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About

Econophysics, Sociophysics & Other Multidisciplinary Sciences Journal (ESOMSJ) of Research Center for Advanced Materials provides a resource of the most important developments in the rapidly evolving area of Econophysics, Sociophysics & other new multidisciplinary sciences, advanced materials, and related fundamental concepts. The journal contains articles from Physics, Econophysics, Sociophysics, Quantum Economics, etc and advanced materials.

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EXPLORATORY DOMAINS OF ECONOPHYSICS.NEWS

Papers of the workshops

EDEN III

The second part

The 15th of July 2010

English version and harmonization of the scientific language
Constantin MANEA

University of Pitesti
Faculty of Sciences, Faculty of Economic Sciences
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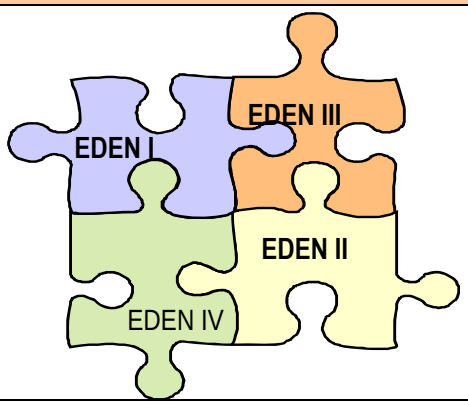
UPIT - CCMA

INTERNATIONAL WORKSHOP PROGRAMME
EDEN III
THE 15TH OF JULY 2010

	9h30 – 14h00 MORNING SESSION Econophysics. New Exploratory Domains	15h30 – 19h00 - AFTERNOON SESSION Econophysics. New Exploratory Domains	
9h30	**Opening speech** **Rector of the University of Pitesti – Gheorghe BARBU**	**S. S. MISHRA and D. C. SHUKLA** *Cost and profit analysis of a non-empty queue*	15h30
9h50	**Gheorghe SĂVOIU Ion Iorga-SIMAN Ioan ŞTEFĂNESCU, Ondrej JAŠKO, Ana JAŠKO, Mladen ČUDANOV** *A multiverse of disciplines in contemporary scientific research*	**Mircea GLIGOR** *Statistical properties of weighted macroeconomic networks* **Gheorghe SĂVOIU, Ion IORGA-SIMĂN** *The concept of time in the physical way of thinking, and its impact on knowledge and the evaluation of inflation as an economic phenomenon*	16h00 16h30
10h20	**Mircea GLIGOR, Marcel AUSLOOS** *Mapping macroeconomic time series into weighted networks*	**Mila MITIC** *Clouds over information systems development process*	17h00
10h50	**Daniel Traian PELE** *Revisiting stock market assumptions. Application for Romanian stock exchange*	**Constantin MANEA, Maria-Camelia MANEA** *Some significant aspects and problems of translation in multidisciplinarity scientific research*	17h30
11h20	**S. S. MISHRA and D. C. SHUKLA** *Performance analysis of truncated multi-channel queue*	**Coffee break**	18h00
11h50	**Coffee break**	**Moderators: Gheorghe SAVOIU Ion IORGA-SIMAN**	
12h20	**Ondrej JAŠKO, Mladen ČUDANOV, Jovan KRIVOKAPIĆ, Jevtić MILOŠ, Gheorghe SAVOIU** *Classical solutions for improvement of restructuring process and representation of organizational structure and alternative future solutions of quantum economics*	**Final discussions** **Workshop closing**	18h30 19h00
12h50	**Ioana-Roxana CHISLEAG LOSADA, Radu CHISLEAG** *Corruption from antique astronomy to contemporary everyday life*		
13h20	**Aretina Magdalena DAVID-PEARSON** *Calculating credit risk for a portfolio of fixed-rate bonds*		
13h50	**Lunch break**		

International Workshop Organizer EDEN III 2010
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CCMA News

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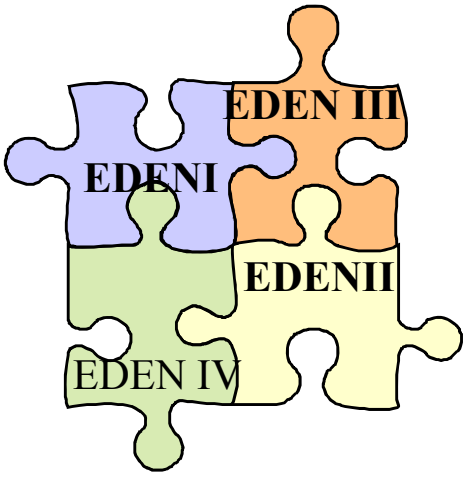
A BRIEF PRESENTATION OF THE EXPLORATORY WORKSHOPS

EDEN I — **2008, 20th of March, University of Pitesti**

EDEN II — **2009, 20th of March, University of Pitesti**

& EDEN II — **2010, 15 th of July, University of Pitesti**



The objectives of the workshops are a brief presentation of the history of Econophysics and the remarkable evolution of research in this inter-, multi-, and trans-disciplinary field, an applicative detail presentation emphasizing its impact on the sphere of the issues relevant of educational, research, banking, finance and administrative institutions, as well as an inventory-drawing of the resources, authors, links, institutes and forms of actively and permanently promoting the new domain in Romanian banking, financial, academic and higher education institutions; the final round tables will make a thematic repertory of new exploratory domains to be applied in Romanian banks and universities, as well as scientific research in Romania, some possible alliances of the Romanian economists and physicist within the new domains in Econophysics, and the necessity of the workshop as a good collaborative work by economists, engineers, physicists, informaticians, statisticians, econometricians, and mathematicians.

The themes of the workshops are defined by the prospective exploration of the Romanian and European academic potential and the inventorying of other exploratory domains of applicative research through Econophysics. The detail presentation of the extraordinary evolution of the researches carried out within the inter-, multi- and trans-disciplinary science of Econophysics is followed by the results of two researches on financing and accreditation of a number of academic and research institutions, the drawing of the resource repertory, and the nucleus of the first national association of econophysicists. The aim of EDEN II and III is to draw the repertory of some new fields of using Econophysics and other multidisciplinary slutions, which can be reordered along the classical coordinates of Econophysics, but also along the new coordinates of Sociophysics, also intending to detail the evolution of the econophysical models already turned classical, too. The detailed presentation of the applied researches of Econophysics on modelling uncertainty in economy, on decision in today's specific uncertainty context, of interest conflicts, in international academic mobilities, or in the didactic processes specific to this new discipline, continues with drawing a repertory of the resources, and, concretely, by founding the first association of the econophysicists in Romania, as well as the papers' presentation of the new RCAM & Econophysics Journal (on–line).

Detailed presentation of the workshop's research themes:

The neologizing of the term Econophysics by Rosario Mantegna and H. Eugene Stanley, during the second Statphys-Kolkata Conference in 1995, represents the official document of Econophysics, born as a new, interdisciplinary, multidisciplinary and transdisciplinary science. Physics has probably had a dominating effect on the development of formal economic theory; however, the historical interdisciplinarity between physics and economics, established through Econophysics, seems very likely to be a model for the future of the multidisciplinary sciences. Transdisciplinarity suggests a deeper synthesis of approaches and ideas from the two main disciplines involved in Econophysics, during a short or medium period of time. The same importance must be given to all interactions between economics and physics, and also between the two types of scientific researchers and demographers, sociologists, mathematicians, linguistics, etc. The periodical meeting of such a multidisciplinary group capable, at first, of constituting the initial nucleus of a potential association of the Romanian econophysicists will be done in the coming years, too, more extensively during the annual workshop (EDEN II,III,IV), to which will be added, starting with 2009, a national conference with international participation, which would be able to develop both the academic scientific research, and the curricula of a number of multidisciplinary MA programmes, primarily oriented towards the graduating physicists and economists. All these aspects represent a necessary detailing of the initial thematic presentation, as well as a welcome prologue before the presentation of the historical evolution of contemporary Econophysics. The contemporary stage of development and especially the dynamics of Econophysics are really exceptional. Some historical opinions about it maintain that statistical mechanics or physics was developed in the second half of the 19th century by James Clerk Maxwell, Ludwig Boltzmann, and Josiah Willard Gibbs, but others reveal that the role of physics models as foundations for the standard neoclassical model that current econophysicists seek to displace is much older than two centuries, the best arguments being N.F. Canard's 1801 work, where supply and demand were ontologically presented as contradicting physical forces, or central concept of general equilibrium theory in economics, in which its author, Léon Walras, was deeply influenced by the physicist Louis Poinsot, and

mostly because the father of American mathematical economics, the well-known statistician Irving Fisher, was a student of the father of statistical mechanics, none else but Josiah Willard Gibbs. But all of these historical opinions agree unanimously that the primordial roots in statistical mechanics approach date back to 1936, when Majorana wrote a pioneering paper, published in 1942 and entitled *Il valore delle leggi statistiche nella fisica e nelle scienze sociali*. First of all, the application of concepts as power-law distributions, correlations, scaling, unpredictable time series and random processes to financial markets was possible only after physicists have achieved important results in statistical mechanics, due to other significant statistical investigations and mathematical formalizations. The oldest example of an adequate law or mathematical distribution to the wealth of individuals in a stable economy belongs to the Italian economist and statistician Vilfredo Pareto. Secondly, the progress of the financial mathematics realized by Louis Bachelier in his doctoral thesis entitled *Théorie de la speculation*, published in 1900, which quantifies the probability of price changes and the differences of the logarithms of prices that are distributed in a Gaussian manner, and thus is an anticipation of Albert Einstein's or Norbert Wiener's researches. Three major events underline the evolution of econophysics, first in 1973, with the appearance of a rational option-pricing formula, such as Black & Scholes' formula, then after 1980, the huge amount of electronically stored financial data readily available, and finally since the 1990s, a growing number of physicists have attempted to analyze and model financial markets and, more generally, economic systems, new interdisciplinary journals have been published, new conferences have been organized, and a lot of new potentially scientific fields, areas, themes and applications have been identified by this new trans-disciplinary science. The researches of econophysics deal with the distributions of returns in financial markets, the time correlation of a financial series, the analogies and differences between price dynamics in a financial market and physical processes as turbulence or ecological systems, the distribution of economic stocks and growth rate variations, the distribution of firm sizes and growth rates, the distribution of city sizes, the distribution of scientific discoveries, the presence of a higher-order correlation in price changes motivated by the reconsideration of some beliefs, the distribution of income and wealth, the studies of the income distribution of firms and studies of the statistical properties of their growth rates. The new real characteristics of Econophysics in a medium and long term will be a result of its new research like rural-urban migration, growth of cities, etc. The real criticism of econophysics is the absence of age variable, because models of Econophysics consider immortal agents who live forever, like atoms, in spite of the evolution of income and wealth as functions of age, that are studied in economics using the so-called overlapping-generations models (Paul Anglin). The first econophysics models published by physicists in a physics journal were those of Mantegna (1991) and Takayasu (1992), though developed a few years earlier. Even a Monte Carlo simulation of a market was published as early as 1964 by Stigler from the Chicago economics school. Nobel laureate of Economics, Markowitz H.M. published, too, with Kim a model for the 1987, about the crash on Wall Street. After the year 2000, econophysics has matured enough to allow generalized applications, their field being called sometimes econo-engineering. We believe that the second workshop EDEN II is a welcome resuming of EDEN I, which was conducted in good felicituosly, as well (as can be seen on the site of the centre for research in advanced materials of the University in Piteşti (http://www.upit.ro/ccma/), from the own resources of the moderators and organizers (Gheorghe Săvoiu and Ion Iorga–Simăn), or supported by the keyspeakers, using the academic spaces and equipment of the University in Piteşti (the moderators and organizers acknowledge to the leading staff of the University in Piteşti for their accommodation support). EDEN II's main aim is to draw the repertory of some new fields of using econophysics, which can be reordered along the classical coordinates of econophysics, but also along the new coordinates of sociophysics, also intending to detail the evolution of the econophysics models already turned classical, but also along the new coordinates of index physics or the physics of the price indexes (able to measure both inflation, and the specialized stock-exchange evolutions), of demographysics, or through econophysics prognosis, a sub domain that combines a better time projection of phenomena, much better calibrated extrapolations and interpolations in the economic, demographical, crime-related, electoral, etc. world. The workshop also materializes in its presentations, through those invited holding the quality of keyspeaker, two practical approaches of econophysics resulting from applying statistical physics, in an original manner and with very interesting results, to the field of financing and accreditation of a number of academic and research institutions. The special potentiality of econophysics will thus be able to reveal to the rest of the people invited, more especially to those belonging to the academic milieus and the disciplines related to management, statistics and finance-banking, to bank managers, mathematicians, physicists, linguists, etc. Its innovative and applicative character is also evinced by the careful repertory-drawing of the principal applications of econophysics, substantiated in the papers that are to be published and presented during the international conferences and symposia, and, moreover, through the investigation, in the latter half of the workshop, of the part played by econophysics, and its main potential fields of application. In order to manage a good collaborative work by economists and physicists, the workshop presents, in its second part, some of the differences existing at present between economics and physics in their own scientific research work, but also between economists and physicists. Since econophyisics was officially born, Romanian scientific researchers in this multidisciplinary field have published a lot of important papers. Among these pioneers one must necessarily mention Adrian Drăgulescu, Radu Chişleag, Mircea Bulinski, Carmen Costea, Mircea Gligor, Margareta Ignat, etc. Since 2003, when the first book entitled *Econophysics* was published, in Romania, by Mircea Gligor and Margareta Ignat, followed four years later by *Investment Econophysics*, written by Anca Gheorghiu and Ion Spinulescu, and up to now, a few round tables and satellite

workshops have been dedicated to econophysics, including even summer schools of econophysics and complexity – its 3rd edition was held in 2007. The above facts trigger the need for the workshop EDEN II to invite some well-known engineers, IT specialists and econophysicists, to a European and international level, as key-speakers (H. Schjær-Jacobsen, Wolfgang Ecker-Lala, Aretina-Magdalena David-Pearson), and to continue a process of repertory-drawing for the internal resources, and making up the nucleus of the first Romanian association of the econophysicists, followed by at least two other workshops, and annual conferences or symposia, which will consolidate the young school of Romanian econophysics (the first ones, EDEN I and II, have already taken place) the third workshop, EDEN III, we hope will take place and be honoured by the participation of the representatives of the Belgian school led by Professor Marcel Ausloss, hence the invitation addressed to Professor Mircea Gligor from Romania, who has been part of professor Ausloss's team, and the fourth edition, EDEN IV, aims at ensuring the participation of the representatives of the school of econophysics in Boston, including the Romanian Adrian Drăgulescu, whence the invitation to the Romanian researcher Constantin Andronache from Boston. The young econophysicists will grow up within this context of Romanian econophysics, turning to account the relations formed, in the course of time, with schools of international research in the domain, which have already reached scientific prestige). Debating the role and the potential of econophysics for Romanian scientific research is now not only an opportunity, but also a necessity for normal evolution both teaching and research in physics and economics. Consequently, the objectives of the workshop are a brief presentation of the history of econophysics' models and the remarkable evolution of research in this inter-, multi-, and trans-disciplinary field, and in the contemporary multiverse of disciplines. An applicative detailed presentation emphasising its impact on the sphere of the issues relevant for the decision in education, research, banking, finance and administrative institutions, as well as to continue an inventory-drawing of the resources, authors, links, institutes and forms of actively and permanently promoting the new domain in Romanian banking, financial, academic and higher education institutions. All the final round tables and discussions identify differences and resemblances existing at present between economics and physics, in their own scientific research work, but also between economists, mathematicians, informaticians, engineers, statisticians, econometricians, and physicists in this new job called econophysicist.

Estimated outcomes

1. The publication, in a newly created journal having this purpose, already named *RCAM & Econophysics Journal*, of the abstracts of the lectures and presentations delivered by the key-speakers, as well as the syntheses of the potential domains, and the summarized contents of the debates on the round table topic;

2. The integral publication of the papers and discussions in a book entitled ***E**xploratory **D**omains of **Econophysics**. **N**ews* (**EDEN I & II**);

3. The detailed presentation of an approach to econophysics and its specific model of analysis of financing and accrediting a number of institutions within the framework of higher education, available of the site of the Research Center for Advanced Materials.

4. The concrete identification of a number of criteria of potential demand as far as research of the Romanian banking market by means of Econophysics is concerned.

5. Scheduling and achieving, in 2011, a special workshop devoted to econophysics (EDEN IV);

6. Scheduling and achieving an international conference, starting 2012, also devoted to econophysics and to other aspects of multidisciplinarity (EDEN V).

7. A site of econophysics for permanent and malleable dialogues meant to promote the future international workshops and conferences (http://www.upit.ro/ ccma/).

List of keyspeakers during EDEN I, II & III:

Professor Hans Schjær-Jacobsen, PhD, Copenhagen University College of Engineering,
Professor Wolfgang Ecker-Lala, PhD, MATH-UP, Viena University,
Professor Radu Chişleag, PhD, Polytechnical University, Bucharest,
Professor Carmen Costea, PhD, A.S.E Bucharest,
Professor S. S. Mishra, PhD, Avadh University, Faizabad, India,
Professor D. C. Shukla, PhD, Avadh University, Faizabad India,
Professor Ion Iorga-Simăn, PhD, University of Piteşti,
Professor Ana Jaško, PhD, Faculty of Organizational Sciences, University of Belgrade, Serbia,
Professor Ioan Ştefănescu, PhD, University of Piteşti,
Professor Ondrej Jaško, PhD, Faculty of Organizational Sciences, University of Belgrade, Serbia,
Senior Lecturer Gheorghe Săvoiu, PhD, University of Piteşti,
Senior Lecturer Constantin Manea, PhD, University of Piteşti,
Senior Lecturer Maria-Camelia Manea, PhD, University of Pitesti,
Lecturer Aretina-Magdalena David-Pearson, PhD, Polytechnical University, Bucharest,
Lecturer Daniel Traian Pele, PhD, University of Economics Bucharest,
Lecturer Mladen Čudanov, PhD, Faculty of Organizational Sciences, Belgrade, Serbia,
Research Associate Constantin Andronache, PhD, Boston College, Information Technology, USA,
Associate Professor Mircea Gligor, PhD, National College Roman Vodă, Roman,
Research and Counselor Mila Mitić, Mihajlo Pupin Institute, Center for Systems Analysis, Belgrade, Serbia

Project manager in 2008: Ion Iorga-Simăn

Project manager in 2009: Gheorghe Săvoiu

Project managers in 2010: Gheorghe Săvoiu and Ion Iorga-Simăn

ACKNOWLEDGMENTS

The project managers and all the keyspeakers and invited colleagues thank to the University of Piteşti for being able to use the University's facilities during the two workshops. EDEN I, II & III

Editors in chief: Gheorghe Săvoiu & Ion Iorga – Simăn

PERFORMANCE ANALYSIS OF TRUNCATED MULTI-CHANNEL QUEUE

S. S. Mishra and D. C. Shukla

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Abstract: *The paper is aimed to focus on the performance analysis of a truncated multi-channel $M/M/C/K$ queuing system to be used in the machine interference models arising out of industrial and computer manufacturing etc. A total cost function is subjected to the optimization in view of arrival and service parameters by using a computing algorithm of numerical methods. The optimal values of various performance measures of the system such as optimal number of machine-customers, optimal waiting time for repair, optimal traffic intensity are evaluated by using hypothetical data-input corresponding to the optimal total cost of the system. Results are tabled and also presented graphically to better gain the insight into applications of derived performance measures of the system in different working conditions.*

Keywords: *System of non-linear equations; total optimal cost; arrival rate; service rate.*

1. INTRODUCTION

Performance analysis of the queuing models occupies a prominent place in the research of queuing theory, a significant aspect of the optimization theory. Optimization techniques are widely used in the areas of production, manufacturing, and planning including the communication systems to effectively assess the performance of the systems. It has drawn the attention of the researchers seriously engaged in this area of research. Also, to date it reveals that no sufficient work has been done with regard to computation of optimal performance measures of the queuing system by optimizing both the parameters, arrival and service rates, in general and truncated multi-channel queuing system in particular.

Nowadays, a trend has been redirected and shifted to investigate more realistic performance measures of the system as compared to general theoretical approach that embodies hardly a bit of application. Some of the relevant researches are in sequel here. Chakravarthy et al. [2] considered a multi-server queuing model in which customers arrive according to Markovian arrival process (MAP). They have performed steady-state analysis of the model using direct truncation and matrix-geometric approximation. Efficient algorithms for computing various steady-state performance measures and illustrative numerical examples have also been presented. Artalejo and Gomez-Corral [1] shown that the limiting distribution of the system state can still be reduced to a Fredholm integral equation. They solved such an equation numerically by introducing an auxiliary truncated system which can easily be evaluated with the help of regenerative approach.

Tirtiroglu [15] has presented an entropy based uncertainty metric for measuring the operating performance of $M/M/1$ and $M/M/1/K$ models. The author considered a connection between entropy and the uncertainty in queuing. El-Taha and Maddah [4] have considered a multi-server first come, first serve (FCFS) queuing model where servers are arranged in two stations in series. They have shown that their scheme provides better system performance than the standard parallel multi-server model in the sense of reducing the mean delay per customer in heavy traffic system. Naor [10] discussed the pricing problem by giving quantitative arguments based on an $M/M/1/K$ queuing model. In this work, he has shown the necessity of limiting the arrivals to a queuing system by a toll to achieve the social optimality. Knudsen [6] has extended Naor's study to a multi-server queuing system. Wang et al. [3] have considered an unloader queuing model in which N identical trailers are unloaded by one or more unloaders and developed a cost model to determine the optimal number of trailers.

Shawky and El-Paoumy [13] treated the truncated multi-channel queue $H_k/M/c/N$ with both balking and reneging concepts. They derived steady-state probabilities of the model together with some measures of effectiveness where these measures were analytically deduced. Taha [14] discussed the two conflicting costs viz. cost of offering the service and the cost of delay in offering the service and established the cost model for the system. He also derived formulas to evaluate the performance measures of various queuing systems. Shawky [12] analyzed the machine interference model $M/M/C/K/N$ with balking, reneging, and spares. He has presented the steady-state probabilities and expected number of customers in the system for four different cases. He also considered the truncated multi-channel queue $M/M/C/K$ as one of the cases under consideration. Gross and Harris [5] have discussed the $M/M/1/K$ queuing system with truncation. They derived steady-state probabilities for the system and obtained formulas for various performance measures of the system. They also discussed the performance measures of the multi-channel queue $M/M/C/K$ with truncation.

Mishra and Mishra [7] discussed the cost analysis of the machine interference model $M/M/C/K/N$. Here, they constructed a cost function in order to determine the total optimal cost of the system. A fast converging N-R method has been used to solve the non-linear function involving service rate and hyper geometric functions including other parameters. They optimized the total cost function with respect to single parameter, service rate μ. Morse [9] has solved the queuing system with hyper-Poisson arrivals and a single exponential channel without balking or reneging. Neuts and Lucantoni [11] studied a queue with N servers who may breakdown and repair at a facility which has c

repair crews. They discussed the stationary distributions of various waiting times. Mishra [8] has made an attempt to compute the total optimal cost of interdependent queuing system with controllable arrival rates as an important performance measure of the system.

. In this paper, we define a total cost function for the system and apply optimization with respect to both the parameters arrival rate and service rate simultaneously. For computing the total optimal cost of the system and other performance measures, like optimal expected number of customers in the system, optimal waiting time in the system, and optimal traffic intensity of the system, a computing algorithm has been developed. Finally, numerical demonstrations in the form of tables and graphs are added to gain a significant insight into the problem. Various observations are drawn to realize the problem closely related to real life situations.

