in Global Competitiveness Report of World Economy Forum (WEF). We'll also comparatively show features linked to the index elaborated by the Institute of Management Development (IMD) in Global Competitiveness Report. WEF Report is published by an outstanding academic press organism (Oxford University Press) and smoothed by prominent academicians from Harward: Jeffrey Sachs and Michael Porter. IMD Report wholly remains a product of business school and doesn't stay as a claim of academic consideration.

The last WEF report contains two competitiveness indices:

- Current Competitiveness Index (CCI)
- Growth Competitiveness Index (GCI)

For ease the analysis we'll base on this set of indices which make clear range differences between countries. The difference between the two indices is as how it follows: CCI "aims to identify the factors which are on the base of productivity and hence current economic performance, measured by GDP per inhabitant" and GCI "desires to measure the factors which contribute to the further growth of an economy measured by the change rate of GDP per inhabitant".
Income level, in WEF model, depends on capital reserves (including human capital) and on "current technology level". This growth depends on the additions to capital and technology reserves.

Current Competitiveness Index (CCI)

CCI is WEF measure of microeconomic base of the competitiveness between countries. It consists of two components:

- Microeconomic business environment quality
- Complexity wherewith companies or subsidiaries relied on international competition.

Both are relied on Porter's work (1990) about national competitive advantage, the former deriving from his famous `diamond of competitiveness".
Business environment quality measures the quality of firm inputs gained from outside while strategy complexity measures internal variable within firms.
There are 64 variables making up CCI on which 49 comprise the business environment and 15, company operations and strategy.
There are two sets of (connected) problems with the calculation of CCI. The first set is about the measures used to capture the determinants

supposed to determine current competitiveness. The second relates to its underlying analytical framework. .

Economic model based on CCI. The main product per capita of the big nations is proportional to the size of capital per inhabitant:

$$y = A * k$$

where:

A – represents technology level added with a simple number which measures average productivity of a capital unit.

k – the dimension of national capital per inhabitant.

Income level is then determined by capital size and technology level. WEF largely defines "capital stock" and "technology level". Unlike physical capital pushed into equipments, buildings and physical infrastructure, capital stock includes education level, manpower's skills and attitudes and managers' skillfulness.

Also, parts of the "capital" stock within an economy, are interventions set and the practices of regulation government activities. Social capital (bigger trusting levels and the presence of networks) also contribute to the quality of the reserves of cluster of capital. Technology includes not only technological knowledge pushed into scientific and technical institutions of a nation but also firm-based technology. Technology is put in every activity that a firm operates like strategies that firms use for concur.

Therefore, technologies can be also viewed as a stock of: knowledge, capacities, institute and company strategies.

When it is for calculate CCI, however WEF doesn't use measures stocks for physical, human, technological or strategic capital. While there are well-known inherent problems for quantifying such stocks for countries, several attempts were made for win them.

There are evaluations of the stock of physical capital for several countries and they are largely used for productivity and growth analysis. There are also evaluations of human capital stock and R&D stocks (though data belong only to some developed countries).

Therefore there is no way to measure the stocks of "technological capacities" in all firms from an economy. There is even difficult to conceive what "stocks" of social capital, linked systems or regulation practices (i.e. government politic having effect over the businesses) can

have sense in quantitative terms or how enterprise practices can be aggregated in a national "stock" of business strategy.
This doesn't impeach WEF to classify the countries in rapport with the 64 variables for microeconomic competitiveness. All these fluxes except one (for patents) are better relied on quality in business viewing then on strong data. The measures are those interesting.
For instance, physical capital is approximated by a variable set for "availability of capital" on its turn, based on qualitative measures of "financial market complexity", "access to market stock", "availability of risk capital" and of other the like. None of this says anything about capital stock. WEF doesn't use even available data at current investment rates. It is a measure of investment rate but this appears in its turn, with other 21 variables in a "financial index" which is a determinant of GCI.
Therefore, there is unusual that "capital availability" catches better the differences between countries in the investment skill or considers human capital other critical determinant of competitiveness. This is caught in CCI by qualitative response to two questions: if "local public schools are of high quality" and "business schools are locally available". As a flux of measures, these are a transfiguration of the literature linked to human capital.

2.1. Growth Competitiveness Index (GCI)

There are three subindices making up GCI: the economic creativity index, the finance index and the international index.

1. **the economic creativity index** consists of variables for current technological effort and technology imports;

2. **The finance index** has variables for financial market sophistication and accessibility, interest rates, financial supervision and so on. The current state of the capital market;

3. **The international index** measures import barriers exchange rate alignment and volatility and capital account liberalization.

Economic creativity index (ECI) is a new entrant to the WEF stable of indices. But the attempt to measure innovation under a separate index was in fact introduced in 1999, when it was called the "Capacity for Innovation" (CAP). However, CAP did not form part of the final competitiveness index in 1999. In the following year, WEF replaced CAP by the (very different) ECI, which plays a prominent role in GCI.

The premises of this index were that patents were a good indicator of innovative capacity and that domestic innovative capacity was the most important technological variable in competitiveness.

Both premises are questionable. Patents are only a rough proxy for commercially relevant innovation, and do not capture the minor, incremental technological effort that accounts for the bulk of productivity increase in most economies. Domestic innovation is a misleading indicator of competitive (technological) capabilities because it ignores the inflow and use of foreign innovation. Technology diffuses today with growing rapidity, especially within multinational corporations setting up integrated production systems spanning the world.

This does not mean that local technological capabilities are irrelevant since the ability to use new technologies efficiently entails significant technological effort. But such effort may not generally result in patentable (i.e. frontier) technologies. R&D expenditures perhaps together with stocks of technical manpower would be better indicators of competitive technological capability. But the innovation index uses R&D as an explanatory rather than dependent variable in the analysis of innovative capacity.

Apart from R&D spending, the innovation index used the following independent variables: per capita income, R&D staff, economic "openness", strength of intellectual property regimes, share in GDP of secondary and tertiary education spending, share of R&D funded by industry and the share funded by universities.

The rationale for some of these variables and the causal links between them are difficult to understand. For instance, the use of per capita GDP as an explanatory variable for innovation is strange. The causation is normally taken by the other way around; in some cases, incomes are highly correlated with all technological and skill measures. Variables such R&D staff, R7D spending and skills are also highly intercorrelated. The obvious problems that arise from multiple

regression analysis are ignored the coefficients yielded by multiple regressions are used to assign wrights to the variables in the index.
The share of total R7D funded by private industry is supposed to measure the strength of local “innovation clusters” while the share of university R&D is meant to measure the strength of linkage between research and industry.
Both are strange measures. The share of business-financed R&D has nothing to do with its geographical or industrial clustering. The share of university-funded R&D has little to do with how closely universities link with industry in technology creation. In most countries, the governments largely determine R&D budgets. In developing countries, a high share of R&D emanating from universities may actually indicate low links between academia and industry. The measure of skills ((the share of GDP spent on secondary and tertiary education) does not reflect the availability of skilled manpower: enrollment or graduation rates at higher levels, particularly of technical staff, would be better indicators.
Both qualitative and patent measures if innovation ability, are positively related to incomes (and so to competitiveness). While the correlations with income are wholly expected, the causal link with competitiveness is tenuous. It is not clear that frontier innovation is a good measure of relevant technological effort in “follower” countries in the developing and even developed world. The appropriate variable would be a combination of technology import and technological effort. WEF ignores this problem and proceeds to generalize about links between frontier innovation and incomes.

3. CONCLUSIONS

National competitiveness has taken a hold on the government and corporate imagination though professional economists tend to be skeptical of the concept and its applications. Economists are also skeptical of attempts to quantify competitiveness. Here the skepticism seems more justified, though there is a strong case for constructing indices that reliably and objectively benchmark national performance. While many institutions make such indices, the task is more difficult than may appear.

Our examination of the WEF index shows that it suffers from several analytical, methodological and quantitative weakness. Moreover, its presentation conceals these weaknesses, giving a misleading impression of precision, robustness and sophistication. At the general level, the WEF index has two problems. The first is its underlying assumption that markets are efficient and that policy intervention, where necessary, must be "market friendly".

This removes from consideration a large, important set of issues, particularly in developing countries, where market failures call for selective responses. The assumption of efficient markets also goes against its stress on innovation, which is prone to many market failures.

The second is that its broad definition "competitiveness" diverts it from its legitimate focus on direct competition between countries, taking it into areas where competitiveness analysis is both unwarranted and has little analytical advantage**.**

The strong point of WEF analysis is its emphasis on the micro-economy as the vital determinant of competitive performance. WEF is correct that getting the macroeconomic situation right, while necessary, cannot by itself lead to sustained growth in countries with serious structural deficiencies.

Many development economists have argued that the economic structure has to be changed and improved and that the classic Washington consensus is inadequate to this task. Many have also argued that there is a large and positive role for government in doing this – by improving markets, remedying market failures and strengthening institutions.

How interventionist the government should be, remains controversial, but it is wrong to assume, as the WEF apparently does, that the case against targeted policies is firmly established. The weaknesses of these approaches are epitomized by its trite conclusions on how least developed countries can cope with globalization.

REFERENCES

[1]. Caragea A., Gheorghiu R, Țurlea G. (2003), *„Economia bazată pe cunoaştere"*, Academia Română, Proiectul prioritar „Societatea informațională – Societatea cunoaşterii".

[2]. Centrul InfoEuropa.

Accesat la: http://www.infoeuropa.ro/
[3]. CIP, Competitivity and Innovation Programme. Accesat la: http://ec.europa.eu/enterprise/enterprise_policy/cip/index_en.htm
[4]. CIP, ICT Policy Support Programme. http://ec.europa.eu/enterprise/enterprise_policy/cip/index_en.htm
[5]. Commision of the European Communities 2006, *Information Society Benchmarking Report*. Accesat la: http://europa.eu.int/information_society/eeurope/i2010/docs/benchmarking/051222%20Final%
[6]. Dascălu, D. (2001), *„Ştiinţa în Societatea Informaţională - Societatea Cunoaşterii”*.
Accesat la:
http://www.racai.ro/INFOSOC-Project/Dascalu_st_d01_new.pdf
[7]. Drăgănescu, M. (2001), „*Societatea informaţională şi a cunoaşterii. Vectorii societăţii cunoaşterii”*. Accesat la: http://www.edemocratie.ro/publicatii/Soc%20info%20si%20a%20cunoasterii%20-%20vectorii%20cunoasterii.pdf
[8]. Drucker Peter. F. (1985), *Innovation and Entrepreneurship*, Harper and Row, New York
[9]. European Commission. Accesat la: http://ec.europa.eu/index_en.htm
[10]. OECD (1997), Oslo Manual
[11]. OECD (2002), The Measurement of Scientific and Technological Activities, Proposed Standard Practise for Surveys on Research and Experimental Development, Frascati Manual
[12]. Peter Doyle, (1998), *Marketing, Management and Strategy*, Prentice Hall Europe
[13]. Reding, V. 2005, „*ICT and the challenges of convergence*”, European Information Technology Observatory
[14]. Utterback J. M., (1986), *Innovation and Corporate Strategy*, International Journal of Technology Management, vol. 1

Dematerialized Monies – New Means of Payment

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ABSTRACT: In this paper, we will outline the financial context in which the main means of payment dematerialization occurs. We will present the main characteristics of these new types of dematerialized monies: electronic money, virtual money, digital money, private money, purses and holders.

Keywords: means of payment, dematerialized monies: electronic, virtual, digital, private, purses and holders.

1. INTRODUCTION

The first dematerialized currencies have appeared in the 1980s, due to an increased use of prepaid cards in telephony. We can perceive three types of dematerialized money: electronic money, virtual money and digital money.

The economic value of electronic money is measured in classical economic units (fiduciary) which must be stored in an electronic device accessible by the consumer. They represent actually scriptural money under binary form which is stored on a smartcard or on another portable device. The status of the issuer and the traceability of the transactions gives the scriptural character of the electronic monies. One can buy new units of payment either with classical money or through a bank account. The transactions are limited to the merchants who support them. Because electronic money does not represent legal tender or have

discharging power, many experts consider that they do not have a straight existence.

Virtual money does not have tangible modes of payment, this being the main difference in respect to electronic money. Virtual monies are stored in software programs which allow transactions to be carried out on open network like the Internet. Virtual money can be regarded as a reference to a bank account. The status of the issuer and the traceability of the transactions give the scriptural character of the virtual money. In some cases virtual money can be also represented by virtual tokens or jetons, which are accepted only in a restricted commercial circuit. The jetons are issued only by trusted services providers and are tied with their banking accounts. A special case is when virtual money are issued by telephone companies under the form of prepaid cards whose value is meant for the payment of the company's services. In the future, telephone companies may have an intermediary role in e-commerce especially in the case of micropayments because they have developed to handle efficiently small payments and for settling accounts. In order for this to happen, a transition from 'virtual purse' to 'electronic purse' must take place so that the value stored in the prepaid card be recognized as a new universal type mean of payment. Another problem would be their regulation by the financial authorities.

In the case of digital money the value is stored under the form of algorithms on a hard disk, in a smartcard or in the memory of the user's computer and each piece is identified by an individual serial number. In order to achieve an efficient dematerialization of money, digital money must have a monetary sign, an authentic economic discharging power that will be accepted by most economic agents, the exchanging of values taking place over a network in real time by means of coded digital coins and their clearance and settlement may be achieved in real or non-real time. After having being verified their authentication, against a centralized or distributed authentication database, the digital money can be exchanged in physical money at different banks. Digital money allow a complete anonymous transaction by separating the payment from the user's identity, but it also has a major drawback, that of creating new universal monies, which are independent from current monetary system. For this reason, digital money has had a lot of technical an legal obstacles. An international digital currency would perturb existing economy and interfere with regional and local

currencies. Delicate problems regarding national sovereignty could make their implementation almost impossible to achieve.

2. ELECTRONIC PURSES

An electronic purse consists of a rechargeable multipurpose prepaid card which can be used either for face-to-face payments or for retailing ones. Electronic purses are actually a substitute for other types of money. They represent portable electronic stores containing a precharged value, containing the funds owned by the cardholder. One of the most important security aspects of the electronic purses is that they are impossible to fake. Their use depends on legal regulations and on the identity of the issuer. In order for banking networks to be considered 'opened', the electronic money has to correspond to a legal currency. This is the reason why a purse which has been issued by a non-bank can only contain jetons and can only be used in restricted circles. Jeton holders are designed for use in certain closed situations just like private means of payments (prepaid telephone cards), which can be used to pay for telecommunication services. The banks find these electronic purses very appealing as they allow for a reduction of the transaction's cost and can even replace classical coins, notes and cheques when small amounts are involved. Electronic purses have proved their usefulness in both face-to-face commerce and when making payments using automatic machines. Traditional payment cards are not suited to face-to-face commerce and miocropayments because the cost of the transaction may exceed the actual amount.

Characteristic	Electronic Purse	Electronic Jeton Holder
Expression of purchasing power	Legal tender	Consumption unit
Unit of payment	Universal: can settle any payment in a defined territory	Specific to transactions involving the issuer
Guarantor of purchasing power	Bank	Service provider
Charging of value	By a bank or its agent	Unregulated
Circuit of financial services	Open	Closed

Figure 1. Comparison between electronic purses and electronic jeton holders.

An interesting approach would be the use of both electronic purses and jeton holders in a multipurpose card. In Figure 1 you can see the main financial and legal differences between electronic purses and electronic jeton holders.

3. VIRTUAL PURSES

One can see a virtual purse as a precharged account with units of legal money and stored at a non-bank entity. The client can access online the virtual purse using special software installed on a personal computer. Services providers open more subaccounts in their banks and inside their own accounts. The clients or the merchants subscribe to one of these subaccounts. Because the stored value is physically intangible, the purse is "virtual", but its payment units represent legal tender. The virtual purse is linked to the subaccount and it contains the purchasing power of the client. All clients have a copy of the balance on their personal computer and specific files that are used in cryptographic algorithms necessary for security reasons. Even in the case of a computer failure the assets of the clients are protected. The virtual purse of the client is debited while the merchant's one is credited with the value of the transaction minus the commission which goes to the operator. The transaction's cost in the case of micropayments is greatly diminguished by the grouping of payments before the clearing.

4. THE PROPERTIES OF TRANSACTIONS WHICH USE DEMATERIALIZED CURRENCIES

All the transactions which use dematerialized currencies must respect several properties:

1. Atomicity: in order to have consequences a transaction has to complete all its states. If this doesn't happen, the previous transaction's state has to be restored.
2. Consistency: the critical aspect of the exchange must be accepted by all parties involved in the transaction.
3. Isolation: there mustn't be any interference among transactions.
4. Durability: if a breakdown do occurs, the system must return to its previous state.

5. Anonymity: revealing the buyer's identity is not mandatory when settling the obligations. On the other hand, personalization supposes that the identity of the buyer is known in order to be able to customize the offer.

6. Non-traceability: besides anonymity, this property means that one shouldn't be able to link two payments made by the same person.

Transactional properties of different means of payment is depicted in figure 2.

Property	Cash	Cheques	Credit transfer	Direct debit
Atomicity	Yes	Yes	Yes	Yes
Consistency	Yes	Yes	Yes	Yes
Isolation	Yes	No	Yes	Yes
Durability	Yes	Yes	Yes	Yes
Anonymity	Yes	No	No	No
Traceability	No	Yes	Yes	Yes
Property	**Debit card**	**Credit card**	**Electronic purse**	**Virtual purse**
Atomicity	Yes	No	Yes	Yes
Consistency	Yes	Yes	Yes	Yes
Isolation	Yes	Yes	Yes	Yes
Durability	Yes	Yes	Yes	Yes
Anonymity	No	No	Maybe	Maybe
Traceability	Yes	Yes	Maybe	Maybe

Figure 2. Transactional properties of different means of payment.

Because there are a lot of payment instruments, not all of them are suited to all the applications. This is an aspect which must be considered carefully when implementing new payment instruments in different societies. In order to obtain cash, cheques are used very often and in order to recharge a checking account cash is most often used. In contrast, besides cash, an electronic purse can be recharged from a checking account and even through a bank card, but the monies can't be discharged in any of this forms. In figure 3 we present the money flow

between an electronic purse and other means of payment.

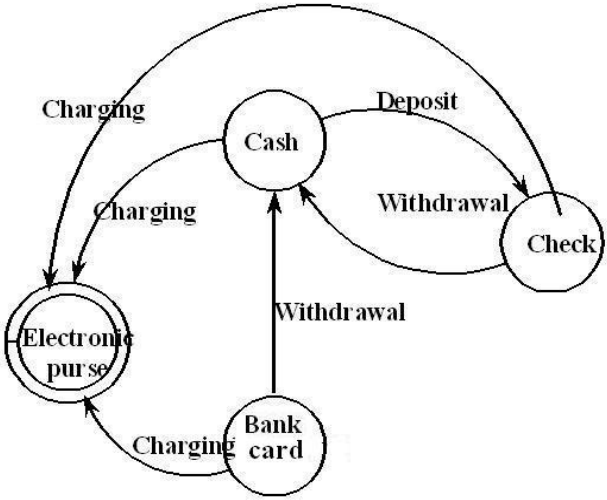

Figure 3. Monetary flow among payment instruments.

The various means of payments have different domains where they can be used. Cash is usually used in face-to-face payments, cheques are used in all cases of payments: face-to-face, remote and business-to-business, credit transfer is used in remote payment and business to business, while direct debit and interbank transfer are suited only in remote payments. Bank card can be used both in business to business and face-to-face payments but a card reader is required in this case.

Type of Money	Nature of Money	Support (the container)	Value Store
Fiduciary	Concrete, material	Paper, piece of metal	Safe, wallet, purse
Scriptural	Immaterial (maintained by a credit institution)	Magnetic, optical, electronic	Account maintained by a credit institution
		Integrated circuit card	Electronic purse
		Computer	Virtual purse (memory allocated by an intermediary)
Type of Money	**Value Representation**	**Mode of Payment**	**Means of Payments (Instrument)**
Fiduciary	Bank notes, coins	Face-to-face transaction	Bank notes, coins
Scriptural	Numerical value	Remote, face-to-face (retail automatic machines)	Check, debit card, credit card, credit transfer
			Electronic fund transfer

Figure 4. Comparison of monies.

Electronic or virtual purse is used with a card reader in face-to-face payments and it might also be used in remote and business to business payments.

Various properties of money and a comparison between them is depicted in figure 4. This evaluation is made by taking into account several criteria : the nature of money, their support, the way how the value is stored and represented, the mode and the means of payment.

The financial and control flow between participants in a system of dematerialized money is presented in figure 5.

The operator is responsible for charging the purse with electronic monetary units and he has an interface with the client presented in relation 1. The operator must verify the financial status of the holder or the validity of payments made by using classical means of payment. After having verified the electronic or virtual purse, the operator puts up-to-date their stored value.

If the charging operator is not a bank, there must be a connection between him and the issuing bank, as presented in figure 5 as relation 2.

The issuing bank must also communicate to the acquiring bank (the merchant's bank), respecting the necessary regulations. This is marked as relation 3.

Relation 4 shows that in order to acquire the merchant's credit, the acquiring operator exchanges information with the acquiring bank.

The corresponding values of the electronic transactions are collected and compensated for crediting the merchant's account, just like it is presented in relation 5.

Relation 6 shows that the transfer of electronic value from the client to the merchant's account is done simultaneously during a purchase.

The charging protocol represents a set of procedures for processes regarding authorization and transfer of electronic value to the owner's purse corresponding to a payment accepted by the charging operator. Protocols must assure a reliable security so that they will resist to outside attacks. The messages should be available only to the participants, a third party which is not a participant should not be able to access, manipulate or to modify these messages.

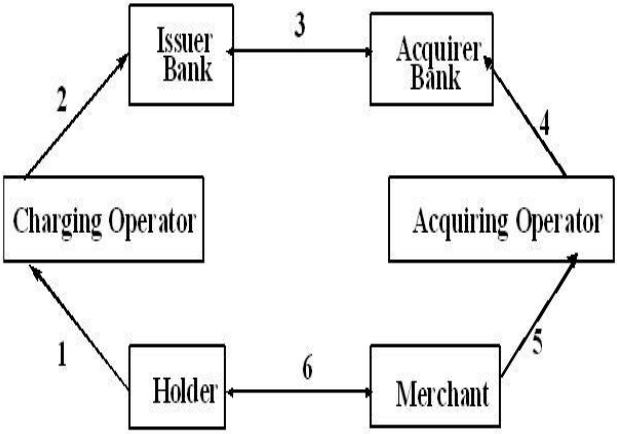

Figure 5. Flows in a transaction by dematerialized money.

The protocols must assure that the charges are authentic and they should prevent a false server from debiting a purse, the recharge of an unidentified purse, recharging with a different amount, other then the one requested, should prevent replay a tax (such as a previous authenticated value be recharged more times) and it should also be able to prevent the repudiation of a charge which has been correctly

executed or a payment which has been made. The protocols should offer the possibility to return to the previous state in case a transmission error occurs.

5. THE CASE OF DIRECT PAYMENTS MADE TO THE MERCHANT

If the payment is directly made to the merchant, the clients have to send the details of their accounts. In order to assure the security of the banking network from the Internet traffic, a payment gateway must be used when making payments from the client's computers by means of a purse or a bank card.

The gateway will get and handle the client's request, and so the gateway operator can be seen as a trusted third party. In order for the gateway operator to be a charging operator, it must be certified by a credit institution. In figure 6 one can observe a location of the payment gateway in electronic commerce.

Due to the large number of projects for electronic purses implemented around the world, a lot of incompatibility problems have emerged.