2. PERFORMANCE ANALYSIS OF THE MODEL

For the truncated multi-channel queue $M/M/C/K$ (Poisson arrival and exponential service), the system probabilities are as given by Shawky [12],

$$P_n = \begin{cases} \dfrac{\rho^n}{n!} P_0 ; \ 0 \le n < C \\ \dfrac{\rho^n}{C! C^{n-C}} P_0 ; \ C \le n \le K \end{cases}$$

$$P_0^{-1} = \sum_{n=0}^{C-1} \frac{\rho^n}{n!} + \frac{\rho^C}{(C-1)!} \cdot \frac{1-(\rho/C)^{K-C+1}}{(C-\rho)} ; \ \ \rho \ne C$$

$$P_0^{-1} = \sum_{n=0}^{C-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^C}{(C-1)!} \cdot \frac{1-(\lambda/C\,\mu)^{K-C+1}}{\left(C-\dfrac{\lambda}{\mu}\right)} ; \ \frac{\lambda}{\mu} \ne C \tag{1}$$

where P_0 is the empty system probability, C is the number of servers, K is the capacity of the system, λ is arrival rate, μ is service rate, and ρ is the traffic intensity.

Expected number of customers in the system L_s is given by (Shawky [12]),

$$L_s = P_0 \left[\sum_{n=1}^{C-1} \frac{\rho^n}{(n-1)!} + \frac{\rho C^{C+1}}{C!(C-\rho)^2} \left\{ C(\rho/C)^{C-1} - (C-1)(\rho/C)^C - (K+1)(\rho/C)^K + K(\rho/C)^{K+1} \right\} \right]$$

$$\text{Or, } L_s = P_0 \left[\sum_{n=1}^{C-1} \frac{\rho^n}{(n-1)!} + \frac{\rho^C}{(C-1)!} \cdot \frac{\left\{C^2 - (C-1)\rho\right\}}{(C-\rho)^2} + \frac{C^{C-K}\rho^{K+1}}{C!} \cdot \frac{\{K\rho - C(K+1)\}}{(C-\rho)^2} \right]$$

$$\text{Or, } L_s = P_0 \left[\sum_{n=1}^{C-1} \frac{(\lambda/\mu)^n}{(n-1)!} + \frac{(\lambda/\mu)^C}{(C-1)!} \cdot \frac{\left\{C^2 - (C-1)(\lambda/\mu)\right\}}{\left(C-\dfrac{\lambda}{\mu}\right)^2} + \frac{C^{C-K}(\lambda/\mu)^{K+1}}{C!} \cdot \frac{\{K(\lambda/\mu) - C(K+1)\}}{\left(C-\dfrac{\lambda}{\mu}\right)^2} \right]$$

Let $P_0^{-1} = f$, and

$$M = \sum_{n=1}^{C-1} \frac{1}{(n-1)!} \left(\frac{\lambda}{\mu}\right)^n + \frac{1}{(C-1)! \left(C-\dfrac{\lambda}{\mu}\right)^2} \times \left[C^2 \left(\frac{\lambda}{\mu}\right)^C - (C-1)\left(\frac{\lambda}{\mu}\right)^{C+1} - (K+1) C^{C-K} \left(\frac{\lambda}{\mu}\right)^{K+1} + K\, C^{C-K-1} \left(\frac{\lambda}{\mu}\right)^{K+2} \right] \tag{2}$$

Therefore,

$$L_s = M P_0 = \frac{M}{f}$$

Differentiating (2) partially with respect to λ, we get

$$\frac{\partial M}{\partial \lambda} = \sum_{n=1}^{C-1} \frac{n}{(n-1)!} \frac{\lambda^{n-1}}{\mu^n} + \frac{C}{(C-1)!} \frac{\lambda^{C-1}}{\mu^C} \frac{\left\{C^2 - (C-1)(\lambda/\mu)\right\}}{\left(C-\dfrac{\lambda}{\mu}\right)^2} + \frac{1}{(C-1)!} \frac{\lambda^C}{\mu^{C+1}} \frac{\{C(C+1) - (C-1)(\lambda/\mu)\}}{\left(C-\dfrac{\lambda}{\mu}\right)^3} + \frac{(K+1)C^{C-K}}{C!} \frac{\lambda^K}{\mu^{K+1}} \frac{\{K(\lambda/\mu) - C(K+1)\}}{\left(C-\dfrac{\lambda}{\mu}\right)^2} + \frac{C^{C-K}}{C!} \frac{\lambda^{K+1}}{\mu^{K+2}} \frac{\{K(\lambda/\mu) - C(K+2)\}}{\left(C-\dfrac{\lambda}{\mu}\right)^3} \tag{3}$$

Differentiating (2) partially with respect to μ, we get

$$\frac{\partial M}{\partial \mu} = -\sum_{n=1}^{C-1} \frac{n}{(n-1)!} \frac{\lambda^n}{\mu^{n+1}} - \frac{C}{(C-1)!} \frac{\lambda^C}{\mu^{C+1}} \frac{\left\{C^2 - (C-1)(\lambda/\mu)\right\}}{\left(C-\dfrac{\lambda}{\mu}\right)^2} - \frac{1}{(C-1)!} \frac{\lambda^{C+1}}{\mu^{C+2}} \frac{\{C(C+1) - (C-1)(\lambda/\mu)\}}{\left(C-\dfrac{\lambda}{\mu}\right)^3} - \frac{(K+1)C^{C-K}}{C!} \frac{\lambda^{K+1}}{\mu^{K+2}} \frac{\{K(\lambda/\mu) - C(K+1)\}}{\left(C-\dfrac{\lambda}{\mu}\right)^2}$$

$$-\frac{C^{C-K}}{C!}\frac{\lambda^{K+2}}{\mu^{K+3}}\frac{\{K(\lambda/\mu)-C(K+2)\}}{\left(C-\frac{\lambda}{\mu}\right)^3} \quad (4)$$

Differentiating (1) partially with respect to λ and μ respectively, we have

$$\frac{\partial f}{\partial \lambda}=\sum_{n=1}^{C-1}\frac{1}{(n-1)!}\frac{\lambda^{n-1}}{\mu^n}+\frac{1}{(C-1)!\left(C-\frac{\lambda}{\mu}\right)^2}$$

$$\times\left[C^2\frac{\lambda^{C-1}}{\mu^C}-(C-1)\frac{\lambda^C}{\mu^{C+1}}-(K+1)C^{C-K}\frac{\lambda^K}{\mu^{K+1}}+K\,C^{C-K-1}\frac{\lambda^{K+1}}{\mu^{K+2}}\right] \quad (5)$$

$$\frac{\partial f}{\partial \mu}=-\sum_{n=1}^{C-1}\frac{1}{(n-1)!}\frac{\lambda^{n}}{\mu^{n+1}}-\frac{1}{(C-1)!\left(C-\frac{\lambda}{\mu}\right)^2}$$

$$\times\left[C^2\frac{\lambda^{C}}{\mu^{C+1}}-(C-1)\frac{\lambda^{C+1}}{\mu^{C+2}}-(K+1)C^{C-K}\frac{\lambda^{K+1}}{\mu^{K+2}}+K\,C^{C-K-1}\frac{\lambda^{K+2}}{\mu^{K+3}}\right] \quad (6)$$

From (5) and (2), we observe that

$$M=\lambda\frac{\partial f}{\partial \lambda} \quad (7)$$

From (6) and (2), we observe that

$$M=-\mu\frac{\partial f}{\partial \mu} \quad (8)$$

From (5) and (6), we observe that

$$\frac{\partial f}{\partial \mu}+\frac{\lambda}{\mu}\frac{\partial f}{\partial \lambda}=0$$

From (3) and (4), we observe that

$$\frac{\partial M}{\partial \mu}+\frac{\lambda}{\mu}\frac{\partial M}{\partial \lambda}=0 \quad (9)$$

The total cost function $TC=C_1(m+C)\mu+C_2\frac{M}{f}$ is a function in two variables λ and μ. Differentiating this equation partially with respect to λ and μ respectively, we get:

$$\frac{\partial(TC)}{\partial \lambda}=C_2\frac{f\frac{\partial M}{\partial \lambda}-M\frac{\partial f}{\partial \lambda}}{f^2} \quad (10)$$

$$\frac{\partial(TC)}{\partial \mu}=C_1(m+C)+C_2\frac{f\frac{\partial M}{\partial \mu}-M\frac{\partial f}{\partial \mu}}{f^2} \quad (11)$$

For critical point $(\bar{\lambda},\bar{\mu})$, we must have $\frac{\partial(TC)}{\partial \lambda}=\frac{\partial(TC)}{\partial \mu}=0$. Therefore from (10) and (11), we have

$$f\frac{\partial M}{\partial \lambda}-M\frac{\partial f}{\partial \lambda}=0 \quad (12)$$

$$C_1(m+C)f^2+C_2\left[f\frac{\partial M}{\partial \mu}-M\frac{\partial f}{\partial \mu}\right]=0 \quad (13)$$

Using (7) and (8) in (12) and (13), we get

$$f\frac{\partial M}{\partial \lambda}-\frac{M^2}{\lambda}=0,\ C_1(m+C)f^2+C_2\left[f\frac{\partial M}{\partial \mu}+\frac{M^2}{\mu}\right]=0$$

Now, let $\phi\equiv\phi(\lambda,\mu)=f\frac{\partial M}{\partial \lambda}-\frac{M^2}{\lambda}$ and

$\psi\equiv\psi(\lambda,\mu)=C_1(m+C)f^2+C_2\left[f\frac{\partial M}{\partial \mu}+\frac{M^2}{\mu}\right]$, then

$$\phi(\lambda,\mu)=0 \quad (14)$$

and $$\psi(\lambda,\mu)=0 \quad (15)$$

constitute a set of two non-linear equations in two variables λ and μ. We shall solve these two equations by applying fast converging Newton-Raphson's method to obtain critical point $(\bar{\lambda},\bar{\mu})$.

If (λ_i,μ_i) is the initial guess for equations (14) and (15) then we have,

$$\lambda_{i+1}-\lambda_i=-\frac{\phi_i(\partial\psi_i/\partial\mu)-\psi_i(\partial\phi_i/\partial\mu)}{\delta}$$

$$\mu_{i+1}-\mu_i=-\frac{\psi_i(\partial\phi_i/\partial\lambda)-\phi_i(\partial\psi_i/\partial\lambda)}{\delta}\ ,\text{ where}$$

$$\delta=\frac{\partial\phi_i}{\partial\lambda}\cdot\frac{\partial\psi_i}{\partial\mu}-\frac{\partial\phi_i}{\partial\mu}\cdot\frac{\partial\psi_i}{\partial\lambda}$$

By partial differentiation, we have

$$\frac{\partial\phi}{\partial\lambda}=f\frac{\partial^2M}{\partial\lambda^2}-\frac{M}{\lambda}\frac{\partial M}{\partial\lambda}+\left(\frac{M}{\lambda}\right)^2 \quad (16)$$

$$\frac{\partial\phi}{\partial\mu}=-f\left(\frac{\mu}{\lambda}\right)\frac{\partial^2M}{\partial\mu^2}-\frac{\partial M}{\partial\mu}\frac{(M+f)}{\lambda} \quad (17)$$

$$\frac{\partial\psi}{\partial\lambda}=-C_2\,f\left(\frac{\lambda}{\mu}\right)\frac{\partial^2M}{\partial\lambda^2}+\frac{C_2}{\mu}\frac{\partial M}{\partial\lambda}\{M-f\}+2C_1(m+C)f\frac{M}{\lambda} \quad (18)$$

$$\frac{\partial\psi}{\partial\mu}=C_2\,f\frac{\partial^2M}{\partial\mu^2}+C_2\left(\frac{M}{\mu}\right)\frac{\partial M}{\partial\mu}-\left\{2C_1(m+C)\,f\left(\frac{M}{\mu}\right)+C_2\frac{M^2}{\mu^2}\right\} \quad (19)$$

From (16), (17), (18), and (19), it is clear that we have to find $\frac{\partial^2M}{\partial\lambda^2}$ and $\frac{\partial^2M}{\partial\mu^2}$.

$$\frac{\partial^2M}{\partial\lambda^2}=\sum_{n=2}^{C-1}\frac{n}{(n-2)!}\frac{\lambda^{n-2}}{\mu^n}+\frac{C}{(C-2)!}\frac{\lambda^{C-2}}{\mu^C}\frac{\left\{C^2-(C-1)(\lambda/\mu)\right\}}{\left(C-\frac{\lambda}{\mu}\right)^2}$$

$$+\frac{2C}{(C-1)!}\frac{\lambda^{C-1}}{\mu^{C+1}}\frac{\{C(C+1)-(C-1)(\lambda/\mu)\}}{\left(C-\frac{\lambda}{\mu}\right)^3}$$

$$+\frac{2}{(C-1)!}\frac{\lambda^{C}}{\mu^{C+2}}\frac{\{C(C+2)-(C-1)(\lambda/\mu)\}}{\left(C-\frac{\lambda}{\mu}\right)^4}$$

$$+\frac{K(K+1)C^{C-K}}{C!}\frac{\lambda^{K-1}}{\mu^{K+1}}\frac{\{K(\lambda/\mu)-C(K+1)\}}{\left(C-\frac{\lambda}{\mu}\right)^2}$$

$$+\frac{2(K+1)C^{C-K}}{C!}\frac{\lambda^{K}}{\mu^{K+2}}\frac{\{K(\lambda/\mu)-C(K+2)\}}{\left(C-\frac{\lambda}{\mu}\right)^3}$$

$$+\frac{C^{C-K}}{C!}\frac{\lambda^{K+1}}{\mu^{K+3}}\frac{2\{K(\lambda/\mu)-C(K+3)\}}{\left(C-\frac{\lambda}{\mu}\right)^4}$$

$$\frac{\partial^2 M}{\partial \mu^2}=\sum_{n=1}^{C-1}\frac{n(n+1)}{(n-1)!}\frac{\lambda^n}{\mu^{n+2}}$$

$$+\frac{C(C+1)}{(C-1)!}\frac{\lambda^{C}}{\mu^{C+2}}\left\{\frac{C^2-(C-1)(\lambda/\mu)}{\left(C-\frac{\lambda}{\mu}\right)^2}\right\}$$

$$+\frac{2(C+1)}{(C-1)!}\frac{\lambda^{C+1}}{\mu^{C+3}}\left\{\frac{C(C+1)-(C-1)(\lambda/\mu)}{\left(C-\frac{\lambda}{\mu}\right)^3}\right\}$$

$$+\frac{2}{(C-1)!}\frac{\lambda^{C+2}}{\mu^{C+4}}\frac{\{C(C+2)-(C-1)(\lambda/\mu)\}}{\left(C-\frac{\lambda}{\mu}\right)^4}$$

$$+\frac{(K+2)(K+1)C^{C-K}}{C!}\frac{\lambda^{K+1}}{\mu^{K+3}}\left\{\frac{K(\lambda/\mu)-C(K+1)}{\left(C-\frac{\lambda}{\mu}\right)^2}\right\}$$

$$+\frac{2(K+2)C^{C-K}}{C!}\frac{\lambda^{K+2}}{\mu^{K+4}}\frac{\{K(\lambda/\mu)-C(K+2)\}}{\left(C-\frac{\lambda}{\mu}\right)^3}$$

$$+\frac{2\,C^{C-K}}{C!}\frac{\lambda^{K+3}}{\mu^{K+5}}\frac{\{K(\lambda/\mu)-C(K+3)\}}{\left(C-\frac{\lambda}{\mu}\right)^4}$$

The total expected cost of the system TC will be optimal at $(\bar{\lambda},\bar{\mu})$ if, $\frac{\partial^2 TC}{\partial \lambda^2}\cdot\frac{\partial^2 TC}{\partial \mu^2}-\frac{\partial^2 TC}{\partial \lambda\,\partial \mu}\cdot\frac{\partial^2 TC}{\partial \mu\,\partial \lambda}>0$ and $\frac{\partial^2 TC}{\partial \lambda^2}>0$ where,

$$\frac{\partial^2 TC}{\partial \lambda^2}=\frac{C_2}{f}\left[\frac{\partial^2 M}{\partial \lambda^2}-3\frac{M}{f\lambda}\frac{\partial M}{\partial \lambda}+\left(\frac{M}{f\lambda}\right)^2(f+2M)\right],$$

$$\frac{\partial^2 TC}{\partial \mu^2}=\frac{C_2}{f}\left[\frac{\partial^2 M}{\partial \mu^2}+3\frac{M}{f\mu}\frac{\partial M}{\partial \mu}-\left(\frac{M}{\mu f}\right)^2(f-2M)\right],$$

$$\frac{\partial^2 TC}{\partial \lambda\,\partial \mu}=\frac{C_2}{f\mu}\left[-\frac{\partial M}{\partial \lambda}-\lambda\frac{\partial^2 M}{\partial \lambda^2}+\frac{3M}{f}\frac{\partial M}{\partial \lambda}-\frac{2M^3}{\lambda f^2}\right],\text{ and}$$

$$\frac{\partial^2 TC}{\partial \mu\,\partial \lambda}=-\frac{C_2}{f\lambda}\left[\frac{\partial M}{\partial \mu}+\mu\frac{\partial^2 M}{\partial \mu^2}+\frac{3M}{f}\frac{\partial M}{\partial \mu}+\frac{2M^3}{\mu f^2}\right]$$

The above conditions are sufficient for the total expected cost of the system TC to be optimal at $(\bar{\lambda},\bar{\mu})$. We find the various performance measures of the system which are optimal expected number of customers in the system $\bar{L}_s$, optimal waiting time in the system $\bar{W}_s$, and optimal traffic intensity $\bar{\rho}$.

3. PUTING ALGORITHM

The following computing algorithm is developed to find out the optimal arrival and service rates, total optimal cost, and other performance measures of the system.

Step 1: begin
Step 2: input all the parameters
Step 3: input initial guess for arrival and service rates
Step 4: compute all the derivatives
Step 5: iterating arrival and service rates
Step 6: compute optimal arrival and service rates
Step 7: compute optimal performance measures
Step 8: compute total optimal cost
Step 9: data output
Step 10: end

4. SENSITIVITY ANALYSIS OF THE MODEL

The aim of the sensitivity analysis is to demonstrate the variability of the model based on the simulations or the hypothetical data-input. In this chapter, we prefer the hypothetical data-input to run the search program of the system. We wrote a program in C++ to apply a two-variable version of N-R method to compute the optimal arrival and service rates and consequently the total optimal cost of the system, optimal expected number of customers in the system, optimal waiting time in the system, and optimal traffic intensity of the system are also computed. In sensitivity analysis, variation effect of parameters on the total optimal cost and other performance measures is presented in the form of graphs and tables.

Table no 1: Service Cost vs. Total Optimal Cost and various Performance Measures

$C = 4,\ K = 20,\ m = 3,\ C_2 = 2.50$

(C_1)	$(\bar{\lambda})$	$(\bar{\mu})$	$(\overline{TC})$	$\bar{L}_s$	$\bar{W}_s$	$\bar{\rho}$
3.50	2.62	4.79	121.92	5.4	2.06	0.55
4.00	2.66	4.80	138.91	6.7	2.52	0.55
4.50	2.69	4.80	155.66	8.1	3.01	0.56
5.50	2.73	4.81	189.59	9.3	3.41	0.57
6.50	2.77	4.82	223.66	11.4	4.12	0.57
7.50	2.79	4.83	257.90	12.2	4.37	0.58
8.50	2.81	4.83	291.68	13.0	4.63	0.58
9.50	2.82	4.83	325.47	15.6	5.53	0.58
10.50	2.83	4.84	360.01	17.7	6.25	0.58

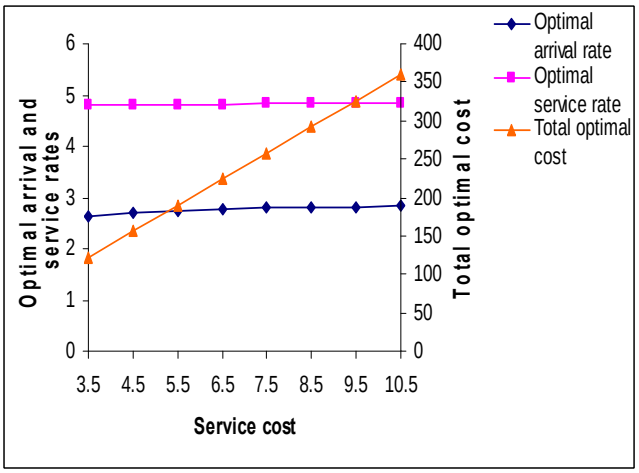

Fig.1.1: Service Cost vs. Total Optimal Cost

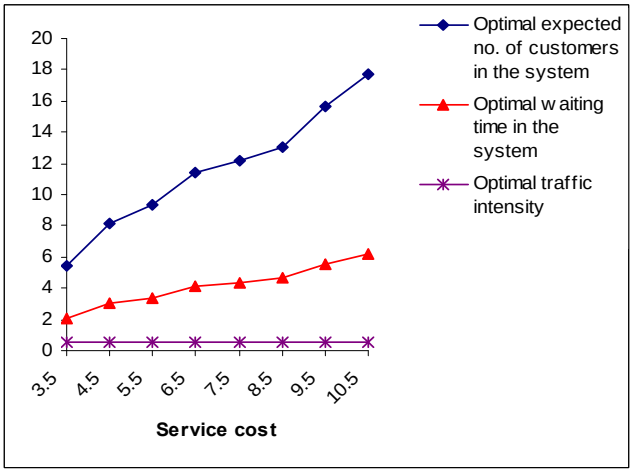

Fig.1.2: Service Cost vs. various Performance Measures

Table no 2: Waiting Cost vs. Total Optimal Cost and various Performance Measures

$C = 4,\ K = 20,\ m = 3,\ C_1 = 10.50$

(C_2)	$(\bar{\lambda})$	$(\bar{\mu})$	$(\overline{TC})$	$\bar{L}_s$	$\bar{W}_s$	$\bar{\rho}$
2.50	2.83	4.84	360.01	17.7	6.25	0.58
3.00	2.81	4.83	360.16	17.2	6.12	0.58
4.00	2.77	4.82	361.22	16.5	5.96	0.57
5.00	2.73	4.81	362.34	15.8	5.79	0.57
6.00	2.68	4.80	363.54	15.0	5.60	0.56
7.00	2.64	4.79	364.76	14.2	5.38	0.55
8.00	2.60	4.78	366.03	13.5	5.19	0.54
9.00	2.55	4.77	367.42	12.7	4.98	0.53

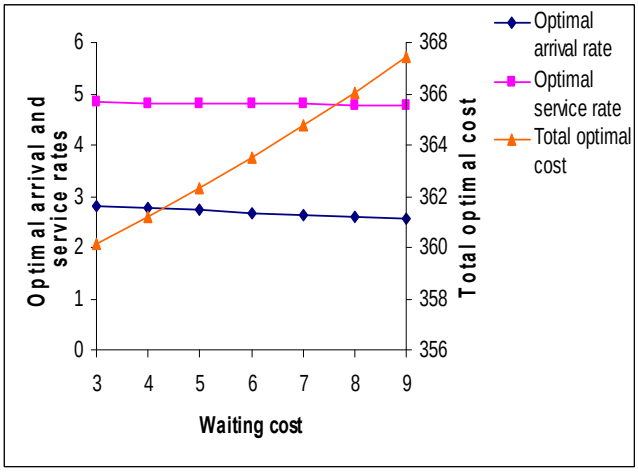

Fig.2.1: Waiting Cost vs. Total Optimal Cost

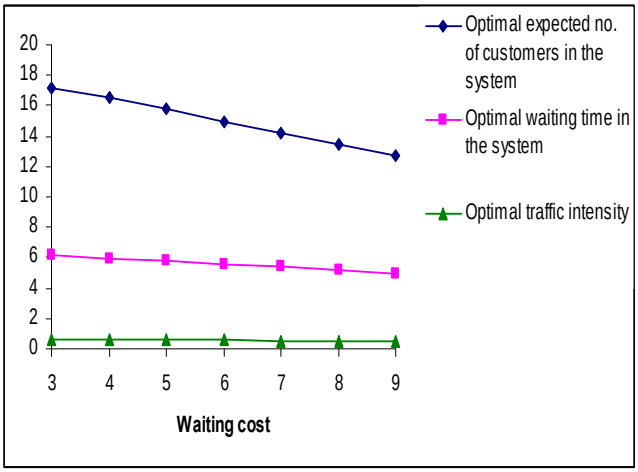

Fig.2.2: Waiting Cost vs. various Performance Measures

Table- 3: No. of Servers vs. Total Optimal Cost and various Performance Measures

$C_1 = 3.50,\ C_2 = 2.50,\ m = 3,\ K = 20$

(C)	$(\bar{\lambda})$	$(\bar{\mu})$	$(\overline{TC})$	$\bar{L}_s$	$\bar{W}_s$	$\bar{\rho}$
3	1.37	1.77	40.33	8.4	6.13	0.77
4	2.62	4.79	121.92	5.3	2.02	0.55
5	2.49	5.38	156.04	5.8	2.33	0.46
6	1.72	4.69	154.55	4.9	2.85	0.37
7	1.11	3.97	147.89	3.6	3.24	0.30