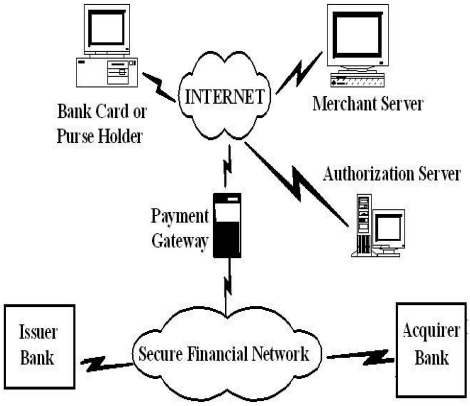

Figure 6. Payment gateways in electronic commerce

An important step in consolidating an unique payment interface is the Electronic Commerce Modeling Language (ECML), described in IETF RFC 3106, which defines how the exchanges between applications and the merchant's site should take place. A digital wallet is a software that manages the details of an online order.

A major disadvantage of the direct payments is that the merchant and the cardholder have to come upon all the details of the

protocol which they use, and this represents an impediment for open exchanges. Most of the payment schemes that could be used must be supported by the merchant's site. For each currency the customer would have to own a purse and due to its cost these could be a serious inconvenience. One solution for overcoming some of these drawbacks is the payment be mediated by intermediaries.

6. PAYMENTS THROUGH AN INTERMEDIARY

In figure 7 we present the position of the payment intermediary in the e-commerce circuit.

The intermediary levels the differences among the various purse schemes in regard with the participants, allowing them to overcome the burden of having specific software for different systems of payment. In order to access the intermediary's gateway, the client must subscribe to this service.

There are two cases: one when the payment will be done by bank card or electronic purse and another when the payment is done through a virtual purse.

In the first case the intermediary usually knows the client's details as they have been previously send through a secure channel. Using this information, the intermediary instructs the banking authorities to debit the buyer's account for the purchases he has made and to credit the supplier with the respective amounts. The holder uses an identifier (that could be encrypted with a secret key) in order to establish a connection.

In the second case the intermediary opens more subaccounts in it's own bank for the users and merchants which subscribe to its services. By means of direct credit or by a bank card the users prepaid their subaccounts. The transactions are grouped and are settled periodically with the banking network after having withdrawn their commission.

The are many services which an intermediary can offer such as: the management of a virtual mall and the payment instrument for the merchant, can take care of exchange rates, import and export taxes, shipping of physical goods, etc. The intermediary has to manage the generation, distribution, archiving and revocation of the encryption keys, the subscriptions of merchants and clients, and must also updates the directories and the black list or revocation list. A nonrepudiation service which timestamps the exchanges can also be implemented.

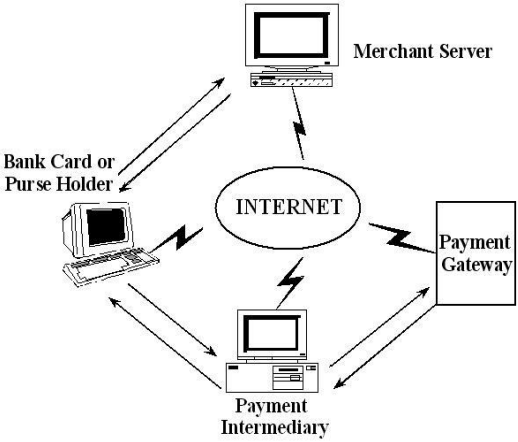

Figure 7. Payment intermediaries in electronic commerceIf the intermediary is a telephone company, we can see the telephone unit as a virtual money unit, which is used between the supplier and the client in micropayments. This can be very useful if the two parties involved are not from the same country.

Important administrative functions could be also fulfilled by intermediary for example the paying of taxes in France, where the DGI (Direction Générale des Impôts – General Taxation Directorate) certifies certain service providers to act as a relaying organization that can send fiscal data according to the law. The intermediary gives its clients the possibility of signing electronic documents. Using the RSA algorithm the public DGI's key is used to encrypt the digest of the document and the symmetric key. Starting from 2000 a fiscal declaration can be send to the fiscal institutions only by EDI partners, according to EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport) .

7. CLEARING AND SETTLEMENT

The process in which banks are settling the accounts by exchanging money is referred as "clearing and settlement". The respective values are analyzed, compared and the accounts are settled in a special clearing house every working day. When talking about electronic and clearing settlement the process is done over computer network.

Several different models for clearance and settlement systems exist in Europe, but differ from country to country in respect with the unique

evolution of the financial circuits, different views over security issues, and the diversity of standards from each of these countries.
We can make a classification of the settlement networks taking into account several criteria like:

1. The dimension of the processing: there can be large value systems and mass systems that process many transaction of relatively small values on a daily bases.
2. The ownership of the managed network: the owner of the network can be the central bank in the case of a public network or more members of a group of banks in the case of a private network.
3. How the settlement is done: the settlement can take place in real time in the same day. In order to avoid the charges for settling the payment, grouping is used whenever the parties involved are from the same group of companies.

8. CONCLUSIONS

Many technical, political and social factors are involved in acceptance of a payment system. The existing architecture of the payment systems must be taken into account when a worldwide e-commerce solution has to be implemented.
Especially in the case of micropayments, intermediaries should be used for assuring a cost effective transaction's billing and collection of monies. These intermediaries should be able to act as a single proxy interface independent of the underlying scheme of the system's payment. The differences in currencies and the fluctuations of the exchange rates are important issues which must be dealt with in the case of micropayments as they pose additional financial risk to all the participants.

9.REFERENCES

[1] Mostafa Hashem Sherif – **Protocols for Secure Electronic Commerce**, CRC Press, US, 2004.

[2] Victor Valeriu Patriciu, Monica Ene-Pietrosanu, Ion Bica, Calin Vaduva, Nicolae Voicu - **Securitatea comertului electronic**, Editura BIC ALL, Bucuresti, 2001.

[3] Victor Valeriu Patriciu, Monica Ene-Pietrosanu, Ion Bica, Justin Priescu - **Semnaturi electronice si securitate informatica**, Editura BIC ALL, Bucuresti, 2006.

[4] Alexandru Pirjan, "Electronic Mobile Commerce", **Information Systems & Operations Management (Isom) Workshop No. 3**, April 20 - 21, 2005, pp.171 - 178, ISBN – 973-87166-8-3.

[5] Alexandru Pirjan, "Quality Evaluation of Electronic Commerce Web Sites Using The EWAM method", **Information Systems & Operations Management (Isom) Workshop No. 4**, March 1-2, 2006, pp.218-227, ISBN – 973-7643-75-5.

[6] Susan Hohenberger – **Phd Thesis, Advances in Signatures, Encryption, and E-Cash from Bilinear Groups**, Massachusetts Institute of Tehnology, 2006.

TECHNIQUES OF ANALYSIS AND DIAGNOSTICS OF THE COMPANIES ON THE BASIS OF FINANCIAL INDEX

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Abstract

Not only banks do that and all the non-financial firms who want to check the solvability of a company. In this way there were created the scoring models. These models help the decided factors from a company to classify the companies and, depending of the score, to give or not the loan.

1. Introduction

On the market the companies work with a lot of financial institutions and also they went on the capital market too. All the companies do that because we all know that a company is a "live" system and it can not be isolated.

Experienced data analysts know that a successful analysis or meaningful report often requires more work in acquiring, merging, and transforming data than in specifying the analysis or report itself. SPSS contains powerful tools for accomplishing and automating these tasks.

2. The primary data used in paper

In the paper I used a representative sample of 15 companies from electrical domain. The information about these firms was taken from balance sheet of the end on 2006 year.

If we want to give a diagnosis of a company we have to calculate a lot of rates between the two positions of the balance sheet and/or the result account. Theoretical, and practical too, we can compute a lot of rates. For example:

a. rates of financial structure;

b. rates of liquidity and treasury - are rates of financial structure too but they express the potential of company for paying depts. on the short term;

c. profitability rates which are computed by using elements from the result account.

In the paper I made a classification of 15 companies, depending of the next economic-financial rates, computing from balance sheets:

I1: depts./social capital

I2: income/assets

I3: gross profit/assets

I4: social capital/income

I5:depts./assets

I6: the growth assets rate

I7: net profit/income

The primary data taken from the balance sheets of the sample of 15 firms are presented in the following table:

Firm	I1	I2	I3	I4	I5	I6	I7
ELECTRIC - AGK SRL	9.55	0.94	0.29	2.08	0.73	0.63	0.36
ELECTRICA SOLUZIONA SA	6.77	0.17	0.09	3.03	0.93	0.25	0.4
ETERN GRUP SRL	2.2	0.9	0	5.5	0.62	0.58	0.4
SC ENERGOMONTAJ SA	2.89	0.76	0.03	1.12	0.6	0.67	0.47
ELECTROMETAL INVEST SRL	1.24	0.65	0.09	1.3	1.06	0.6	0.43
SC ROMCONVERT SA	0.69	0.54	0.06	3.21	0.31	0.65	0.45
Digitech Electric	7.92	0.37	0.07	3.05	0.57	0.9	0.47
SC IMSAT CUADRIPOL SA	1.43	0.69	0.03	1.37	0.88	0.26	0.35
MATRIX ROM	3.96	0.86	0.18	4.04	0.61	0.35	0.37
TELEELECTRON	5.59	0.7	0.43	4.5	0.32	0.36	0.42
SBA INS S.R.L	4.33	0.5	0.55	2.9	0.7	0.57	0.48
PFGP	3.27	0.45	0.67	3.5	0.45	0.58	0.34
S.C. TECHINSTAL S.R.L.	0.81	0.23	0.23	3.67	0.56	0.37	0.52
S.C. VES ELECTRIC S.R.L.	1.65	0.34	0.53	2.43	0.23	0.45	0.39
LP ELECTRIC	2.5	0.56	0.98	1.9	0.24	0.48	0.41

Statistical Package for the Social Sciences (SPSS) is a comprehensive integrated software package for statistical data analysis. SPSS for Windows allows you to store data, perform transformations and analyses, and produce charts and graphs of results. Data are entered using a spreadsheet and results are displayed in a separate output window. The data and the output can be saved independently for the next work session. The output tables can be copied to a word processing application for inclusion in papers.

SPSS contains powerful tools for accomplishing and automating these tasks. While much of this capability is available through the graphical user interface, many of the most powerful features are available only through command syntax, the macro facility that extends the power of command syntax, and the scripting facility.

3. **Algorithms used in application**

The algorithm used to analyze and diagnostic firms or company through financial indicators is based on:

- Grouping those firms in unitary classes based on seven indicators. For this thing we will use an hierarchical aggregate algorithm.

a. Eigenvalues that offers informations about fitting quality are represented by specific falues of correlation matrix.

b. Factor Score Coefficients offers informations about principal axis.

- Grouping of those seven financial indicators in homogeneous classes. The start point is the primary data matrix, and then we calculate Euclidian distances between matrix columns.
- Based on scores matrix from SPSS output we find two indicators with high scores. With this two indicators we can catalogue the studied firms based on scoring values we obtain.

The purpose of classifying methods and cluster analysis is grouping of individuals, identified by a series of attributes-numeric variables-into a restraint number of unitary classes.

What characterizes those classes is the fact that they make a global analysis of the individuals that are studied through a large number of variables, and the suppositions are minim. The purpose of classifying is not only the individuals (data matrix rows) but also the variables (data matrix columns).

We what to make classes (groups) in a way that individuals belonging to a same group, to be very similar between them through variables values, but the build groups to be as different as possible.

The cluster analysis implies two steps:

- picking an proximity measure, defining an ‘approach’ measure between individuals based on observed variables, to be precise;

- elaboration of certain rules regarding the construction of classes in a way that the difference between them be as large as possible, and the individuals from this groups to as closer as possible.

3.1 Principal component analysis-firm classification

The purpose of principal component analysis is that for a X matrix to identify new variables that should synthetic explain the old variables so that the quantity of information to be lost in a controlled mode.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.712	24.461	24.461	1.712	24.461	24.461	1.587	22.677	22.677
2	1.453	20.761	45.222	1.453	20.761	45.222	1.480	21.143	43.820
3	1.263	18.048	63.270	1.263	18.048	63.270	1.299	18.554	62.374
4	1.063	15.179	78.449	1.063	15.179	78.449	1.125	16.075	78.449
5	0.917	13.096	91.544						
6	0.346	4.945	96.489						
7	0.246	3.511	100.000						

The Total Variance Explained table from above offers informations about intrinsec values of the correlation matrix, quantity of recovered information form each factorial axix. We can se that after four factors we stoped because the maximum quantity of information was recovered.

The Component Score Coefficient Matrix table offers information about axis versors $u^* = (u_1^*, u_2^*, ..., u_p^*)$. A versor is a vector with norm equal with 1 that gives the direction of factorial axis. The versor elements give us the percentage which each variable participate in the new component.

	Component			
	1	2	3	4
I1	-0.034	0.323	0.432	-0.023
I2	0.102	0.471	0.161	0.145
I3	-0.610	0.083	-0.014	-0.232
I4	0.059	0.034	-0.052	0.864
I5	0.489	0.069	-0.108	-0.263
I6	-0.053	-0.077	0.706	-0.049
I7	0.133	-0.579	0.222	0.099

We notice that I4 row has the highest score in the 4 column (0,864), and I3 row the lowest score in the first column (-0,610).

The Euclidian distance is a measure of dissimilarly between firms. If this is at a higher level means that the companies are very different. Proximity parameter shows the approaching or difference that exist between two individuals from the data matrix when we take in consideration all variables related to entities(firms).

To reflect as good as possible the real world we used in the analysis the square of Euclidian distances.

Case	Absolute Squared Euclidean Distance														
	1:Case 1	2:Case 2	3:Case 3	4:Case 4	5:Case 5	6:Case 6	7:Case 7	8:Case 8	9:Case 9	10:Case 10	11:Case 11	12:Case 12	13:Case 13	14:Case 14	15:Case 15
1:Case 1	0.000	0.443	7.931	0.298	4.932	10.72	0.239	3.588	2.942	1.866	1.129	3.271	10.46	5.372	1.911
2:Case 2	0.443	0.000	5.393	0.502	3.301	7.982	0.107	2.139	1.393	0.714	0.240	1.615	7.506	3.260	1.104
3:Case 3	7.931	5.393	0.000	6.758	3.099	0.411	6.032	2.699	1.546	2.639	3.710	1.561	0.428	0.705	3.806
4:Case 4	0.298	0.502	6.758	0.000	3.495	9.327	0.293	2.525	2.355	1.623	1.056	2.955	9.377	4.886	2.278
5:Case 5	4.932	3.301	3.099	3.495	0.000	4.618	3.906	0.520	2.235	3.040	3.045	3.093	4.467	3.861	5.180
6:Case 6	10.72	7.982	0.411	9.327	4.618	0.000	8.576	4.658	3.334	4.696	6.015	3.202	0.225	1.718	5.923
7:Case 7	0.239	0.107	6.032	0.293	3.906	8.576	0.000	2.774	1.783	0.948	0.422	1.974	8.320	3.708	1.211
8:Case 8	3.588	2.139	2.699	2.525	0.520	4.658	2.774	0.000	1.127	1.703	1.843	2.022	4.401	2.895	3.410
9:Case 9	2.942	1.393	1.546	2.355	2.235	3.334	1.783	1.127	0.000	0.199	0.576	0.190	3.140	0.683	0.983
10:Case 10	1.866	0.714	2.639	1.623	3.040	4.696	0.948	1.703	0.199	0.000	0.150	0.265	4.431	1.085	0.418
11:Case 11	1.129	0.240	3.710	1.056	3.045	6.015	0.422	1.843	0.576	0.150	0.000	0.635	5.621	1.827	0.507
12:Case 12	3.271	1.615	1.561	2.955	3.093	3.202	1.974	2.022	0.190	0.265	0.635	0.000	2.889	0.340	0.657
13:Case 13	10.46	7.506	0.428	9.377	4.467	0.225	8.320	4.401	3.140	4.431	5.621	2.889	0.000	1.485	5.550
14:Case 14	5.372	3.260	0.705	4.886	3.861	1.718	3.708	2.895	0.683	1.085	1.827	0.340	1.485	0.000	1.511
15:Case 15	1.911	1.104	3.806	2.278	5.180	5.923	1.211	3.410	0.983	0.418	0.507	0.657	5.550	1.511	0.000

When we want to evaluate the vicinity among individuals from different classes we can use many techniques. The more distant neighbor method require that the distance between two classes to be assimilated with the distance between the more distant element (elements will be from different classes).

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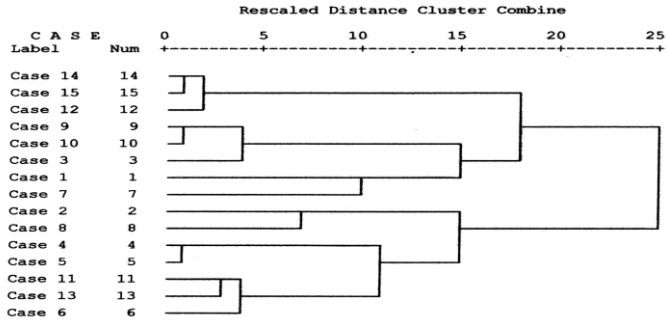
* * * * *

Dendrogram using Complete Linkage



From the SPSS output dendogram results that we can form many classes depending on its ‘cut’. If the ‘cut’ is between 15 and 20 we can form 3 classes: (12,15,14); (9,10,3,1,7) and (2,8,4,5,11,13,6). The most convenient situation is when the ‘cut’ is situated between 20 and 25, when we can form 2 classes: (14,15,12,9,10,3,1,7) and (2,8,4,5,11,13) because this is the purpose of the analysis.

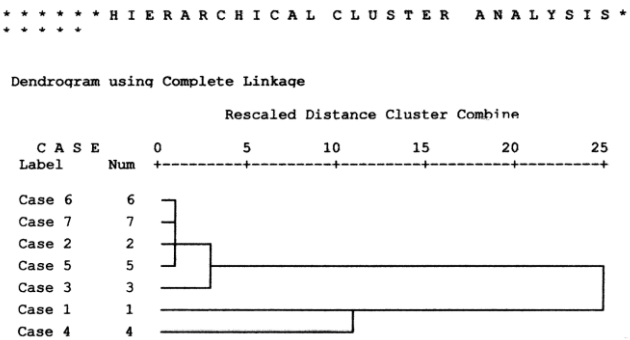
3.2 Classification of financial indicators

We obtain above two classes of firms suitable for: firms with good financial situation and for firms with inferior financial situation. Applying the same method of classification for the indicators we obtain the following informations:

- initial data

	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f14	f15
I1	9.55	6.67	2.2	2.89	1.24	0.69	7.92	1.43	3.96	5.59	4.33	3.27	0.81	1.65	2.5
I2	0.94	0.17	0.9	0.76	0.65	0.54	0.37	0.69	0.86	0.7	0.5	0.45	0.23	0.34	0.56
I3	0.29	0.09	0	0.03	0.09	0.06	0.07	0.03	0.18	0.43	0.55	0.67	0.23	0.53	0.98
I4	2.08	3.03	5.5	1.12	1.3	3.21	3.05	1.37	4.04	4.5	2.9	3.5	3.67	2.43	1.9
I5	0.73	0.93	0.62	0.6	1.06	0.31	0.57	0.88	0.61	0.32	0.7	0.45	0.56	0.23	0.24
I6	0.63	0.25	0.58	0.67	0.6	0.65	0.9	0.26	0.35	0.36	0.57	0.58	0.37	0.45	0.48
I7	0.36	0.4	0.4	0.47	0.43	0.45	0.47	0.35	0.37	0.42	0.48	0.34	0.52	0.39	0.41

- the dendogram

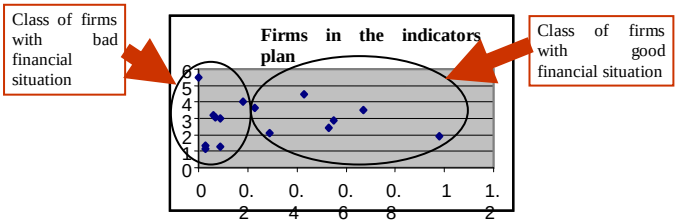


From the dendogram we can observe that the studied indicators are grouped in two classes: first class is obtained form indicator 1 and 4 and the second class include the following indicators: 6, 7, 2, 5 and 3.

3.3 Taking decisions regarding SPSS outputs

For analysis we take two indicators: I3 (gross income/total asset) and I4 (registered capital/turnover). If a company has a good value for I3 and a bad value for I4 then this firm is has a good profitability, otherwise this firm is not going to well form financial point of view.

Firm	I3(profit indicator)	I4	Firm status
1	0.29	2.08	F
2	0.09	3.03	F
3	0	5.5	F
4	0.03	1.12	F
5	0.09	1.3	F
6	0.06	3.21	F
7	0.07	3.05	F
8	0.03	1.37	F
9	0.18	4.04	B
10	0.43	4.5	B
11	0.55	2.9	B
12	0.67	3.5	B
13	0.23	3.67	B
14	0.53	2.43	B
15	0.98	1.9	B



The I4 indicator being aggregated by division of gross income at total assets, shows if a firm has profit. If this ratio is grater this means that the company is doing very well. The I3 indicator aggregated by

division of registered capital at turnover, shows if a firm has loses or not. If this ratio is smaller the status of the company is good and if this ratio is grater the firm will enter in bankrupt.

4. Conclusion

After marking all the samples from the studied firms we can observe by looking on graphic how those companies are distributed. If a certain bank wants to give a credit to a company will have to verify if the firm is solvent or if he can guarantee for the credit. Not only banks should make this verification, but also non-banking institutions should verify if a company is solvent or not. After we apply the classification of companies methods we can make decisions at tactical and strategically level.

References:

[1] Analiza datelor - aplicatii economice, autor: Liliana Spircu, ed ASE, Bucuresti, 2005

[2] Analiza statistica a activitatii economice si a gestiunii financiare a intreprinderii, autori: Liviu Troie, Monica Roman, Octavian Zaharia, Miruna Hurduzeu, ed ASE, Bucuresti, 2001

[3] Metode cantitative pentru analiza datelor de mediu autori: Vergil Voineagu, Dana Colibaba, Giani Gradinaru, editura ASE, Bucuresti, 2006

[4] Rating financiar, autor: Sorin Lazarescu, ed. ASE, Bucuresti, 2006

[5] Analiza datelor, autor: Maria Viorica Stefanescu, ed. ASE, Bucuresti, 2006

[6] Analiza economico-financiara, autori: Vasile Robu, Nicolae Georgescu, ed. ASE, Bucuresti, 2006

[7] Analiza economico-financiara, autori: Aurel Isfanescu, Vasile Robu, Anca Maria Hristea, Camelia Vasilescu, ed ASE, Bucuresti, 2006

[8] Analiza economico-financiara a intreprinderii, autori: Irina Daniela Cismasu, Mihaela Diana Negescu, Ana Maria Popescu-Fundulea, ed. ASE, Bucuresti, 2006

[9] Audit financiar-contabil, autor: Prof.univ.dr.Ana Stoian, ed. ASE, Bucuresti, 2006

[10] Statistica financiar-bancara, autor: Monica Roman, ed. ASE, Bucuresti, an 2006

[11] The evaluation of classification models for credit scoring, autor: Yang Liu, Arbeitsbericht Nr. 02/2002**,** Hrsg.: Matthias Schumann, University of Goettingen, Germany

[12] ESTAD´ISTICA Pr´acticas de ordenador con SPSS para Windows Licenciatura en Documentaci´on Curso Acad´emico 2001/2002 Departamento de Estad´ıstica e Investigaci´on Operativa Profesora: Dra. Josefa Mar´ın Fern´andez

[13] Tehnologia informatiei si cercetarii de piata - curs, autor: Dragos Stavarache, Universitatea virtuala de afaceri, Bucuresti, 2005

[14] http://www.mfinante.ro/link.jsp?body=/bilant.do

[15] http://www.oceanus.ro/listafirme/

[16] www.portal-electric.ro

Robust Monetary Policy

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ABSTRACT: While there is uncertainty about the data that enter into economic models and about the parameters that govern economic models, the fact that economists often approach macroeconomic data armed with different models of the economy suggests that uncertainty, or ambiguity, about the model could also be potentially important. A policy can be made "robust" to model uncertainty by designing it to perform well on average across all of the available fully specified models rather than to reign supreme in any particular model. In this paper we compare the implications of robust monetary policy versus non robust monetary policy for a model based on a new Keynesian model with two equations that represent the dynamics of inflation and the dynamics of the output gap. Using Matlab, we are able to approximate the solution to the linear–quadratic problem associated with the estimated model, thus obtaining the optimal monetary policy decision.