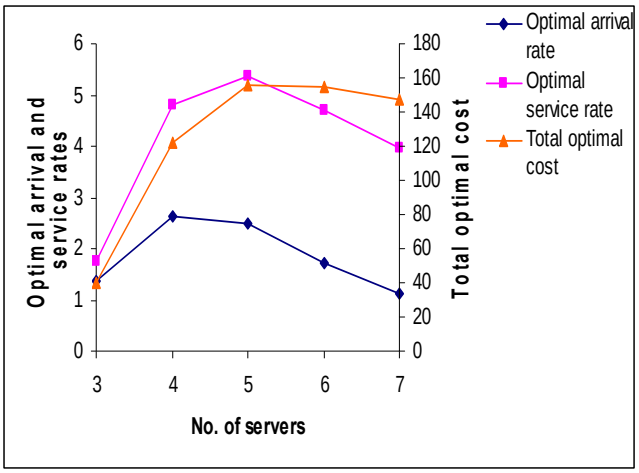

Fig.3.1: No. of Servers vs. Total Optimal Cost

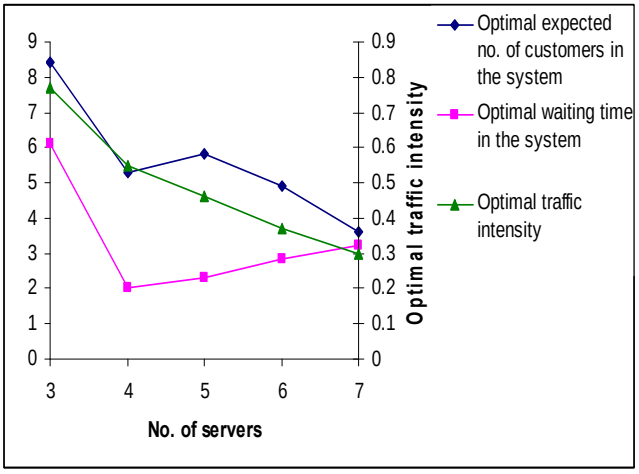

Fig.3.2: No. of Servers vs. various Performance Measures

Table- 4: No. of Customers in the System (m) vs. Total Optimal Cost and various Performance Measures

$C = 7,\ K = 20,\ C_1 = 3.50,\ C_2 = 2.50,\ m < C$

(m)	$(\bar{\lambda})$	$(\bar{\mu})$	$(\overline{TC})$	$\bar{L}_s$	$\bar{W}_s$	$\bar{\rho}$
3	1.11	3.97	147.89	3.6	3.24	0.28
4	1.13	3.98	162.04	3.8	3.36	0.28
5	1.14	3.99	176.33	3.8	3.33	0.29
6	1.77	4.72	221.43	4.4	2.49	0.38

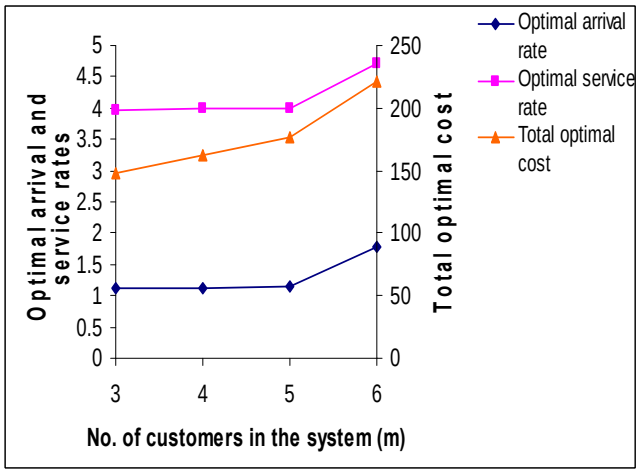

Fig.4.1: No. of Customers in the System (m) vs. Total Optimal Cost

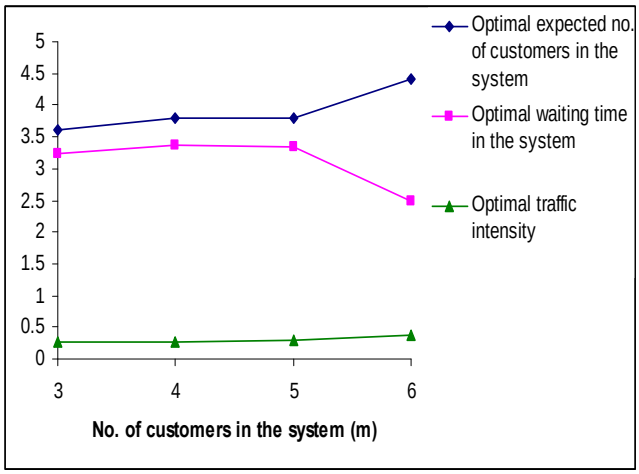

Fig.4.2: No. of Customers in the System (m) vs. various Performance Measures

Table no 5: Capacity of the System vs. Total Optimal Cost and various Performance Measures

$C = 4,\ m = 3,\ C_1 = 3.50,\ C_2 = 2.50$

(K)	$(\bar{\lambda})$	$(\bar{\mu})$	$\overline{TC}$	$\bar{L}_s$	$\bar{W}_s$	$\bar{\rho}$
20	2.62	4.79	121.92	5.3	2.02	0.55
22	2.59	4.76	121.21	5.8	2.24	0.54
24	2.57	4.74	120.74	6.5	2.53	0.54
26	2.56	4.73	120.50	6.9	2.70	0.54
28	2.55	4.72	120.26	7.3	2.86	0.54
30	2.55	4.72	120.26	8.1	3.18	0.54
32	2.55	4.72	120.26	8.8	3.45	0.54
34	2.55	4.71	120.00	9.4	3.69	0.54
36	2.55	4.71	120.00	10.1	3.96	0.54
38	2.54	4.71	120.03	10.7	4.21	0.54
40	2.54	4.71	120.03	11.0	4.33	0.54

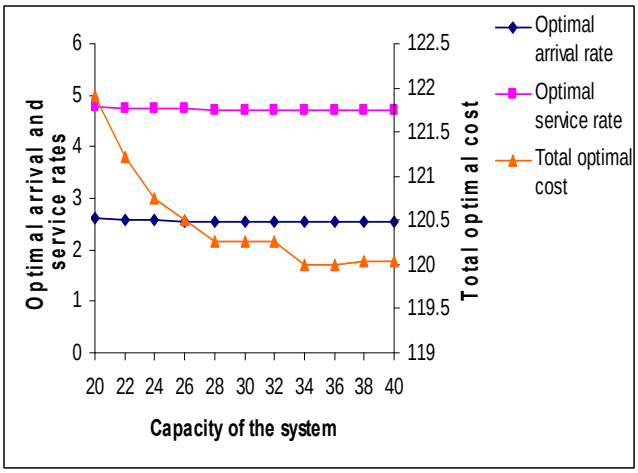

Fig.5.1: Capacity of the System vs. Total Optimal Cost

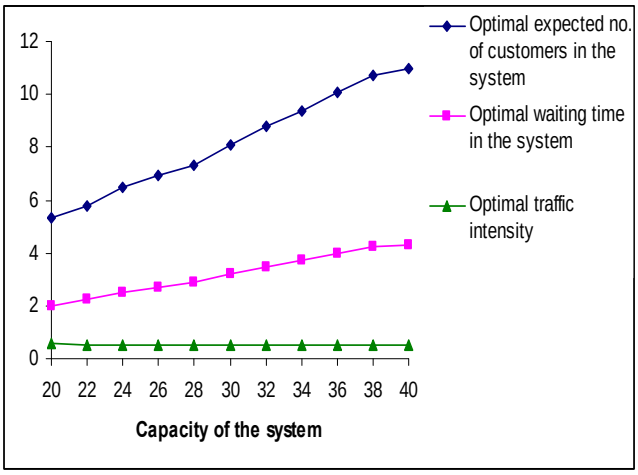

Fig.5.2: Capacity of the System vs. various Performance Measures

Observations: In Figure 1.1, we see that the optimum arrival and service rates do not vary as service cost increases which shows that the system is independent of service cost after a certain stage of arrival and service. As service cost increases the total optimal cost also increases. An increase of about 14.3% in service cost causes about 13.9% increase in total optimal cost. Hence these two costs show the positive correlation between them. In Figure 1.2, we observe that as service cost increases optimal expected number of customers in the system and optimal waiting time in the system also increase but the optimal traffic intensity remains constant. In fact 22.2% increase in service cost produces 14.8% increase in optimal expected number of customers in the system and 13.3% increase in optimal waiting time in the system. Thus these two performance measures are in positive correlation with service cost.

In Figure 2.1, we observe that the optimum arrival and service rates do not vary as waiting cost increases which shows that the system is independent of waiting cost after a certain stage of arrival and service. As waiting cost increases the total optimal cost also increases but quite slowly. In Figure 2.2, we see that as waiting cost increases the optimal expected number of customers in the system and optimal waiting time in system decrease quite slowly and traffic intensity does not vary significantly. It is almost constant. Thus there is a weak correlation between waiting cost and optimal expected number of customers in the system and optimal waiting time in the system.

In Figure 3.1, we see that as the number of servers increases the optimum arrival and service rates are also shown as fluctuating. As number of servers increases the total optimal cost fluctuates but it shows an increasing trend. In this way, a positive correlation between number of servers and total optimal cost can be seen here. In Figure 3.2, we observe that optimal expected number of customers in the system fluctuates in the beginning and then shows decreasing trend whereas optimal waiting time in the system also fluctuates in the beginning but shows increasing trend as number of servers increases. The optimal traffic intensity of the system decreases as number of servers increases. In fact 28.5% decrease is observed in optimal traffic intensity by increase of one server.

In Figure 4.1, we find that the number of customers in the system m increases but optimum arrival and service rates do not vary significantly. As m increases the total optimal cost increases. In fact, an increase of one customer in the system causes about 9.8% increase in total optimal cost. In Figure 4.2, we observe that optimal expected number of customers in the system, optimal waiting time in the system, and optimal traffic intensity does not vary significantly as number of customers in the system m increases.

In Figure 5.1, it may be of interest to note that the optimum arrival and service rates are not varying as capacity of the system increases which shows the stability of the system. Moreover, there is no correlation between capacity of the system, optimum arrival and service rates. As capacity of the system increases the total optimal cost does not vary. In Figure 5.2, we observe that optimal expected number of customers in the system and optimal waiting time in the system increase as capacity of the system increases and increase of two units in the capacity of the system causes 9.4% increase in optimal expected number of customers in the system and 10.8% increase in optimal waiting time in the system. Thus both the performance measures of the system are in positive correlation with the capacity of the system. The optimal traffic intensity does not vary with capacity of the system.

5. CONCLUSION

Finally, we conclude with the remark that present research on the computation of optimal performance measures of the truncated multi-channel queuing model with Poisson arrival, exponential service, and finite capacity can pave the way for future progress of research in various fields including technical applications for the digital communication systems and as well as in assessing the performance measures in the form of optimal arrival, optimal service, and optimal cost of computer networking by applying this queuing approach. The aim of the numerical demonstration is to study the variability of the model that is, to assess the effect of one parameter on the others especially such parameters which characterize the performance measures of the model. Numerical demonstration is carried out with the help of hypothetical

data-input. The computer program developed in the paper can also be tested for any real case study at later stage. It has also a good deal of potential to the applications in other areas such as inventory management, production management, computer system etc.

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STATISTICAL PROPERTIES OF WEIGHTED MACROECONOMIC NETWORKS

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Abstract. *The properties of the weighted networks are investigated using some statistical physics tools, taking into account the statistical ensemble of the networks with fixed number of vertices. As application, the correlations between GDP/capita time series are investigated in various time windows, over the time interval 1993-2008. The target group of countries is the 27 EU members in 2008. The mean correlation coefficients are attached to the edges of a fully connected weighted network having the countries as nodes. Particularly, the concept of entropy, based on the probability of one particular realisation from the statistical ensemble, may yield some more information about the structure, stability and evolution of the EU country clusters.*

Keywords: *network, clusters, free energy, entropy*
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1. INTRODUCTION

The study of nonequilibrium growing networks has become in the last years a well-defined field of research in theoretical physics and several large reviews are now available ([1] – [6]). In this section we aim at pointing out several important steps performed so far in two particular problems: the first one consist in the recent transition from the study of classical unweighted graphs to the weighted networks seen today as a better modeling of the most social, economic and ecological systems; the second one is related to the statistical mechanics methodology applied so far in the study of the unweighted networks, namely so-called "Hamiltonian approaches" of network statistical ensembles.

The goal of the present paper is to investigate the weighted fully connected network of the $N = 27$ countries forming the European Union in 2008 (EU-27). The ties between countries are supposed to be proportional to the degree of similitude of the macroeconomic fluctuations referring to the GDP/capita annual rates of growth between 1993 and 2008. The countries are abbreviated according to The Roots Web Surname List (RSL) [7] which uses 3 letters standardized abbreviations to designate countries and other regional locations. The World Bank database [8] is here used as data source.The common measure of 2-country fluctuation similarity is the (Pearson's) correlation coefficient of the two time series describing the time evolution of the considered indicator. The correlation coefficient is calculated in a moving time window of $T = 5$ years size. The constant size time window is moved with 1 year time step until the full time interval 1993-2008 (containing $\Delta t = 16$ data points) is scanned. In this way a number of $\Delta t - T + 1 = 12$ correlation coefficients are obtained for each pair of countries.

The weight w_{ij} assigned to the network edge *i-j* are supposed to be equal to the average correlation coefficient of *i* and *j* countries. The correlation coefficients can only be averaged only by turning them into additive measures such as the coefficients of determination or Fisher *z*-scores. The averaging is effectuated in the both ways in Section 2 and the properties of the adjacency matrix eigensystem are comparatively analyzed. Using some arguments from the factor analysis, we find that for the cluster analysis goals, the averaging by means of coefficients of determination leads to better results than the averaging through *z*-values.

In Section 3, the actual EU-27 weighted network is seen as a particular realization from the statistical ensemble of networks having a fixed number of vertices. Mapping the weighted network into a multi-graph, the probability of this particular realization is calculated considering the links randomly attached between the $N = 27$ vertices. Some thermodynamic quantities, namely the entropy, free energy, mean energy/link and thermal susceptibility are defined following the standard tools of the classical statistical mechanics. The variation of these quantities is investigated, during a thinking process that consists in removing the countries one by one starting from the strongest connected ones and from the weakest connected ones respectively. Different paths of variation are found, and a sort of phase transition is identified from the variation of the thermal susceptibility. The economic meaning is straightforward, by observing that the transition point corresponds to the complete removal of some clusters of countries.

The conclusions and some further possible developments are given in Section 4.

2. AVERAGING THE CORRELATION COEFFICIENTS

An average of correlation coefficients in a number of samples does not represent an "average correlation" in all those samples. Because the value of the correlation coefficient is not a linear function of the magnitude of the relation between the variables, correlation coefficients cannot simply be averaged. In cases when one needs to average correlations, they first have to be converted into additive measures. The methods usually recommended in the statistics literature (e.g. [9]) are: (a) to square them and so to obtain the *coefficients of determination* which are additive, or, (b) to convert them into so-called *Fisher z* values, which are also additive.

The first method gives the average correlation coefficients of the form:

$$\hat{C}_{ij}^{(d)}(T) = \left[\frac{1}{\nu} \sum_{t=k}^{k+T} C_{ij}^2(t) \right]^{1/2}, \quad k = 0, 1, \ldots, \Delta t - T, \tag{1}$$

where Δt is the total number of points (the time span), T is the time window size used for the analysis, $\nu = \Delta t - T + 1$, and t is a discrete counter variable.

In order to apply the second method, the Fisher z-values are firstly calculated:

$$z_{ij} = \frac{C_{ij} - \mu}{\sigma}, \tag{2}$$

where μ and σ are the mean and the standard deviation of the C_{ij}'s distribution. The z-values are averaged as in Eq. (1) for the T-size time window moving over the Δt points of the dataset:

$$\hat{z}_{ij} = \frac{1}{\nu} \sum_{t=k}^{k+T} z_{ij}(t), \qquad k = 0, 1, \ldots, \Delta t - T. \tag{3}$$

At last, one comes back to the distribution having the mean μ and the standard deviation σ:

$$\hat{C}_{ij}^{(z)}(T) = \sigma \cdot \hat{z}_{ij}(T) + \mu \tag{4}$$

In the present approach, the considered time interval is between 1990 and 2005, i.e. Δt = 16 years, and the time window size is T = 5 years. The problem of the "optimal" choosing of the time window size is in close relation to the C_{ij}'s distribution, and it has been discussed elsewhere [10].

The clustering scheme of the N = 27 countries may be now constructed by the both ways. The correlation matrix eigensystems are analysed for $[C_{ij}^{(d)}]$ and $[C_{ij}^{(z)}]$ respectively.

Let us recall firstly that the eigenvalues can be interpreted as the proportion of variance explained by each canonical correlation relating two sets of variables. There will be as many eigenvalues as there are canonical correlations (roots), and each successive eigenvalue will be smaller than the last since each successive root will explain less and less of the data. In factor analysis, the eigenvectors of a correlation matrix correspond to factors, and eigenvalues to factor loadings. The observable random variables are modeled as linear combinations of the factors, plus the "error" terms.

Having a measure of how much variance each successive factor extracts, one can call the question of how many factors to retain. By its nature this is somehow an arbitrary decision. However, there are some guidelines that are commonly used [9], and that, in practice, seem to yield the best results. Firstly, we can retain only factors with eigenvalues greater than 1. In essence this is like saying that, unless a factor extracts at least as much as the equivalent of one original variable, one has to drop it. This criterion, firstly proposed by Kaiser [11], is probably the one most widely used. A graphical method is the "scree" test first proposed by Cattell [12]. Plotting the eigenvalues in a simple line plot, one has to find the place where the smooth decrease of eigenvalues appears to level off to the right of the plot. To the right of this point, presumably, one finds only "factorial scree" ("scree" is the geological term referring to the debris which collects on the lower part of a rocky slope). Both criteria have been studied in detail [13-15]. By generating random data based on a particular number of factors [13, 14], it was found that the first method (Kaiser criterion) sometimes retains too many factors, while the second technique (scree test) sometimes retains too few; However, both methods were found remarkably convergent when the number of common factors is not too large [15].

The above considerations explain why the first eigenvectors (i.e. the ones corresponding to the largest eigenvalues) are generally considered as carrying the useful information. The clustering scheme of the EU-27 countries is further constructed on the structure of these eigenvectors, pertaining to the correlation matrices $[C_{ij}^{(d)}]$ and $[C_{ij}^{(z)}]$.

In Table 1 one can see the first ten values from the two matrices eigenspectra. According to the above mentioned factor analysis criteria one has to retain two common factors when the averaging was done by means of the coefficients of determination and at least four when the averaging was done by means of the Fisher z-values.

Table 1 The first 10 eigenvalues of the correlation matrices constructed by averaging the coefficients of determination (the first row) and Fisher z-values (the second row)

Eval$[C_{ij}^{(d)}]$	**15.132**	**2.255**	1.159	1.077	0.912	0.719	0.663	0.603	0.505	0.428
Eval$[C_{ij}^{(z)}]$	**10.029**	**3.813**	**2.365**	1.940	1.412	1.206	0.976	0.860	0.676	0.397

In [10] the cluster structure of the EU-27 countries was done by token of the first two eigenvectors ($\boldsymbol{V}_1$ and $\boldsymbol{V}_2$) of $[C_{ij}^{(d)}]$. The countries can be partitioned into five groups, which we can call "Continental", "Scandinavian", "Mediteraneean", "Anglo" and "East-European". This partion is in good agreement with the results recently reported in the economic literature ([16-20]).

On the other hand one can see that using $[C_{ij}^{(z)}]$, the number of statistically significant eigenvalues is certainly greather than two. To have a more exact representation, in addition to the repreentation ($\boldsymbol{V}_1$ and $\boldsymbol{V}_2$), other two-eigenvector structures must be done: ($\boldsymbol{V}_1$ and $\boldsymbol{V}_3$) and ($\boldsymbol{V}_2$ and $\boldsymbol{V}_3$). Each important feature of the cluster structure that was done by token of the first two eigenvectors ($\boldsymbol{V}_1$ and

$\boldsymbol{V_2}$) of $[C_{ij}^{(d)}]$ can be recovered in at least one of the three representations ($\boldsymbol{V_1}$; $\boldsymbol{V_2}$), ($\boldsymbol{V_2}$; $\boldsymbol{V_3}$) and ($\boldsymbol{V_1}$; $\boldsymbol{V_3}$). The three representations are nothing else but orthogonal projections of the same *N*-points structure in the 3-dimensional eigenvector space. (Note that the full information would be derived in a 4-dimensional and 6-dimensional space respectively, in order to take into account *all* the significant eigenvalues in Table 1).

One can conclude that averaging the correlation coefficients by means of the *z*-values leads to a *more informative* but *harder comprehensible* clustering scheme, as compared to the one obtained by averaging by means of the coefficients of determination.

3. THE STATISTICAL TERMODYNMICS OF THE EU-27 WEIGHTED NETWORK

A. The statistical ensemble of networks with fixed number of vertices

Let us observe firstly that any weighted graph with $0 \leq w_{ij} \leq 1$ can be turn into a graph with positive integer weights and respectively into an unweighted multi-graph through a suitable multiplication of edge weights. For example, the weighted graph in Fig. 3a has been turned into the unweighted multi-graph in Fig. 3b by multiplying its weights by 10.

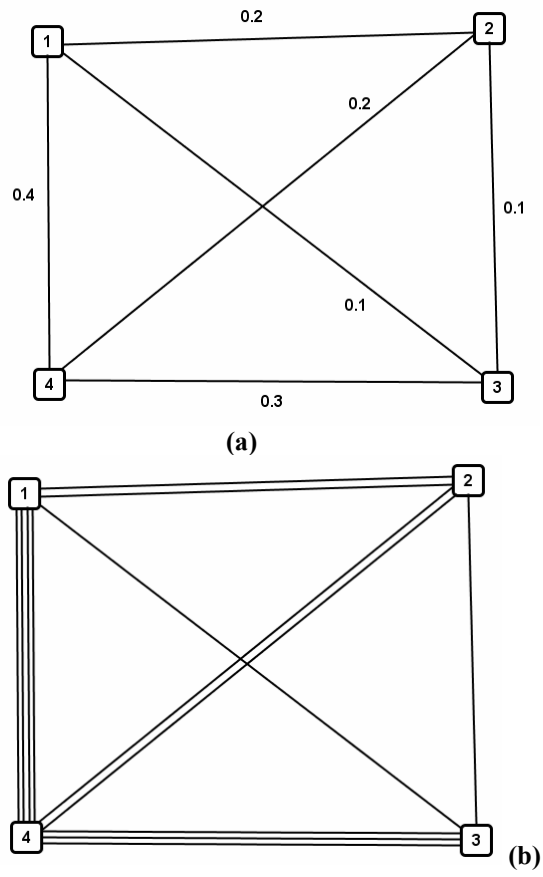


Fig. 3 The weighted graph (a) is turned into the multi-graph (b). The edge weights multiplied by 10 become positive integers and thus they can be mapped into unweighted multiple edges.