1. INTRODUCTION

According to Alan Greenspan (2003), "Uncertainty is not just an important feature of the monetary policy landscape; it is the defining characteristic of that landscape". In fact, the recognition that all monetary policymakers must bow to the presence of uncertainty appears to underlie Greenspan's (2003) view that central banks are driven to a "risk management" approach to policy, whereby policymakers "need to reach a judgement about the probabilities, costs, and the benefits of the various possible outcomes under alternative choices for policy".

Uncertainty comes in many forms. One obvious form is simply ignorance about the shocks that will disturb the economy in the future (oil prices, for example). Other forms of uncertainty, perhaps more insidious can also have resounding implications on how policy should

be conducted, three of which are data uncertainty, parameter uncertainty, and model uncertainty.

2. THE MODEL

When solving robust control problems there are generally two distinct equilibria that are of interest. The first is the "worst-case" equilibrium, which is the equilibrium that pertains when the policymaker and private agents design policy and form expectations based on the worst-case misspecification and the worst-case misspecification is realized. The second is the "approximating" equilibrium, which is the equilibrium that pertains when the policymaker and private agents design policy and form expectations based on the worst-case misspecification, but the reference model transpires to be specified correctly.

According to the state – space formulation, the economic environment is one in which the behavior of an $n \times 1$ vector of endogenous variables, z_t, consisting of n_1 predetermined variables, z_{1t}, and $n_2 (n_2 = n - n_1)$ non predetermined variables, z_{2t}, are governed by the reference model

$$z_{1t+1} = A_{11} z_{1t} + A_{12} z_{2t} + B_1 u_t + C_1 \varepsilon_{1t+1}, \qquad (1)$$

$$E_t z_{2t+1} = A_{21} z_{1t} + A_{22} z_{2t} + B_2 u_t, \qquad (2)$$

where u_t is a $p \times 1$ vector of control variables, $\varepsilon_{1t} \approx iid[0, I_s]$ is an $s \times 1$ vector, $s \le n_1$, of white – noise innovations, and E_t is the mathematical expectations operator conditional upon information available up to and including period t. The reference model is the model that private agents and the policy maker believe most accurately describes the data generating process. The matrices $A_{11}, A_{12}, A_{21}, A_{22}, B_1, B_2$ contain structural parameteres and are conformable with z_{1t}, z_{2t} and u_t as necessary. The matrix C_1 is determined to insure that ε_{1t} has the identity matrix as its variance – covariance matrix.

The policymaker's problem is to choose a sequence for its control variables, $\{u_t\}_0^\infty$, to minimize the objective function

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[z_t' R z_t + 2 z_t' U u_t + u_t' Q u_t \right], \tag{3}$$

where $\beta \in (0,1)$ is the discount factor. The weighting matrices, $R, U,$ and Q reflect the policymaker's preferences; R and Q are assumed to be positive semidefinite and positive definite, respectively.

Acknowledging that their reference model may be misspecified, private agents and the policymaker surround their reference model with a class of models of the form

$$z_{1t+1} = A_{11} z_{1t} + A_{12} z_{2t} + B_1 u_t + C_1 (v_{t+1} + \varepsilon_{1t+1}), \tag{4}$$

$$E_t z_{2t+1} = A_{21} z_{1t} + A_{22} z_{2t} + B_2 u_t, \tag{5}$$

where v_{t+1} is a vector of specification errors, to arrive at a "distorted" model. The specification errors are intertemporally constrained to satisfy

$$E_0 \sum_{t=0}^{\infty} \beta^t v_{t+1}' v_{t+1} \le \eta, \tag{6}$$

where $\eta \in [0, \overline{\eta}]$ represents the "budget" for misspecification.

3. ROBUST POLICYMAKING WITH COMMITMENT USING STATE – SPACE METHODS

In the commitment solution, both the policymaker and the evil agent are assumed to commit to a policy strategy and not succumb to incentives to renege on that strategy. Employing the definitions

$$\tilde{u}_t \equiv \begin{bmatrix} u_t \\ v_{t+1} \end{bmatrix}, \tilde{B} \equiv \begin{bmatrix} B & C_1 \end{bmatrix}, \tag{7}$$

$$\tilde{U} \equiv \begin{bmatrix} U & 0 \end{bmatrix}, \tilde{Q} \equiv \begin{bmatrix} Q & 0 \\ 0 & -\theta I \end{bmatrix} \tag{8}$$

the optimization problem can be written as

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[z_t' R z_t + 2 z_t' \tilde{U} \tilde{u}_t + \tilde{u}_t' \tilde{Q} \tilde{u}_t \right], \tag{9}$$

subject to

$$z_{t+1} = Az_t + \tilde{B}u_t + \tilde{C}\varepsilon_{t+1}, \tag{10}$$

which, because the first – order conditions for a maximum are the same as those for a minimum, has a form that can be solved using the methods developed by Backus and Drifill ([1]). Those methods involve formulating the problem as linear – quadratic, the value function has the form $V(z_t) = z_t'Vz_t + d$ and the dynamic program can be written as

$$z_t'Vz_t + d = \min_{u_t} \max_{v_{t+1}} [z_t'Rz_t + 2z_t'\tilde{U}\tilde{u}_t' + \tilde{u}_t'\tilde{Q}\tilde{u}_t + \beta E_t(z_{t+1}'Vz_{t+1} + d)]. \tag{11}$$

It is well known that the solution to this optimization problem takes the form

$$\begin{bmatrix} u_t \\ v_{t+1} \end{bmatrix} = -FT^{-1}\begin{bmatrix} z_{1t} \\ p_{2t} \end{bmatrix}, \tag{12}$$

$$z_{2t} = [V_{22}^{-1}V_{21}V_{22}^{-1}]\begin{bmatrix} z_{1t} \\ p_{2t} \end{bmatrix}, \tag{13}$$

$$\begin{bmatrix} z_{1t+1} \\ p_{2t+1} \end{bmatrix} = T(A - \tilde{B}F)T^{-1}\begin{bmatrix} z_{1t} \\ p_{2t} \end{bmatrix} + C\varepsilon_{1t+1} \tag{14}$$

where p_{2t} is an $n_2 \times 1$ vector of shadow prices associated with the non predetermined variables, z_{2t}. The matrix T provides a mapping between the state variables, z_{1t} and p_{2t}, and z_t and is given by

$$T = \begin{bmatrix} I & 0 \\ V_{21} & V_{22} \end{bmatrix}, \tag{15}$$

where V_{21} and V_{22} are submatrices of V. Finally, V and F are obtained by solving for the fix – point of

$$V = R - 2\tilde{U}F + F'\tilde{Q}F + \beta(A - \tilde{B}F)'V(A - \tilde{B}F), \tag{16}$$

$$F = (\tilde{Q} + \beta\tilde{B}'V\tilde{B})^{-1}(\tilde{U}' + \beta\tilde{B}'VA). \tag{17}$$

When the worst case misspecification is realized, the economy behaves according to equations (16) – (18). While the worst case equilibrium is certainly interesting, it is also important to consider how the economy behaves when the reference model transpires to be specified correctly. Partitioning F into $[F_u' \quad F_v']'$ where F_u and F_v are conformable

with u_t and v_{t+1}, respectively. The approximating equilibrium has the form

$$z_{1t+1} = (A_{11} + A_{12}H_{21} + B_1F_{z1}^u)z_{1t} + (A_{12}H_{22} + B_1F_{p2}^u)p_{2t} + C_1\varepsilon_{1t+1}, \tag{18}$$

$$p_{2t+1} = M_{21}z_{1t} + M_{22}p_{2t}, \tag{19}$$

$$z_{2t} = H_{21}z_{1t} + H_{22}p_{2t}, \tag{20}$$

$$u_t = F_{z1}^u z_{1t} + F_{p2}^u p_{2t}, \tag{21}$$

where $H_{21} \equiv V_{22}^{-1}V_{21}$, $H_{22} \equiv V_{22}^{-1}$, $[F_{z1}^u \quad F_{p2}^u] \equiv -F_u T^{-1}$, and

$$\begin{bmatrix} M_{11} & M_{12} \\ M_{21} & M_{22} \end{bmatrix} \equiv T(A - \tilde{B}F)T^{-1}. \tag{22}$$

Interestingly, the worst-case equilibrium and the approximating equilibrium share certain features. For instance, the worst-case equilibrium and the approximating equilibrium differ only with respect to the law of motion for the predetermined variables and, as a consequence, following innovations to the system the initial-period responses of the predetermined variables are the same for the approximating equilibrium as for the worst-case equilibrium. But since the decision rules for z_{2t} and u_t are also the same for the two equilibria, it follows that the initial-period responses by the nonpredetermined variables and by the policy variables are also the same. With respect to impulse response functions, differences between the approximating equilibrium and the worst-case equilibrium then only occur one period after innovations occur.

Furthermore, because the coefficient matrix on the innovations is C_1, which scales the standard deviations of the innovations, it follows that adding noise to the innovations or changing their correlation structure is not part of the evil agent's strategy. Instead, the optimally designed misspecification has the effect of changing the law of motion for the predetermined variables. More precisely, since the specification errors enter only the stochastic component of z_{1t}, the evil agent's strategy is to change the conditional means of the shock processes but not their conditional volatility.

4. ROBUST POLICY IN AN EMPIRICAL MODEL

To illustrate the robust control approach, we study the model estimated by Rudebusch ([8]), which is based on a standard New Keynesian model and contains two equations that, conditional upon the short – term interest rate, i_t, summarize the dynamics of inflation, π_t, and the dynamics of the output gap, y_t:

$$\pi_t = \mu_\pi E_t \pi_{t+1} + (1-\mu_\pi)\pi_{t-1} + \alpha y_t + \varepsilon_{\pi,t}, \tag{23}$$

$$y_t = \mu_y E_t \pi_{t+1} + (1-\mu_y) y_{t-1} - \beta(i_t - E_t \pi_{t+1}) + \varepsilon_{y,t} \tag{24}$$

Equation (23) is a "New Keynesian Phillips curve" derived from the optimal pricesetting behavior of firms acting under monopolistic competition, but facing price rigidities. The presence of lagged inflation and the "supply shock" $\varepsilon_{\pi,t}$ can be motivated by indexing those prices that are not reoptimized in a given period and by a time-varying elasticity of substitution across goods, leading to time-varying markups. Equation (24) can be derived from the household consumption Euler equation, where habits in consumption imply that current decisions depend to some extent on past decisions. The "demand shock" $\varepsilon_{y,t}$ can be attributed to government spending shocks or to movements in the natural level of output.8 An empirical version of this model, suitable for quarterly data and similar to that estimated by Rudebusch ([9]), is given by

$$\pi_t = \mu_\pi E_{t-1}\bar{\pi}_{t+3} + (1-\mu_\pi)\sum_{j=1}^{4} \alpha_{\pi j}\pi_{t-j} + \alpha_y y_{t-1} + \varepsilon_{\pi,t}, \tag{25}$$

$$y_t = \mu_y E_{t-1} y_{t+1} + (1-\mu_y)\sum_{j=1}^{2} \beta_{yj} y_{t-j} - \beta_r (i_{t-1} - E_{t-1}\bar{\pi}_{t+3}) + \varepsilon_{y,t} \tag{26}$$

where $\bar{\pi}_t = 1/4\sum_{j=0}^{3}\pi_{t-j}$ is four – quarter inflation and i_t is the nominal federal funds rate (the policy instrument). We generalize the model slightly to include forward – looking behavior in the output gap equation, as in Rudebusch ([9]). The model's parameters estimates, shown in Table 1, are taken from Rudebusch ([8]) and are obtained using OLS (and survey expectations) on quarterly U.S. data from

1968:Q3 to 1996:Q4, except for the parameter μ_y, which is set to the average estimate.

Table 1 – Parameter Values

Inflation		Output		Monetary Policy	
μ_π	0.29	μ_y	0.20	β	0.99
$\alpha_{\pi 1}$	0.07	β_{y1}	1.15	λ	0.50
$\alpha_{\pi 2}$	-0.14	β_{y2}	-0.27	υ	0.10
$\alpha_{\pi 3}$	0.40	β_r	0.09		
$\alpha_{\pi 4}$	0.07	σ_y	0.833		
α_y	0.13				
σ_π	1.012				

The model's key features are that inflation and the output gap are highly persistent, that monetary policy affects the economy only with a lag, and that expectations are formed using period $t-1$ information. Notice, also, that the weights on expected future inflation and output. While consistent with much of the empirical literature, are small relative to many theory – based specifications.

The central bank's objective function is assumed to be

$$\min_{\{i_t\}} E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \lambda y_t^2 + v i_t^2) \quad , \qquad (27)$$

where we $\beta = 0.99, \lambda = 0.5, v = 0.1$. Thus, the central bank sets monetary policy to avoid volatility in inflation around its target (normalized to zero) and in the output gap around zero (precluding any discretionary inflation bias). In addition, the central bank desires to limit volatility in the nominal interest rate around target (normalized to zero). The concern for misspecification, ϕ, is chosen so that the detection error probability is 0.1, given a sample of 200 observations. This implies that $\theta = 54.5$.

The model can be written in state – space form as follows:

$$z_{t+1} = Az_t + Bu_t + C\varepsilon_{t+1}, \tag{28}$$

$$\min_{u_t} E_0 \sum_{t=0}^{\infty} \beta^t [z_t' R z_t + u_t' Q u_t], \tag{29}$$

where $z_{1t} = \begin{pmatrix} \pi_t & \pi_{t-1} & \pi_{t-2} & \pi_{t-3} & y_t & y_{t-1} \end{pmatrix}'$,

$z_{2t} = \begin{pmatrix} E_t\pi_{t+1} & E_t\pi_{t+2} & E_t\pi_{t+3} & E_t y_{t+1} \end{pmatrix}'$,

$z = \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}$,

$\varepsilon_t = \begin{pmatrix} \varepsilon_{\pi t} & \varepsilon_{yt} \end{pmatrix}'$,

$u_t = i_t$,

$$A = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ -6.56 & 1.37 & -3.92 & -0.69 & -1.79 & 0 & 12.79 & -1 & -1 & 0 \\ 0.74 & -0.15 & 0.44 & 0.077 & -4.4 & 1.08 & -1.44 & 0 & 0 & 0 \end{pmatrix}$$

$$B = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.45 \end{pmatrix}'$$

$$C = \begin{pmatrix} 1.012 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0.833 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$$

$$R = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix},$$

$$Q = 0.1$$

We first solved the linear quadratic optimization problem in the nonrobust case. The matrix which gives the optimal feedback is

$$K = \begin{pmatrix} 0.1 & -10.36 & 3.54 & 0.913 & -6.947 & 2.399 & -41.088 & 40.245 & -16.047 & -4.296 \end{pmatrix} \quad (33)$$

and the optimal control is:

$$u_t = i_t = Fz_t = -Kz_t \,. \quad (30)$$

Next, we solved the worst – case robust control problem. In this case,

$$u_t = \begin{pmatrix} i_t \\ v_{\pi,t+1} \\ v_{y,t+1} \end{pmatrix},$$

$$\overline{B} = \begin{pmatrix} 0 & 1.012 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0.833 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0.45 & 0 & 0 \end{pmatrix},$$

$$\overline{Q} = \begin{pmatrix} 0.1 & 0 & 0 \\ 0 & 54.5 & 0 \\ 0 & 0 & 54.5 \end{pmatrix}.$$ Matrices A, C and R are the same as in the nonrobust case.

Solving the linear quadratic optimisation problem, we obtained the optimal feedback matrix

$$\overline{K} = \begin{pmatrix} 1.6733 & 0.992 & -1.65 & -0.302 & -9.741 & 2.3038 & -0.99 & 1.22 & -3.38 & -0.22 \\ -1.4045 & 0.783 & -0.61 & -0.125 & -0.315 & -0.0005 & 3.26 & -1.97 & 0.055 & 0.216 \\ -1.4969 & 0.472 & -0.83 & -0.152 & -0.422 & -0.0008 & 2.99 & -0.62 & -0.33 & 0.206 \end{pmatrix}$$

(31)

The optimal control is given by $\overline{u}_t = -\overline{K} z_t$, which means that the optimal policy rule and misspecification are given by:

Coefficient on

	π_t	π_{t-1}	π_{t-2}	π_{t-3}	y_t	y_{t-1}
Policy rule i_t	-1.67	-0.99	1.65	0.30	9.74	0.99

Misspeficiation						
$v_{\pi,t+1}$	1.4	-0.78	0.61	0.12	0.31	0.0005
$v_{y,t+1}$	1.49	-0.47	0.83	0.15	0.42	0.0008

In figures 1, 2, we plot impulse responses to unit – sized innovations to inflation ($\varepsilon_{\pi,t}$) under commitment using the state – space method, for the nonrobust and robust cases, respectively.

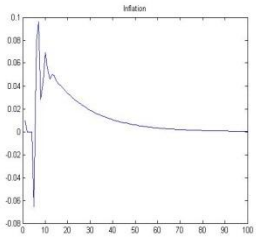

Figure 1

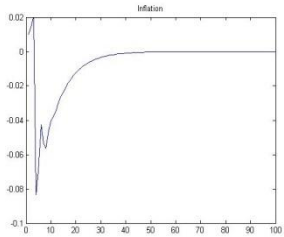

Figure 2

6. CONCLUSIONS

In formulating monetary policy, central banks must cope with substantial economic uncertainty.

Economic uncertainty can arise from different sources: the state of the economy, the nature of economic relationships, and the magnitude and persistence of ongoing shocks.

Robust control theory instructs decision makers to investigate the fragility of decision rules by conducting worst-case analyses.

In this paper we show how state space methods and structural-form solution methods can be applied to robust control problems, thereby making it easier to analyze complex models.

We illustrate the state space solution methods by applying them to an empirical New Keynesian business cycle model of the genre widely used to study monetary policy under rational expectations. A key finding from this exercise is that the strategically designed specification errors will tend to distort the Phillips curve in an effort to make inflation more persistent, and hence harder and more costly to stabilize. The optimal response to these distortions is for the central bank to become more activist in its response to shocks.

REFERENCES

[1] Backus, David K. and John Driffill (1986), "The consistency of optimal policy in stochastic rational expectations models", Discussion Paper No. 124, Centre for Economic Policy Research.

[2] Dennis, R., Leitemo, K. and Soderstrom, U., "**Methods for robust control**", Working Paper 2006 – 10, Federal Reserve Bank of San Francisco

[3] Giordani, Paolo and Paul Soderlind (2004), "**Solution of macromodels with Hansen-Sargent robust policies: Some extensions**", Journal of Economic Dynamics and Control 28 (12), 2367–2397.

[4] Hansen, Lars Peter and Thomas J. Sargent (2001), "**Robust control and model uncertainty**", American Economic Review Papers and Proceedings 91 (2), 60–66.

[5] Hansen, Lars Peter and Thomas J. Sargent (2003), "**Robust control of forward-looking models**", Journal of Monetary Economics 50 (3), 581–604.

[6] Hansen, Lars Peter and Thomas J. Sargent (2006), **Robustness**, University of Chicago and New York University, Princeton University Press.

[7] Leitemo, Kai and Ulf Soderstrom (2004), "**Robust monetary policy in the New-Keynesian framework**" Discussion Paper No. 4805, Centre for Economic Policy Research, Macroeconomic Dynamics.

[8] Rudebusch, Glenn D., "**Assessing nominal income rules for monetary policy with model and data uncertainty**", Economic Journal, 112 (479), 1–31.

[9] Rudebusch, Glenn D., "**Term structure evidence on interest rate smoothing and monetary policy inertia**" Journal of Monetary Economics, 49 (6), 1161–1187.

INTELLIGENT VEHICLE SAFETY SYSTEMS-eCALL

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ABSTRACT

The European Union is promoting *eCall* to reduce the number of roadway fatalities by minimizing the response time when an accident has occurred. *eCall* is a combination of an In Vehicle System (IVS), a device with a GSM cell phone and GPS location capability, and a corresponding infrastructure of Public Safety Answering Points (PSAPs) Intelligent Vehicle Safety Systems use Information and Communications Technologies for providing solutions for improving road safety in particular in the pre-crash phase when the accident can still be avoided or at least its severity significantly reduced.With these systems,which can operate either autonomously on-board the vehicle, or be based on vehicle-tovehicle or vehicle-to-infrastructure communication (co-operative systems), the number of accidents and their severity can be reduced. Location-enhanced emergency calls like in-vehicle e-Call have their primary benefit to society of saving lives and in offering an increased sense of security. The articol presents the system eCall and how does it work.

Keywords: eCall, functional architecture, PSAP

1. INTRODUCTION

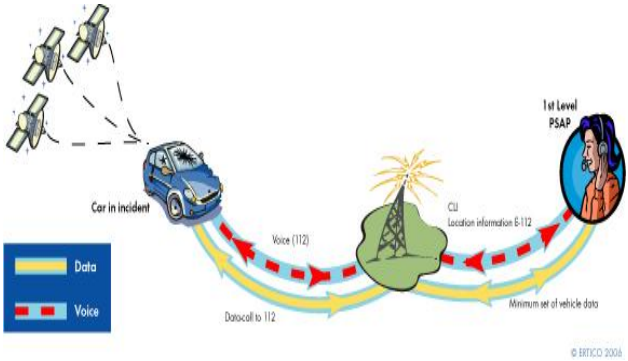
The EU plans to have every new car equipped with the eCall system from 2010. The system will automatically generate an emergency call

after a serious accident. With this call, the data of the vehicle including location is transmitted to the 112 emergency call centre.(PSAP)

The eCall Generator initiate the eCall by sensors triggered and/or manually, send the in-vehicle triggered eCall to a PSAP. The eCall consists of two elements: a pure voice (audio) telephone call based on 112 and the minimum set of data (MSD)

The eCall (data + voice) carried through the mobile network, is recognized by the mobile network operator (MNO) as a 112 emergency call, and is first handled by the MNO. Based on the 112 handling the MNO enrich the call with the CLI (caller line identification), and at the same time, according to E112 recommendation, add the best location available .After the 112 handling, the telecom operator delivers the 112-voice together with the CLI, mobile location and the eCall MSD to the appropriate PSAP.

The PSAP transmits an acknowledgement to the eCall Generator specifying that the MSD have been properly received.[1]



2. eCALL SERVICE CHAIN

The overall performance criteria for the eCall service chain have been derived from a range of studies and experiences from the various stakeholder groups involved. Furthermore, experiences from comparable automatic and manual vehicle emergency or assistance calling systems and current PSAP operation systems and emergency response systems have been taken into account.

eCall involves a number of different stakeholders all with separate responsibilities and tasks, which even overlap. In order to provide a clear understanding of the different aspects of the eCall chain six different domains have been identified :

- Vehicle eCall Triggering System —›112 eCall Trigger (eCall sensors or manual) —› Transmission over vehicle bus
- eCall Generator (EG) —›In-vehicle software triggers 112 call —› in-vehicle communication module initiates 112 all and send MSD
- EG 2 MNO —› Receive 112 call and MSD
- Mobile Network Operator (MNO) —› 112 call with CLI, celluar location and MSD
- MNO 2 PSAP —› Forward 112 voice, CLI, celluar location and MSD to PSAP
- PSAP —› Answer 112 voice call, decode and visualise celluar location and MSD

3. FUNCTIONAL ARCHITECTURE

The eCall IVS function is to :

- Collect data from the vehicle network and from vehicle sensors, and maintain an up-to-date GPS fix of the vehicle's location.
- Automatically detect a crash based on car-sensor information.
- Call a PSAP automatically when a crash is detected, or when the driver presses a dedicated *eCall* button.

Each call has 2 main parts:

- Establish voice contact between the car's occupant and a PSAP operator to provide assistance to the driver.
- Transmit a Minimum Set of Data (MSD) to the PSAP, including the current GPS position and direction the car was heading.[5]

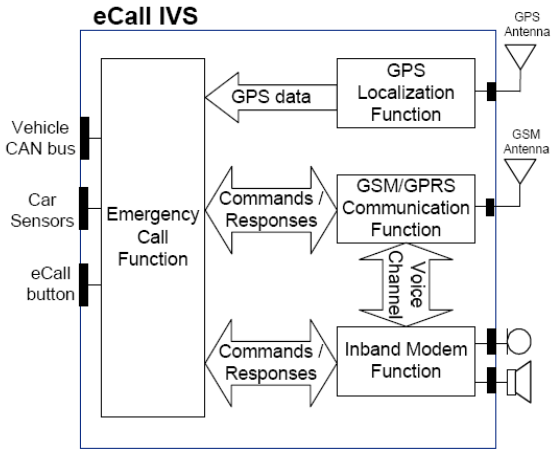


Figure 1: eCall - functional architecture.

Figure 1 depicts the architecture of an *eCall* IVS. Its functional blocks are:

- Emergency Call Function: This is the *eCall* application. It gathers vehicle information through the CAN bus or other sensors and geo-location information from the GPS function. In case of a crash, it sends an emergency message to the PSAP through the GSM/GPRS function.
- GPS: The GPS function is responsible for gathering information from GPS satellites and processing this information to accurately compute the vehicle's geo-location.
- GSM/GPRS: The GSM/GPRS function is responsible for establishing and maintaining a GSM call to the PSAP so that the crash information can be sent and a voice connection established between the car occupants and an operator.
- In-band Modem: Among a few technologies to send data to the PSAP (SMS ,GPRS or inband modem), the most likely to be used is the in-band modem. This technology uses the voice channel; typically a special processing unit in the audio path encodes/decodes messages.

4. eCALL MINIMUM SET OF DATA (MSD)

The requirements to the minimum set of data were set by a group of emergency services involved in the Driving Group (DC) eCall. The

requirements were based on the information that emergency agencies would need to speed up the response time and to ensure a correct deployment of emergency resources.[2]

The DG eCall recommends that the below MSD content should be standardized by an appropriate standardization body.

The MSD provides the following information:

- GPS Position
- Direction of travel
- Number of triggers of the call
- Colour, make, model of the vehicle
- Indicates which sensors are triggered: airbag, roll-over, front crash, side crash or rear crash sensor (at least two should be activated)
- Time stamp of the event
- SP ID(Service Provider Identification)
- SP telephone number
- Country ID, and
- Special vehicle /user code.

It is recommended to send the minimum set of data in the 112-voice channel to the PSAP

via a specific vehicle protocol - Global Telematic Protocol (GTP). During testing the

consortium decided to use short message service (SMS) to transfer the eCall MSD to the

PSAP and if subscribed there to the full set of data (FSD) to the Service provider using the same vehicle protocol (GTP).

The PSAP is the public controlled call centre responsible for providing a first point of contact to a 112 call. The PSAP is thus receiving the Emergency 112-voice call and the MSD. Based on the voice connection and the MSD content, the PSAP operator decides the handover to the correct dispatcher, which will handle the remaining part of the specific emergency response. The PSAP's source of information is the voice, the MSD and the location information provided by E112. For cases where the driver is subscribing to a SP the additional set of data can be pulled by the PSAP operator over a secure Internet IP connection. It may happen that the PSAP operator does not speak the

language of the driver involved in the accident. In that case and under the sole condition that the driver has a service provider subscription, it is possible for the PSAP operator to set up a conference voice call between himself, the vehicle occupant and the operator at the responsible service provider.[4]

The specification of the minimum set of data was created by the emergency agencies. These specifications were set on the basis of the information the emergency agencies would need to make a correct response and to speed up the response time. The definition of the MSD was made in close co-operation with the vehicle makers because in the end, the vehicle manufactures need to make sure that the information was present. The minimum set of data has been coded using the GTP protocol and consists of the following information that will be forwarded, together with the voice call, to the PSAP operator when receiving an in-vehicle eCall:

- "When" via time stamp
- "Where" via precise locations (e.g. satellite positions including the direction of driving)
- "Who" via vehicle description (caller line identification [CLI], colour, make and model including, if possible the vehicle identification number, VIN)
- "Where to obtain more information" via service provider identifier (IP address, including for example telephone number and country code), and
- "How severe" via eCall qualifier (source of the trigger – manual or automatic including what type of sensors or, if available, the number of sensors).

The minimum set of data makes it possible for the PSAP operator to respond to the eCall

even without the voice connection. It was requested by the PSAP operators that at least

two sensors should be activated and send information to the PSAP before they deal with

the call as a silent call. The reason being that the PSAP wanted to minimise the number of false calls in case of a failure on a sensor in the vehicle. The minimum set of data is critical for supplying the correct

service to the crash-site and to speed up the response. It is generally expected by the PSAP's that the response time can be improved by 5-10% when this information is available at the PSAP immediately after the crash.

The necessary standardisation activities in Europe related to the technical solution for the implementation of a pan-European emergency eCall system for road vehicles cover two main issues: (1) the transport protocol by which the minimum set of data (MSD) will be send via the mobile telecommunication network (e.g. GSM) to the public service answering point (PSAP), and (2) the content and format of the MSD.

The Commission approached ETSI in 2005 to look for developing supporting standards for eCall. ETSI subsequently divided the work into two parts [3]

a) the agreement of a communication link (transport protocol) was assigned to ETSI MSG

b) a standard to specify the overall architecture and MSD was assigned to ETSI ERM TG37.

5. CONCLUSIONS

In order to make the reporting of an accident more simple and to give the emergency call operator more information about the accident the European Commission launched a communication telling the EU Member States to implement the single European emergency call number 112, which has been follow by all EU Member States. In addition the European Communication launched a recommendation about the enhanced E112- number, with also provides the location when an emergency call is made from a cellular phone.

The problem with the existing eCall solutions provided by the different vehicle manufacturers and service providers today is that they only operate in on country.

From the network operators and service provider's perspective they are developing different systems for all vehicles manufactures, which is making the system expensive and not able to work across the different EU Member States [3]

Another conclusion is that if there should be a Pan-European eCall system, the vehicle manufactures or the network providers can't develop this themselves. It is very important to include the public

authorities in this matter and the public body for this has to be the EU. Only here can a solution be pushed across all EU Member States.

6. REFERENCES

[1] https:// eSafetySuport.org
[2] www.escope.info
[3]http://ec.europa.eu/information_society/programmes/esafety/index_en.htm
[4] http://www.prevent-ip.org/
[5] wawecom blue paper no 2-implementing eCall

An INTRODUCTION TO CUDA Programming

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Abstract. The graphics boards have become so powerful that they are usded for mathematical computations, such as matrix multiplication and transposition, which are required for complex visual and physics simulations in computer games. NVIDIA has supported this trend by releasing the **CUDA** (Compute Unified Device Architecture) interface library to allow applications developers to write code that can be uploaded into an NVIDIA-based card for execution by NVIDIA's massively parallel GPUs. This paper is an introduction to the CUDA programming based on the documentation from [2] and [4].

Introduction

The programmable graphics processor unit (GPU) has evolved into an absolute computing workhorse. Today's GPUs offer a lot of resources for both graphics and non-graphics processing. Data-parallel processing maps data elements to parallel processing threads. Many applications that process large data sets such as arrays can use a data-parallel programming model to speed up the computations. In 3D rendering large sets of pixels and vertices are mapped to parallel threads. Similarly, image and media processing applications can map image blocks and pixels to parallel processing threads. A lot of any other algorithms except the image rendering and processing algorithms are accelerated by data-parallel processing.

In this scope, Nvidia developed CUDA (**Compute Unified Device Architecture**) [1], a new hardware and software architecture for issuing and managing computations on the GPU as a data-parallel computing device without the need of mapping them to a graphics API. It is available for the GeForce 8 Series, Quadro FX 5600/4600, and Tesla solutions.

The paper presents the principal features of CUDA programming. It is presented the CUDA architecture and the application programming interface in CUDA, based on the documentation from [2] and [4]. Also there is an simple CUDA program for adding two matrix which uses the parallel capabilities of CUDA, which was presented in [3].

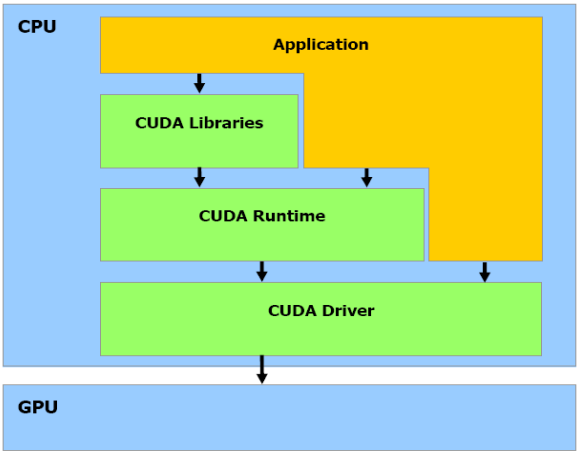

Figure 1. The CUDA software stack

The CUDA Architecture

CUDA is a framework which works in a modern massively-parallel environment. CUDA-enabled graphics processors operate as co-processors within the host computer. This means that each GPU is considered to have its own memory and processing elements that are separate from the host computer. To perform useful work, data must be transferred between the memory space of the host computer and CUDA device(s).

As in [2], the CUDA software stack is composed of several layers: (i) a hardware driver, (ii) an application programming interface (API) and its runtime, (iii) two higher-level mathematical libraries of common usage, as in Figure 1.

CUDA provides general DRAM memory addressing [2]: the ability to read and write data at any location in DRAM, just like on a CPU. CUDA has a parallel data cache with very fast general read and write access, that threads use to share data with each other.

When programmed with CUDA, the GPU is viewed as a **compute device** capable of executing a very high number of threads in parallel. It operates as a coprocessor to the main CPU (**host**). The host and the device maintain their own DRAM, **the host memory** and **device memory**, respectively, as in [2].

The batch of threads that executes a kernel is organized as a grid of thread blocks like in Figure 2, as in [2].

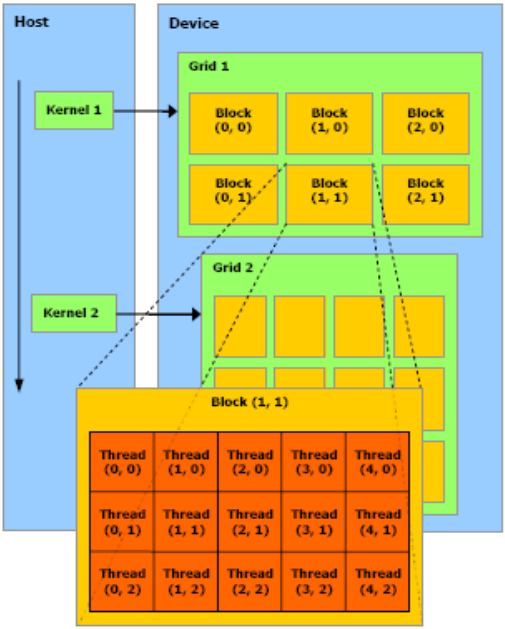

Figure 2. Thread batching

A thread block is a batch of threads that can cooperate together by efficiently sharing data through some fast shared memory and synchronizing their execution to coordinate memory accesses. Each thread is identified by its **thread ID**, which is the thread number within the block. An application can also specify a block as a two- or three-dimensional array of arbitrary size and identify each thread using a 2- or 3-component index instead. There is a limited maximum number of threads that a block can contain. The blocks of same dimensionality and

size that execute the same kernel can be batched together into **a grid of blocks**. Threads in different thread blocks from the same grid cannot communicate and synchronize with each other. A device may run all the blocks of a grid sequentially if it has very few parallel capabilities, or in parallel if it has a lot of parallel capabilities, or usually a combination of both. Each block is identified by its **block ID**, which is the block number within the grid. An application can also specify a grid as a two-dimensional array of arbitrary size and identify each block using a 2-component index instead.A thread that executes on the device has only access to the device's DRAM and on-chip memory through the following memory spaces, as illustrated in Figure 3 (as described in [2]): (i) read-write per-thread registers, (ii) read-write per-thread local memory, (iii) read-write per-block shared memory, (iv) read-write per-grid global memory, (v) read-only per-grid constant memory, (vi) read-only per-grid texture memory.

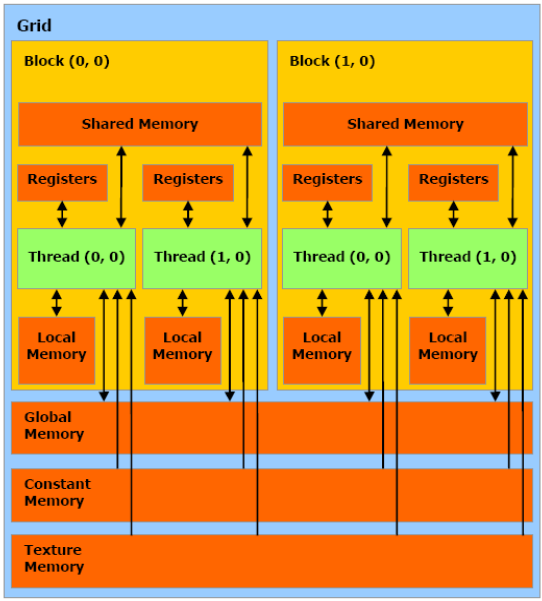

Figure 3. The Memory model

The device is implemented as a set of multiprocessors as illustrated in Figure 4, as described in [2]. Each multiprocessor has a Single Instruction, Multiple Data architecture (SIMD). At any given clock cycle, each processor of the multiprocessor executes the same instruction, but operates on different data. Each multiprocessor has on-chip memory of the four following types: (i) one set of local 32-bit registers per processor, (ii) a parallel data cache (shared memory) that is shared by all the processors and implements the shared memory space, (iii) a read-only constant cache that is shared by all the processors and speeds up reads from the constant memory space, which is implemented as a read-only region of device memory, (iv) a read-only texture cache that is shared by all the processors and speeds up reads from the texture memory space, which is implemented as a read-only region of device memory.

The local and global memory spaces are implemented as read-write regions of device memory and are not cached. Each multiprocessor accesses the texture cache via a texture unit that implements the various addressing modes and data filtering.

A grid of thread blocks is executed on the device by executing one or more blocks on each multiprocessor using time slicing: Each block is split into SIMD groups of threads called **warps**; each of these warps contains the same number of threads, called the **warp size**, and is executed by the multiprocessor in a SIMD fashion; **a thread scheduler** periodically switches from one warp to another to maximize the use of the multiprocessor's computational resources. A block is processed by only one multiprocessor, so that the shared memory space resides in the on-chip shared memory leading to very fast memory accesses. The multiprocessor's registers are allocated among the threads of the block. If the number of registers used per thread multiplied by the number of threads in the block is greater than the total number of registers per multiprocessor, the block cannot be executed and the corresponding kernel will fail to launch. Several blocks can be processed by the same multiprocessor concurrently by allocating the multiprocessor's registers and shared memory among the blocks. The issue order of the warps within a block is undefined, but their execution can be synchronized.

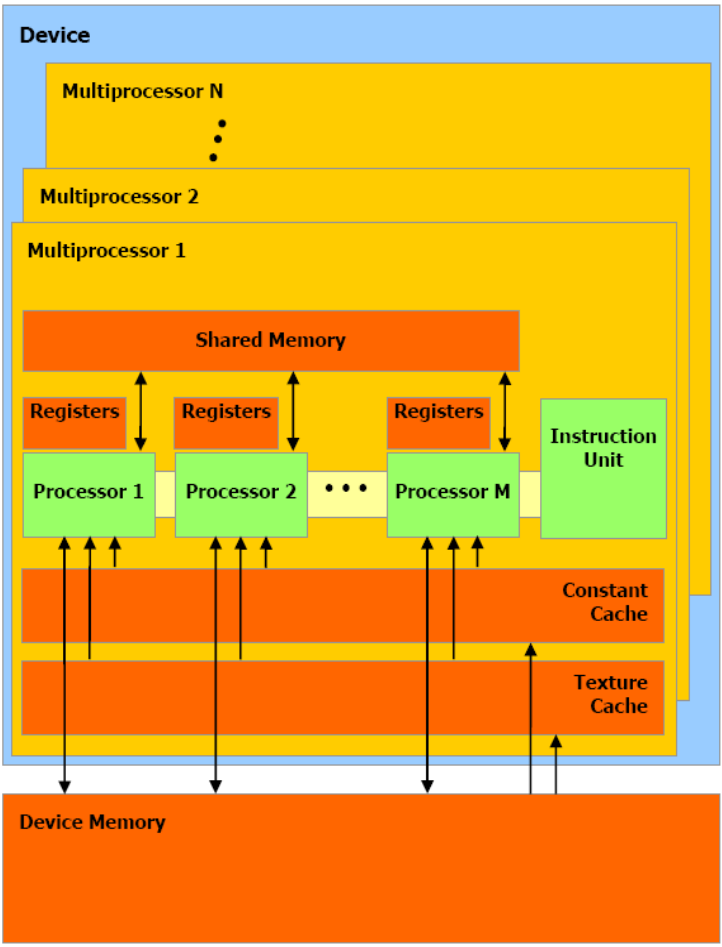

Figure 4. The hardware model

The CUDA application programming interface

The goal of the CUDA programming is to provide a relatively simple path for users familiar with the C. Based on [2], it consists of:

- A runtime library (presented in Table 1) split into:

- A host component, that runs on the host and provides functions to control and access one or more compute devices from the host;
- A device component, that runs on the device and provides device-specific functions;
- A common component, that provides built-in vector types and a subset of the C standard library that are supported in both host and device code.

- A minimal set of extensions to the C language, that allow the programmer to target portions of the source code for execution on the device (composed of four parts presented in Table 2).

The host component	Multiple devices supported
	Memory: linear or CUDA arrays
	OpenGL and DirectX interoperability
	Asynchronicity: __global__ functions and most runtime functions return to the application before the device has completed the requested task
The device component	Synchronization function
	Type conversion
	Type casting
	Atomic functions (performs a read-modify-write operation on one 32 bit word residing in global memory)
A common component	Built-in Vector types (**float1, float2, int3, ushort4** etc)
	Constructor type creation: **int2 i = make int2(i, j)**
	Mathematical functions (standard **math.h** on CPU)

	Time function for benchmarking
	Texture references

Table 1 The runtime library

Function type qualifiers to specify whether a function executes on the host or on the device and whether it is callable from the host or from the device	**__device__** declares a function that is: (i) executed on the device, (ii) callable from the device only.
	__global__ declares a function as being a kernel: (i) executed on the device, (ii) callable from the host only.
	__host__ declares a function that is: (i) executed on the host, (ii) callable from the host only.
Variable type qualifiers to specify memory location on the device of a variable	**__device__** declares a variable that resides on the device: (i) resides in global memory space, (ii) has the lifetime of an application, (iii) it is accessible from all the threads within the the grid and from the host through the runtime library.
	__constant__ (optionally used with __device__), declares a variable that: (i) Resides in constant memory space, (ii) has the lifetime of an application, (iii) it is accessible from all the threads within the grid and from the host through the runtime library.
	__shared__ , (optionally used with __device__), declares a variable that: (i) resides in the shared memory space of a thread block, (ii) has the lifetime of the block, (iii) is only accessible from all the threads within the block.
A new directive to specify how a kernel is executed on the device from the host	• Any call to a __global__ function must specify the execution configuration for that call. • The execution configuration defines the

	dimension of the grid and blocks that will be used to execute the function on the device. ● It is specified by the expression <<<Dg,Db,Ns>>> inserted between the function name and the parenthesized argument list, where: (i) **Dg** is of type **dim3** and specifies the dimension and size of the grid (Dg.x*Dg.y*Dg.y is the number of blocks being launched), (ii) **Db** is of type **dim3** and specifies the dimension and size of each block, (Db.x*Db.y*Db.z is the number of threads per block), (iii) **Ns** is of type **size_t** and specifies the number of bytes in shared memory that is dynamically allocated per block for this call in addition to the statically allocated memory.
Four built-in variables that specify the grid and block dimensions and the block and thread indices	**gridDim** is of type **dim3** and contains the dimensions of the grid.
	blockIdx is of type **uint3** and contains the block index within the grid.
	blockDim is of type **dim3** and contains the dimensions of the block.
	threadIdx is of type **uint3** and contains the thread index within the block.

Table 2. The set of extensions to the C language

A CUDA example

In the following it is presented a CUDA program for adding two matrix in parallel comparing with the same program write in C, which is described in [3]:

CPU Program	Observations	CUDA Program

void
add_matrix
(float* a,
float* b,
float* c, int
N) {
int index;
 	
for (int i = 0; i < N; i++)
for (int j = 0; j < N; j++)
{
index = i + j*N;
c[index] = a[index] + b[index];
}
}
 	
int main() {
add_matrix(a, b, c, N);
}
	The nested for-loops are replaced with an implicit grid	__global__ add_matrix
		(float* a, float* b, float* c, int N)
		{
		int i = blockIdx.x * blockDim.x +
		threadIdx.x;
		int j = blockIdx.y * blockDim.y +
		threadIdx.y;
		int index = i + j*N;
		
		if (i < N && j < N)
		c[index] = a[index] + b[index];
		}
		
		int main() {
		dim3 dimBlock(blocksize, blocksize);
		dim3 dimGrid(N/dimBlock.x,N/dimBlock.y);
		add_matrix<<<dimGrid,dimBlock>>>(a,b,c,N);
		}

Bellow it is presented the whole source version of the above program, as pesented in [3]:

Program	Observations
const int N = 1024; const int blocksize = 16;	Set grid size

__global__
void add_matrix(float* a, float *b, float *c, int N)
{
int i = blockIdx.x * blockDim.x + threadIdx.x;
int j = blockIdx.y * blockDim.y + threadIdx.y;
int index = i + j*N;
if (i < N && j < N)
c[index] = a[index] + b[index];
}
	Compute kernel

int main() {	

float *a = new float[N*N];
float *b = new float[N*N];
float *c = new float[N*N];
for (int i = 0; i < N*N; ++i) a[i] = 1.0f; b[i] = 3.5f;
	CPU memory allocation

float *ad, *bd, *cd;
const int size = N*N*sizeof(float);
cudaMalloc((void**)&ad, size);
cudaMalloc((void**)&bd, size);
cudaMalloc((void**)&cd, size);
	GPU memory allocation

cudaMemcpy(ad, a, size, cudaMemcpyHostToDevice); cudaMemcpy(bd, b, size, cudaMemcpyHostToDevice);	Copy data to GPU
dim3 dimBlock(blocksize, blocksize); dim3 dimGrid(N/dimBlock.x, N/dimBlock.y);	Execute kernel

add_matrix<<<dimGrid, dimBlock>>>(d, bd, cd, N);	
cudaMemcpy(c, cd, size, cudaMemcpyDeviceToHost);	Copy result back to CPU
cudaFree(ad); cudaFree(bd); cudaFree(cd); delete[] a; delete[] b; delete[] c; return EXIT_SUCCESS;	Clean up and return
}	

Conclusions

CUDA has several advantages over traditional general purpose computation on GPUs (GPGPU) using graphics APIs:

- It uses the standard C language, with some simple extensions; it is no need to learn graphics API;
- Scattered writes – code can write to arbitrary addresses in memory;
- Shared memory – CUDA exposes a fast shared memory region that can be shared amongst threads;

  But CUDA has some limitations:
- Recursive functions are not supported and must be converted to loops.
- Threads should be run in groups of at least 32 for best performance.
- CUDA-enabled GPUs are only available from Nvidia (GeForce 8 series and above, Quadro and Tesla)

Bibliography

1. http://www.nvidia.com/object/cuda_home.html
2. http://developer.download.nvidia.com/compute/cuda/1_0/NVIDIA_CUDA_Programming_Guide_1.0.pdf
3. Johan Seland - Cuda Programming, Winter School in Parallel Computing,Geilo, January 20-25, 2008, (http://heim.ifi.uio.no/~knutm/geilo2008/seland.pdf)
4. http://www.gpgpu.org/sc2007/

INTRODUCTION TO ZEND FRAMEWORK

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ABSTRACT

*A **software framework** provides the skeleton of an application that can be customized by an application developer. Like software libraries, software frameworks aid the software developer by containing source code that solves problems for a given domain and provides a simple API. However, while a code library acts like a servant to other programs, software frameworks reverse the master/servant relationship. This reversal, called inversion of control, expresses the essence of software frameworks.*

*A **web application framework** is a software framework that is designed to support the development of dynamic websites, Web applications and Web services. The framework aims to alleviate the overhead associated with common activities used in Web development. For example, many frameworks provide libraries for database access, templating frameworks and session management, and often promote code reuse.*

1. INTRODUCING ZEND FRAMEWORK

Zend Framework was designed and built to improve developer productivity. Unlike other frameworks that require large configuration files to work, most aspects of a Zend Framework application can be defined at runtime using simple PHP commands. This saves developers time because instead of complex configuration files controlling every aspect of the application, you only configure the parts that deviate from the norm.