Now we can try to find the probability of having the weight w_{ij} assigned to the edge i - j on the hypothesis that in the isomorphic multi-graph the links are attached *randomly* between the *N* edges. For example, in Fig. 3b the probability of having three edges between the vertices (3) and (4) should be of the form: $p_{34} = C\cdot(1/6)^3$, where C is a positive constant accounting all the possible permutations of vertex labels, and (1/6) is the probability of having a link *somewhere* between a pair of vertices in the graph. If we have *N* vertices, the corresponding number of possible connections becomes: $\binom{N}{2} = N(N-1)/2$, and the probability of having w_{ij} simple edges between the vertices (i) and (j) is read:

$$p_{ij} = C\frac{1}{\binom{N}{2}^{w_{ij}}} = C\left(\frac{N(N-1)}{2}\right)^{-w_{ij}}.$$

Introducing the notation: $\Lambda = N(N-1)/2$, after the normalization:

$$\sum_{\substack{i,j \\ i>j}} p_{ij} = 1,$$

the above probability becomes:

$$p_{ij} = \frac{\Lambda^{-w_{ij}}}{\sum_{\substack{i,j \\ i>j}} \Lambda^{-w_{ij}}}$$

(9)

Finally, one can turn back to the initial network with $0 \leq w_{ij} \leq 1$; defining:

$$\beta = \ln \Lambda = \ln \frac{N(N-1)}{2},$$

(10)

Eq. (9) gets the more familiar "canonical" form:

$$p_{ij} = \frac{\exp(-\beta w_{ij})}{\sum_{\substack{i,j \\ i>j}} \exp(-\beta w_{ij})}.$$

(11)

Several remarks have to be done here.

(i) During the network "thinking" construction process, the links have been supposed to be *randomly* attached between the *N* vertices. Thus, the mechanism of network generating excludes any "preferential attachment". As a consequence, the probability in Eq. 11 has the typical form for an *exponentially growing network*, the term "growth" referring here at the increasing number of edges while the number of vertices has been kept constant.

(ii) The parameter β in Eq. 10 is not related to any temperature. Nonetheless, β can be seen as an *internal* parameter of the statistical ensemble of *N*-vertex networks, in the same way in which the temperature is for the canonical ensemble. Unlike the thermodynamic meaning, the changing of β does involve neither warming nor

cooling process, but it simply means the shifting from a statistical ensemble to another one.

On the above assumptions, some basic thermodynamic quantities can be defined in correspondence to the classical statistical mechanics, as follows:

- The partition function:

$$Z = \sum_{\substack{i,j \\ i>j}} \exp(-\beta w_{ij}) \tag{12}$$

- The entropy:

$$S = -\sum_{\substack{i,j \\ i>j}} p_{ij} \ln p_{ij} = -\sum_{\substack{i,j \\ i>j}} \frac{\exp(-\beta w_{ij})}{\sum_{\substack{i,j \\ i>j}} \exp(-\beta w_{ij})} \ln \frac{\exp(-\beta w_{ij})}{\sum_{\substack{i,j \\ i>j}} \exp(-\beta w_{ij})} \tag{13}$$

- The free energy:

$$F = \frac{1}{\beta} \ln Z = \frac{1}{\beta} \ln \sum_{\substack{i,j \\ i>j}} \exp(-\beta w_{ij}) \tag{14}$$

- The average energy / link:

$$< w >= \sum_{\substack{i,j \\ i>j}} p_{ij} w_{ij} = \sum_{\substack{i,j \\ i>j}} \frac{w_{ij} \exp(-\beta w_{ij})}{\sum_{\substack{i,j \\ i>j}} \exp(-\beta w_{ij})} \tag{15}$$

- The "thermal" susceptibility:

$$\Lambda \chi_T = \frac{d < w >}{d(1/\beta)} = -\beta^2 \frac{d < w >}{d\beta} = \beta^2 \left[< w^2 > - < w >^2 \right] \tag{16}$$

B. Deconstructing the EU-27 weighted network

In order to get some more information about the structure of the EU-27 weighted network we examine it during a thinking process of decomposition, which consist of removing the countries one by one, in decreasing and, respectively, increasing order of the overlapping coefficients displayed in Table 2. The overlapping coefficients (defined and calculated in Ref. [10] for all the EU-27 countries) are quantities able to measure to what extent a country is "connected" to the whole system.

Table 2 The country average overlapping index of each EU-27 country

SWE	0.38	NLD	0.35	CYP	0.32
DNK	0.37	AUT	0.35	SVN	0.32
GER	0.37	FIN	0.35	CZE	0.31
FRA	0.37	POL	0.35	ROM	0.31
HUN	0.37	ESP	0.35	BGR	0.31
SVK	0.37	PRT	0.35	LTU	0.31
BEL	0.36	ITA	0.34	LVA	0.31
IRL	0.36	MLT	0.33	EST	0.30
LUX	0.36	GRC	0.33	GBR	0.29

Keeping somehow the "thermodynamic" analogy, the quantities defined by Eqs. 12-16 are studied as functions of β, which is a measure of the number of remainder countries, and $(1 / \beta)$ that is a measure of the number of removed countries.

The results are plotted in Figs. 4-8. The entropy is found to have a power law dependence on β. (The country removing corresponds to decreasing values of β, so the deconstruction process in Fig. 4 and Fig. 5 can be followed by reading the x-axis from right to left). The two paths of deconstruction are not differentiated: the two plots collapses onto a single one.As opposite, the two paths of country removing appear as clearly differentiated in Fig. 5, where the free energy per link variation is represented in semi-log plot. The free energy per link is found to depend exponentially on β.

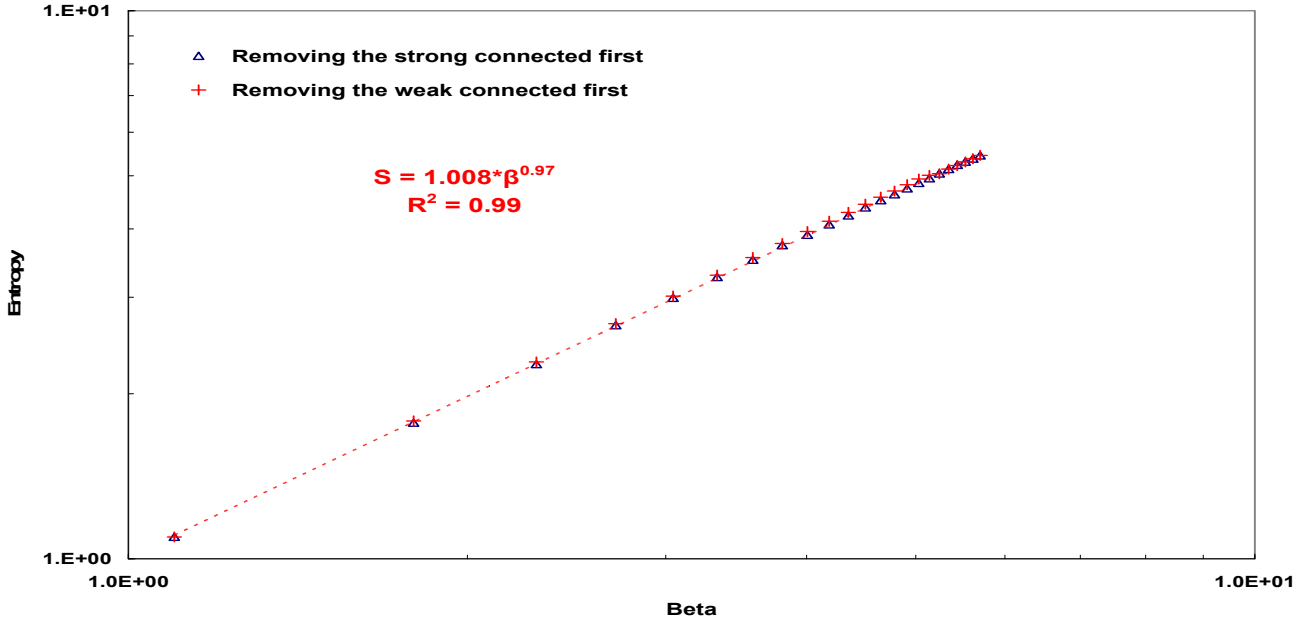


Fig. 4 The entropy variation in EU-27 country removing process, in log-log plot. The dashed line is the power law fit. R^2 is the square of Pearson's product moment correlation coefficient of fitting.

An interesting bi-fractal behavior displays the average energy per link when countries are removed in increasing order of connectness (Fig. 6). Such effect (if it exists) cannot be observed in the other path of deconstruction. One must stress here that removing the countries in decreasing order of connectness (i.e. starting with the strongest tied) generally involves large fluctuations at each step, thus this way of the deconstruction process can be seen as having a high level of noise.

The same noisy behavior displays the thermal susceptibility (Fig. 7). Nonetheless, as the statistical results are as more relevant as we have more elements in the system, we can restrict our analysis on the range of small values of $1/\beta$ (i.e. large values of N), where two local minima (one for each path of deconstruction) can be easily seen. They correspond to $(1/\beta)_1 = 0.25$ (i.e. 15 countries removed) when countries are removed in decreasing order of connectness, and to $(1/\beta)_2 = 0.19$ (i.e. 6 countries removed) when countries are removed in increasing order of connectness. From Table 2 one can easily find that this critical behavior corresponds to cluster separation (the East European cluster, GBR and the group MLT-GRC-CYP are separated in the first case; the East European cluster and GBR are separated in the second case).

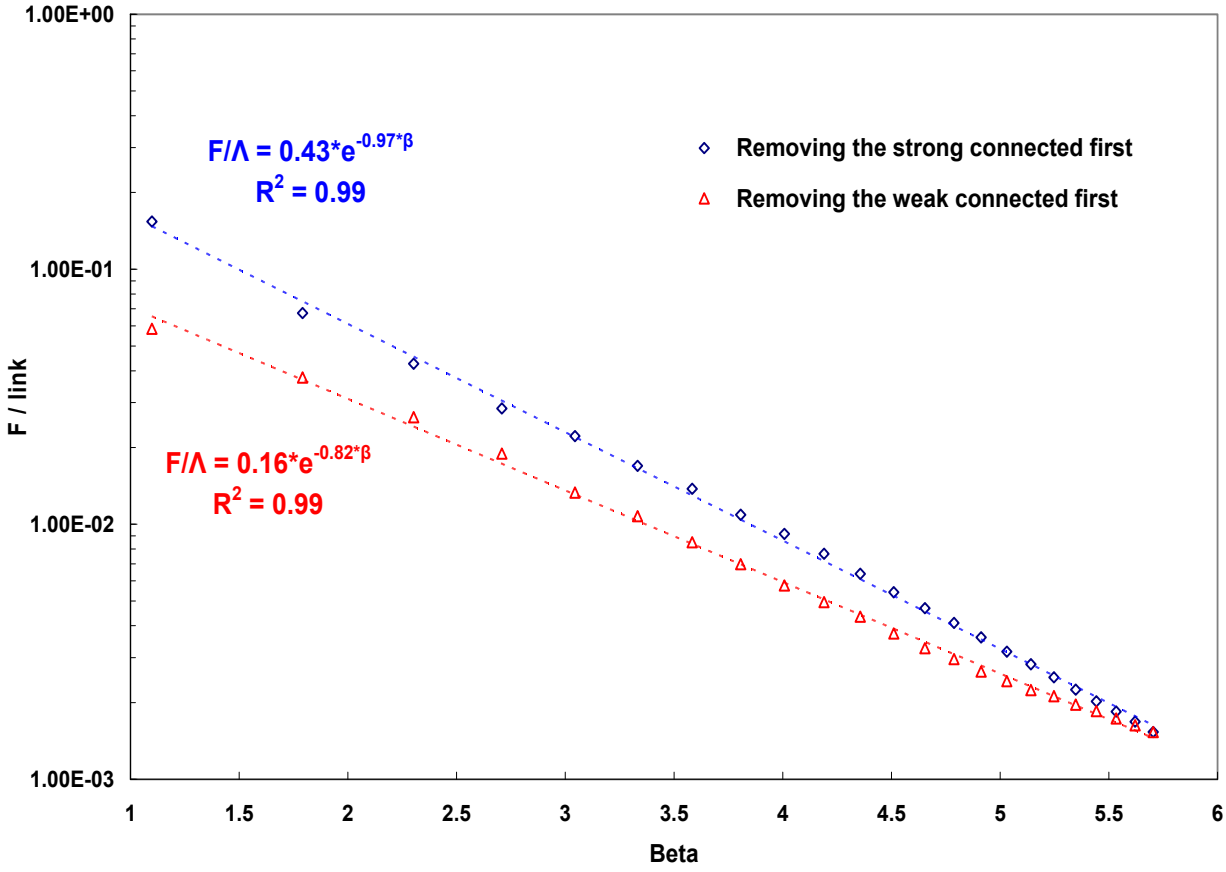


Fig. 5 The free energy per link variation in EU-27 country removing process in semi-log plot. The dashed lines are the exponential fits. R^2 is the square of Pearson's product moment correlation coefficient of fitting.

A well-established numerical method for analysis of critical points [21] consists in studying the temperature dependence of the fourth cumulant of $<w>$,

$$V_L = 1 - \frac{< w_{ij}^4 >}{3 < w_{ij}^2 >^2} \qquad (17)$$

This quantity is supposed to have a local minimum in the vicinity of the critical points, both for continuous and discontinuous phase transitions [22].

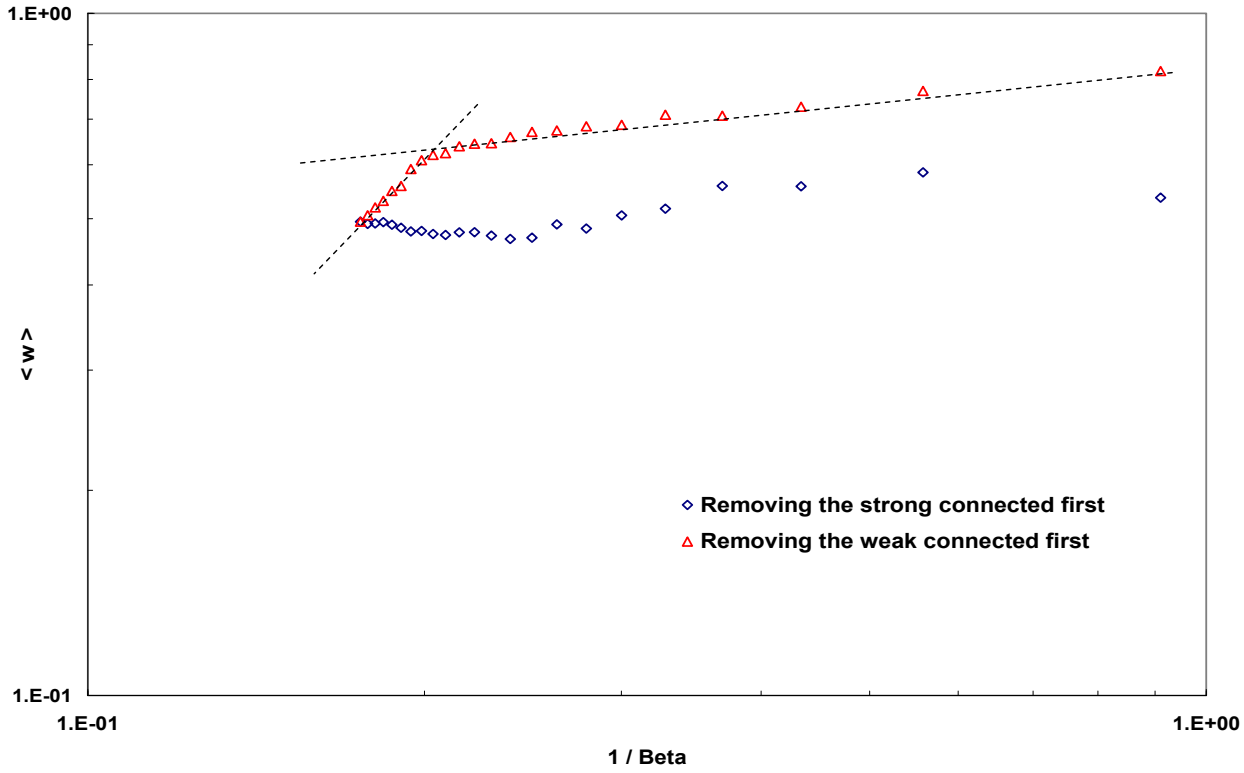


Fig. 6 The average energy per link variation in EU-27 country removing process in log-log plot. A bi-fractal behaviour is found when countries are removed in increasing order of connectness.

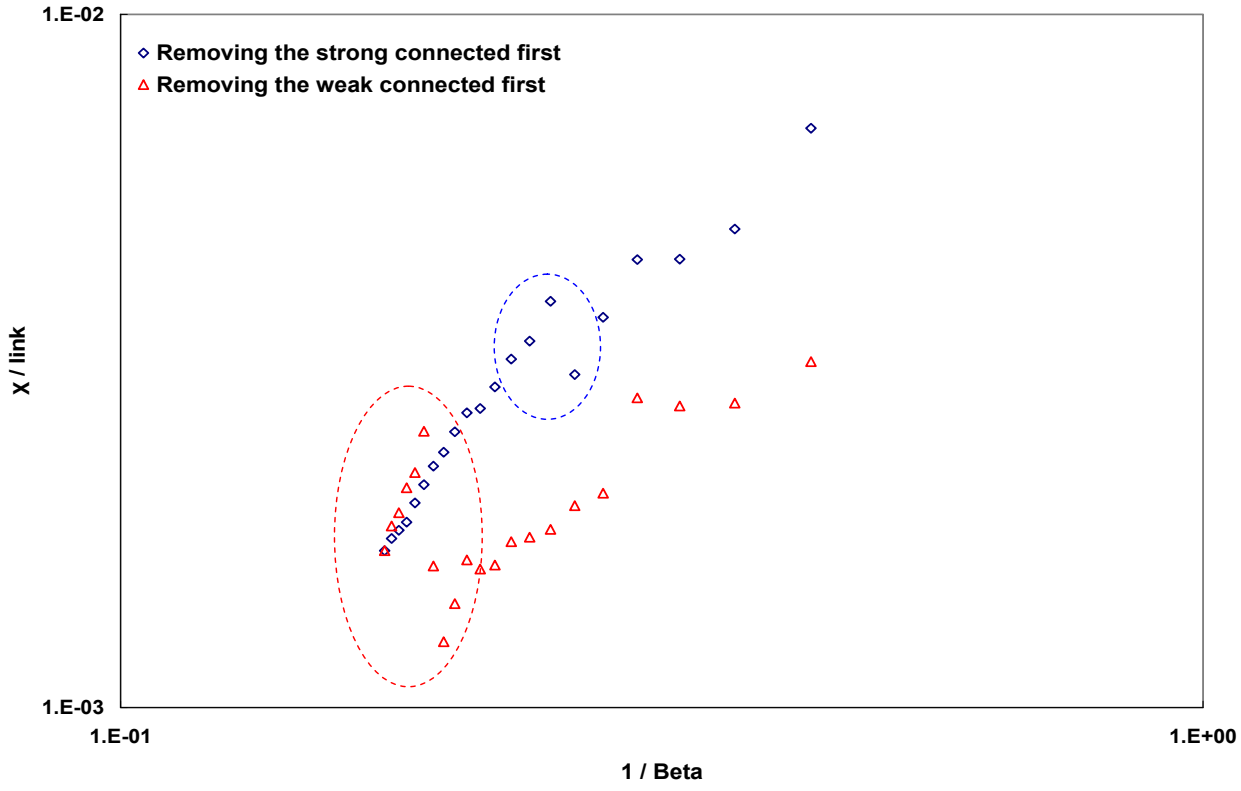
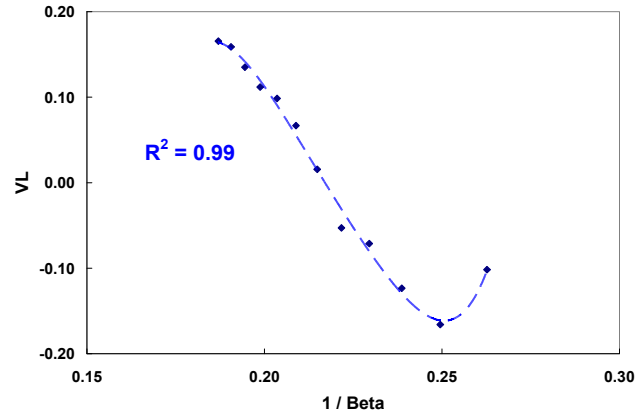
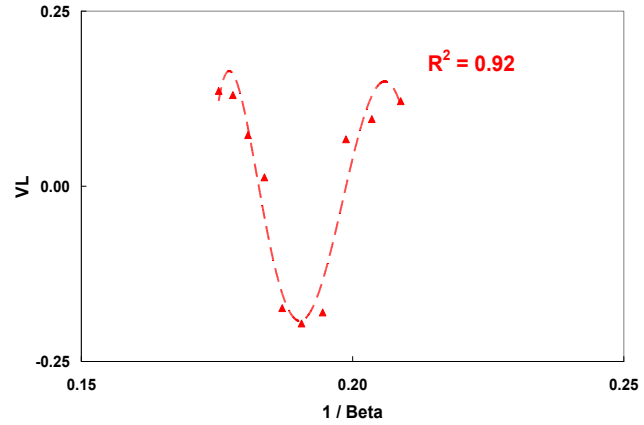


Fig. 7 The thermal susceptibility variation in EU-27 country removing process, in log-log plot. The first local maximum in each plot can be seen as critical point.



(a)



(b)

Fig. 8 The fourth central cumulant V_L variation in EU-27 country removing process, in the vicinity of the critical points. The minima correspond to the first local maxima of the thermal susceptibility found in Fig.7.

Given that the distribution mean and variance are changing from a statistical ensemble to another one, in the present approach the central moments are considered, thus Eq. (17) is read:

$$V_L = 1 - \frac{< (w_{ij} - < w_{ij} >)^4 >}{3 < (w_{ij} - < w_{ij} >)^2 >^2} \qquad (18)$$

This quantity is found to have two local minima in the vicinity of the two critical points above mentioned (Fig. 8).

4. CONCLUSION

Two recent topics in network analysis have been caught more an more interest in the last few years: the first one refers to extending the analytical investigations from the classical binary graphs to the weighted networks, which yield a more appropriate framework of modelling the real networks from communications, biology and economy; the second one, mostly restricted so far to the binary graphs, refers to construct a genuine statistical mechanics of networks, based on the fundamental notions of the field.

The goal of the present paper has been to join the two topics in a particular framework derived from mapping the macroeconomic time series into weighted graphs.The weights in the analyzed EU-27 weighted network represent some average correlation coefficients between the GDP/capita rates of growth, calculated for each pair of countries in a 5 years moving time window. The two ways of turning the correlation coefficients into additive measures have been comparatively analyzed in Section 2. It was proved that the averaging the correlation coefficients by means of the *z*-values as compared with the averaging by means of the coefficients of determination leads to a more informative but harder comprehensible clustering scheme.

The statistical ensemble of networks with fixed number of vertices was constructed and analyzed in Section 3. A probability has been assigned to each two-country connection by random attachment mechanism, and the corresponding partition function was built. The basic thermodynamic quantities, namely entropy, free energy, average energy per link and thermal susceptibility have been defined using the partition function. The variation of the thermodynamic quantities have been investigated during a thinking process of network deconstruction, which consist of removing the countries one by one, in decreasing and, respectively, increasing order of the overlapping coefficients. Some evidences for critical points have been found, the corresponding phase transitions being generated by removing compact clusters of countries from the system.