The framework was written entirely in PHP 5. It will not run on any server that does not have a minimum of PHP 5.1.4 installed. The current version has been thoroughly tested and over 80% of the code is covered by test cases using PHPUnit.

Zend Framework was built on several key concepts:

- Best Practices
- Community Driven
- Extensionability
- Extreme Simplicity
- Liberal BSD License

Unlike many other frameworks available for PHP, Zend Framework chose not to implement the ActiveRecord pattern and not to ship with an Object-Relation Mapper (ORM). Contrary to popular opinion, this was not an oversight but a conscious decision by the framework team.

The Zend Framework is really a hybrid framework and as such can be used in amuch larger range of projects than strict "application frameworks". While many components in Zend Framework can be used stand-alone like a component library, it is, at its core an implementation of the "Model-View-Controller" (MVC) pattern.

2. HISTORY AND PHILOSOPHY

Zend Framework was conceived in early 2005 while many new frameworks, such as Ruby on Rails and the Spring Framework, were gaining popularity in the web development community. ZF was publicly announced at the first Zend Conference. At the same time, no widely used framework had been made available to the PHP community to fulfill similar web development needs. The designers of Zend Framework sought to combine the ease-of-use and rapid application development (RAD) features of these new frameworks with the simplicity, openness, and real-world practicality that is highly valued in the PHP community.

Typically, specific development usage scenarios are implemented using more generalized software components through automatic configuration and/or code generation. In previous releases, the Zend Framework community has opted to complete development and testing of these underlying components before starting work on simplifying development tasks such as database migrations, generating scaffolding, and project creation and configuration. This practice has been the subject of some criticism since some functionality considered by many as necessary for a general release for modern web application frameworks is slated for future Zend Framework releases. Many ZF users, however, have found such generalized software components more reusable and extensible in implementing their applications. Zend

Framework also seeks to promote web development best practices in the PHP community; conventions are not as commonly used in ZF as in many other frameworks, rather suggestions are put forth by setting reasonable defaults that can be overridden for each ZF application's specific requirements.

3. THE ZEND FRAMEWORK COMMUNITY

Possibly the greatest asset that Zend Framework has is its community. The community around Zend Framework is growing daily. While several of the developers working on Zend Framework actually work for Zend, the majority of them do not.

The process of proposing and reviewing new components is open and community driven. Because the community is comprised of both beginner and advanced programmers, there is never any shortage of help for new adopters. Whether you prefer mailing lists, forums or chat, Zend Framework community is always there and willing to help. The community realized early on that with any framework, getting started is the hardest part. Therefore, there are numerous tutorials and quickstart guides to help both novice and advanced users get up and running. The project Web site (http://framework.zend.com) houses not only the documentation and downloads for the project but a full bug-tracking/ticketing system that allows anyone to register and submit bugs. This level of openness helps them meet the first goal of the project, "Community Driven".

4. THE ZEND FRAMEWORK LICENSE AND INTELLECTUAL PROPERTY CONCERNS

All contributors to Zend Framework sign a "Contributors License Agreement" stating that the code they are contributing is IP clean. The practice and agreement is similar in nature to that required by the Apache group. This was done not as an exclusionary practice but to give peace of mind to companies considering adopting Zend Framework to build commercial applications. To facilitate its adoption by both open source projects as well as commercial entities, Zend Framework was released under a BSD style license. This allows for the framework to be used in the widest possible range of projects and puts the fewest restrictions on adopters. A complete copy of the BSD

License can be found on Zend Framework Web site (http://framework.zend.com/license).

5. MVC

MVC, like so many great things in computers, came out of Xerox's PARC in 1978-1979. These days MVC is a common pattern for frameworks to implement because it separates the code into three logical groups.

- ***The model*** can be thought of as the representation of the data that your application will utilize. In simple terms, the model can be thought of as the "nouns" of your project. An "order", a "member", an "article", these are all examples of potential models in your system.
- ***The view*** contains all the display logic. In the majority of PHP applications, this means the HTML output of your application. However, even in web applications, this can mean a variety of output formats. Whatever the format, the view is responsible for the merging of the data from the model and the actions of the controller and sending it to the proper client. (In most cases with PHP, that's a web browser).
- ***The controller*** is responsible for the domain logic in your applications. It represents the verbs or events. "Add," "edit" and "submit" are all actions your application can take. The controller embodies these actions for you. There are many good examples of MVC-implemented frameworks in PHP. If that were its only selling point then Zend Framework would be just another framework in an ever-growing list. Zend Framework however, separates itself by allowing you to pull pieces of it out and use them independently. The Zend Framework teams calls this "use at will" architecture. Most of the components that are not part of the MVC core can be pulled out and used as "standalone" components in your application.

Examples of the "use at will" components are

- Zend_Cache
- Zend Rest_Client
- Zend_Feed
- Zend_Log

Each of these can be used independently of the framework itself and that means their functionality can be easily incorporated into existing applications. Simply put, if all you need is a single component, you can use just that component. However when the job requires a full framework, you have that option also.

It should be noted here though that MVC is not something you can retrofit into an existing application. If you are maintaining existing code, the component library aspect of Zend Framework will be of much more interest to you because you can easily integrate the pieces you need without disturbing your existing legacy code. However, if you are building in "green fields" then the MVC aspect of Zend Framework will be of more interest because you have the luxury of building from scratch.

6. FEATURES

- All components are fully object-oriented PHP 5 and are E STRICT compliant
- Use-at-will architecture with loosely coupled components and minimal interdependencies
- Extensible MVC implementation supporting layouts and PHP-based templates by default
- Flexible Table Gateway implementation for accessing data from a relational database in an object-oriented environment
- Support for multiple database systems and vendors, including MySQL, Oracle, IBM DB2, Microsoft SQL Server, PostgreSQL, SQLite, and Informix Dynamic Server
- Authentication and ACL-based authorization using a variety of backend systems
- Data filtering and validation for enhanced application security
- Session management
- Configuration component to promote consistent configuration management throughout the Zend Framework and ZF applications
- Email composition and delivery, retrieval via mbox, Maildir, POP3 and IMAP4
- Indexing and search that supports the Lucene index file format
- Internationalization and localization
- Creation of forms using PHP, configuration files, or XML
- Identity 2.0 technologies such as Microsoft InfoCard and OpenID

- Multiple formats for web services, including XML-RPC, REST, and Google GData.
- Flexible caching sub-system with support for many types of backends, such as memory or a file system.
- Simple logging component inspired by log4j
- Native-PHP component for reading, updating, and creating PDF documents
- Serialization of PHP data structures to and from JSON to facilitate AJAX development
- API for consuming RSS and Atom feeds
- Client libraries for many web services out of the box, including Amazon E-Commerce Service , Akismet, del.icio.us, Flickr, StrikeIron, Yahoo!, Audioscrobbler, and Simpy.

7. ORGANIZATIONS USING ZEND FRAMEWORK:

- brainbits
- Berlin Museums
- Digital Sublimity
- Eurotransplant
- GNU/Linux Matters for Poliglota.
- IBM
- Marseille City School System
- Nokia
- Right Media
- Magento
- Shoppingads
- Australia Week

REFERENCES

[1] Cal Evans, "***php|architect's Guide to Programming with Zend Framework***", Marco Tabini & Associates, Inc. 2008

[2] Wikipedia, http://en.wikipedia.org/wiki /Zend_Framework

[3] Zend, http://framework.zend.com/

[4] IBM, http://www.ibm.com/developerw /opensource/library/os-php-zend1/

Decision support systems

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ABSTRACT: Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities. A properly-designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions. DSS belong to an environment with multidisciplinary foundations, including database reasearch, artificial intelligence, human computer interaction, simulation methods, software engineering and telecomunication.

Keywords: decision support system, decision makers, computer-based

1. INTRODUCTION

Information systems researchers and technologist have built and investigated decision support systems for almost 40 years, meaning that the concept of an interactive computer based system that helps companies make better business decisions has been around since computers came into widespread use.

Decision support systems are created to help people make decisions by providing access to information and analysis tools, it's a way to model data and make quality decisions based upon it. Decision support systems constitute a class of computer-based information systems including knowledge based systems that support decision making activities. Making the right decision in business is usually based on the data quality and the ability to sift through and analyze the data to find trends that can create solutions and strategies.

DSS are interactive computer based systems and subsystems intended to help decision makers use communications technologies, data, documents, knowledge and models to complete decision process tasks.

A decision support system may present information graphically and may include an expert system or artificial intelligence.
Typical information that a decision support application might gather and present would be: accessing all information assets, including legacy and relational data sources, comparative data figures, projected figures based on new data or assumptions, consequences of different decision alternatives, given past experience in a specific context.
While many people think of decision support as a specialized part of a business, most companies have actually integrated this system into their day to day operating activities. Many companies constantly download and analyze sales data, budget sheets and forecasts and they update their strategy once they analyze and evaluate the current results.
The solution to decision support systems is to gather data, analyze and shape the data that is collected and then try to make sound decisions or construct strategies from analysis.
Decision support applications that just collect data and organize it effectively are usually called passive models, they do not suggest a specific decision and they only reveal data. On the other hand, an active decision support system actually processes data and explicitly shows solutions based upon that data.
A cooperative decision support system is when data is collected, analyzed and then is provided to a human component which can help the system revise or refine it. It means that both a human component and computer component work together to come up with the best solution.

2. TYPES OF DECISION SUPPORT SYSTEMS

There are a number of decision support systems. These can be categorized into five types: communications driven DSS, data driven DSS, document driven DSS, knowledge driven DSS and model driven DSS.
A communication driven DSS supports more than one person working on a shared task. Many collaborators work together to come up with a series of decision to set in motion a solution or strategy. Most communications driven DSSs are targeted at internal teams, including partners. The most commons technology used to deploy the DSS is a web or a client server. In general, groupware, bulletin boards, audio and

video conferencing are the primary technologies for communication driven decision support.

Data driven DSS model puts its emphasis on collected data that is then manipulated to fit the decision maker's needs. This data can be internal, external and in a variety of formats. This model emphasizes access to and manipulation of a time series of internal company data and sometimes external and real time data. Simple file systems accessed by query and retrieval tools provide the most elementary level of functionality. Most data driven DSSs are targeted at managers, staff and also product / service suppliers. It is used to query a database or data warehouse to seek specific answers for specific purposes. It is deployed via a main frame system, client server link or via web.

Document driven DSSs are more common, targeted at a broad base of user groups. The purpose of such a decision support system is to search web pages and find documents on a specific set of keywords or search terms. This model uses computer storage and processing technologies to provide document retrieval and analysis. A document driven DSS model uses documents in a variety of data type such as text documents, spreadsheets and database records to come up with decisions and manipulate the information to refine strategies. The usual technology used to set up such decision support systems are via web or a client / server system.

Knowledge driven DSSs are a catch-all category covering a broad range of systems covering users within the organization setting it up, but may also include others interacting with the organization. It is essentially used to provide management advice or to choose products or services. Knowledge-driven DSS can suggest or recommend actions to managers. These DSS are person-computer systems with specialized problem-solving expertise. The expertise consists of knowledge about a particular domain, understanding of problems within that domain, and skill at solving some of these problems. The typical deployment technology used to set up such systems could be client / server systems, the web, or software running on stand-alone PCs.

Model driven DSSs are complex systems that help analyse decisions or choose between different options. A model driven DSS emphasizes access to and manipulation of financial, optimization and / or simulation models. Simple quantitative models provide the most elementary level of functionality. Model-driven DSS use limited data and parameters

provided by decision makers to aid decision makers in analyzing a situation, but in general large data bases are not needed for model-driven DSS. These are used by managers and staff members of a business, or people who interact with the organization, for a number of purposes depending on how the model is set up. These DSSs can be deployed via software / hardware in stand-alone PCs, client/server systems or the web.

3. DSS ARCHITECTURE

Decision support systems are not entirely different from other systems and require a structure approach. The framework has tree main levels: technology levels, people involved and the developmental approach.

Technology levels are divided into tree levels of hardware and software: level 1 – specific DSS, level 2 – DSS generator and level 3 – DSS tools.

Level 1 – specific DSS is the actual application that will be used by the user. This is the part of the application that allows the decision maker to make decisions in a particular problem area. The user can act upon that particular problem.

Level 2 – DSS generator contains hardware and software environment that allows people to easily develop specific DSS applications. This level makes use of case tools or systems.

Level 3 – DSS tools contains lower level hardware and software, DSS generators including special languages, function libraries and linking modules.

There are five roles involved in a typical DSS development cycle: the end user, an intermediary, DSS developer, technical supporter, systems expert.

The developmental approach for a DSS system should be iterative. This will allow for the application to be changed and redesigned at various intervals. The initial problem is used to design the system on and then tested and revised to ensure the desired outcome is achieved.

Decision support systems are classified into six frameworks: text-oriented DSS, database-oriented DSS, solver-oriented DSS, rule-oriented DSS and compound DSS.

The most popular classification for a DSS is the compound DSS.

A decision support system consist of two major sub-systems: human decision makers and computer systems. The function of a human

decision maker as a component of DSS is to exercise judgment or intuition throughout the entire decision making process.
The first step of a decision making process begins with the creation of a decision support model, using and integrated DSS program such as Microsoft Excel, Lotus 1-2-3, Interactive Financial Planning Systems. The user interface sub-system is the gateway to both database management systems and model based management systems. Database management systems are a set of computer programs that create and manage the database, as well as control access to the data stored within it. The DNMS can be either an independent program or embedded within a DSS generator to allow users to create a database file that is to be used as an input to the DSS. Model based management system is a set of computer programs embedded within a DSS generator that allows users to create, edit, update, and / or delete a model.
Today, most of the DSS in use are developed to generate and evaluate decision alternatives via "what-if" analysis and "goal-seeking" analysis in the design and choice stages. Accounting models facilitate planning by calculating the consequences of planned actions on estimate of income statements, balance sheets and other financial statements. Representational models estimate the future consequences of actions on the basis of partially non definitional models, including all simulation models. Optimization models generate the optimal solutions. Suggestion models leads to a specific suggested decision for a fairly structured task. Such systems perform mechanical calculations and leave little role for managerial judgment.

4. DSS CLASIFICATION AND IMPLEMENTATION

The support given by a decision support system can be separated into three different, interrelated categories: group support, knowledge based support and organizational support.
Single user DSS and group DSS can be distinguished in many different ways in terms of purpose and components (hardware, software, people, procedures). First, group DSS and single user DSS have distinguishable purposes. A DSS group is defined as an interactive computer based system which facilitates solution of unstructured problems by a set of decision makers working together as a group.
To support a set of decision makers working together as a group, DSS have a special technological requirements of hardware, software, people

and procedures. Each member of the group have a personal computer linked to the personal computer of the other group members and to one or more large public viewing screens, so that each member can see the inputs of other members or let other members to see their work. Computer based information systems to support group activities have been conducted under the titles of group decision support systems (GDSS), computer-supported cooperative work (CSCW), group support systems GSS), collaboration support systems (CSS), and electronic meeting systems (EMS).

Knowledge based decision support systems helps solving a broad range of organizational problems. A broad range of real-world managerial problems can be better solved by using the analysis of both quantitative and qualitative data. The system can support decision makers by harnessing the expertise of key organizational members.

An organizational decision support system is a DSS that is used by individuals or groups at several work stations in more than one organizational unit who make different decisions using a common set of tools. The two factors to achieve in this model are: transmittal of consistent, timely information up and down the organizational hierarchy in forms that are appropriate to each decision maker; and a set of decision-aiding models that use this information and that are appropriate for the decisions being made by each decision maker.

In most cases, the use of some computer based information systems is mandatory, but decision support systems are optional systems. DSS is widely used in business and management.

A flourishing area of DSS applications, principles, concepts and techniques is in agricultural production, marketing for sustainable development. DSS can be designed to help make decisions on the stock market, or deciding which area or segment to market a product toward. We can say that DSS nature is changing from optional system to mandatory survival tool. Consequently, individual differences, cognitive styles, personality, demographics, and user-situational variables may become less critical success factors. Shifting the focus of implementation research from user-related factors to task-related, organizational, and external environmental factors may be necessary to reflect the changing decision environment in which organization must survive and prosper.

The benefits of DSS implementation are: improves personal efficiency, expedites problem solving, facilitates interpersonal communications, promotes learning or training, increase organizational control, generates new evidence in support of a decision, creates a comprehensive advantage over competition, encourages exploration and discovery on the part of decision maker, reveals new approaches to thinking about problem space.

5. CONCLUSIONS

DSS practice, research and technology continue to evolve. Trends suggest that data-driven DSS will use faster, real time access to larger, better integrated databases. Model-driven DSS will be more complex and system built using simulations and their accompanying visual displays will be increasingly realistic. Communications-driven DSS will provide more real-time video communications support. Document-driven DSS will access larger repositories of unstructured data and the systems will present appropriate documents in more useable formats. Knowledge-driven DSS will likely be more sophisticated and more comprehensive.

The new tools and technologies are adding new capabilities to DSS and will reshape DSS developments in organizations. They include hardware and mathematical software developments, artificial intelligence techniques, the data warehouse / multidimensional databases (MDDB), data mining, online analytical processing (OLAP), enterprise resource planning (ERP) systems, intelligent agents, telecommunication technologies such as World Wide Web technologies, the Internet, and corporate intranets.

REFERENCES

[1] D.J. Power, **Decision support systems: concepts and resources for managers**, Westport, Conn., Quorum Books, 2002

[2] C.W. Holsapple, A.B.Whinston, **Decision support systems: A knowledge-based approach,** St. Paul: West Publishing, 1996

[3] G.M. Marakas, **Decision support system in the twenty-first century,** Upper Saddle River, N.J., Prentice Hall, 1999

[4] Haag, Cummings, McCubbrey, Pinsonneault, Donovan, **Management information systems: for the information age,** McGraw-Hill Ryerson Limited: 136-140, 2000

[5] R.H. Sprague, E.D. Carlson, **Building effective decision support systems,** Englewood Cliffs, N.J., Prentice-Hall, 1982

[6] A.M. Hackathorn, P.G.W. Keen, **Organizational trategies for personal computing in decision support systems,** MIS Quarterly, Vol. 5, No. 3

Time Delays and The Underwriting Cycle

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ABSTRACT: We shall consider the concept of time delays and the extent to which this is a common feature in many general insurance systems. We shall then present an example of a model of an insurance system with delays that helps to explain the phenomenon of underwriting cycles.

Keywords: insurance, time delays, underwriting cycle, forecasting, rating formula.

Delays in non-life insurance

The insurer's liability to pay a claim crystallizes at the time of the insured event. Many favors can lead to delays between the occurrence of the event and the actual payment of the claim Thus, Ackman et al. (1985)[1] identify five sets of factors:

1. The event covered by the insurance policy may not occur at a single instant - for example, workmen's compensation claims arising from industrial disease may relate to exposure over a long time period and may not be recognized as claimable events until many years have elapsed since the inception of the policy.
2. There may be delays before a claimable event is reported to the insurer.
3. The legal liability of the insurer may not always be dear-cut, and

there may be considerable delays before the situation is clarified (possibly involving the courts).
4. It may not be possible to determine the magnitude of the claim until some time after the occurrence of the insured event - for example, in motor damage claims there may be a delay until the vehicle can be examined and the damage assessed, and more extreme examples may arise in personal injury cases which involve the courts.
5. There may be processing delays within the insurer's administration departments, in recording the necessary statistical information on the claim, managing and updating of the claims file, and payment of the claim.
Time delays are introduced also by the regulatory process (see, for example, Lemaire 1985)[10]. Insurance premium rates are regulated in many countries. Insurance companies may be required to have their rates ed by regulatory authorities prior to use (as in the US) or to approved by follow a uniform, national tariff (as in Switzerland). Regulation almost always creates additional delays between the experience period and the effective date of application of the revised rates. In addition, premium rates may be revised less frequently than under a competitive system (Cummins and Outreville, 1987)[7].
The process of collection and analysis of the data, the projection into the future and the effect of system delays have been well illustrated by Coutts (1984)[6], who demonstrates that, although motor insurance premiums may only be expected to be in force for one year and the length of each contact is only one year, the premium estimation process can involve projections of up to eight years. The presence of time delays in notification and settlement of claims and in data collection leads to this effect. Such an extension of the time frame under consideration then necessitates a number of important, subjective decisions, for example (Coutts, 1984)[6].

The underwriting cycle

A number of autors (for example, Cummins and Outreville (1987)[7] and Venezian (1985) [14]) have noted the existence of a cycle with a period of about six years in the profits of non-life insurance companies (or property-casualty companies, as they are named in North America).
The usual explanation for the existence of the cycle is that it is caused

by increased profits leading to increased capably, leading to aggressive marketing and a decline in underwriting standards. This then leads to reduced profits, a decline in capacity, stricter underwriting and increased profits, and so the cycle is repeated Several other competing hypotheses have been proposed in the literature to explain the cycle: for example, Cummins and Outreville (1987)[7], Rantala (1988)[11] and Daykin et at. (1994)[9] provide more detailed reviews. For example, Venezian (1985)[14] puts forward an explanation in which he assumes that premiums as determined independently of the market by an insular, but he proposes a relationship between insurer behavior and the existence of cycles which is based on projections. Specifically Venezian points out that premium rating, at least as practiced in the US, relies on extrapolating past claim costs in order to predict future claim costs. These extrapolations tend to involve an estimation period of approximately three years, and an extrapolation period of about two years (Cummins and Outreville, 1987)[7].

Model based on time delays

We now turn to the specification of a model for explaining the existence of underwriting cycles. We exclude any consideration of expenses, taxes, investment income, interaction with the capital market or the methodology for fixing the premium rate. The main hypotheses is that the dynamics of the cycle come from the fact that profits feed back into surplus (or reserves) with a time delay.

A second-order autoregressive equation will generate a six-year cycle with particular values of the parameters, as in Venezian's (1985) analysis (see above). We shall describe a simple model that leads to such an equation and thus provides one possible explanation for the phenomenon of the underwriting cycle (see Berger, 1988[5], Daykin et al , 1994[9]). To reach this goal, it is necessary to assume two one-year delays in the structure of the business. In the presentation here, we follow the argument of Berger (1988)[5].

Thus, we assume that:

1. the insurer sets its underwriting policy for the forthcoming year on the basis of the end-of-year surplus (or reserves), so that the more financially secure is the insurer, the more walling it will be to underwrite the more marginal risks,

2. the profit and loss results follow from the underwriting policy with a one-year time delay;
3. the profit and loss results are passed directly into the surplus (or reserves) so that there are no distributions to policyholders or shareholders,
4. the effects of investment income, expenses and other cash flows can be honor.