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THE CONCEPT OF TIME IN THE PHYSICAL WAY OF THINKING, AND ITS IMPACT ON KNOWLEDGE AND THE EVALUATION OF INFLATION AS AN ECONOMIC PHENOMENON

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Abstract. *The concept of time in physics has evolved from the statutes of absolute time to that of a space-time object, omnipresent and exclusive, in the generalized theory of relativity. Physical thinking has attracted under its influence imaginary time as well, decomposing it in three senses: the entropic sense, the psychological sense, and the cosmological sense. Physical thinking has personalized itself within a space of the expanding universe, and the analogy with the economic phenomenon, particularly with inflation, is only natural. From the analytical overlapping of the concepts there emerge similarities between the space-time of the theory of relativity, and economic time. Which are the similarities of physical and economic thinking about time and inflation? An attempt to define what is the meaning of time, time series, indices time series and physical correspondences a brief historical background of a hundred years of inflation in Romania, some significant graphical resemblances, together with the specific method used in physics to analyze economic data and economic processes and finally a short review of major results and new domains in refereed literature are the principal themes or the major content of this paper, which remains nothing else but a modest contribution for starting a debate about the concept of time in physics as a remarkable start point inflation analysis.*

Keywords: *Time, Space-Time Object, Imaginary Time, Entropic Time, Psychological and Cosmological Time, Time Series, Indices of Inflation, Equilibrium of Development, Non-equilibrium of contraction.*

1. INTRODUCTION

Of course Brâncuşi was right when saying that we cease to exist the moment when we are no longer children. Consequently, we forget that actually those children who, during childhood, used to exist inside everyone's inner being, though not possessing enough information to ask questions considered "important", besides the permanent "why?", would quite often pose into discussion, in a natural manner, the things the adults considered complete, durable and incontestable realities. We all remember asking, when we were children, various questions such as where the sun comes from, if the hands of a clock can move backwards, and time elapse in a reverse way, why the trajectory of a glass to the floor can only end in its final breaking, though the reverse path is no longer possible (intuiting or not the existence of the double sense from chaos to order, but also from order or negentropy towards disorder or entropy), or where the necessity appeared of assigning order in our apparently stable and eternal world, etc.

Adults permanently correlate time and space, while children enjoy the apparent infinity of day and the horizon, the grown-ups complain about the narrowness of the two dimensions, getting absolutely scared by the mere idea that the lapse of time could be reversed from effect to cause, the effect preceding the cause and, suddenly, instead of the cause, we would suddenly remember the effect…

2. FROM THE ABSOLUTE TIME OF CLASSICAL PHUSICS TO THE SPACE-TIME OF THE THEORYOF RELATIVITY

From Aristotle, with his spherical world proved by the arguments of the circularity of the moon and the eclipses ("*On the skies*") and Ptolemy, where the Earth could only be the centre of the universe, an assertion apparently demonstrated through the perfection of the circular motion of the Sun round the Earth, up to the formation of the classical concept due to Copernicus', Kepler's and Newton's contributions, no scientist or learned man suggested at least that the universe is expanding; the time was considered a god or a divinity (i.e. the illustrious Chronus), something absolute and divine. Classical time in physics did not allow any kind of ambiguity, save perhaps that connected with the imperfection of timepieces, which man wanted to measure its perfect course... Classical time in physics was completely separated from space. Although Newton considered that, in proportion to a light impulse sent from one place to another, the time needed for the travel was unique and absolute, generating the accord of all the observers with respect to its duration, it was just that unanimous opinion that was to lead to the disagreement of the same observers with respect to the distance the light travelled. But as the speed of light represented the ratio of the distance (in disagreement) and time (in unanimous accord), all the observers obtaining different distances of the light, a fundamental paradox of Newtonian or classical physics was thus generated…

In the theory of relativity or relativistic physics, absolute time is no longer present. [1] The demise of absolute time in classical physics coincides with the birth of an object called "space-time". The process of that event or expected natality is complex. To make it easier to understand, let us return to the fundamental paradox of Newtonian or classical physics. While in the theory of classical physics, the observers were in complete disagreement with respect to the speed of light, they become completely disagreeable with respect to the uniqueness of the value of light, in accordance with the theory of relativity. Reanalyzing the calculation of that speed, i.e. the speed declared and now recognized as a constant, but in the context of distances considered as different by the observers, can only "kill"

the unique or absolute time, and generate the different time of the observers or shortly the observed time. Finally, in the theory of relativity, each observer has their own time or their own measure for time. Thus, the absolute time of classical physics is disobjectived and becomes subjective or relative... [2]

Any observer can know or precisely determine both the time and the position (the space) of the event attributed by any other observer, on condition they know the relative speed of the other observer. A meter, as a unit used to determine space, becomes the distance travelled by light in 0.000000003335640952 seconds, measured with a Cessium timepiece. A new standard measuring unit appears nearly instantaneously, called a second-light [3]

In the modern spatial and temporal connection, in keeping with the theory of relativity the contents of classical time and space is essentially modified, and the concept or the physical "object" called space-time is accepted exclusively (from that moment on, time is no longer separated from space), and the positioning of a number of phenomena and processes (event or observers) is done in four coordinates, respectively, three spatial, and one temporal. The new positioning according to the theory of relativity is virtually quadri-dimensional. Einstein, through his generalized theory of relativity, starting from the finding that gravity is not a force, but rather a consequence of the fact that the object space-time is not plane but "curved" ("wrapped") by the distribution of the mass or energy it contains ($E = mc^2$), proposes and rigorously defines the "geodesic line" to be the shortest (or the longest) trajectory between two neighbouring points.

The final conclusion of the generalized theory of relativity underlines the special dynamism of the space-time object; when a given body is moving, or a force acts, it affects the curving line of space-time and the structure of that modified object space-time affects the manner in which the bodies move, and acts on the forces through which matter and energy manifest themselves.

Relativized and modern space and time in physics are affected by everything happens in the universe. It becomes practically pointless to talk about space and time outside the universe, a dynamic universe, in expansion between a past finite moment and another, future, moment, which is completely uncertain… but even under those circumstances physical thought can only speculate on time: the universe must have had a beginning, in the same manner as it must have an end, as Roger Penrose and Stephen Hawking actually state [2].

1. PHYSICAL TIME AND ECONOMIC TIME

The time of modern physics (in fact, the space-time object), presents a few important characteristic features, which can represent guiding points in thinking modern economic time.

The theory of generalized relativity redefines the relationship between the energy of light and its frequency (the number of lightwaves per second):

A. **The greater the energy, the higher its frequency**.

When the light propagates upwards in the Earth's gravitational field, it loses energy, and so the frequency goes down while the time between a peak of the lightwave and the next increases.

B. For someone who is located at a higher place, everything happening below looks as if needing a longer (greater) time.

The paradox of the twins emphasiyes, in the theory of physices, what can happen in an irreal way, when the physical thinking of a classical type of the absolute (Newtonian) time intertwines with the thinking of the relativistic physics of space and time. If, out of two twins, one travels into an interplanetary space, he will grow older faster, while the one remained on Earth will remain much younger. In the thinking of the theory of generalized relativity, each of the twins will have his own personalized time, at the level of the observer, his own time measure, which would irretrievably depend on space (location) and the speed they move, and the twins will grow old in the same manner.

C. There exists a contracted, and a dilated cycle of life, in keeping with the location or space, and speed.

Stephen Hawking, in his attempt to unify the theory of generalized relativity and quantum physics, introduces a new concept concerning time, i.e. imaginary time, which does not differ from the directions of space. In the same manner the going direction north has a return direction south, also imaginary time possesses both directions, from the past towards the future ("forward" from a temporal standpoint), and from the future towards the past ("backwards" in the sense of the temporal course). [1]

The laws of science, Stephen Hawking states, make no difference between the past and the future, and do not change when combining the operations or symmetries called C, P and T:

C = change of the particle for its antiparticle;

P = change for the mirror image;

T = inversion of the movement direction of all the particles (the "backward" motion)

Physical thinking has attracted under its influence imaginary time as well, decomposing it into three directions: the entropic sense, the psychological sense, and the cosmological sense. The increase in disorder (entropy) is the most often invoked sense of time, from the past to future, and translates as from less to more entropy). The psychological or the sense felt by the human being is the one that makes us remember the past and not the future in keeping with the entropic (thermodynamic) sense, and the cosmological sense is the sense given in the universe that expand rather than contracting.

D. The universe itself must have begun immediately after the Big Bang with a period of exponential "inflationist" expansion, when it increased in size by a very great factor.

During that expansion, the fluctuations in the density of the universe should have remained small at the beginning, and then begun to increase.

E. A greater density of the universe is correlated with a smaller fluctuation, made slower by universal attraction.

Obviously, there exist regions of the universe having a higher or smaller density, and some of them should have stopped their expansion and suffered a collapse, forming galaxies, stars, and, why not, even human beings…

F. The universe thus begins in a homogenous, and hence ordered state, which gradually becomes heterogeneous or disordered, as "time passes", in all its senses…

Physical time was personalized in a space of the universe in expansion, and analogy with the economic phenomenon, in particular with inflation, is only natural.

In a synthesis, a lot of questions can appear, partially synthesized in the table below:

The antinomies and synonymies of time in a physical and economic context

Table no. 1

TEMPORAL QUESTIONS ABOUT THE UNIVERSE	TEMPORAL QUESTIONS ABOUT THE INFLATION
PHYSICAL TIME	**ECONOMIC TIME**
1. What do we know about the time of the universe, and how was that information come by?	1. What do we know about inflationary economic time, and how did we know about it?
2. From what direction of time does the universe come, and where is it heading?	2. Where does the time of inflation come from, and where is it heading?
3. Does the universe have a temporal beginning, and if so, what happened before the Big Bang?	3. Does inflation have a temporal inception, and if so, what happened before the first inflationary moment?
4. What is the nature of physical time?	4. What is the nature of inflationary economic time?
5.Will physical time reach at a final time (Big Crunch)?	5. Will the time of economic inflation reach an ending moment?

Still, the answers are not, as we are going to see below, so different in the economic subuniverse as compared with the physical one. To do that, the investigation of inflation, considered practically the specific temporality of all the economies, and its measuring instruments, especially in Romania, constitutes a good example for the analysis conducted, and the ideas formulated at the beginning and, respectively, at the end of the present article.

4. SOME IMPORTANT ASPECTS OF THE INFLATION

Inflation is an evolution perceived as a diminution of the value or buying power of a national currency, defined either as an imbalance between the steeper rise of the domestic/national prices, and the increase in the external / international prices, or as a major macro-economic imbalance of a monetary-material nature, and seen, in the practical field, as a general, sustained rise of the prices; it appeared long before the science of economics. The climactic periods, or the inflationary "critical moments" were typically defined by the end of the 3rd century, the begining of the 16th century, the whole of the 17th century, and the 20th century. The end of the 3rd century is marked by inflation through the currency, i.e. excessively issuing uncovered currency/coins in the Roman Empire, which was vainly and non-economically treated by emperor Diocletian's "famous" AD 301 decree of maximal prices, which sanctioned death penalty for the "offence" of raising prices. The western Roman Empire collapsed, and the eastern Roman Empire, reformed by emperor Constantine the Great, imposed the imperial coin called "solidus" or "nomisma", after AD 306, for another nearly 1,000 years. The beginning of the 16th century brings in, as a result of the great geographical discoveries, accompanied by massive amounts of gold and silver from the "new world", price rising more than tenfold, generating problem for the whole of Europe, through the excess of precious metal in Spain and Portugal, materialized in sapping the buying power of the national currencies of those tow nations, and, eventually, of all the money in Europe. If the 17th century was a century of the inflationary "princes", who would fuel wars by issuing counterfeited coins, coins of diminished or oscillating value, the 20th century was marked by waves of inflation, such as the one occurring during the "great Slump/Depression", and of the 1930 economic crisis, by hidden inflation via the imposed, controlled and artificial prices of the "great Planning", the inflation generated by the evolution of the price of the oil barrel, or the occasionally galloping inflation of the transition of the East-European countries to market economy. Neither the "decrees", nor the "assignates" of Catherine II, as financial guaranties of the currency, nor the imposed or controlled prices represented lasting solutions in fighting inflation. Inflation was determined *par excellence* by the term "excess", be it excess of currency issuing, or inflation through currency/coins, excess of creditworthy demand, or inflation through demand, excess of nominal demand, i.e. credit, or inflation through credit, excess in costs, or inflation through costs, and only seldom by the term scarcity, as was the case of insufficient production, when there was no corresponding excess, or inflation through supply. Measuring the phenomenon of general, steep increase in prices, an operation which was initiated by bishop William Fleetwood in 1707, by estimating to about 500% the value of the inflation occurring in the English economy, between 1440 and 1707, devolves upon the science of statistics, and is substantiated in multifarious specific assessment instruments, all daubed price indices, which originated in interpret indices. The modern range of issues and ideas in the domain requires new techniques, from econophysical modelling to modelling based on the new fuzzy numbers resulting from the fuzzy logic.

5. THE INDEX NUMBERS AS MAJOR INFLATION INSTRUMENTS

Defining a statistical index, in as concise, simple and accurate a manner as possible, is a difficult undertaking. The etymological root of the concept of index is the Latin word *index*, variously meaning "index finger, indicator, title, inscription list". The above senses have been maintained, and were even diversified with those of "clue, indication, hint, sign". Indices are accepted as method, system, proportion, ratio (comparison), size or relative indicator, average weighted value of relative dimensions, or average relative variation, instrument or measure of relative change, *pure* number, adimensional numeric

expression, simplified representation through substituting rough data, mathematical function, or value specific to the axiomatic theory of indices", etc.

Defined as a *pure* number, or as an adimensional numerical expression, the idex is a particular form of "numeric purity", i.e. of independence as to the measuring unit of compared values. The term of index initially applied to the data of dynamic series, and it is expressed in the shape of relative numbers. To this day it is considered, in statistical terms, a dimensionless number, obtained either through putting in proportion of two values of the same simple variable, which correspond to two different time or space periods, or of two values of a complex indicator, whose simple values are nonhomogeneous, thus being unable to be directly summed up. The first category is that of individual, particular or elementary indexes, while the second one – in fact, the most important one – is known as the category of synthetic or group indexes. Seen as the scheme of variation of one or several values or phenomena, an index is a simplified representation, through substituting the rough data by their ratio (and comparison), and aiming at restoring the temporal and spatial evolution of the values under observation. Whenever a variable modifies its level, in time or space, a statistical index is generated (Henri Guitton). Aproahed as a statistical-mathematical function, the index has generated an entire axiomatic theory, which redefines it as an economic measure, a function F :D→ R, which projects, on the ne hand, a group, or a set D of objectives (informatin and data) bearing economic interest, onto a group, or set R of real numbers, and which satisfies, on the other hand, a system of relevant economic conditions – for instance, the properties of monotonousness, of homogeneity, or of homotethicity, or relative identity (Wolfgang Eichhorn).

Consequently, the concep of index is revealed via a general method of decomposition and factorial analysis, and prevalently used in practical matters as a system. Indexes are defined either as a ratio, or raio comparison that yields a characteristic number, or as a relative synthetic value, or a relative indicator in an adimensional numeric expression, or in its capacity as a pure number, or in the most condensed defining variant, as an average weighted values of relative values, or as a measure of the relative average variation of a number of variables at various moments in time, in different locations, or in different categories, and, last but not least, as a manner of simplified mathematical representation via substituting rough data for their proprotion/ratio through the agency of a function bearing the same name –the index function – i.e. $F:D\rightarrow R$, where $F(z_1,z_2,\ldots,z_k) = z_1/z_2$, with z representing the specific variable and D is the set of the objectives, items of information and data of (an economic) interest, and R remains the set of the real numbers.Constructed in the multifarious world of prices, the first index was an *interpret* index. In the present context, the term has the signification of the original Latin terms maing it up, i.e. *inter* "between (implicit mediation)", and, respectively, *pretium* "price". The evolution in time of indices needed, over more than tree centuries, solving numerous theoretical and methodological problems concerning the calculation method used, including the formula, choosing the base and the system of weighting/balancing, and, more especially, the practice way of construing. The process of optimizing the range of issues having to do with the construction is far from being finished even today, although the history of its enunciation was a troubled one[5].

Emerged, like modern statistics itself, as a by-result of the *school of political arithmeticians*, the index was fathered by an Anglican bishop, called William Fleetwood. The date of birth of the first interpreter index is 1707, and it is recorded by the study of the evolution of prices in England, between 1440 and 1707, a record known by the name of "Chronicon Preciosum". The value of this first index was 30/5, or 600.0%, and it was construed based on the simple arithmetical mean value of eight products: wheat, barley, beans, clothes, beer, beef, mutton and ham. As a matter of fact, the world of prices, which is hard to approach due to the specific ampleness of its scope, to its sui-generis heterogeneity, and to its tendency to apparent infinity, was translated onto a homogenized population through the agency of the interpreter indices. In 1738, C. Dutot conducts a research into the decrease of the buying power of the French currency, between 1515 and 1735, through the agency of another interpreter index, more extended, having the following formula:

(1) *Dutot* index: $\frac{p_1 + p_2 + \ldots + p_n}{\mathrm{P}_1 + \mathrm{P}_2 + \ldots + \mathrm{P}_n} = \frac{\sum_{i=1}^{n} p_i}{\sum_{i=1}^{n} \mathrm{P}_i}$, where: p_i and P_i = the prices of the current, and base periods

If the numerator and the denominator of the index are multiplied by (1/n), the calculus formula of the *Dutot* index becomes a ratio of mean values, i.e. $(\sum_{i=1}^{n} p_i /n):(\sum_{i=1}^{n} \mathrm{P}_i /n)$. In order to quantify the effect of the precious metal brought to Europe after America was discovered, the Italian astronomer and economist Gian Rinaldo Carli used, in 1764, the simple arithmetical mean value for three products, namely wheat, wine and oil, in construing a similar interpreter index, determined for the period 1500 to 1750:

(2) *Carli* index: $\frac{1}{n}\left(\frac{p_1}{\mathrm{P}_1} + \frac{p_2}{\mathrm{P}_2} + \ldots + \frac{p_n}{\mathrm{P}_n}\right) = \frac{1}{n}\sum_{i=1}^{n}\frac{p_i}{\mathrm{P}_i}$

While William Fleetwood's merit was that of being the first to homogenize heterogeneous variables, through putting them in proportion, and utilizing the results thus obtained to secure the necessary comparisons, Dutot and Carli are laudable for generating the problem of adimensionality, i.e. transforming absolute values into relative values, generally non-comparable, or by no means reductible to a central, essential or typical value (which has a variation coefficient that is admissible from a statistical point of view). But the most important improvement to the construction of the index and to *fluidifying* its processing belongs to the Englishman Arthur Young, who introduced *weighting*, that is a number of coefficients, meant of underline the *relative importance of the various articles that make up the index*.Young used two weighting formulae, having as a starting point either *Dutot*:

(3) *Young* index (1): $\frac{p_1k_1 + p_2k_2 + ... + p_nk_n}{P_1K_1 + P_2K_2 + ... + P_nK_n} = \frac{\sum_{i=1}^{n} p_ik_i}{\sum_{i=1}^{n} P_iK_i}$,

where k_i=coefficient of importance of the product *i*,

or *Carli*:

(4) *Young* index (2):

$$\frac{1}{\sum_{i=1}^{n} C_i}\left(\frac{p_1}{P_1}C_1 + \frac{p_2}{P_2} + C_2 ... + \frac{p_n}{Pn}C_n\right) = \frac{1}{\sum_{i=1}^{n} C_i} \times \sum_{i=1}^{n} \frac{p_i}{P_i} \times C_i =$$

$$\sum_{i=1}^{n} \frac{p_i}{P_i} \times \frac{C_i}{\sum_{i=1}^{n} C_i}, \text{ where } \frac{C_i}{\sum_{i=1}^{n} C_i} = \text{ weighting coefficient}$$

(w.c.) and $\sum_{i=1}^{n} (w.c.)_i = 1$.

After the 1812 *Young solution*, the new problem of projecting indices was to become the effect of the variation of weights. Sir George Shuckburgh Evelyn introduced, in the year 1798, the notion of base year, and thus anticipated the dilemma of *the selection of the base, and the construction of the weighting system.* In 1863, through an index calculated as the geometric mean value of the individual indices, Stanley Jevons extends the range of the issues discussed to the formula, and especially to the mean value to be used:

(5) *Jevons* index: $\sqrt[n]{\prod_{i=1}^{n} \frac{p_i}{P_i}}$

Jevons was not going to differentiate the individual indices, as he gave them the same importance.

Two indices imposed by the German school of statistics remain to this day, like the two poles of the Earth, the limits of construction along the axis of the *weighting systems*. The first one is Etienne Laspeyres's index, construed in 1864 by using weighting with he base period, and the second is Hermann Paasche's index, elaborated in 1874, which uses the current period as a criterion of weighting.

(6) *Laspeyres* index: $\frac{\sum p_{i1}q_{i0}}{\sum p_{i0}q_{i0}}$ or $\frac{\sum p_{i0}q_{i1}}{\sum p_{i0}q_{i0}}$ and

(7) *Paasche* index: $\frac{\sum p_{i1}q_{i1}}{\sum p_{i0}q_{i1}}$ or $\frac{\sum p_{i1}q_{i1}}{\sum p_{i1}q_{i0}}$, where:

p_{i0} and p_{i1} = prices of the base period (0), and current prices (1)

q_{i0} and q_{i1} = quantities of the base period (0), and current quantities (1).

Although the above-mentioned indices verify only the condition of identity ($I_{1/1}^{X}$=X_1/X_1 =1), out of all Fisher's tests for elementary indices, they are yet the most frequently used in practical matters, owing to the economic contents of either of them. Within the difference between the Laspeyres and Paasche indices, yet accompanied by the loss of their specific economic contents, and outside Ladislaus von Bortkiewicz's relation, were placed many "theoretical" indices. The latter can be unreservedly called *indices of a "mesonic"* type, starting from their authors' wish for the values to be situated within the difference (P – L), in order to supply an equilibrium solution between the two limit values from the angle of choosing the base. At the same time as the two systems of balancing were to e generated, successively, the issue ranges of the constancy, but also of the lack of constancy of the balancing, and also that of the linking/connecting of the bases as they grow out of date or obsolescent. Out the formulae of the indices of the "mesonic" type, the best-known are the constructions which use common, usual statistical mean values. The simple arithmetic mean value of the Laspeyres and Paasche indices is known as *Sidgwik–Drobisch* index.

(8) *Sidgwig-Drobisch* index: $\frac{L+P}{2}$

The arithmetical mean value of the quantities in the two periods, which has thus become a balance, generates the *Marshall-Edgeworth*, or *Bowley-Edgeworth* index (1885-1887).

(9) *Marshall-Edgeworth* index: $\frac{\sum p_{i1}(q_{i0}+q_{i1})}{\sum p_{i0}(q_{i0}+q_{i1})}$

The geometrical mean value of the quantities in the two periods, turned into a balance, entirely describes a *Walsh* index (1901).

(10) *Walsh* index: $\frac{\sum p_{i1}\sqrt{(q_{i1} \times q_{i0})}}{\sum p_{i0}\sqrt{(q_{i1} \times q_{i0})}}$

The simple geometrical mean value of the Laspeyres and Paasche index is nothing else but the reputed *Fisher* index (1922).

(11) *Fisher* index: $\sqrt{(L \times P)}$

This is the index that verifies three out of the four author tests, or Irving Fisher tests: the test of identity, the test of symmetry, or the test of reversibility in time, and the test of completeness, or the test of factor reversibility. The only test that is not entirely satisfied is the test of linking (or circularity). The advantage created by the reversibility of the Fisher index:

(12) $F_{0/1} = \sqrt{(L_{1/0} \times P_{1/0})} = \frac{1}{\sqrt{(L_{1/0} \times P_{1/0})}} = \frac{1}{F_{1/0}}$

is, unfortunately, counterpoised by the disadvantage caused by its lack of *real economic* contents.

A construction endowed with real practical power is that of *R.H.I. Palgrave* (1886), who proposed a calculus formula for an arithmetical mean index, balanced by the total value of the goods in keeping with the current period ($v_{1i} = p_{1i} \cdot q_{1i}$) :

(13) *Palgrave* index: $\frac{\sum i_{1/0} \times (p_{1i}q_{i1})}{\sum p_{i1}q_{i1}} = \frac{\sum i_{1/0} \times (v_{1i})}{\sum v_{1i}}$.

The series of the purely theoretical or generalized indices is unpredictable and characterized by abundant originality.

The *Cobb-Douglas* solution (1928) is a generalization of the Jevons index, which uses unequal balance values, and satisfies three Fisher tests (except for completeness, or the reversibility of the factors):

(14) *Cobb-Douglas* index: $\prod_{i=1}^{n}\left(\frac{p_i}{P_i}\right)^{\alpha_i}$, where $\alpha_i > 0$ and $\sum_{i=1}^{n}\alpha_i = 1$

Stuvel's variant, an index combined between a Laspeyres "of the price factor" (L^P), and a Laspeyres "of the quantity factor" (L^q), realized in 1957, satisfies, like its source, exclusively the condition of identity:

(15) *Stuvel* index: $\frac{L^p - P^q}{2} + \sqrt{\frac{\left(L^p - P^q\right)^2}{4} + I^{(p\times q)}}$

(where $I^{(pxq)}$ = index of total variation)

Another construction, this time inspired from the method of "experimental" projection, centred on the factorial conception, but lacking operational powers from an economic standpoint, as it lacks this kind of signification, is R.S. Banerjee's index (1961), again a combination of indices of the Laspeyres and Paasche type:

(16) *Banerjee* index: $\frac{L+1}{\frac{1}{P}+1} = \frac{P\left(L+1\right)}{\left(P+1\right)}$

A real limit point of classic theorization in the field of index theory is represented by the *autoregressive* index.

(17) AUTOREGRESSIVE index : $\frac{\sum\left(p_i P_i a_i^2\right)}{\sum\left(P_i\right)^2 \times a_i^2}$,

Here a_i stands for quantities of products or coefficients of balancing (importance). It only verifies the condition of identity, though it is construed in a conditioned manner, namely $\sum\left[p_i - P_i \times I_{AUTOREGRESIV}\right]^2 =$ minimum.

The *Torngvist* (1936) and *Divisia* (1925) indices are the result of the generalizations of a mathematic type, and are defined by the following relations:

(18) ln (Torngvist index)$= \sum\frac{1}{2}\left[\frac{p_i q_i}{\sum p_i q_i} + \frac{P_i Q_i}{\sum P_i Q_i}\right] \times \ln\frac{p_i}{P_i}$,

where: $\frac{p_i q_i}{\sum p_i q_i}$ and $\frac{P_i Q_i}{\sum P_i Q_i}$ are weights of the value of the specific transactions p_iq_i and P_iQ_i.

The usual form the *Divisia* index can be found in is:

(19) $P_{0t}\,Q_{0t} = \frac{\sum p_{it} q_{it}}{\sum p_{i0} q_{i0}}$ as a mean value resulting from a determinating relationship of the individual price indices, namely $P\left(i_{p1} + i_{p2} + \ldots + i_{pn}\right) = i_{pi}$.

Nowadays, the processes of multiplication of the calculus formulae for the indices see two tendencies, *one already visible, namely extreme axiomatization and mathematization*, following the patterns of the *Torngvist* and *Divisia indices*, which culminated in the school of axiomatic indices, and a second one, which resumes the logical vein of economic signification of the index constructions, specific to the latest construction worldwide at the end of the 20th century, i.e. variants of integrating the additive, or the mixed additive–multiplicative models of construction, which come closer to the signification of real phenomena. In that respect, a summary presentation will be in order of the index of the said comparative advantage, or the David Neven index (1895)

(20) *David Neven* index: $\left(\frac{x_k}{\sum x_k} - \frac{m_k}{\sum m_k}\right) \times 100$, where x and m are values of the export, and, respectively, of the import on the level of industry k. The index belongs to the interval of values (-100%; 100%), but it seldom reaches, in real practice, values higher than 10%, or smaller than –10%, etc.

The definitive instauration in the language of a sign, even it is gradual, remains a long process, where the sign (the representation, or the signifying element) replaces, at a given time, the represented entity (i.e. the signified). The sign substitutes an object, and is able to express either a quality (qualisemn), or its current existence (synsign), or a general law (legisign). Thus, the index appears as a sign by the side of the icon (e.g. the table, the graph), the symbol (e.g. the currency / the coins), the rheme (e.g. the mere possibility), the dicent (e.g. the action/deed), the argument (e.g. the syllogism), etc. The *index* of semiotics, or the *indicator* can be defined as a sign that loses its character of a sign, as soon as the object disappears or is destroyed, but does not lose that character if there is no interpreter. The index can therefore easily become its own sign-interpreter. Currency, as a sign, assumes nearly all the forms semiotics presents in detail, from the qualisign, or the quality of hard currency, to the symbol of a broad range of sciences, or the legisigns specific to the monetary or banking world. In the same manner world history is marked by inflation, and, implicitly, by the use of currency – as briefly shown in the previous part of this article– likewise the favourite index of the inflationist phenomenon is the interpret index.

The family of the index numbers and its "demographic" evolution constitute a lesson in statistical history as far the practical construction of price indices is concerned. In general the usual characteristic values of two series of data cannot be compared. The main reason for it is represented by heterogeneity, in point of both level of variation, and the measuring unit used. Making comparisons, in a heterogeneous universe like the one of prices in the world of economy and economics, can be still done through a mere ratio, or a ratio comparison, quick and easy, generating a specific, and obviously adimensional, index. Therefore, the need to homogenize and "adimensionalize" heterogeneous variables (prices and various values) through a process of turning absolute values into relative values, combined with both the requirement to eliminate the effect of the differences of quantity through a process of weighting or co-measuring, and the obligation of doing away with the effect of variation, and even of obsolescence of the weights, through the diversification of the systems of weighting used, and their periodic connection, all the above requirements taken as a whole have led to the emergence and evolution of the concept of statistical interpreter index. The alteration of the level of the prices is the main object of reflection. In its synthetic or "composite" form, the interpret index is in the main the result of processing the chronological price series, and it expresses a functional relationship y = f(x), where: x - is the explanatory, independent variable (time, space, etc.), and y – is the

resultative, dependent variable (the level of the price, or, as a result of the difference from the stationary index, the alteration of the price level). The dependency is not causal, nor is the time, and neither is space, which are by no means the determining elements of price variation.

As instruments of measuring inflation, the interpret indices use quantity (q_i) as a co-measurer, or weight/balance, starting from the total amount of transactions $T_i = p_i q_i$. The quality factor is, permanently, the price (p_i). An interpreter index comes in the classic form given by expression: $P=\frac{\sum q_{ai}p_{1i}}{\sum q_{ai}p_{ai}}$, where a=0 or a=1. Sometimes q_{ai} can be the result of a simple mediation of a geometric type $\left(\sqrt{q_1 \cdot q_2}\right)$, or arithmetic one $\boxed{1/2(q_1+q_2)}$, etc. With slight modifications, the calculus formula of the Dutot index, known by the name of *Bradstreet index*, in the expression: $\left(\sum_{i=1}^{n} p_i / n\right):\left(\sum_{i=1}^{n} P_i / n\right)$, is the solution used in England, starting with the year 1895 – and published in the journal of the same name. The main shortcoming of the Bradstreet index is the failure to fulfill the comensurability axiom, as it is not independent of the measuring unit. Gian Rinaldo Carli's interpret index has long been utilized in calculating the index of the wholesale prices for 45 commodities, in keeping with a relation of the following type: $\frac{1}{45}\left(\frac{p_1}{P_1}+\frac{p_2}{P_2}+\ldots+\frac{p_{45}}{P_{45}}\right)=\frac{1}{45}\sum_{i=1}^{45}\frac{p_i}{P_i}$

William Newmarch's interpret index, constructed and published in 1859, in *Journal of Statistical Society*, was called by its author *Index Number*. The index number "applies to the series in which a given/selected term (the base) is written in the form "100", and the other terms are expressed as percentage values compared to it". An index number is a "number which shows, through its variation, either the increase, or the decrease in a value that is hardly likely to enjoy an (extremely) accurate measurement. This is the definition Edgeworth provides in *Economic Journal*, in 1925, while "The index number is used to measure the change of a quantitative nature, which cannot be directly observed…" is another definition of the *Index Number*, given by Bowley in *Elements of Statistics*, in 1920. The *Index-Number* has remained typical of English-speaking nations, and it was subsequently taken over by the French statistical literature as *nombre-indice*, or by the German literature in the field, as *Indexziffer*. *Index Number* is in fact synonymous to the Romanian term *indice*. The evolution of the batch of the indices is demonstrated by the very specific classifications. An early clasification of the interpret indices was that of *budget* interpret indices, and *monetary* interpret indices. The first category represents the indices constructed with a view to emphasize the variations of a given budget (of goods exchange), due to the mobility of the prices, and the best-known such index is the cost of life index, or the ICV interpret index (in Romania). The category of the monetary indices was introduced as a result of the manner in which the notion of price is regarded. "If the commodity "comes cheaper" its price, as expressed in a number of monetary units decreases, and the price as expressed in commodity-units per currency unit, goes up. The thing, if considered from this latter angle, entitles us to say that the currency has grown "more expensive".A process of currency "reduction" would consequently trigger a "rise in the price" of the goods, and the other way round." (Nicolae Georgescu–Roegen, in *The Statistical Method*). It follows that the monetary index is an interpreter index construed such a way as to measure the variation of the whole set of prices due not only to the variation in the value of the currency, as the best-known of all the indices in that class is the interpret index of the consumer goods prices (of the IPC type), whose reversed value represents the evolution of the buying power of the national currency. The geometric mean is the appropriate solution, both in point of form, and also statistically, in calculating the individual indices, and it is imperative for the interpret index of a monetary type to be construed in accordance with the Laspeyres model, which largely satisfies the monetary standpoint. This is in fact the pragmatic conclusion of the classical theory of the indices. The second classification of the interpret indices is that of the *domestic* interpret indices, the *regional* interpret indices, and the *international* interpret indices. In the first category are included the interpret indices of the domestic type, or those reflecting the evolution of the prices within the national economic space, in the second one – the interpret index of the community harmonized type (HIPC), which reflects the evolution of the prices within the community economic space, and in the last one – the interpret indices of an international type (the best-known being the index of the unitary value, used in keeping with the UNO methodology). The third classification of the interpret indices distinguishes between the interpret indices of the *stock exchange* type (dealing with products in stock exchanges, or of quotations of the shares), the interpret indices of the *banking* type (the index resulting from taking into account the interest rate, or its evolution, of the dynamics of the exchange rate, etc.), the interpret indices of the *specific to other markets* (the index of the nominal income, or that of the real income for the labour market, the interpret index of the rent for the land market, etc.). The diversity of the indices of the stock exchange type, from Dow Jones (n =65), Financial Times, Ordinary Share Index (n =30), Nikkei (n=225), CAC 40 (n =40), Moody (n =15), Reuter (n =21), HWWA (n = 47), to BET, BET-C, BET-FI (n =10) or ROTX (n = 6), the last ones being examples of indices of the Stock Exchange in Bucharest, expresses only to a small extent the exponential demographic growth of the interpret index population.

Distinct definitions, occurring in various national and community statistics, attributed to the variegated types of price, validate, through synthetization, the statement that the interpret index has the following characteristic features as constantly identical elements:

- a measuring instrument that provides an *estimate* of the evolution of the prices (consumer goods in CPI, industrial goods in IPPI, or regarding import/export, tariffs and rents, costs in building activities, etc.);
- *alienation* of goods/commodities, and services (i.e. *actually used* prices and tariffs);

-*modification of prices within a fixed period* (called the base, or reference period), and *a variable period* (called the current period).

The most widely used interpret indices are the following:

- CPI – the index of the prices (of consumer goods) for the consumption of the population, which measures the overall evolution of the prices for the goods bought, and of the tariffs for the services used, being considered the main tool for evaluating inflation;
- IPPI – the index of the industrial production prices, which synthetically expresses the evolution or the average changes in the prices of the products manufactured and delivered by the domestic producers, which are actually practised in the first stage of their trading; it is used both in deflating industrial production evaluated in current prices, and in determining inflation in the sphere of "producer prices". This index is one of the few such indices endowed with a kind of "premonition", a real Cassandra in the so populous world of the instruments measuring inflation. Thus, IPPI anticipates the evolution of CPI. From analysing the past 17 years, a parallel dynamics could be noticed of the evolution of the two statistical instruments for inflation assessment, revealing the prediction capacity of the dynamics of CPI, starting from the evolution of IPPI;
- UVI – the index of the unitary value of the export/import characterizes the dynamics of the prices in the contracts of export/import, the extension of the variation of the commodity prices considered as representative finally ensuring a rate of maximal coverage of the products of 92%, which allows deflating, through its agency, the indicators that characterizes the external exchanges, and even calculating the exchange rate;
- CLI – the cost of living index, which shows which is the cost of the market prices in the current period, meant to maintain he living standards reached during the base period; it is calculated as a proportion of this hypothetical cost and the actual (consumption) cost of the base period, the necessity of this type of interpreter index being obvious especially in determining real income and real salary;
- IRP – the index of the retail prices, which establishes the modification of the prices for all the goods sold in the retail commerce network; its importance as a measuring instrument for inflation in the sphere of the *retail prices* is self-evident;
- CBAI – the index of the cost of the building activities, which assesses the modification of prices in civil engineering business, serving to index the numerous rents, irrespective of the calculation method chosen; it can be used both independently, but also as part of CPI;
- PA-FPI – the index of the prices of the agricultural and food produce, which measures the evolution of the price of agricultural and food produce on the *farmer's market* (the market of the individual or associate agricultural producers), supplying important information about the inflation on that special market;
- The deflating index of the GDP, or the *implicit deflator of the* GDP is the index of the prices of the gross national product that is not calculated directly through measuring the modification of the prices, but as a result of the proportion between the nominal GDP, or in current prices, and the GDP as expressed in comparable prices (after the separate deflating of each component of that macro-economic indicator);.

The instrumental and applied description of the price index of the consumer goods has the following guidelines: defining, advantages and disadvantages of its use, the scope, the source of the data, the samples used in constructing it, the weighting system, the actual calculus, the inflation calculated as the rhythm of CPI, the specific indicators of inflation, uses of CPI, and the index of the buying power of the national currency.

6. A TRADITIONAL PRICE INDEX FOR THE INFLATION'S MEASUREMENT IN ROMANIA

Three constructions of price indices mark the remarkable tradition of Romanian statistics. One of them belongs to an endeavor coming from outside the national statistical institution, and is known as the *index according to Argus*, being a product of the early economic thought, and the first interpret index ever published in this country:

Table no. 3.

The Index according to ARGUS (1916 - 1926) %						
1916	**1921**	**1922**	**1923**	**1924**	**1925**	**1926**
100	1500	2170	3162	3954	4557	5100

Source: *Everyone's Yearbook*, "*Cultura Poporului*" Publishing House, Bucharest, 1929.

The second one is the interpret index of the cost-of-living type compiled by the Central Statistics Institute, more precisely by the price department led by none other than N. Georgescu – Roegen as an index of the unitary value. The theory concerning the cost-of-living (i.e. the cost-of-living index theory) dominated the inter-war period, being developed, independently, by both the Russian mathematician A.A. Konüs, and most of the English-speaking economists of the thirties (whose solutions were synthetized by R. Frisch, in 1936, in an article, as famous as that index "bible" authored by Irving Fisher (*The Making of Index Numbers*. *A Study of Their Varieties, Tests, and Reliability*, published in 1922). This explains why the CLI put forward as an interpret solution, generating a Paasche index, was used by Georgescu-Roegen in constructing the Romanian index. Comparability and the wish of instrumental confrontation are prevalent in the inter-war age of statistics. Culling prices, processing the data and publishing them position Romania in a high-class, prominent context of the price statistics that are comparable internationally:

Table no. 2.

The cost-of-living index in various countries (1932-1938)						
1932	**1933**	**1934**	**1935**	**1936**	**1937**	**1938**
62,2	56,7	53,4	55,6	57,9	66,1	74,6

Source: *Romania's statistical summary,* vol. II -1939, ICS, Bucharest, 1939

Since 1990 up to the present, the National Institute of Statistics has undertaken an effort quite comparable to that in the period following the year 1910. Compiled in a very short period – in December 1990 the first type PCI interpret index had already been published – and based on the French method of NISSE, adapted, in view of the great number of assortments (2551), to the relative „penury" of the Romanian market, the interpret index planned holds a

special significance in the statistical practice. The system of balancing used in constructing the index for commodity price index is of CPI Laspeyres type CPI = $\frac{\sum I^{p}(p_0q_0)}{\sum(p_0q_0)}$,

where: $\frac{(p_0q_0)}{\sum(p_0q_0)} = C_p$ and: I^p = price index of the level of aggregation specific to the post, or group of commodities and services, C_p = coefficient of balancing specific to the post, or group of commodities and services. This new interpret index, constructed by the statistician V.V. Dumitrescu, is published in the first number of the *Bulletin of public information* of CNS, in December 1990:

Table no. 4.

Index of prices for public consumption in November, as compared to October 1990 (on the aggregate, and per categories of expenses)	
General total	*123.4*
Food goods	120.4
Non-food goods	124.7
Services	127.0

Source: *Statistical Bulletin of Prices,* no. 1/ 1990, Ed. DCS, Bucharest, 1990

The remarkable instrumental comparability must be underlined, no less than the tradition of Romanian statistics as compared to that of French extraction, represented by the famous *l'indice des 34 articles*, constructed starting in 1914, or the equally well-known *l'indice des 13 articles*, published constantly since 1916. It is to the same 1914-1916, period of the American price interpret indices, or those of the overwhelming majority of the European economies belong.

In the practical, actual construction there were quite a lot of obstacles, starting from the essential differences of conception and de evaluation between the principal systems of balancing of the price interpret indices (of the Paasche and Laspeyres types), which underlie the constructions belonging to the CLI and CPI standards, and maybe ending with the solution of the ratio between the nominal and real wages in *Romania's Statistical Yearbook* for the period 1952-1989, where the administration of the single prices tried to conceal inflation – actually, a rather moderate one, yet considered to be an economic term incompatible with planned economy. Although the statistical effort of the sequencings is outstanding, while the theory of the chronological index series apparently contributes to further complicate any attempt at making a long-term index construction through imposing periodical relational reassessments (generated by the changes occurring in the balancing coefficients), be it for the impressive effort of the Romanian statistical and economic school, a centennial construction of a Romanian interpret index of inflation was in order. The main bibliographical and methodological landmarks of the construction proposed are:

- *Anuarul pentru toți* (INDEX ARGUS), Tipografia "Cultura poporului" Bucureşti, 1929;
- N. Georgescu-Roegen (coord.), *Statistica prețurilor pe anii 1928 şi 1929* (*The Price Statistics for the Years 1928 and 1929*), Ed. ICS, Bucureşti, 1930;
- N. Georgescu-Roegen (coord.), *Statistica prețurilor pe anul 1937* (*The Price Statistics for the Year 1937*), Ed. ICS Bucureşti, 1939;
- *Breviarul statistic al României* (*Romania's Statistical Summary*), vol. II-1939, Ed. ICS Bucureşti, 1939;
- *Enciclopedia României* (*Romania's Encyclopaedia*), vol. IV, Bucureşti, Ed. Monitorul Oficial şi Imprimeriile Statului, Imprimeria Națională, Bucureşti, 1943;
- *Anuarul statistic al României* (*Romania's Statistical Yearbook*), Ed DCS, INS, Bucureşti, the 1960-2008 collection, and
- *Buletinul statistic de prețuri* (*The Statistical Price Bulletin*), the December 1990 - March 2009 collection, INS, Bucureşti.

Methodologically, not every aspect could be solved, which was specific to the theory of the construction of Schumpeterian statistical indices, but a few original solutions of redressing and "intrapolation" were attempted. The result of that simultaneous historical, economic and statistical investigation is presented below, by the name of Romanian centennial interpret index:

The evolution of the Romanian centennial interpret index of the CPI type (Instrumental proposal) [20]

Table no. 5.

Year	Interpret index of the CPI type		Year	Interpret index of the CPI type		Year	Interpret index of the CPI type	
1913	1,000	100,0	1947	243588,800	24358880,0	1980	41,509	4150,9
1914	0,820	82,0	15.08. 1947	A doua mare reformă monetară		1981		43,312
1915	-	-	1947	12,179	1217,9	1982	51,022	5102,2
1916	0,755	75,0	1948	-	-	1983	53,062	5306,2
1917	-	-	1949	-	-	1984	53,593	5359,3
1918	-	-	1950	-	-	1985	54,713	5471,3
1919	-	-	1951	-	-	1986	55,687	5568,7
1920	-	-	1952	24,360	2436,0	1987	57,027	5702,7
1921	11,330	1133,0	1953*	25,651	2565,1	1988	58,610	5861,0
1922	16,390	1639,0	1954*	27,015	2701,5	1989	59,682	5968,2
1923	23,880	2388,0	1955	28,452	2845,2	1990	62,727	6272,7

1924	29,850	2985,0	1956	29,451	2945,1	1991	169,497	16949,7
1925	32,500	3250,0	1957	29,524	2952,4	1992	526,079	52607,9
1926	35,520	3552,0	1958	31,497	3149,7	1993	1873,381	187338,1
1927	38,550	3855,0	1959	31,205	3120,5	1994	4434,275	443427,5
1928	39,640	3964,0	1960	30,669	3066,9	1995	5866,546	586654,6
7.02. 1929	Prima mare reformă monetară		1961	31,400	3140,0	1996	8142,768	814276,8
1929	39,030	3903,0	1962	31,540	3154,0	1997	20747,802	2074780,2
1930	34,500	3450,0	1963	31,058	3205,8	1998	33009,749	3300974,9
1931	28,370	2837,0	1964	32,715	3271,5	1999	48128,214	4812821,4
1932	24,280	2428,0	1965	32,886	3288,6	2000	70122,808	7012280,8
1933	22,130	2213,0	1966	32,959	3295,9	2001	94315,176	9431517,6
1934	20,840	2084,0	1967	32,789	3278,9	2002	115536,091	11553609,1
1935	21,700	2170,0	1968	33,641	3364,1	2003	133213,113	13321311,3
1936	22,600	2260,0	1969	34,323	3432,3	2004	149065,474	14906547,4
1937	25,800	2580,0	1970	34,348	3434,8	2005***	162481,366	16248136,6
1938	29,120	2912,0	1971**	33,714	3371,4	2006	173140,144	17314014,4
1939	30,400	3040,0	1972**	33,739	3373,9	2007	181520,127	18152012,7
1940	43,130	4313,0	1973**	34,104	3410,4	2008	195769,457	19576945,7
1941	-	-	1974**	34,737	3473,7	2009	206732,547	20673254,7
1942	-	-	1975	35,444	3544,4	1.04.2010	211083,502	21108350,2
1943	-	-	1976	35,858	3585,8	2011	*	*
1944	364,800	36480,0	1977	35,980	3598,0	2012	*	*
1945	-	-	1978	36,808	3680,8	2013	*	*
1946	-	-	1979	37,758	3775,8	2014	*	*

Note* - = data missing * = Useful data în the future till the moment of cmonetary convergeance RON - EURO

7. SIMILARITIES OF PHYSICAL TIME-SPACE IN PROPORTION TO THE ECONOMIC TIME OF INFLATION

Starting from the example of inflation in Romania, the time series of the inflationary phenomenon conduce to a set of conclusions similar to those formulated in section 3 of this article.

To illustrate this aspect, one can consider again, comparatively:

A. **The greater the energy, the higher its frequency**.

A. The higher the degree of economic development, the higher the frequency of the apparition of the price rises.

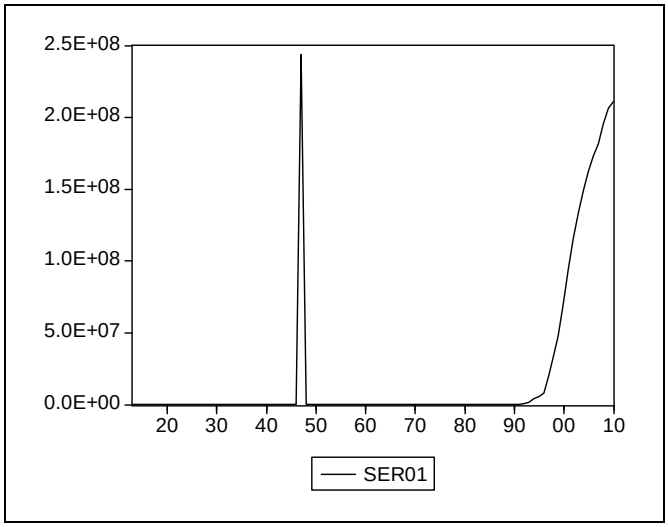
B. For someone who is located at a higher place, everything happening below looks as if needing a longer (greater) time.