We let P_t, Q_t, S_t and p_t respectively present market premium (or price), quantity, surplus (reserves) and economic profits for year *t*.
Given 1, we assume that the market supply or quantity is a function of the surplus in the immediately preceding period (since, as Berger (1988)[5] has shown, insurers will be more willing at any premium to underwrite marginal risks on the surplus is increased).
The resultant market premium and quantity will also depend on the surplus in immediately preceding period (since the position of the supply function will determine the intersection of the supply and demand functions): $(P_t, Q_t) = f(S_{t-1})$ for dome *f*.
We also assume (from 2.) that the profit in year *t* is a function of the premium (price) and quantity in year *t - 1*, i.e.

$$p_t = g(P_{t-1}, Q_{t-1}) = gf(S_{t-2}) = h(S_{t-2})$$

for some functions g and h.
We thus have, from 3.,

$$S_t = p_t + S_{t-1} \quad (1)$$

by definition, and

$$p_t = h(S_{t-2}) = h(S_{t-3} + p_{t-2}) \quad (2)$$

If *h* is invertible, we have a second-order difference equation, possibly non-linear, for *p*, namely:

$$p_t = h(h^{-1}(p_{t-1}) + p_{t-2}) \quad (3)$$

When h is linear, $h(S) = aS + b$ and $h^{-1}(p) = (p-b)/a$, so we have:

$$p_t = p_{t-1} + ap_{t-2} \quad (4)$$

which is a homogeneous difference equation with general solution $p_t = k_1 c_1^t + k_2 c_2^t$ where c_1 and c_2 are solutions of $c^2 = c + a$, and

k_1 and k_2 depend on the initial conditions p_0 and p_{-1}. Thus,

$$p_0 = k_1 + k_2 \text{ and } p_{-1} = \frac{k_1}{c_1} + \frac{k_2}{c_2}.$$

If $1+4a<0$ (i.e. $a<-\frac{1}{4}$), c_1 and c_2 are complex conjugates, $c_1 = re^{i\theta}$, $c_2 = re^{-i\theta}$, where $r^2 = -a$ and $2r\cos\theta = 1$ so that $\cos\theta = 1/2\sqrt{-a}$.
Then

$$\begin{aligned} p_t &= k_1 c_1^t + k_2 c_2^t \\ &= r^t \left[\ k_1 + k_2 \ \cos t\theta + i \ \ k_1 - k_2 \ \sin t\theta \right] \\ &= r^t \left[p_0 \cos t\theta + \left(\frac{2ap_{-1} + p_0}{2r\sin\theta} \right) \sin t\theta \right] \end{aligned}$$

on eliminating k_1 and k_2.
So

$$\begin{aligned} p_t &= r^t \left[p_0 \cos t\theta + \left(\frac{2ap_{-1} + p_0}{\sqrt{-4a-1}} \right) \sin t\theta \right] \\ &= \alpha r^t \sin(t\theta + \beta) \end{aligned}$$

for some constants α and β that depend on a and the initial conditions.
The sine function has the property that $\sin(t_0\theta + \beta) = \sin(t_0\theta + 2\pi + \beta)$ for some t_0, which is equivalent to a cycle. To identify the period of the cycle T, we note that we would require

$$(t_0 + T)\theta + \beta = t_0\theta + 2\pi + \beta$$

i.e.

$$T = \frac{2\pi}{\theta}.$$

Thus, p_t follows a cycle with period:

$$T = \frac{2\pi}{\theta} = \frac{2\pi}{\cos^{-1}(\frac{1}{2\sqrt{-a}})}$$

If $a = -1$, then $T = 6$ years. Also, if $a = -1$ we note that, consistent with a six year cycle, $p_t + p_{t-3} = 0$.

We note also that the magnitude of r determine whether the cycles have an increasing $(r > 1)$, decreasing (r < 1) or constant (r = 1) amplitude.

Model based on forecasting and rating formula

In this section, we consider how the use of certain premium rating formulae can lead to damped sinusoidal variations in premiums, loss ratios and solvency ratios even if the claims process does not originally contain such elements. The result again would be the phenomenon of the underwriting cycle. The discussion here is based on the model of Balzer and Benjamin (1980)[3].

An intrinsic feature of insurance systems is the delay before claims are notified and settled. In some classes of business, 25% of the incurred claims may be unreported and/or unpaid after two years, while the situation could be more extreme with long-tailed classes of business like liability insurance.

We let C_t be the claims incurred for year t, and $1-e$ be the proportion of premiums absorbed by expenses, so that:

$$p_t = eP_t - C_t. \quad (5)$$

For the fixing of P_t, we shall analyze the effects of a 'wait and see' strategy. We shall relate P_t to B_t, the base premium for year t, and include (an element of profit-sharing so that premiums are reduced in year t, if recent business has been profitable to the insurance company. In practice, most insurers would experience difficulties in having final figures from year $t-1$ available for use in year t. Also, they may be a sufficient number of unpaid claims to render those figures undesirable for the purposes of purposes of profit-sharing feedback. The 'wait and see' or time-delayed strategy would be equivalent to saying that, for L time periods after the premium is paid, the accumulated surplus is unreliable and so for year t the value from year $t-L$ should be used

for the profit sharing 'feedback' formulae, i.e.,

$$P_t = B_t - dS_{t-L} \quad 0 < d < 1 \quad (6)$$

So, from equations 5 and 6 we have

$$p_t = kB_t - C_t - deS_{t-L}$$

and, from equation 1, then

$$S_t - S_{t-L} + deS_{t-L} = A_t \, (7)$$

where $A_t = eB_t - C_t$.

Equation 7 is a difference equation for S_t which can be solved to determine P_t via equation 6.

We note that if the solution for S_t converges as $t \to \infty$ to a specific value S and A_t similarly converges to A, then, in the limit

$$S = \frac{A}{de}. \, (8)$$

If we require S > 0 then we would simply require $A > 0$ (or $eB > C$). If the sequence converges in the long run, it will converge to a positive value if, in the long run, the amount of base premium left after deducting expenses is greater than the claim amount. Of course, this does not guarantee convergence. We note that $A = 0$ would lead to a steady state solution of S = 0, if convergence occurs.

We follow Balzer and Benjamin (1980)[3] and consider some specific choices for L.

If $\mathrm{L} = 1$, equation 7 becomes

$$S_t - mS_{t-1} = A \text{ where } m = 1 - de \quad (9)$$

With $S_0 = 0$, the solution is

$$S_t = \sum_{j=0}^{t-1} A_{t-j} m^j = \sum_{j=0}^{t-1} (eB_{t-j} - C_{t-j}) m^j \quad (10)$$

If $L = 2$, equation 7 becomes

$$S_t - S_{t-1} + deS_{t-2} = A_t \quad (11)$$

A trial solution of the form $S_t = x^t$ yields the quadratic $x^2 - x + q^2 = 0$ where $q^2 = de$, which has roots

$x_{1,}x_2 = 1 \pm i\sqrt{4q^2 - 1}/2$ assuming that $4q^2 > 1$. For convenience, we rewrite x_1 and x_2 as $x_1 = qe^{i\varphi}$ and $x_2 = qe^{-i\varphi}$ and $\tan\varphi = \sqrt{4q^2 - 1}$. Then with $S_0 = 0$, the solution to 11 becomes, after some algebraic simplification,

$$S_t = \sum_{j=0}^{t-1} A_{t-j} q^j \frac{\sin(j+1)\varphi}{\sin\varphi} \quad (12)$$

Typical values of e and d might be 0.8 and 0.5 so that m = 0.6, q = 0.6325 and φ = 0.659.

Some insight can be gained by observing the reaction of accumulated surplus to a single pulse of incurred claims, C_1.Consequently we put B_t = 0 and C_2 = C_3 = ... = 0, leaving C_1 = X, non-zero and positive. Under these conditions, for $L = 1$,

$$S_t = -m^{t-1}.X = -(0.6)^{t-1} X$$

which involves a simple decay factor of 0.6 per annum.

For L = 2,

$$S_t = -q^{t-1}\left(\frac{\sin t\varphi}{\sin\varphi}\right) X = \frac{-(0.6325)^{t-1}(\sin 0.659t)X}{0.612}$$

which is an oscillatory result with a period $T = 2\pi/\varphi = 9.5$ years and a decay factor of 0.6325 per annum.

For the case L = 1, the dynamic response of S_t to the isolated group of unpredicted claims is satisfactory although the effects of this disturbance still take approximately seven periods to be eliminated (for the case m = 0.6).

When the delay L is increased to two periods, the responses oscillatory and overshoots. No recovery of the loss is attempted for two periods. Then it is over-collected in the next four periods, resulting in the insurer having to repay some of it in the following periods. This is not a situation with which insured or insurer would be happy. The overall settling time is extended by about one or two periods relative to the L = 1 case (Balzer and Benjamin,1980)[3].

It is a general principle of control engineering that the introduction of time delays into a feedback loop leads to instability. When L = 5,

numerical experiments with equation 7 show that the system becomes completely unstable watts ever-increasing oscillations in S_t. With S_t diverging as $t \to \infty$, it is clear that one or other of the parties to the contract would withdraw from the arrangement rather than suffer these dramatic oscillations.

The value of L does not necessarily imply a delay of L years. The use of quarterly feedback and a delay time of two years would correspond to L = 8, which again leads to high instability.

It is noteworthy that these particular results are quite general, and are independent of the type of insurance and the choice of base premiums. Further, stability and instability are properties of the system itself and are not related to the nature of the particular disturbance input we have used as an illustration.

These results have arisen from a positive 'spike' of unexpected claims. The insured may be more interested in the effect of lower than expected claims. This can be| similarly analyzed by considering the effect of a negative X as input.

Dagg (1995)[8] has exploded the properties of the model further by numerically analyzing the results for some more complicated cases, as follows.

Example 1

Consider *d=0.5* and *e=0.8* as before, and the effect of a stream of higher than expected claims i.e. $B_t = 1$ and $C_t = 1$ for each 1. Since $eB_t < C_t$, we would expect that, if convergence occurs, it leads to a negative long-run value. The results as shown in Figure1. We note that the amplitude of oscillation increases with the length of the lag, *L*, and that for $L = 1$,...4 the oscillations appear to be reducing over time and tending to a limit of about -0.5, as determined by equation 8. It is apparent that for L = 5 the curve is becoming increasingly unstable.

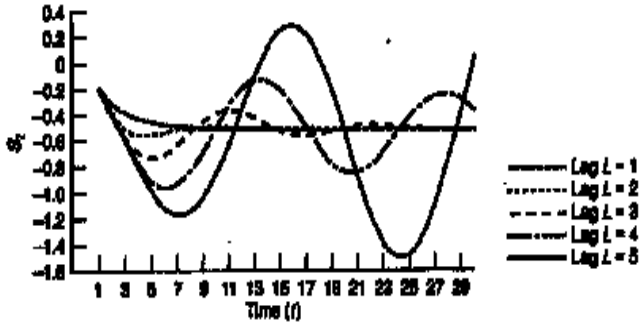

Fig. 1: Plot of accumulated surplus against time

Example 2

We consider $B_t = 1$ and $C_t = 1 + \sin(\pi t/3)$ so that the claims vary sinusoidally with a period of six years and upper and lower limits of 2 and 0 respectively. The patterns in Figure.2 for S_t are not as consistent as for Example 1. There is evidence that the amplitude increases with the delay L, but there is no clear evidence of convergence. We note that the increased complexity of the input has led to a more complex output.

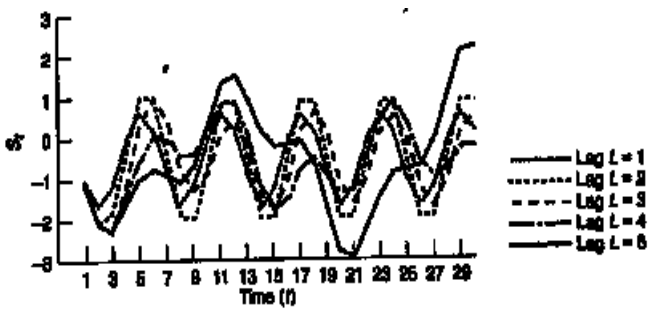

Fig 2. Plot of stimulated surplus against time.

REFERENCES

[1] Ackman, R. C., Green, P.A.G. and Young, A.G. (1983) **Estimating Claims Outstanding**. General Insurance Monograph. Actuarial Education Service, Oxford , UK.

[2] Balzer, L.A. (1982) **Control of Insurance Systems with Delayed Profit/Loss Sharing Feedback and Persisting Unpredicted Claims**. *Journal of the Institute of Actuaries*, Vol. 109, pp. 285-316.
[3] Balzer, L.A. and Benjamin, S. (1980) **Dynamic Response of Insurance Systems with Delayed Profit/Loss Sharing Feedback to Isolated Unpredicted Claims**. *Journal of Institute of Actuaries*, Vol.107, pp. 513-728.
[4] Benjamin S. (1989) **Driving the Pension Fund**. *Journal of the Institute of Actuaries*, Vol.116, pp. 717-735.
[5] Berger, L.A. (1988) **A Model of the underwriting Cycle in the Property/Liability Insurance Industry**. *Journal of Risk and Insurance*, Vol. 55, pp 298-306.
[6] Coutts, S M. (1984) **Motor Insurance Rating, an Actuarial Approach**. *Journal of the Institute of Actuaries*. Vol 111, pp 87-148.
[7] Cummings, J D. and Outreville, J F. (1987) **An International Analysis of Under- writing Cycles in Property-Liability Insurance**. *Journal of Risk and Insurance*. Vol 54, pp 246-262
[8] Dagg, R.A. (1995) **Delays in Insurance Systems and Mathematical Models of the Underwriting Cycle**. Department of Actuarial Science and Statistics, City University London.
[9] Daykin, C.D., Pentikainen, T. and Pesonen, M. (1994) **Practical Risk Theory for Actuaries**, Chapman and Hall, London.
[10] Lamaire, J. (1985) **Automobile Insurance: Actuarial Models**. Kluwer-Nijhoff, Hingham, USA
[11] Rantala, J (1988) **Fluctuations in Insurance Business result. Some Control Theoretic Aspects**. Transactions of the 23rd International Congress of Actuaries, Vol. R pp. 43-78
[12] Taylor, G.C. (1987) **Control of Unfunded and Partially Funded Systems of Payments**. *Journal of the Institute of Actuaries*, Vol. 114, pp 371-392
[13] Vandebroek. M. (1990) Pension Funding and **Optimal Control**. Mitteilungen der Vereinigung Schweizerischer Versicherungsmathematiker, pp 313-325
[14] Venezian, E.C. (1985) **Rate-Making Methods and Profit Cycles in Property and Liability Insurance** *Journal of Risk and Insurance*, Vol 52, pp. 477-500

Power plants automation and control using PLC tehnology

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Abstract: This paper describes the Advanced System Simulator ASIMA that uses a microprocessor for its internal functions. In the existing configuration, a Siemens Simatic S7 300 is used to study different the control functions. The automatic operating of a Conveyor Charging System is illustrated in the paper taking in account the control scheme..

1. Introduction

Power plants control and automation is always a challenge for industry because electric power has such an important roll in the development of civilization. Upgrading from first automation systems (electromagmetic relays - cable logic) to modern systems that use Programmable Logic Controllers (PLC) is an important stage in the development of automation systems used in power engineering (generation, transport, distribution, consumption), followed by cost reduction.

2. Programmable Logic Controllers

Process control systems have a hardware structure (and an aditional software component) that assures stability, accuracy and good transitions. These performances are realized by interconnection of PLCs and a central digital language. The Programmable Logic Controller is used for automation of industrial processes and replaces the circuits of sequential command in cable logic.

A PLC (figure 1) is an example of a real time system since output results must be produced in response to input conditions within a bounded time, otherwise unintended operation will result. These structures can be connected with different peripheral devices: chart instruments, sensors, brakers, engines etc.

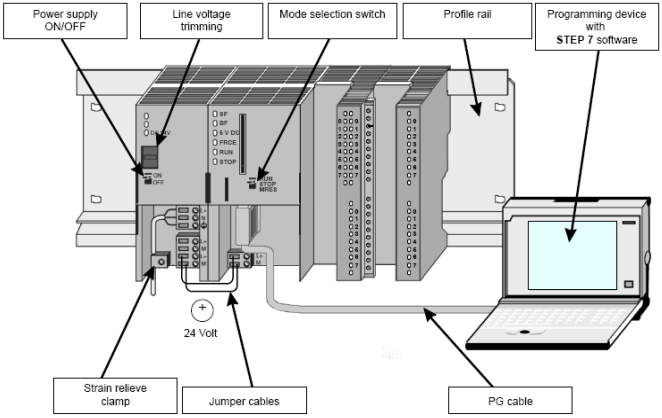

Figure 1. Structure of automation system Siemens S7-300

Compared to the systems with electromagnetic relays, PLCs have the next advantages:

- The connections number is reduced with 80%;
- Collapses are detected automatic, in a very short time;
- PLCs can be connected to computers which makes it easier to modify the programming sequence of the system, without changing the connections between the PLC and the system;
- The cost for implementing a control system is reduced;
- PLCs realize distributed control of the systems; they are connected to a DCS (Distributed Control System) most of the time.

3. Description of System Simulator ASIMA

The Advanced System Simulator ASIMA developed by ELWE is an advanced version of the System Simulator ASIMA (figure 2) which, for many years, has been very reliable and copied several times. The new version sets new standards:

- The System Simulator ASIMA can be used in combination with all PLC products that are equipped with

standard signal levels for digital (24 V DC) and analog (0 ... 10 V DC) inputs and outputs.

- 33 masks are subdivided into threemask sets, corresponding to the level of the PLC programs that are to be designed, according to the assignments. The range of assignments allows you to study the field of automation without previous knowledge starting with small control circuits and also upmarket solution strategies by using the full scale of functions offered by large programmable logical control systems.
- The front panel is clearly structured containing the connection panel for the PLC connection, a demonstration panel to hold a mask with a large image of the system and a system specific labelled control panel.

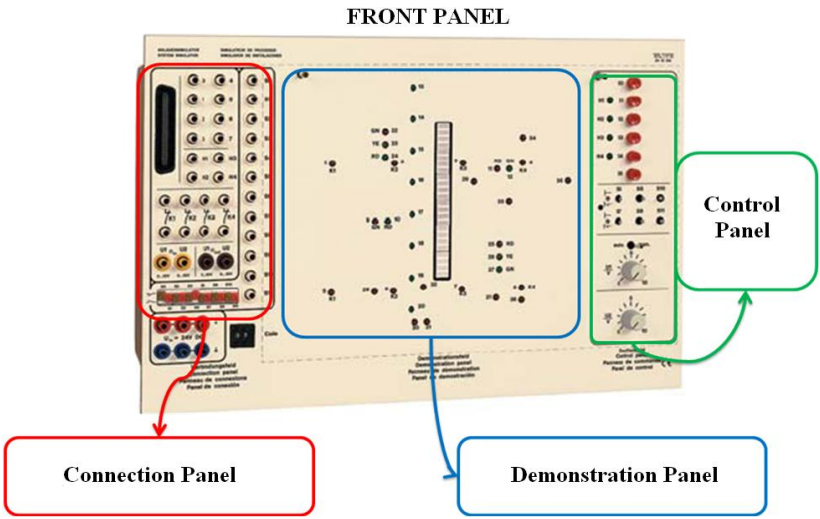

Figure 2. System Simulator ASIMA

- Due to the use of amicroprocessor, up to 12 digital inputs and outputs, 2 analog inputs and outputs and 2 potentiometers are clearly assigned to the control panel as well as the sensors and actuators of the system image on the applied mask.

- Many system simulation processes run automatically due to the microprocessor, so that the system functions can be clearly observed. It also facilitates testing the designed PLC programs.
- The simulator can be connected to the PLC either practically via individual connection cables and 4-mm safety sockets or alternatively via a flat-ribbon cable and the 50-pin connector without set-up times.
- 4 relay contacts allow you to connect solenoids for safe control of illustrated actuators as in real applications.
- All individual switch and sensor functions can be physically selected as a make or break contact with a change-over switch to allow a connection to the PLC which is safe to line breakage as in real applications.
- A microprocessor-controlled LED strip with 24 segments indicates levels, movements, positions etc. in the connection scheme on the applied mask.
- 36 red, yellow and green LEDs are assigned to the digital inputs and outputs by the microprocessor according to the selected system on the appropriate mask and indicate the illustrated sensor and actuator states.
- Analog variables of a system function, such as the unload speed of a silo, the flow rate of a pump or setpoint values can be changed either with the potentiometer on the control panel or with analog signals from the PLC

4. Control simulation of a Conveyor Charging System, implemented on ASIMA simulator

The figure 3 presents the mask for a system of 4 conveyors. Conveyors 1 and 2 are for feeding and 3 and 4 are for discharge. Each conveyor is driven by a motor (M1 - M4). These are connected to the switches S1 - S4 that are controled by one ON button(S1 - S4). The operating state of the four conveyors is indicated by its pilot lamp (H1, H2, H3 and H4). With pushbutton S0 (all off) the entire system is switched off, independent of the operating status. The feeding conveyors can also be switched off with pushbutton S5. Conveyors 1

and 2 feed the two discharge conveyors 3 and 4 through two ducts that overlap. One of the two ways of feeding is chosen by the flap position:

a. If only one discharge conveyor is running, then only one feeding conveyor can be switched on (the flap position allows feeding only for the working conveyor);

b. If both of the discharge conveyors are working, then both feeding conveyors need to be switched on (the flap position is central).

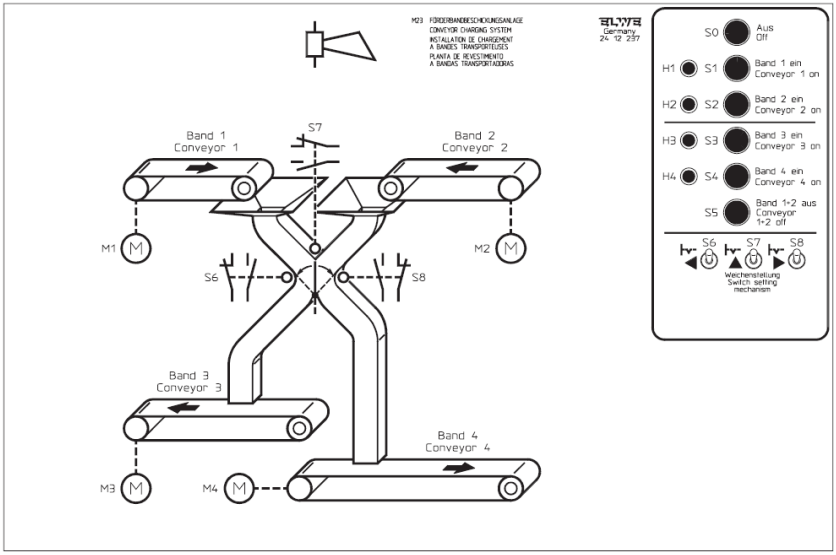

Figure 3. Mask for a Conveyor Charging System

Functional description a: Only one feeding conveyor can be switched on if the discharge conveyor 3 or 4 is running. The flap position is detected by a cam on the flap shaft and the limit switches S6, S7 and S8.

Locking conditions for functional description a:

$$K1 = S6 \cdot \overline{K2} \cdot K4 + S8 \cdot \overline{K2} \cdot K3 + S7 \cdot \overline{K2} \cdot K3$$

$$K2 = S6 \cdot \overline{K1} \cdot K4 + S8 \cdot \overline{K1} \cdot K3 + S7 \cdot \overline{K1} \cdot K4$$

$$K3 = \overline{K4}(S7 + S8)$$

$$K4 = \overline{K3}(S6 + S7)$$

Current flow chart for functional description *a* is shown in figure 4:

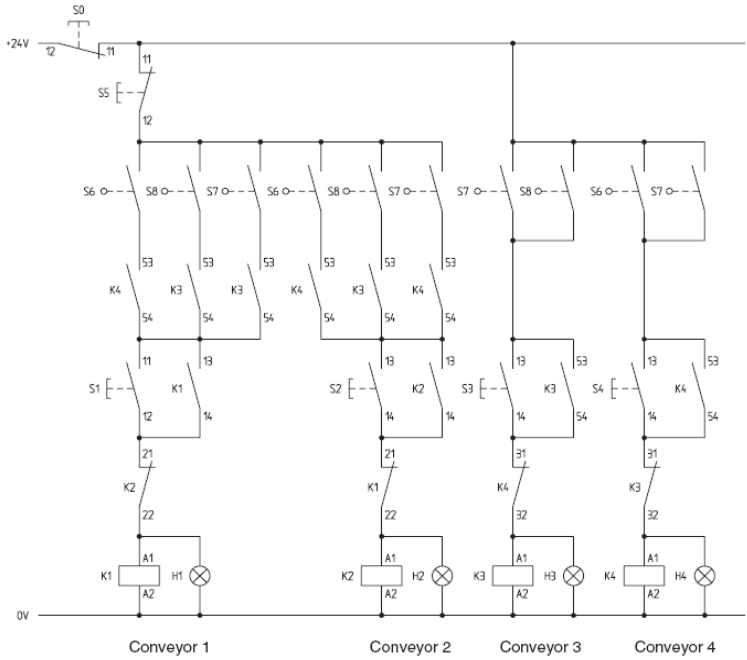

Figure 4. Current flow for functional description a

Functional description b: Both discharge conveyors and then both feeding conveyors can be switched on when the flap is on centre position. Due to the uneven surroundings or operating conditions,

stoppages caused by jammed limit switches S6, S7 or S8 occasionally occur. Therefore, the limit switch functions must be monitored, so that none of the conveyors can be switched on and an acoustic signal sounds when two limit switches are simultaneously “activated".

Locking conditions for functional description b:

$$K1 = S6 \cdot K4 \cdot \overline{K2} + S7 \cdot K3 + S8 \cdot K3 \cdot \overline{K2}$$

$$K2 = S6 \cdot K4 \cdot \overline{K1} + S7 \cdot K4 + S8 \cdot K3 \cdot \overline{K1}$$

$$K3 = S7 + S8$$

$$K4 = S7 + S6$$

$$K5 = S6 \cdot S7 + S6 \cdot S8 + S7 \cdot S8 = S6(S7 \cdot S8) + S7 \cdot S8$$

Current flow chart for functional description b is shown in figure 5:

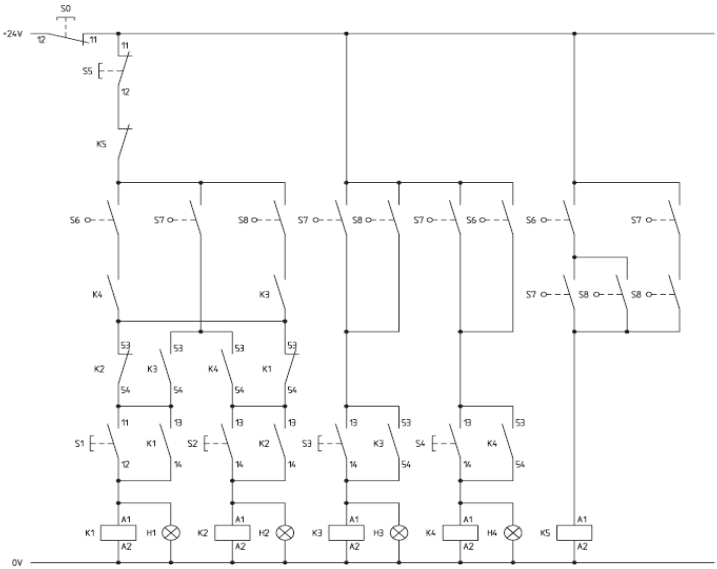

Figure 5. Current flow for functional description b

Current flow chart for the power supply unit is presented in the following figure:

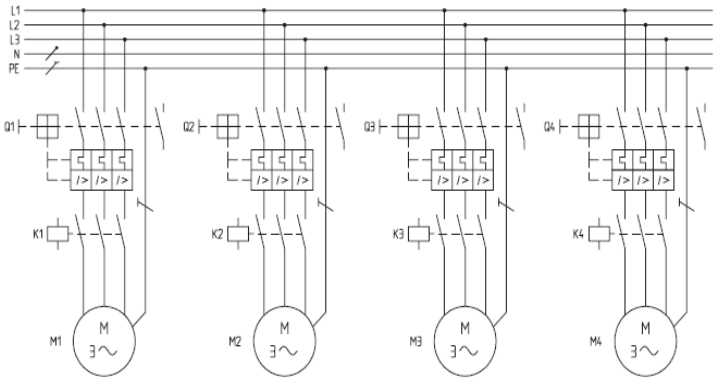

Figure 6. Current flow chart for the power supply unit

5. Conclusions:

The ELWE Advanced System Simulator ASIMA replaces a vast number of expensive systems or function models.

Although the system has applications that are independent of the PLC (Simatic S7 300), it enables different languages (STL (statement list), LAD (ladder diagram), FUB (function block), ST(structured text)) and allows extenting the commands and the addressing of input and output variables.

REFERENCES:

[1], * * * , Experimental Manual Controlling of System Simulators (ASIMA) with PLC, ELWE-Technik Dr. Bagh GmbH, Elwestraße 6, D - 38162 Cremlingen / Schandelah, 2005

[2], *Mihoc, D., Iliescu, S.St., Făgărăşan, Ioana, Ţăranu,Gh., Matei,G.*, Automatizarea sistemelor electro- şi termoenergetice, Ed. Printech, Bucureşti, 2008

[3], *Arghira, Nicoleta, Costianu, D.R., Făgărăşan, Ioana, Iliescu, S. St.* - Automatizarea şi conducerea proceselor din centralele electrice folosind automate programabile, Sesiunea de comunicări ştiinţifice studenteşti, mai, 2008

DIAGRAMS, FUNCTIONAL AND CONSTRUCTIVE SOLUTIONS OF THE STABILITY CONTROL SYSTEMS FOR AUTOMOTIVE APPLICATION

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Abstract: *The modern car must correspond to certain requirements regarding the driver safety and more than that it must convince the potential buyer that it will offer him the safety he is so much in need of. For that reason the number and the diversity of the safety systems have increased so fast. Despite all this for the time being it can not be stated that a particular vehicle is totally safe and it can come through any difficult situation. Because of that the research in the field is carried on and the number of those who propose solutions mend to improve the vehicle behavior is getting bigger.*

Key words: active safety, vehicle, control

1. Introduction

There are three issues in the research of the vehicle stability control systems. These issues include the observer design for estimating the vehicle states difficult to measure directly, the vehicle stability controller design for the lateral motion and the actuator control for the acquisition of the yaw moment through the distribution of the braking forces. In this study, it is investigated the controller design issue and left other for future study. Shibahara [l] proposed a method called "I-method" for the vehicle stability controller design and discussed how the yaw moment generated by the lateral force of the front and rear wheels changes in response to the vehicle sideslip angle. Matsumoto [2] reported the yaw rate model following control with the yaw rate

feedback but fail to advance considerable performance improvement on the low friction road. Alberti [3] proposed a control strategy for controlling the sideslip rate in addition to the yaw rate. Inagaki [4] analyzed the stability of vehicle motion by the phase-plane of the sideslip angle and proposed a brake forces control law depending on the yaw moment. Shibahara pointed out the instability of vehicle is caused by the decrease of the restoring yaw moment as the vehicle sideslip angle increases. In addition to the previous analytic approach, many researchers have proposed the vehicle stability controllers based on the nonlinear control design methodologies. Recent studies based on the adaptive control, H-∞ control and |i-synthesis have been proposed [6]. Yoshimi[7] proposed the sliding mode control and Tohru [8] designed the sliding mode controller with the sideslip angle and yaw rate feedback. Commercial systems including the VDC (Vehicle dynamic control system) of BOSCH, the VSC (Vehicle stability control system) of Toyota, and the ESP (Electronic stability program) of ITT et al. have been developed mainly based on the experimental knowledge.

In [13] the direct yaw moment controller (DYC) is used, in which the yaw moment on the vehicle is supplied directly. DYC is the approach of the controller design for maintaining the handling stability by means of controlling the longitudinal and lateral vehicle motion. The traction force, the braking force and the steering angle can generate the desired yaw moment input in general. In [13] it is assumed the yaw moment input can be realized through the distribution of the braking force at individual wheels because this approach is simple and effective.

As the vehicle stability control system guarantees the vehicle stability by means of controlling the vehicle motion corresponding to the driver's will, the controller should use the reference model that could express the driver's will. Most of previous studies have used the yaw rate reference model with the yaw rate feedback that could be measured easily. Though the vehicle with the yaw rate feedback could follow the reference yaw rate on the low friction road such as ice, it could not trace the slip angle and need significant driver's steering efforts. The latest research proposed the slip angle feedback; these have the limitation for the real application because of the requirement of the differentiation of the measurement. [7]

In [11] the authors propose a vehicle stability controller based on the multiple siding mode control approach in order to overcome the

uncertainty and the nonlinear behavior of the real vehicle. The proposed controller feeds back both the sideslip angle and makes the sideslip angle track the desired one so that it guarantee the vehicle stability on various driving conditions. It is shown the feasibility of the proposed controller through computer simulations based on a nonlinear fifteen degree-of-freedom vehicle model with the UA tire model, which has been verified through the experimental vehicle test.

In [10] in contrast to a conventional ESP, not only the yaw motion and the vehicle side slip angle but also the lateral motion with respect to the driving lane is stabilized.

A nonlinear control concept based on online design of a Riccati-controller is used to obtain a stabilizing steering angle. In order to make use of the maximally available side force and to reduce the effects of changes in road friction, the side slip angle at the wheels is limited based on a nonlinear side force model.

Based on the nominal controller a range of reasonable steering angles is defined to assess, whether the driver steering is adequate or an intervention by the PVD System is necessary to stabilize the vehicle.

In [9] it is developed vehicle side slip angle and tire side slip angle estimation logic. Also, it is necessary to estimate road surface friction coefficients in order to respond to various road surfaces. Furthermore, the vehicle's yaw moment and side slip angle are corrected with the optimal 4-wheel slip control logic. All this is created using data like steering angle, longitudinal acceleration, lateral acceleration, yaw rate and wheel velocity.

The method for estimating vehicle side slip angle is a logic that can estimate forces on each tire by combining the conventional two tire vehicle model and nonlinear tire model.

The μ estimation logic is the most important issue in this research. The aim is to estimate the limit conditions in the worst possible scenario and in order to achieve that four separate calculations are made.

In [12] the aim is to develop a generic controller design methodology that can be used with existing chassis subsystems controllers.

The controller monitors the driver's demands and the state of the vehicle motion to produce safe and comfortable motion by actuating the drive, steering, suspension and brake subsystems. The supervisor is

aware of vehicle parameter changes and can adapt the controller accordingly.

The sliding mode controller can provide excellent setpoint tracking performance in terms of response speed, overshoot and settling time. In terms of robustness, there are limits on what can be achieved. These limits are influenced by the friction force available at the wheel and the desired setpoint to be reached by the controller. It is pertinent therefore to identify an operating envelope for the controller in terms of the friction force available at each wheel and the maximum longitudinal and lateral forces achievable.

2. Electronic Stability Program (ESP) for passenger cars

2.1. Function

The Electronic Stability Program, ESP, is a closed-loop control system integrated in the vehicle's braking system and drivetrain which prevents the vehicle from breaking away to the side. While ABS (Antilock Braking System) prevents the wheels from locking when braked and TCS (Traction Control System) prevents the driven wheels from spinning, ESP prevents the vehicle from "pushing out" of the turn or spinning out of the turn when it is steered.

Further to the benefits of ABS and TCS, ESP improves active driving safety in the following points:

- Provides the driver with active support, even in critical lateral dynamic situations.
- Enhances directional and vehicle stability even at the vehicle's physical driving limits in all operating statuses, such as full braking, partial braking, coasting, accelerating, engine drag, and load changes.
- Enhances directional stability even in extreme steering maneuvers (fear and panic reactions), resulting in a drastic reduction in the risk of skidding.
- Improved handling also at the vehicle's physical driving limits. For the driver, handling becomes predictable as a function of the driver's driving experience. The vehicle remains fully under control even in critical traffic situations.
- Depending on the situation, enhanced utilization of the friction potential between the tires and the road when ABS and TCS intervene,

and therefore improved traction and braking distances in addition to improved steerability and stability.

2.2. ESP control systems

The control of the handling characteristics at the vehicle's physical driving limits must influence the vehicle's three degrees of freedom in the plane of the road (linear and lateral velocities, and yaw velocity about the vertical axis) so that vehicle handling is adapted to the driver command and the prevailing road-surface conditions. In this respect, as shown in the block diagram, it must first be defined how the vehicle is to behave at its physical driving limits in accordance with driver command (nominal behavior), and how it actually behaves (actual behavior. In order to minimize the difference between nominal and actual behavior (deviation), the tire forces must in some way be controlled by actuators.

The overall system (figure "Overall control system of ESP" below), shows the vehicle as a controlled system, with sensors (1...5) for defining the controller input variables, and actuators (6 and 7) for influencing the motive and braking forces. Also shown are the hierarchically structured controller, comprising the higher-level vehicle dynamics controller, and the lower-level slip controllers. The higher-level controllers determine the nominal values to the lower-level controllers in the form of nominal slip. The "observer" determines the controlled state variable (float angle β).

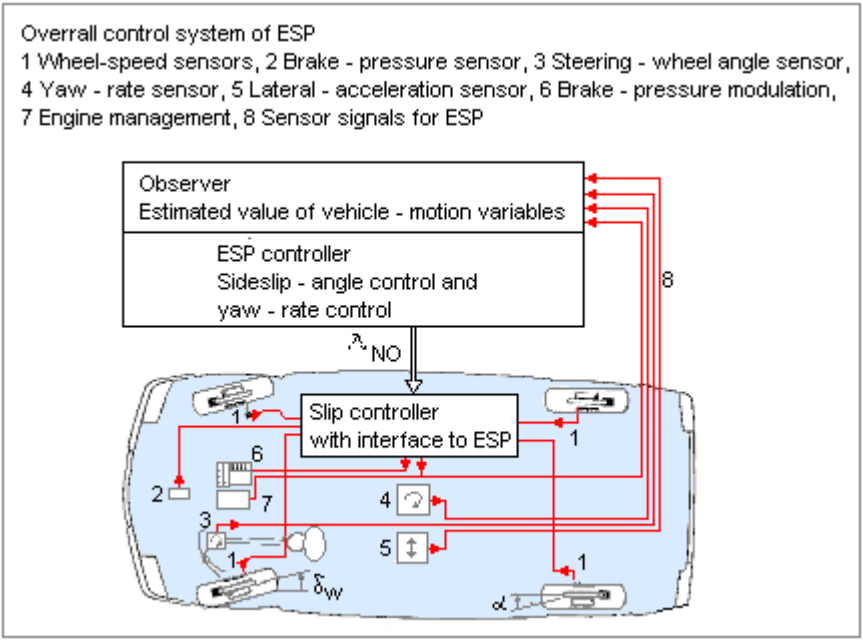

Fig. 1. *Overall control system of ESP*

In order to determine the nominal behavior, the signals defining driver command are evaluated. These comprise the signals from the steering-wheel angle sensor (3, driver's steering input), the brake-pressure sensor (2, desired deceleration input), and the engine management (7, desired drive torque). Apart from the vehicle speed, the calculation of the nominal behavior also takes the coefficients of friction between the tires and the road into account. These are calculated from the signals sent by the wheel-speed sensors (1), the lateral-acceleration sensor (5), the yaw-rate sensor (4), and the brake-pressure sensor (2). Depending on the control deviation, the yaw moment, which is necessary to make the actual-state variables approach the desired-state variables, is then calculated.

In order to generate the required yaw moment, it is necessary for the changos in desired slip al the wheels to be determined by the vehicle dynamics controller. These ore then set by means of the lower

brake-slip and traction controllers together with the "brake-hydraulics" actuator (6), and the "engine-management actuator" (7).

The system relies on tried and proven ABS and TCS components. The TCS hydraulic modulator (6), which is described elsewhere, permits high levels of dynamic braking of all wheels throughout the complete temperature range encountered.

The necessary engine torque can be set by means of the engine management (7) and the CAN interface, so that the traction-slip values at the wheels can be adjusted accordingly.

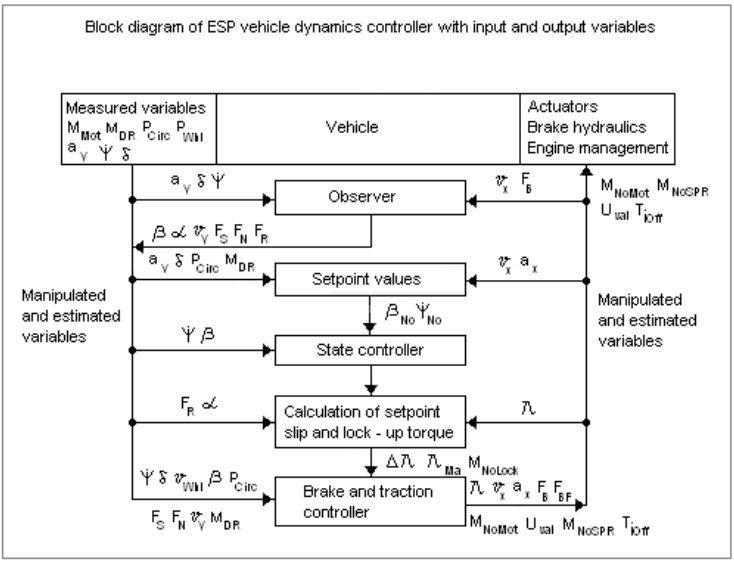

Fig. 2. *Block diagram of ESP vehicle dynamics controller*

The items which appear in the diagram above are listed below:

a_x Estimated vehicle longitudinal acceleration

a_y Measured vehicle lateral acceleration

D_λ Tolerance band of drive-slip difference between driven wheels

F_B Tire braking force

F_{BF} Steady-state (filtered) braking force on the tire

F_N	Vertical tire force (normal force)
F_R	Resultant tire force
F_S	Lateral tire force
M_{DR}	Driver – input engine toque
M_{Mot}	Actual engine torque
M_{NoMot}	Nominal engine torque
M_{NoLock}	Nominal brake-locking torque at the driven wheels
M_{NoSPR}	Nominal engine-torque reduction by spark retard
p_{Circ}	Brake-circuit pressure induced by the driver
p_{Whl}	Pressure in wheel-brake cylinder
$T_{.jOFF}$	Injection blank-out period
U_{val}	Valve-triggering mode
υ_{Vhl}	Measured wheel speed
υ_x	Vehicle linear velocity
υ_y	Vehicle lateral velocity
α	Tire slip angle
β	Vehicle float angle
δ	Steering-wheel angle
λ	Tire slip
λ_{Ma}	Average nominal traction slip of the driven wheels
$\dot{\Psi}$	Yaw velocity

3. Vehicle Stability Assist

The Vehicle Stability Assist (VSA) system adds side slip control to ABS and TCS systems. This system controls sudden changes in vehicle behavior, giving the driver the time to keep control of the situation. When driving in the rain or on snow, the system stabilizes the vehicle, reducing counter-productive driver tension.

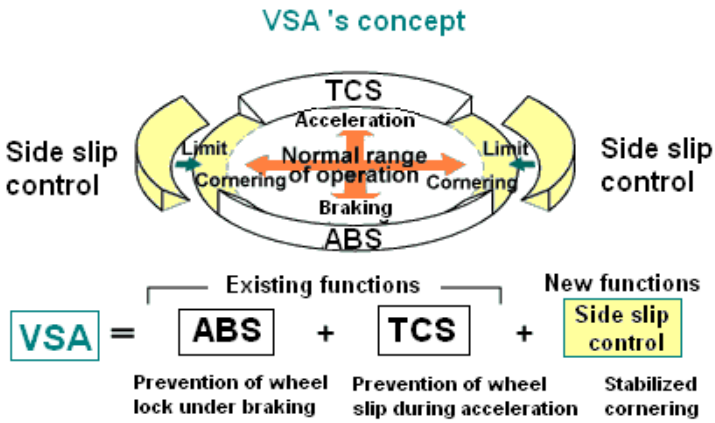

Fig. 3. VSA's functioning principle

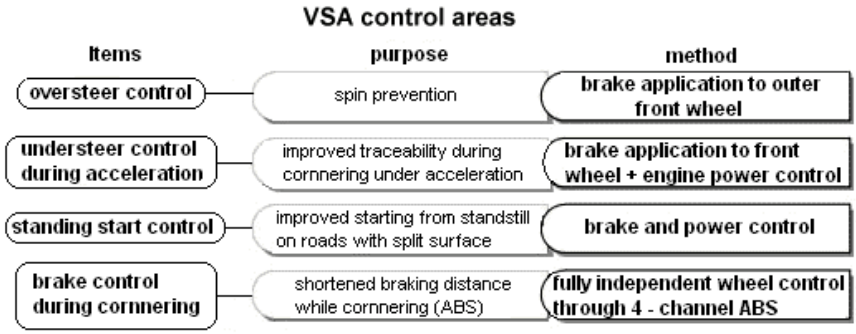

Fig. 4. *VSA's control areas*

The system controls the oversteer tendency of the vehicle by braking the outer front wheel thus generating an outward moment. The cornering force at the front is thus reduced, decreasing the spin generating moment and stabilizing vehicle behavior.

When the car's cornering line widens under excessive throttle application, the system intervenes by reducing engine torque and, if necessary, by braking the inside front wheel. This creates an inward moment helping the car trace the line originally intended by the driver.

The yaw rate intended by the driver (target yaw rate) is calculated according to lateral acceleration, steering angle and vehicle speed. If the actual yaw rate exceeds or is below the target, the VSA system intervenes.

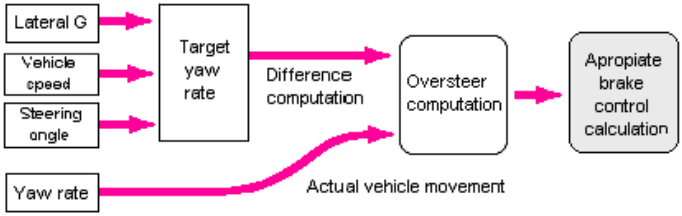

Fig. 5. *Oversteer control strategy*

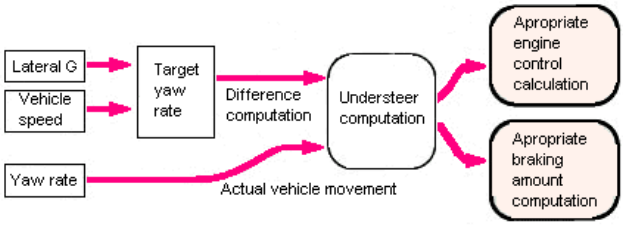

Fig. 6. *Understeer control strategy*

3.1 . Standing Start Slip Control

When accelerating on a split surface with different grip coefficients, engine torque is usually transmitted to the wheel with the lowest grip level, resulting in traction loss. By braking the wheel with the lowest grip, greater torque is provided to the wheel on the other side, ensuring quick, powerful acceleration.

3.2. Braking control under cornering

When high cornering forces are detected, ABS automatically switches to the 4-channel mode (3-channel mode when in a straight line or when cornering at lower speeds). Taking advantage of the weight transfer during cornering, the system applies a higher brake pressure on the outer rear wheel, improving braking performance.