B. For the developed economies or located at the North Pole, in the figurative economic sense, economic development is greater, economic time flows faster, inflation evolves coherently and with a much greater degree of coverage, whereas for the economies located at the South Pole economic time elapses more slowly.

C. There exists a contracted, and a dilated cycle of life, in keeping with the location or space, and speed.

C. There is cyclicity, as shown in the very inflationary economic time in Romania, with graphically expansion and contraction.

Graph no.1



D. The universe itself must have begun immediately after the Big Bang with a period of exponential "inflationist" expansion, when it increased in size by a very great factor.

D. Inflation in Romanian economy flows after a time of the balance of expansion different from that of the imbalance of economic contraction *(different times of Equilibrium of Development and Non-equilibrium of contraction)*. It is the fluctuations of inflationary density that denote the aspects expounded.

E. A greater density of the universe is correlated with a smaller fluctuation, made slower by universal attraction.

E. The fluctuations mentioned unde letter D is amplified or contracted through the inflation imported or exported from the world economy. There are nations or regions in

the world having a greater inflation, which export their own inflation to other countries once with the products, thus diminishing its level.

F. The universe thus begins in a homogenous, and hence ordered state, which gradually becomes heterogeneous or disordered, as "time passes", in all its senses…

F. The graph of the Romanian economic inflation implicitly describes the phenomenon amplified by uncertainty and disorder, or enhanced non-equilibrium generated by inflation over the period of the second world war, and the prolonged transition after 1989.

8. A FINAL REMARK

The physical space-time is to be found during economic inflation, as the thinking of modern physics provides a manner of interpretation in Romania's market economy, but also in the economy of all the countries having freely competitional economies, and implicitly inflationary non-equilibria. The universe has a beginning in the real time through Big Bang, and modern economy – through the inflationary time. Still there exists an imaginary time specific to the general physical or economic theoretical approaches, perpendicularly on the real time, which has neither beginning nor end, as every one of us sees it intuitively, as a representative of the kind of Homo Oeconomicus...

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CLASSICAL SOLUTIONS FOR IMPROVEMENT OF RESTRUCTURING PROCESS AND REPRESENTATION OF ORGANIZATIONAL STRUCTURE AND ALTERNATIVE FUTURE SOLUTIONS OF QUANTUM ECONOMICS

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Abstract. ***Abstract:*** *This paper presents improvement of restructuring process and representation of organizational structure through different measurements and divisions, based on theoretical assumptions of Henry Mintzberg and Michael Porter. By combining these concepts, we have proposed a new job classification approach, which could improve decision making process during restructuring. Data used for development of this model comes from analysis of 21 communal and public service enterprises, project implemented by Faculty of organizational sciences during the year of 2009. Background documents were mainly job descriptions, basic HRM data and performance data, along with wide array of other formal organizational documents. Time span of analysis covered 18 months, and we have analyzed data according to usual methodologies and good practices of consultancy in organizational design, with main proposed improvement that is described in this paper. Reason for introduction of that improvement was due to the fact that the companies perform wide variety of activities, and thus have defined different job structure, very hard to compare between different companies. This model standardized usual existing approach and introduced a new model of job classification. In this way, conditions were created for comparison among companies from totally different industries, yielding better results during restructuring. The model is based on set of typical jobs, connected with particular jobs in each organization. Connecting existing positions in companies with positions in the introduced standardized model was done relying on the descriptions of tasks performed for the observed positions. It should be emphasized that employees in different positions often belong to the same process and are thus responsible for the same performance, so they are linked and grouped in the analysis. This model provides more quantitative background for decision making during restructuring processes.* The second part of this paper offers some alternative solutions in a new economic way of thinking. An original analysis made under the circumstances of Quantum Economics new approach can change the classical way of thinking in contemporary economics and in the future of economic process or phenomena.

Keywords: *Restructuring, Value chain, Organizational configurations, Job classification, Benchmarking, Quantum Physics, Quantum Economics.*

1. INTRODUCTION

This paper proposes improvements of restructuring methodology by introduction of job classification model based on combination of value chain and organizational configurations. It came from consultant work of the project team from the Faculty of Organizational Sciences during the project of business restructuring of the group of public and public-utility companies, implemented in the second half of the year of 2009, including 21 public and public-utility company in Serbia that are employing over 18,000 people. During similar projects a common problem of the lack of standardized systematization of job positions in the company often occurred. Theoretical background for this idea was provided by works of Henry Mintzberg and Michael Porter. In the light of their organizational configurations and value chain, during the project of restructuring public enterprises and public utilities we have proposed systematization of typical basic jobs, which diminished different number of jobs in observed companies by several tens of times. The analysis were performed to describe current status within each company - subject of the project, but also to compare companies among themselves.

In order to perform mentioned analysis effectively, it was necessary to modify representation of the existing structures in those companies. The cause of this was that the companies engaged in different industries and have had different classification of jobs, making comparison among them difficult. Consequently, employees performing similar jobs in different companies have different job titles, and specific positions are often treated as different jobs, although in essence are not. It was therefore necessary to introduce a new model that would have the smallest set of typical jobs and to associate these jobs with job existing in observed companies.

2. APPLIED MODEL OF STRUCTURE REPRESENTATION

In order to represent structure of each enterprise, Porter's value chain has been used, as a well known in the literature and empirically proven model. According to that model, sharing of the overall organization's task is based on the different contributions of specific activities to competitive ability of the organization.[1] The functions are divided into 2 groups - support activities and primary activities - and then can still be divided to the subgroups integrating a partial set of activities by functions.[2] Porter value chain is combined with Mintzberg's model, which divides organization into the 5 elements, namely the strategic apex, middle line, operating core, technostructure and support staff.

Adapting to the needs of the project, we proposed a new model with 91 positions. This standardized positions match activities that are identified by modifying the Porter's value chain and Mintzberg's model in another paper[3], as each part of value chain or organization block corresponds to one or more typical positions. The presented model is extended in each company for more specific positions in the operational area. Types of positions are shown below:

1. <u>Support activities</u>

1.1. Top management
- 1.1.1. Chief Executive Officer
- 1.1.2. Executive Officer
- 1.1.3. Chief Technical Officer
- 1.1.4. Chief (Sector function) Officer
- 1.1.5. Deputy to Executive Officer
- 1.1.6. Executive Officer's Assistant
- 1.1.7. Advisor to Executive Officer
- 1.1.8. Top Management Support Staff
- 1.1.9. Top Management Assistant

1.2. Management
- 1.2.1. Director
- 1.2.2. Manager
- 1.2.3. Supervisor
- 1.2.4. Foreman
- 1.2.5. Management Support Staff
- 1.2.6. Management Assistant

1.3. Finance
- 1.3.1. Financial Manager
- 1.3.2. Financial operations staff
- 1.3.3. Financial planning and Analysis Staff
- 1.3.4. Salary and Personal Finance Staff
- 1.3.5. Other Financial Staff

1.4. Accounting
- 1.4.1. Accounting manager
- 1.4.2. Accountant
- 1.4.3. Other accounting staff

1.5. IT Support
- 1.5.1. IT Support Manager
- 1.5.2. IT Support Designer
- 1.5.3. IT Support Administrator
- 1.5.4. IT Support Operator
- 1.5.5. Other IT Support Staff

1.6. Legal Affairs
- 1.6.1. Legal Affairs
- 1.6.2. Labor Law Affairs Staff
- 1.6.3. Legal Attorney
- 1.6.4. Other Legal Affairs Staff

1.7. Planing, Preparation and Control
- 1.7.1. Planning, Preparation and Control Manager
- 1.7.2. Planer
- 1.7.3. Controller
- 1.7.4. Technologist
- 1.7.5. Planning, Preparation and Control Support Staff
- 1.7.6. Dispatcher
- 1.7.7. Other Planning, Preparation and Control Staff

1.8. Marketing and Public Relations
- 1.8.1. Marketing and Public Relations Manager
- 1.8.2. Marketing and Public Relations Staff

1.9. Other Business Infrastructure Activities
- 1.9.1. Business Infrastructure Activities Manager
- 1.9.2. Business Infrastructure Activities Staff

1.10. Human Resources Management
- 1.10.1. Human Resource Manager
- 1.10.2. Human Resource Support Staff

1.11. Technological Development
- 1.11.1. Technological Development Manager
- 1.11.2. Technological Development Support Staff

1.12. Public Procurement
- 1.12.1. Public Procurement Manager
- 1.12.2. Public Procurement Support Staff
- 1.12.3. Other Public Procurement Staff

1.13. Procurement
- 1.13.1. Procurement Manager
- 1.13.2. Procurement Staff

1.14. Security and Safety
- 1.14.1. Security and Safety Manager
- 1.14.2. Security Staff
- 1.14.3. Fire Protection Staff
- 1.14.4. Occupational Health Staff

1.15. Facility Maintenace and Hygiene
- 1.15.1. Facility Maintenance and Hygiene Manager
- 1.15.2. Facility Hygiene Staff
- 1.15.3. Facility Maintenance Staff

1.16. Nutrition and Employee Standard

[1] Porter M. E., "Strategy and the Internet," Harvard Business Review, 2001.

[2] Dulanović Ž., Jaško O., "Osnovi organizacije poslovnih sistema", Fakultet organizacionih nauka, Beograd, 2009.

[3] Čudanov M, Savoiu G, Krivokapić J, 2010, Organizational configurations and value chain as basis for restructuring. Proceedings of Symorg 2010 XII International symposium, Faculty of organizational sciences, Belgrade

1.16.1. Nutrition and Employee Standard Manager
1.16.2. Nutrition and Employee Standard Staff

1.17. Registry and Archives
1.17.1. Registry and Archives Manager
1.17.2. Archivist

2. Primary Activities

2.1. Warehousing
2.1.1. Warehouse Manager
2.1.2. Warehouse Support Staff
2.1.3. Storeman
2.1.4. Warehouse Manipulation Staff
2.1.5. Other Warehouse Staff

2.2. Material Transport
2.2.1. Material Transport Manager
2.2.2. Material Transport Support Staff
2.2.3. Material Transport Staff

2.3. Maintanace
2.3.1. Maintenance Manager
2.3.2. Maintenance Support Staff
2.3.3. Maintenance Staff

1.17.3. Courier
1.17.4. Other Registry and Archives Staff

1.18. Other Support Activities
1.18.1. Other Support Activities Manager
1.18.2. Other Support Activities Staff

2.4. Operations
2.4.1. Operations Manager
2.4.2. Operations Staff
2.4.3. Operations Support Staff

2.5. Output Logistics
2.5.1. Output Logistics Manager
2.5.2. Output Logistic Staff
2.5.3. Output Logistic Support Staff

2.6. Sales
2.6.1. Sales Manager
2.6.2. Salesman
2.6.3. Other Sales Staff

2.7. Service
2.7.1. Services Manager
2.7.2. Service Staff
2.7.3. Service Support Staff
2.7.4. Other Service Staff

Existing positions in companies were connected with standardized jobs by using jobs systematizations and description of tasks on each specific workplace. Consequently, different positions with similar job descriptions were linked to one typified position in new model. For example, position of "Bookkeeping expert", "Examiner of business accounts", "Account clerk", "Financial account inspector" were associated with the position of "Accountant", after detailed analyses. Therefore, this model provided not only basis for benchmarking between companies, but also for analyses that will be presented in this paper.

3.PERFORMANCE ANALYSIS ENABLED BY THIS MODEL

Decisions regarding performance analysis are in nature made by quantitative means, but comparison among different performance analysis or even the same performance analysis has been much burdened by subjective approximations. This can be very important issue if restructuring includes downsizing, demanding responsible approach that avoids unnecessary layoffs.[4] Restructuring and downsizing are often interconnected,[5] because downsizing changes proportion among employees in different activities[6] and therefore initiates changes in organizational structure. In such connection, often the focus of the process can be ration of employees in support and core activities.[7] Performance of the company includes its ability to achieve a certain result, under the given conditions of operation. Performance is, therefore, the ability to provide certain services or produce the products, based on what will be achieved by the income, with certain costs, by a number of people for some time.

The analysis led to the performance data of the period in which it was achieved with more or less efficiency, and identified the key causes of the achieved results. Performance management, in the context of the project, meant to determine the optimal relationship between specific characteristics of the organizational and staffing structure and the achieved results. Improving performance is often stated as the goal of restructuring, especially in transition economies.[8] This means that it is possible to determine in which direction some changes (rationalization) in the current organizational and staffing structure could be made, and this reduction should not affect the ability of the fulfillment of tasks. The achieved results by listed standardized jobs, which are measured on the basis of appropriate indicators, suggest that there are potential reserves for employees who perform these tasks.

[4] Cascio W, 2002, Rensponsible restructuring: creative and profitable alternatives to downsizing, San Francisco, USA: Berrett-Koehler Books, p 54.
[5] Burke R.J, & Nelson, D.L, 1997, Downsizing and restructuring: lessons from the firing line for revitalizing organizations", Leadership & Organization Development Journal, Vol. 18 No. 7, pp 325-334.
[6] Lewin J.E, Johnston W.J, 2000, The Impact Of Downsizing And Restructuring On Organizational Competitiveness. Competitiveness Review: An International Business Journal incorporating Journal of Global Competitiveness, Vol. 10, No. 1, pp. 45 - 55
[7] Cascio F.W, 2005, Strategies for Responsible Restructuring, Academy of Management Executive. 2005, Vol. 19, No. 4, pp 39-50.
[8] Mathijs E, Swinnen J, 2001, Production Organization and Efficiency during Transition: An Empirical Analyses of East German Agriculture. Review of Economics and Statistics, Vol 83, pp. 100–107

- **Analysis of performance by core and support activities:**
  Organization performances are shown using a clear distinction between the direct value creation activities and support activities. It is important to notice that support activities could be compared between enterprises in observed group, but activities which create outputs are specific for each company, and therefore, comparison is only partially possible at the group level. On the other hand, it is possible to make some comparison with companies that operate in the private sector.
- **Performance analysis by the standardized jobs with the most employees:**
  This analysis is completed in order to show twenty standardized jobs with the most employees, and to find potential reserves among them. A negative value indicates that there was a lack of workers in a particular workplace, while positive value in this column indicates that there are reserves in the observed workplace.

4. ANALYSIS OF STAFF STRUCTURE ENABLED BY THIS MODEL

This model enables analysis of the staff structure to be done more efficiently and effectively during the restructuring process, as it was applied on this particular project. Analysis of HR can set directions for restructuring and downsizing, as observed in the case of oil and chemicals industry[9]. HR data has been analyzed in order to check its conformity with the requirements of efficient conduct of all business tasks. The analysis included both qualitative and quantitative characteristics of the organizational structure. Background data for the analysis of the observed group of companies were individual reports related to human resources in each company. These partial reports consist of analysis of the organizational structure and division of work in the company, analysis of span of management control, analysis of organization units by the criteria of core/non-core activities, analysis of the current job classification, the proposed systematization of jobs, analysis of qualification of employees, age structure, service and overall fluctuations. Analyses related to human resources have strong impact not only to restructuring and downsizing directions, but also imply financial results of the enterprise[10].

- **Specialization:**
  This analysis is completed in order to recognize existing model of organizational structure in each company, then its organizational units, and the employees' number in each one of them.
- **The span of control:**
  This analysis is associated with the cost of management and efficiency of task control. The span of control indicates the number of workers directly subordinated to a supervisor. In this project it is presented by the total number of managers in the company, the average span of control by a supervisor, and also the highest and lowest range by the organizational units.
- **Organizing units by the criteria of core/non-core activities:**
  During this project it was necessary to recognize core units, which directly contribute to carrying out basic activities of enterprises, and non-core units, which provide indirect contribution. This analysis was made at the level of sectors and/or offices, depending on the company size this analysis.
- **Organizing employees by the criteria of core/non core /support activities:**
  Three groups of employees were recognized by this criterion. The first group consists of employees who directly contribute to the basic business activities, the second of employees who contribute indirectly to the basic activities of the company, and the third group of employing support staff, whose job is to provide support and assistance to other employees while performing their tasks.
- **The current position classification analysis:**
  As it was mentioned earlier, a large number of positions, that were valued differently, were observed in the existing classification. The main reason was the ability or commitment of employees. Therefore, standardized positions are suggested and it still allows stimulation of employees over the variable part of salaries and related mechanisms. This analysis shows the total number of positions in the existing classification, as well as the total number of standardized positions in the company.
- **Systematization of typical positions:**
  The next step was to propose a set of standardized positions, through the enrichment of basic activities, but with respect to technological limitations. The common services were conducted at the level of coordination of all public and public utility companies which were included in the project. For such defined positions, various categories that would depend on the level of education of an executor or any other parameter such as experience or previous results could be defined.
- **Employees' qualification analysis:**

[9] Ritson N, 1999, Corporate strategy and the role of HRM: critical cases in oil and chemicals. Employee Relations, Vol. 21 No. 2, pp 159-176.

[10] Chhinzer N, Ghatehorde G, 2009, Challenging Relationships: HR Metrics and Organizational Financial Performance. The Journal of Business Inquiry, Vol. 8, No. 1, pp. 37-48.

Education of employees is analyzed according to the classification of the seven degrees of qualification.

- **Employees' age structure analysis:**
  Age structure of employees is analyzed by two classifications. The first classification divides the workers into groups by common organizational culture. Age group up to 30 years (although specific manifestation depends of the organizational culture) usually seeks success and ambitions that motivate them, and is ready to work hard with the use of new technologies. Main motivators for the group aged 30-45 are quality of life, nonconformity, seeking autonomy, and loyalty of employees is directed primarily towards themselves and their own family. Age group over 45 years is characterized by conservatism, which can be manifested differently, but in environment of this project is often expressed through the rejection of change, desire for job security and resentment with new values that are accepted in the enterprise, as also stated in the literature.[11] The second classification groups workers by decades of age, where the first covers the period up to 30 years, next to 40 and so to the last, which includes workers aged 60 and older. This analysis includes indicators of average age, then determines the difference in years between the youngest and oldest employee in the company, the average age by the organizational units that were previously defined, and the prevailing culture of the company.
- **Overall employee experience analysis:**
  Experience of employees was analyzed by average, minimum and maximum values for all organizational units at the highest level. Four groups were formed: a group of up to 30 years of service, a group of 31-35 years of service, a group of 36-38 years of service and a group of over 38 years of service.
- **Fluctuations analysis:**
  Fluctuation analysis was performed for the period from 01/01/2008 to 01/07/200. It presents the total number of newly employed workers and the total number of workers who had left the company during this period.

5.CONCLUSION

The comparison of organizational and HR structure between companies engaged in different activities has long been burdened by flaws of organizational structure representation. It was mostly regarded as impossible or essentially subjective task,[12] due to lack of standardized model applicable to average enterprise. Subjectivity of approach described in this paper is mostly limited to the classification of jobs according to job descriptions in the corresponding categories. When this task is complete, the organization can be represented as a standardized system that could be compared with other business systems, and consultants can make objective decisions on restructuring and downsizing after benchmarking different companies with structure represented in this way. Another benefit is the possibility of comparing various parameters of organizational structure, either at the particular organizational level, in particular organization or in business system that consists of multiple organizations. At the level of the complex business systems, application of these approaches can create a synthetic image that incorporates all parts of the structure for all the organizations that are parts of that system. The third advantage was observed during the study was that the implementation of such concise view of simplifying the model and the structure becomes clearer, it is very important during the analysis phase. Creative ideas and suggestions are much easier to generate if the basis for making decisions is concisely presented. Also, in the later stages, in which the consultants present their ideas to management, or they are employed, a graphical representation is much simpler and is not burdened with details. A simple version may be developed in detailed, classical model of the organizational structure if there is a need for it.

The general theory of management offers several theoretical approaches that comply with described problem, and we have used Porter value chain model and Mintzberg's organizational structure. In this case, as often occurs in management, it became necessary to combine the techniques into new methods, and even methods into new leadership and management systems, with a view to attain an increased management efficiency.[13] In order to answer on demands of the project, a new set of standardized positions, and a new way to represent organizational structure was presented, and explained in this paper. First step that needs to be done is the simplification of the existing structure, with goal to detect the key similarities and differences between the observed companies. Next, usage of this generalization enables new model to be developed, with special concern to limitations that result from perceived differences in basic set of jobs specific for different core operations in enterprises. Internal

[11] Hofstede G., "Cultures Consequences, international differences in work related values", Beverly Hills, Co, Sage Pubblication, 1990.

[12] Krivokapić J, Čudanov M, 2010, Typification of Related Positions as the Base For Internal Benchmarking in a Group of Companies. Proceedings of Symorg 2010 XII International symposium, Faculty of organizational sciences, Belgrade

[13] Savoiu G, Jaško O, Dulanović Ž, Čudanov M& Craciuneanu V, 2008, The Value of General Methods, Quantitative Techniques and Management Models in Professionalizing Management. Management – Journal for Management Theory and Practice, Vol. 13, No. 49-50, pp. 5-11.

benchmarking is enabled by classification of 91 standardized positions, and analysis described above can be used to evaluate and improve performance. Therefore, the general conclusion is that the application of the described model improves the process of organizational restructuring and representation technique of organizational structure.

6. QUANTUM ECONOMICS – A NEW METHOD, A NEW APPROACH OR A NEW WAY OF THINKING IN ECONOMICS ?

A distinctive feature of the economical sciences is that, while these share with physics the descriptive and explanatory application of mathematical statistics – in population and probabilistic interpretations – it seems to lack strict and universal laws of the sort "recognized" in physics. The profound implications of physics in the fields of economics or social sciences have already created econophysics, sociophysics, and quantum economics. Econophysics and sociophysics seek to integrate the physics' methods, models, and laws with classical economics' and sociology's theory and thinking, seeing this new domain of applied physics as an unlimited one. Econophysics and sociophysics replace conventional ways, with the new and broader views of physics' thinking. Could be Quantum Physics a different direction of a new and modern applied physics' way of thinking? What means Quantum Economics in this new context?

Classical economics had always a first option for particle (unit, entity, individual, person, family, household, agent, financial or non financial corporation and agency, labour market or other market, territory, region, country etc.). The continuous aggregation inside the economic phenomenon makes finally from some micro entities only one economic macro attitude called macro realism. Classical economics deals only with a certain aspect of reality, the macro realism of this sort of "economic reality", in which man employs scarce resources, and thus it has encouraged the application of quantitative and formal methods, to gain intellectual legitimacy associated with the virtues of precision and objectivity. The absence of scenarios was also a characteristic option for classical economics. Even the economic aggregate subjects are somehow made from the same simple units that are individuals: entity, person, family, household, agent, financial or non financial corporation and agency, labor market or other market, territory, region, country, etc.), economic systems are increasing day by day, in the human and natural environments like physical, biological and social types.

The contemporary capitalism trend becomes more and more one of the individual level. That means a multiplication of the firms' number on economic reality and also on internet (10^{10} and perhaps more than 10^{20} specific products and services, during the next 50 years).

Thus economic reality could be more adequate for quantum physics' models and methods. In the nowadays economic world, this effect still does not exist, but the macroscopic world cannot however explain in the next future its own behaviour without it.

But what has this to do with quantum economics? First let us try to define the specificity of quantum physics' way of thinking.

Quantum physics remains the powerful science for studying subatomic particles. Very small particles at very high velocities behave differently from billiard balls and solar system planets and there are some non-intuitive effects of trying to observe and pinpoint features of individual particles. Quantum physics emerge from classical statistical physics or classical statistics[14]. A typical quantum system describes an isolated subsystem of a classical statistical ensemble with infinitely many classical states. The state of this subsystem can be characterized by only a few probabilistic variables. Their expectation values define a density matrix if they obey a "purity constraint". Then all the usual laws of quantum follow, including Heisenberg's uncertainty relation, entanglement and a violation of inequalities. No concepts beyond classical statistics are needed for quantum physics - the differences are only apparent and result from the particularities of those classical statistical systems which admit a quantum mechanical description. The rule for quantum probabilities follows from the probability concept for a classical statistical ensemble. In particular, the non-commuting properties of quantum operators are associated to the use of conditional probabilities within the classical system, and a unitary time evolution reflects the isolation of the subsystem.