3.3. System Configuration and Principal of Operation

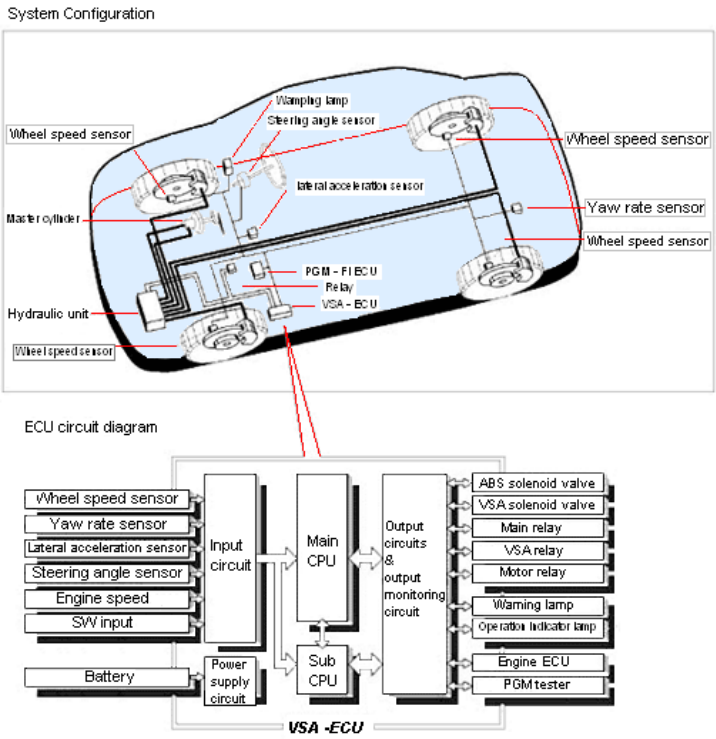

Fig. 7. *System configuration*

4. Conclusion

The impact of the control systems to the fluency of the traffic under safety is in continuous growth and their evolution must be linked to the real necessities of the driver so that the control system and the human being act like a single system.

In this respect the control systems the driver comes in contact with must be discreet and they must guess the driver's intention and act immediately eliminating thus the human imprecision and uncertainty.

All of these modern systems represent a plus of safety for the driver providing him a real support in different difficult driving situations.

REFERENCES

[1] Shibahata, Y., Shimada, K., and Tomari, T. (1992). The Improvement of Vehicle Maneuverability by Direct Yaw Mment Control. *Proc. Of the International Symposium on Advanced Vehicle Control, pp.* 452-457.

[2] Matsumoto, S. et al, (1992). Brake force distribution control for improved vehicle dynamics. *Proc. of the International Symposium on Advanced Vehicle Control*, pp. 441-446.

[3] Alberti, V. et al, (1996). Improved driving stability by active braking of the individual wheels, *Proc. of the International Symposium on Advanced Vehicle Control*, pp. 717-732.

[4] Inagaki, S. et al, (1994). Analysis on vehicle stability in critical cornering using phase- plane method, *Proc. of the International Symposium on Advanced Vehicle Control*, pp. 287-292.

[5] Ken, K., Masaki, Y., Yoshiki, F., and Shoji, I. (1996). Vehicle Stability Control in Limit Cornering by Active Brake. *SAE 960487*.

[6] Masao, N., Yutaka, H., and Sachiko, Y., (1997). Integrated Robust Control of Active Rear Wheel Steering and Direct Yaw Moment Control. *Vehicle System Dynamics*, Vol. 28, pp. 416-421.

[7] Yoshimi, F., and Masato, A. (1996). On-Board-Tire-Model Reference Control for Cooperation of 4WS and Direct Yaw Moment

Control for Improving Active Safety of Vehicle Handling. *Proc. of the International Symposium on Advanced Vehicle Control*, pp. 507-526.
[8] Thoru, Y., Tomohiko, A., Tetsuro, B., Haruki., O., and Hirotaka, M. (1998). Application of Sliding-mode Control Vehicle Stability. *Proc. of the International Symposium on Advanced Vehicle Control*, pp. 455-460.
http://www.youtube.com/watch?v=zlQXqvoFInA

RESOLVING THE CIRCULATION OF INTERN PAPER WORK AND MANAGING INFORMATION WITH DATABASE APPLICATION FOR THE PERSONAL TRAINING SECTOR

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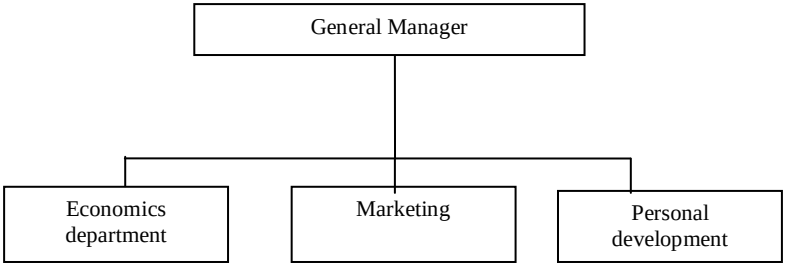
❖ Introduction

S.C. Formenerg S.A. is a training firm that organizes courses especially for the people working in the Romanian National Energetic System. It offers a variety of training courses from a variety of fields like management, marketing, maintenance and repair, projection and designing of electrical systems, marketing, IT, PR, foreign languages.

❖ Company structure

Formenerg is a medium sized firm with 54 employees and with approximately 80 partners (the teachers).

The firm is dived in 3 departments: Marketing, Economics, Personal Development.



The main training cent is located in the center of Bucharest, but Formenerg has also 4 filials in Craiova, Suceava, Constanta and Busteni and a few partnerships with hotels all around Romania in witch the training courses are hold.

- **Position on the market**

The company is one of the most successful in the energy sector, having as main clients the largest company that produce and distribute energy in Romania, like Transelectrica, Hidroelectrica & Nuclearelectrica.

The firm has also a good position in the private sector due to its international Partnerships with Dida Group, an Italian company that provides training for Enel employees.

Formenerg has approximately a number of 10.000 customers annual, with expectations of doubling that number in 2009 due to the free courses organised for free with European funding.

- **The main objectives of the application**

The General manager has decided to interconnect the three main departments with the help of an database based application, that with speed up the processing of information received and distributed to the clients.

The management wishes to have at is disposal regular reports on the number of trainees that attend a course, a monthly report showing how many people where trained and the courses that where held and also the foresight of the currents month income.

The application will also generate a number of reports that are necessary for the marketing department like:

- the number of trainees from each firm, with the period that they will be staying in the hotel, simplifying the reservation process.
- All the clients request and reservations for training courses sorted by periods of time, firms, courses, offering the marketing department a powerful tool in their market research activities

For the economical department the database application will offer foresights of
the future income, information about the sums they will need to charge each client firm, and also about the necessary payments that need to be maid to the hotels where the training courses where held

The ones who will have the most to gain will be the personal development department. They will have at their disposal reports like:

- information about each customer
- automated catalogues
- automated notifications for the clients that they must attend a training course
- automated certificates for the clients who graduate a course
- automated contracts needed before the training process begins

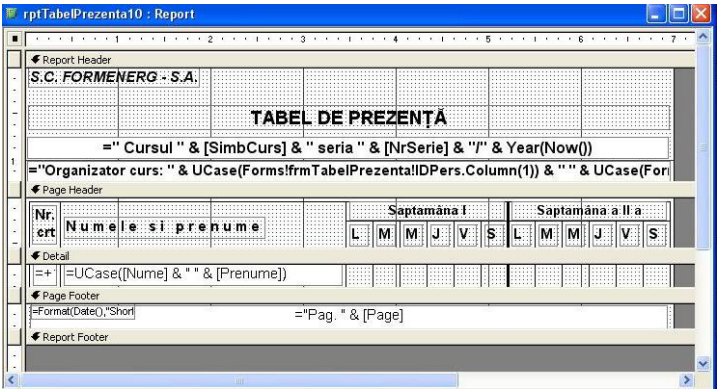
❖ **Reports**

Here are a few previews of reports from each department:

Number of trainees from each client firm

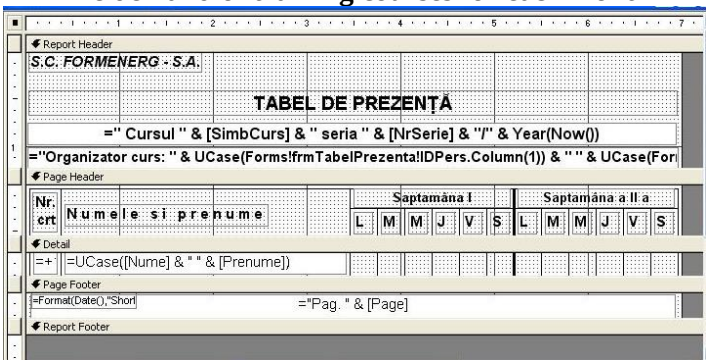
This report is used by the economics department for charging the clients with the corresponding sums for the training courses they attended.

Automated catalogue



This report, and a few otters are used by personal development department to generate a the necessary paperwork that needs to be filled out for each training course, in this a catalogue

The demand of training courses for each month



Reports like this one will be used by marketing department to serve in marketing research activities.

❖ **The structure**

The information will be stored in 17 tables, each one containing information about only one specific subject. Here is an example:

Table TblCursuri

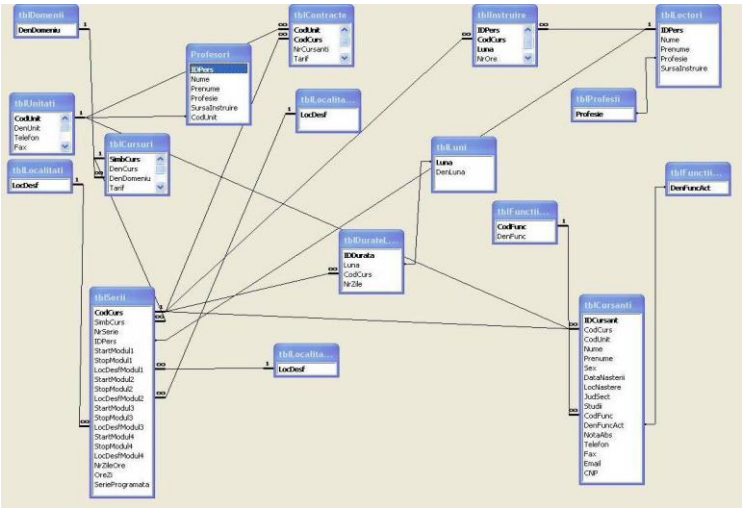
CODE	Type	LENGHT	COMMENTS
SimbCurs	Text	10	The symbol of the

			training course. This is also the primary key of the table
DenCurs	Text	245	The name of the training course
DenDomeniu	Text	75	The courses domain
Tarif	Currency	Standard	The price of 1 training day
Moneda	Text	4	Currecncy
Subcontractant	Text	50	The subcontracted firm (if that is the case
CNFPA	Yes/No		If the training course is certified by the National Comitty of Adult Training

This table stores information about each course the S.C. Formenerg S.A. can offer. All the training courses available when the application is installed, will be stored before beginning using the application, having also the possibility to ad a new course at any time.

❖ **Relationships**

For the application to work properly each table needs to have a primary key, an external key (or more than one) and to be linked to at least another table.



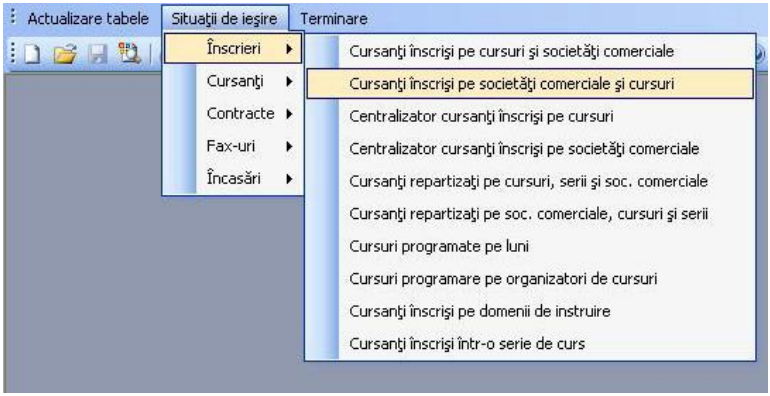
Relationships Scheme

❖

❖ **User Interface**

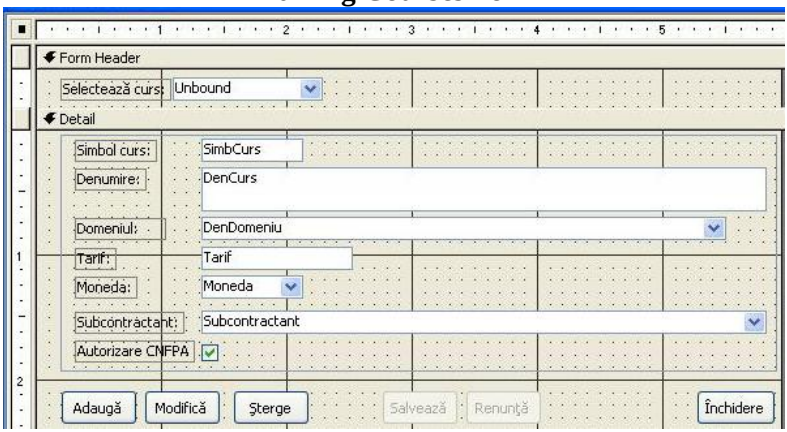
For easy access to reports and filling out data forms the main menu is divided in two: *filling out data* and *generating reports*, each with its one specific options.

The Menu



In order to populate the tables with information in a user friendly environment each element from the *filling out data* submenu has a form associated with it, like the one below.

Training Courses Form



In this particular form the employee using the application can ad for example a new training course, change existing information, or delete one of the courses.

Every form when filling out data has 4 main options:

- *Add* – for adding new information (courses clients, etc.)
- *Modify* – for modifying current displayed information
- *Delete* – for erasing current displayed information from the database
- *Close* – for closing the current form.

The Hachemeister's Algorithm for Heterogenous Portofolios

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ABSTRACT: *The Hachemeister's model is based on an econometric essence combined with one of numeral analysis, both applied on goods insurance. The specific feature of using this type of numeral analysis model given other types of model for premium establishment is the fact that takes in consideration both the evolution in time of contracts number and of inflation's effect over the value of demands showed during time and also the fact that it can be applied succesfully where we have to provide for an heterogenous risks portofolio.*

Keywords: heterogenous portofolios, theory of credibility, risk premiums

Suppose we have an insurance company making a contract for a real estate insurance. Normally, this contract covers different risks: fire, lightning, the coming up against, an outside object, earthquake, explosion, flood, burglary. The company has data about the reparations which the demands corresponding to each type of showing up in a certain year or certain type of contract of that repartion: normal repartion; -Poisson repartion; -classic binomial repartion.

These data and parameters of functions corresponding to each reparation were obtained from own experience also from special papers.

Normally, the pure risk premium should be calculated as an average of some aleatory variables having the reparation functions that we previous mentioned. Because the values of demands number corresponding to each type of risk are little, the available data can't be considered relevant for each type of risk. But we have information

regarding a history of earthquake in Romania in the last 400 years also information regarding the frequency and evolution in time of others insured risks. With the help of these data we can calculate the parameters of reparation functions previous mentioned, for example through the method of moments' identification.

Having these data (the repartion types, the parameters of repartion function etc.) can be simulated other values for the number of demands from the last ten years, data which this time will not be real but obtained through simulation on the basis of the data that we have from a bigger data base.

Using a cycle composed by a pre-established number of simulations can be established more possible values for the next year risk premium with the help of an algorithm presented in the next pages and this premium must be paid by the insured person to the company in cause.

The respective model is based on econometric essence combined with a numeric analysis one, of course, applied as part as the insurances. The particularities of using this type of premiums are considered also the evolution in time of the number of contracts, of the inflation effect aver the value of demands showed up during time and also the fact that can be also successfully applied in cases like that one we previous presented, when we have to insure an heterogenous risks portofolio.

A series of specific features of this model for different certain situations or deliberate simplifications of reality in order to obtain an easier model to use are the Bulhman model, the Bulhman-Stramb model, the Jewell model. These models either do not consider the inflation or tackle the case easier when the certain type of contract's moments or lengths of existence in portofolio suit for each insured risk.

These models belong to a part of discipline called "The numeral analysis in actuarial mathematics", part called "The theory of credibility".

The theory of credibility is a technique of establishment of premium in insurances for different risks as part of heterogenous portofolio, technique which is based on previous experience utilization regarding the way how those insured risks have increased during the years for which we have information. This technique is used especially in the case when we have less information regarding the evolution of

individual risks as part of portofolio but when we have enough information regarding evolution of the whole risks portofolio. In such cases are necessary both the scientific method's utilization and the experience to obtain in time reasonable risk premiums, both for insurer and for insured person.

Having a portofolio containing a k number of contracts for each contract being suit certain type of risk, it's obvious that one of them will be heterogenous: however, for a type of contract took individually are used informations regarding the risk's previous evolution respectively suited for that contract and the evolution of collective risk joined in portofolio. At the two types of experience will have attached for each risk a coefficient of credibility Z_j and 1 - Z_j, where Z_j is the weight suited as part of insurance company's potofolio.

When $Z_j = 0$, the individual premium will be equal with the average premium on the whole portofolio: this method is used especially for almost homogenous portofolios, being less indicated their utilization as part of some portofolios which represent a certain degree of heterogeneousness.

When $Z_j = 1$, the contract is individually estimated on the basis of just the own experience regarding the demands to cover the damages suited to the respective risk. In general, this type of information regarding the individual type of risk is reduced enough, so usually this type of estimation can't be used in practice. Also, sometimes this type of estimation is inadequate (for example, in case of a risk for which never have been registered damages, the individual premium should be zero).

So, we obtain a repartion of risk on the basis of the two types of risks: individual and collective, with the shape: $\theta_j^a = Z_j\theta_j + (1 - Z_j)\bar{\theta}$.

The theory of credibility offers methods for calculus of Z, and also of $M(\theta_j^a)$, average that should correspond to a premium paid by the insured person.

In fact, what we are interested for are especially the moments of the degree 1 and 2 for the considered risks, either they are individual or collective, because with their help can be easy established a politics of tariff for different types of contracts. Therefore, having a risk θ and observing his producing during a period of t years, for the year t+1 the used premium will be $\mu(\theta) = M[X|\theta]$.

In general, to calculate this moment is searched solutions of linear shape:

$$\mu(\theta) = c_0 + \sum_{r=1}^{t} c_r X_r \qquad (1)$$

The coefficients are obtained through regression using the method of the most little squares, being resolved a problem of the type:

$$[\min]\ M\left\{\left[\mu(\theta) - c_0 - \sum_{r=1}^{t} c_r X_r\right]^2\right\}.$$

As part of Hachemeister's model we have the next data of enter:

$$X_j = \begin{pmatrix} X_{j1} \\ \cdot \\ \cdot \\ \cdot \\ X_{jt} \end{pmatrix} \qquad W_j = \begin{pmatrix} W_{1,1} & \cdot & \cdot & \cdot & W_{1,t} \\ \cdot & & & & \cdot \\ \cdot & & & & \cdot \\ \cdot & & & & \cdot \\ W_{t,1} & \cdot & \cdot & \cdot & W_{t,t} \end{pmatrix} \qquad x = \begin{pmatrix} 1 & 1^{q_1} & \cdot & \cdot & \cdot & 1^{q_{n-1}} \\ 1 & 2^{q_1} & & & & 2^{q_{n-1}} \\ \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & & & & \cdot \\ 1 & t^{q_1} & \cdot & \cdot & \cdot & t^{q_{n-1}} \end{pmatrix} \qquad (2)$$

With Hachemeister's model help we search vectors of the type:

$$\beta(\theta)_j = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \cdot \\ \cdot \\ \cdot \\ \beta_n \end{pmatrix} \qquad (3)$$

These vectors model in an econometric way the evolution in time of compensation demands. With their help we obtain suited values ajustate $\hat{X}_j = \beta(\theta)_j\, x$, which in essence don't have a special utility for this example. What we can do once we modeled the past evolution of

compensation demands for different risks, is to extrapolate the results obtained calculating a medium expected value of demands for the next year.

$$Y_j = \beta_j \begin{pmatrix} 1 \\ \theta_{+1}^{q_1} \\ \vdots \\ \theta_{+1}^{q_{n-1}} \end{pmatrix} \ldots j = 1, k \qquad (4)$$

With this value help it can be established a premium for these risks that consider all the aspects we previous mentioned. These values will be:

For the year t+2 it can be used again the formula:

$$Y_j = \beta_j \begin{pmatrix} 1 \\ \theta_{+2}^{q_1} \\ \vdots \\ \theta_{+2}^{q_{n-1}} \end{pmatrix} \ldots j = 1, k \qquad (5)$$

Or can calculate again β_j with the help of data from the years l, t+l so, the data's importance to be bigger (also through the introducing of the observations made in the last year, the most significant one, but also through the growth of the period of time took in consideration).

The simulation is used to obtain an average value of these Y_j after many cycles of simulation. As we presented before, this value is much more appropriated by the real average (which can be calculated through analytic methods, situation that stimulates the simulation) than any other individual value obtained after a single cycle of simulation.

Further on we'll present the algorithm built on basis of Hachemeister's model, algorithm that is based on the interactive calculus of credibility coefficients Z_j, until is obtained a value near a satisfying estimation of value of A; after that is calculated β_j and then Y_j.

The algorithm based on Hachemeister's method is the next one:

Read k,t,n, epsilon

Read Wj; j=l,k

Read x;

Read Xj;

A:=In;

$\beta j := \left(x' W_j^{-1} x\right)^{-1} x' W_j^{-1} X_j$;

Repeat

A1:=A;

$Z_j := A(A + s^2 \left(x' W_j^{-1} x\right)^{-1})^{-1}$; *for_j = l,k*

$$Z := \sum_{j=1}^{k} Z_j \ ;$$

$$b := Z^{-1} \sum_{j=1}^{k} Z_j \beta_j \ ;$$

$$s^2 = \frac{1}{k(-n)} \sum_{j=1}^{k} \left(X_j - x\beta_j\right)' W_j^{-1} \left(X_j - x\beta_j\right);$$

$$A = \frac{1}{k-1} \sum_{j=1}^{k} Z_j \left(\beta_j - b\right)\left(\beta_j - b\right)'$$

Until $(|A1 - A| < epsilon)$;

$\beta(j) := Z_j \beta_j + (n - Z_j)\, b$;

$Y(j) := \beta(j)\, x$.

All the elements that we presented in this algorithm are matrix.

Of course, this algorithm is part of a simulation cycle for different values of aleatory vectors X_j (j = 1,k) to obtain an average value Y, that can be used to establish the premiums for the next year.

The problem that can appear is that not always the algorithm leads us to a solution of equilibrium. As in other trajectory study models case of other cybernetic systems it's possible that starting from an initial situation to enter in a stable equilibrium cycle of 2,3,4 etc degree. In this case, in a real situation it should be calculated analytically which of the obtained values realizes the minimum as part of the most little squares method that is the theoretical base of the algorithm. In this

program we'll introduce as a finite condition of algorithm also the touching of a number with 150 iterations, number that's considered sufficient to touch the equilibrium value. If it's passed over the iteration 150 without being obtained the equilibrium value, is registered the next generation of enter data, X_j, not being recorded the simulation cycle number made.

BIBLIOGRAPHY:

1. Bădescu A., Dobre I. – „*Modelarea deciziilor economico-financiare*", Editura Conphis, Râmnicu-Vâlcea, 2002:
2. Dubos J., - *Statistique descriptive, Dunod, Paris, 1984:*
3. Gravele, R.; Rees, R. - "*Microeconomics*", Ed. Longman. 1992,
4. Vicusi, W. Kip - "*Decizii alarmiste în informație incompletă*", The Economic Journal, nr. 107, nov. 1997.