But first of all, despite the scientific character of quantum physics, this incredible way of thinking offers and takes a spiritual perspective in which there are no separate parts, in which everything is fluid and always changing, from particle or atom to wave or energy, from material to spiritual, from macro realism to micro idealism, etc.

It is through our thoughts that we transform this ever-changing energy into observable reality. Therefore, we can create our reality with our thoughts. With quantum physics, science is leaving behind the notion that human beings are powerless victims and moving toward an understanding that we are fully empowered creators of our lives and of our world. Quantum physics shows that what's happening on the inside determines what's happening on the outside. It says that our world is shaped by our thoughts. Quantum physics' way of thinking is the nearest thought to the universe, and even beyond universe.

The original connection between quantum physics and thought was made by David Bohm in 1951. The human brain is no Turing Machine. Roger Penrose tries to prove that our consciousness is non-algorithmic, and that we seem - to our conscious selves - able to make decisions in a flash. He finds that this could be explained only by quantum physical thought processes that proceed in sub-graviton parallelism until they reach graviton level, when they collapse and produce a conscious thought. [15]

[14] Wetterich,C. (2009), *Quantum mechanics from classical statistics,* Submitted on 26 Jun (v2), http://EzineArticles.com/

[15] Roger Penrose, (1989), *The Emperor's New Mind, Concerning computers, Minds, and the Law of Physics*, Oxford; New York: Oxford, University Press.

Both Roger Penrose and Amit Goswami note that where quantum physics seems mystical, it is because it is not complete, stable, or a finished theory. Since quantum theory cannot explain the collapse of wave functions adequately we should not try to use to explain more complex phenomena either. We need better tools. Obviously, the brain is composed of particles obeying quantum laws (a notable case is that the retina accepts photons, which are small enough to behave strangely in terms of classical physics). Quantum physics is strange. So is consciousness. Maybe there is something in common between the two. The indeterminism in quantum physics is commonly modelled in a wave function - which is a combination function of possible outcomes, and determining the outcome is commonly termed "collapse of a wave function".

Penrose says that consciousness as a side effect of running an algorithm is not possible. Amit Goswami completes this idea, and reconciling macro realism with micro idealism is possible in quantum physics' way of thinking because of six main reasons[16,17]

- quantum state of a system is determined by the Schrodinger equation, but the solution of Schrodinger equation, the wave function is not directly related to anything that can be seen by someone;
- quantum objects are governed by the Heisenberg uncertainty principle: it is impossible to measure simultaneously and with certainty pairs of conjugate variables such as position and momentum;
- the paradox of wave-particle duality consist of quantum objects, needing for a solution which involves interpretation and philosophy;
- discontinuity and quantum leaps are truly fundamental features of quantum systems behaviour
- physical reality could be or not a coherent superposition;
- under certain conditions (for example, when energy levels of atoms are separated by very small spaces), quantum mechanical predictions could be reduced to those of classical mechanics.

Realism arises whenever economics appear, but difficulties are more and more significant because of the quantum nature of reality,

Very much as the measuring process gets us acquainted with quantum thinking, the concepts of statistical collective and ensemble, being tantamount to a number of sequences of probabilities and mean values of the variables of quantum physics, allow the mental associations among molecules or particles, and economic agents, or subjects. The world of physics thinking can impose to economical thought the probabilistic character of its forecasts, even in the case of a pure statistical collective, gradually eliminating the exclusively deterministic models of prognosis specific to classical economics.

The thinking of quantum physics does not exclude, through generalization, the macroscopic world, to which reference is made, in economics and economic statistics as well, under the name of populations or economies. The laws of quantum physics are the most general laws of nature also for the reason that they start from the wave equation (function). The wave represents, in physics, the propagation of a perturbation that comes from a point-shaped (punctual) source, in an ideal, linear, homogeneous, isotropic, conservative medium. [18]

A wave is described by a function *f(x,y,z;t)*, which can be a scalar or a vector function. Whatever the nature of that function, it satisfies the following equation:

$$\frac{\partial^2 f(x,y,z;t)}{\partial x^2}+\frac{\partial^2 f(x,y,z;t)}{\partial y^2}+\frac{\partial^2 f(x,y,z;t)}{\partial z^2}-\frac{1}{v^2}\frac{\partial^2 f(x,y,z;t)}{\partial t^2}=0$$

or $$\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}+\frac{\partial^2 \psi}{\partial z^2}-\frac{1}{v^2}\frac{\partial^2 \psi}{\partial t^2}=0 \qquad (1)$$

The value *v* is a material constant having the dimension of velocity, and it has been demonstrated that it is the speed wave front. That is the equation called the equation of wave. In the simplest of cases, the function only depends on x and t, f(x, t). In that case, the equation of the waves becomes:

$$\frac{\partial^2 f(x,t)}{\partial x^2}-\frac{1}{v^2}\frac{\partial^2 f(x,t)}{\partial t^2}=0 \qquad (2)$$

That equation actually describes the probability distribution of the particle with respect to space and time. The application of this hypothesis of the quantum theory implies the fact that the total sum of the information concerning a certain particle must be contained in the wave function which is associated to it, as the formalism of the wave functions is considered adequate because their predictions are in keeping with the experiments. The basic laws of quantum physics and mechanics describe the physics of the sub-atom world, but the macroscopic world is itself a final case of that science of the greatest generality. In the thinking of quantum mechanics, an entity of a sub-atom particle, such as the electron, could behave not only as a particle, but also as a wave. That odd quantum effect is supposed to disappear, in accordance with the thinking of quantum physics, when the entities become bigger. In the normal world, this effect does not exist, but the macroscopic world cannot however explain its own behaviour without it. The whole quantum theory centres on the wave equation, the mathematical formalization of which was discovered by Schrödinger, starting from the Klein–Gordon equation:

$$\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\psi\left(x,t;\vec{p}\right)-\nabla^2\psi\left(x,t;p\right)=-\left(\frac{mc^2}{\hbar}\right)\psi\left(x,t;p\right) \qquad (3)$$

where ∇^2 represents the Laplace operator defined through the relation:

[16] Goswami, Amit, Deepak Chopra (2000), *The Visionary Window: A Quantum Physicisl's Guide to Enlightenment,* Quest Books, Hampton Roads, Publishing company.

[17] Goswami, Amit, (2000), *Universul conştient de sine*. *Conştiinţa Creează Lumea Materială*, Ed. Orfeu, Bucharest

[18] Săvoiu G., 2008), *The Scientific Way of Thinking in Statistics, Statistical Physics and Quantum Mechanics,* Romanian Statistical Review no 11/ 2008, pp. S XIII pp. 1- 10

$$\nabla^2 \equiv \frac{\partial^2}{\partial x_1^2} + \frac{\partial^2}{\partial x_2^2} + \frac{\partial^2}{\partial x_3^2} \quad (4)$$

and which he reformulated for a free particle as follows:

$$i\hbar \frac{\partial}{\partial t}\psi(x,t) = -\frac{\hbar^2}{2m}\nabla^2\psi(x,t) \quad (5)$$

Schröedinger's equation allows studying the time evolution of the wave function that characterizes a system of micro-particles. If the energy E of the system is constant with respect to time, Schröedinger's equation acquires the following forma: $H\psi = E\psi$, which allows to find the own wave functions and the energy spectre for the system considered. The probability of finding a particle is given by a function having conformity with the principles of wave mechanics. Thus, the particle is dissipated in space, and it is only the probability of finding it in a certain location can be calculated, until it is noticed in a practical way. The thinking of quantum statistics leads to the conclusion that using the probabilistic scenario with alternative state variants (very much as the particle–wave, in the quantum model), stands the best chances of coming near the description of the macroscopic, macroeconomic, macro-financial world, and, of course, to understand and anticipate their future also…

Probabilistic density will thus generate previsional models based on the probabilistic thinking structured in distinct scenarios. The merit of the quantum physics is that of acknowledging its limits in foreseeing future events, centred on the principle of uncertainty, and becoming familiar to future economics, as well. Economical thinking will also take over, in future, the simultaneity of the states of particle or wave, from quantum statistics, in an alternative approach to the various specific units defined through binary states.

Finally, the quantum economics is the scientific compromise between the economic vision and quantum physics' thought. Quantum economics means also the coalition and the equilibrium between the two sciences.[19] This coalition has three steps:

- the coalition must have "positive measure" (the coalition "matters", in the general sense);
- the both sciences (economics and quantum physics) prefer the new allocations of the common sense of thinking;
- the total endowment of the coalition must be sufficient for them to conduct to a better understanding of the economic world (more atomized and thus continuum).

The major idea of the new quantum economics could be that any modern company, even when she is "financially dead" still produces energy. Thus we must evaluate the results in the future in a quantum physics manner not in a vulgate classical economic one…

There is an essential contemporary difference between quantum physics and quantum economics. The uncertainty of observation in the quantum physics quantities relates not only ever changing realities but also the ways of observations.

The main issue is measuring and observing in the quantum economics is putting parameters after analyzing of the information when the difference between economical quantities and final observations are even greater hence the measurements start from the same or even totally opposite points so the relevance between and among these measurements is based on their directions, length and the angles of their projections (in fact these are more and more scientific bias of the economics).

7. SOME FUTURE ALTERNATIVE CONCLUSIONS IN THE QUANTUM ECONOMICS' WAY OF THINKING

The idealism of Quantum economics' approach changes the classical conclusions described in the first part of this paper. Quantum economy is a quantum economic model of a finite economic system that consists of an economic subsystem (or simply economy) with a certain number of buyers and sellers (economy agents) and its external environment (institutions) with certain interactions between economy agents, and between the economy agents and institutions. All quantum models that describe finite economic systems are based on using quantum physical models of the corresponding abstract or virtual finite physical systems consisting of point bodies with different parameters and different interactions among them. Quantum economy in the large sense is a field of science about physical modeling of finite economic systems by means of corresponding finite physical systems and studying of such economic models with the help of quantum mechanics methods. In this sense it can be called also quantum economics. Quantum economy can also be seen as a new subsection of econophysics which gives quantum physical models for finite economic systems. The traditional econophysics subsections give physical models for infinite economic systems, and the statistical physics methods can be used for their description.[20]

The principal aspect in developing a physical model is a selection of function which helps us to describe economy dynamics, like movement of buyers and sellers in price space. As such a function in classical economy the economists can chose the agent's trajectory in a price space supposing implicitly that behavior or movement of the market agent comes to establishing a price for goods and commodities at every point of time by negotiations or information exchange both between economic agents and agents with external environment. It looks like economic agents adjust their trajectories to each other based on their principal concerns for their own and common profit that leads to some determination in their behavior or movement in price space. This must be a better description of a restructuring process… The evolution of the economic processes could be given only by "parameters of expansion, contraction or sometimes the both" so they can develop in "certain areas" to "certain extend" and then changed or adjusted, it may be done in a way to disperse accumulating energy so instead of big wave: the ways

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energies are accumulated and create big waves is the example of each market appreciation: which is positive for the economy to the extend of providing additional capital and equity thus expanding individual capitalization and investing. Quantum physics and quantum economics can also imagine a better solution of these three economic situations. Quantum physics is compatible with three distinct metaphysical "packages", one in which the agents (particles) are regarded as individuals, one in which they are regarded as energy (wave) and one where the both possibilities are accepted… This approach could be a better for measuring organizational structure of a company in the very next future, in a quantum economics way of thinking.

The first classical and realistic conclusion underlines the necessity of a standard model for restructuring a company. Hence the conclusion of a special quantum thought appears: the future of standardization is from the quantum physics essence and extraction (particles are more and more standardized in modern quantum economics)…

The second important realistic conclusion is the possibility of comparing various parameters of organizational structure, either at the particular organizational level, in particular organization or in business system that consists of multiple organizations.

Quantum economics could do a better job in this situation, using the scenarios of multiple structures, but finally with the same results as benefits parameters…

The third major classical conclusion was that the implementation of such concise view of simplifying the model and the structure becomes clearer, it is very important during the analysis phase. The simple version may be developed in detailed, classical model of the organizational structure if there is a need for it. It is obvious that quantum economics models of the organizational structure for a company is the most synthetic of all kinds of scientific models, too.

8. SOME FINAL REMARKS

This paper tries to underline the future superiority of quantum economics thinking. Physics, in general, can work with real market data, can also derive empirical laws and construct phenomenological theories, and statistical physics has useful approaches to economic systems, composed of many interacting parts. Quantum physics can change the entire way of economics' thinking, due to interacting units in economics are thinking agents with adaptive strategies and they are not so far from the "mindless" particles obeying simple microscopic laws. Thus, finally quantum economics could be the best solution for understanding economic process and phenomena. This idea is related to the significance of the integration of the thinking of quantum physics into the economic and statistical thinking of the future. The thinking of quantum physics does not exclude, through generalization, the macroscopic world, to which reference is made, in economics or statistics as well, under the name of populations and economies. The laws of quantum physics are the most general laws of nature, also for the reason that they start from the wave equation (function), and the new science of quantum economics will inherit all these qualities...

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SOME SIGNIFICANT ASPECTS AND PROBLEMS OF TRANSLATION IN MULTDISCIPLINARITY SCIENTIFIC RESEARCH

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Abstract. *The authors of the present contribution wanted to capitalize on their experience in working on specialized, interdisciplinary translations. They intended the paper as an illustrative glimpse of a number of theoretical and practical aspects of the arduous way to adequacy (in point of semantics, structure, function and style) translations aim at in the texts needed by the academic researchers' activity. Such issues were sketchily presented as: the mutual relationship between translation and translation studies, and interdisciplinarity, the role of the translator/interpreter as an intermediator between the cultural worlds in contact, the pressure of the specialized term in specialized translations, some of the main obstacles to appropriateness. Various examples of distortion and mistranslation were provided, including barbarisms and calked terms.*

Keywords: *communication, translation, cross-cultural communication distortion, barbarisms.appropriateness, interdisciplinarity.*

To say that communication has always been an important need of all societies is a sheer truism. One of the commonest definitions of communication describes it as a process by means of which information is enclosed in a package, then conveyed through a channel and passed on by a sender to a recipient via a certain medium; it is in fact one of the many such definitions currently used in order to conceptualize the processes by which people assign and exchange meaning.

Communication essentially means transferring information from one entity to another. The process relies on a sign-mediated interaction between at least two agents, who share a repertoire of signs and semiotic rules: it is the exchange of ideas, information, etc. between two or more people. The main elements underlying the act of communication are usually one speaker or sender / transmitter, the message being transmitted, and a person (or several persons) for whom this message is intended, i.e. the recipient / receiver. Communication can be seen as a mechanical process – a message is constructed / created and encoded by a sender, conveyed through a channel, then received and decoded by a receiver. The basic elements circumscribing the field of the communication theory are best expressed by Lasswell's maxim: "who says what to whom through what channel, and with what effect". Out of the three major types of communication (verbal, i.e. through dialogue / conversation – be it interpersonal or public speaking–, non-verbal – sending and receiving wordless messages –, and visual – through visual aids), the most important is of course the verbal type. Language being an instrument of communication, it will be redundant to say that speech has the central role in communication. In the process of communication, the *message* is at the very centre.

Incidentally, the human communication system has a lot in common with the animal one, the essential difference being their respective degrees of complexity and organization. The diversity and richness of human messages are indeed outstanding; unlike animal "language" systems (animals can transmit an unlimited number of signals, every message representing a mere variant of a single message schema), languages enable humans to convey well-formed sentences without ever ending the number of the possible well-formed sentences in the respective idiom: so, a human speaker may benefit by an unlimited number of discrete (linguistic) signals. When words and sentences are used in communication, they combine to make meaning in different ways. *Novelty* can be considered the key word when referring to human (linguistic) communication, as human languages are "open-ended", consisting of sets, and generating (possible) messages, whose number is actually infinite / unlimited: people can talk freely about virtually anything, and new items are permanently being introduced, borrowed or coined; it is, of course, novelty of meaning, not (usually) of structure. In most cases though, communication can also be understood as the exchanging of understanding.

In addition to common oral and written communication, researchers also define organisational communication (commonly studied as a subfield of the larger discipline of communication studies); it deals with the analysis and criticism of the role of communication in organizational contexts. Since communication is absolutely essential to organizations, the main focus of their communication (and researchers') endeavours has turned, since the 1980s, to prevalently business-oriented approach to communication.

In today's world, probably the most common type of communication is business communication, as used in presentations, meetings, socializing, small talk, correspondence, report writing, recruiting and applying for jobs, etc. Business communication has developed considerably in the area of mass communication media. The business articles in newspapers and magazines, as well as their readership, have greatly increased. The most mobile vocabulary compartment in the business areas includes economic, commercial and political terms. Such terms and phrases (and sometimes even structures) become increasingly better known, and also used in a proliferating manner.

On the other hand, both people of the same culture and language, and people belonging to different cultures communicate among them. It is true that intercultural communication, occurring between people of different cultural backgrounds, poses more problems than communication between people belonging to the same cultural background. Someone's cultural conventions and expectations play a vital role in the interpretation of the other's speech; when those cultural conventions are wide apart, disruptions (such as misunderstanding and

misinterpretation) will more often than not arise, or there may even occur total breakdown of communication. Intercultural / cross-cultural communication studies the way people coming from different cultural backgrounds communicate, as well as the way people try to communicate across cultures, paying attention to the degree of similarity between the manners of communication employed. Most specialists in the field emphasize the significance of *expression*. In fact, the message and the "package" are articulated as one entity. The construction of the message and the message itself are performed within a historical context. Some others say that there even exists a ritual process of communication exists, which can hardly be separated from a particular historical and social context.

In the same connection, translation is one of the many ways in which human communication has taken place for thousands of years. It has always played a central role in human interaction – and, indeed, translation can be defined in terms of communication. The translator has the role of transferring information from one language – the source language, to another – the target language. Today translation gains importance within the process of communication between the representatives of different linguistic communities. Furthermore, it is generally accepted that translators and interpreters, both professional amd amateur, have played a significant part in the evolution of national languages and modern cultures.

The growing interrelationship linking people and places in the current global world highlights the visibility of translation as a means of circulating knowledge across both linguistic and political frontiers. That contributes to a better awareness of the issues of worldwide reciprocal influencing, better knowledge among individuals and groups, better efficiency of the exchanges of ideas in the most variegated domains of human knowledge. Although its fundamental merit in the circulation of that stream of ideas, which is essential for today's society, is hardly recognized for its genuine value, translation unfolds vigorously in various senses, helping, among other things, to generate instruments of international cooperation and regulation, supported by transnational interaction in the domains of scientific research, world trade, placement of informatics programmes, etc.

The translator, before being a "writer" as such, is primarily a "message conveyor." In most cases, translation is to be understood as the process through which a message expressed in a specific source language is linguistically transformed in order to be understood by readers of the target language. The essential task in the process is preserving semantic and stylistic equivalences. By rendering a source language (SL) text in a target language (TL) text, one has to ensure that the surface meaning of the two is approximately similar, and the structure of the SL is preserved as closely and accurately as possible. Therefore, no particular adapting work is usually required from the translator, whose work essentially consists of conveying the meaning expressed by the original writer.

Felicitously understanding and rendering the terms and phrases subject to the transfer of the message from the source-text to the target-text means felicitously "transplating" various language items out of their linguistic nativeness. Hence, the process of translation is a highly complex undertaking, as it involves a lot of qualities and (specific) skills. The translator's work can become extremely difficult if one considers the fact that he/she has to cope with various problems arising from the divergences of the respective languages, whether in point of grammar, or lexical and stylistic structures and conventions. Moreover, the translator/interpreter must intermediate between the cultural worlds in contact, and not merely "transliterate" – be it in an informative manner – written or oral messages. Thus, translation is an intelligent activity, and it requires creative problem-solving in ever novel textual, social and cultural conditions. A real / good translator seems never to get bored, he/she is never inactive or routine-ridden.

Though the study of translation has traditionally been anchored in the combined established practices of both linguistics and literary studies, it is significantly (and qualitatively) more than that. One may suspect of utter self-flattery those experts in the field of translation who say it is both an art and a science; some define translation as a craft; Eugene Nida says it is a science, Mounin thinks it is an art, whose foundation is thoroughly scientific (comparable, for instance, to the scientific study undertaken by medicine).

In this connection, the concept of re-writing an original text will be in order. The action performed by a translator / interpreter is relatable to the whole of a text rather than to fragments of it, or else to particular words selected out of it. The text represents a *communicative unit*, significantly including particles of cultural information – and a good translator should be familiar with that aspect of a text, as well. Besides being familiar with, and quite proficient in, the source and the target languages, the translator must thoroughly know the *purpose* of the communication and the audience in order to achieve effective cross-cultural communication. Hence it appears the need for a good command of both the SL and the TL. Moreover, a fair amount of sensitivity to differences between cultures is necessary in order to successfully conduct business communication in situations such as meetings, direct or indirect negotiation and writing commercial letters.

Mistranslations, especially when frequent / current (or generalized), jeopardize both the rendered meaning, and the "hygiene" of the target-language itself. Distortions of every kind must be avoided, reduced or eliminated; that is to say that the major differences between the original and the received messages are to be eliminated. It follows that a set of special techniques are actually needed to avoid the difficulties that appear in the process of translation. Since the reality of multidisciplinary translation is very complex, the needs, problems and challenges that a translator has to face when translating specific documents are innumerable and rather hard to deal with.

In addition, translation studies – and translation itself, as a specific human activity – are naturally connected with the idea of *interdisciplinarity*. As a matter of fact, communication itself furthers interdisciplinary progress. More and more intercultural bridges increase the need for ever new interdisciplinary approaches, where the

humanity's hopes for solving some of the world's social predicaments lie. Globalization keeps challenging the older inter-discipline boundaries, and the fact is all the more evident in the field of social sciences. In the process, the role played by translation is not only that of an intermediary, but also that of an own source of new vistas and methods, established by the permanent contact with the other disciplines of human knowledge.

Virtually everybody today agrees that translation has a natural – or "genetic" calling for multi- and inter-disciplinarity. Actually, the very development of translation studies as an academic domain embraced a variety of sources, and continues to encompass various sub-competences and methodological and applicative models. The part it plays can only be understood in close connection with its natural flexibility, which allows it to unfold across and through textual, discourse or thematic realities characterizing its social function. Its natural supplement is, of course, scientific rigour and accuracy, or at least the aspiration to attain such accuracy effectively.

On the other hand, it will be fair to admit that knowing, being familiar with, or proficient in, most of the fields of today's scientific and cultural concerns is no easy job. A translator must possess, to a significant extent, interdisciplinary overall culture. Of course, good dictionaries and lexical-grammatical corpora are always there to assist one, as translation work instruments – but it is a fact that the sense of coordination and the accurate discrimination of detail must belong to the translator himself/herself. Specialists – i.e. qualified, experimented experts in the field – typically possess genuine propriety of the terms utilized, in both the SL and the TL; when such people are not sure about the exact meaning of a word or phrase, they look them up in good, or technically appropriate dictionaries: consequently, they will be able to employ them in a conscious manner, while appropriately contextualizing them.

Translation of legal texts, for example, allows but little space for rewriting and adaptation; translating, for instance, leasing or insurance contracts has little if anything to do with style: the user / reader actually wants to have as faithful a text as possible – which essentially implies semantics, not usually style and register. On the other hand, there are texts that massively require an "active communication" approach – thus, the very wording of the original text is the crux – but this rewording should be done cautiously and subtly. This may function as yet another piece of evidence to the fact that the translator is not essentially an *author*, but a *message conveyor*. Though the translator is an individual who significantly contributes to the end-product (and, in a way, we can say that his/her work is conducted in close cooperation with the original writer), he/she is a self-effacing person, who "naturally takes cover", as it were, behind someone else's text.

When the proficiency of the translators is relatively (or drastically) limited, there are major risks for the correct / faithful translation, i.e. the suitable text needed for an appropriate, efficient communication.

The range of the types of mistranslation, or of the cases of infelicitous or (grossly) approximate rendition is however alarmingly broad: in the field of Anglo-Romanian translation, for instance, there are plenty of translation variants that circulate sheer mistakes, barbarisms and Anglicised clichés, improprieties, some of which are genuine howlers. Such errors variously betray lack of empathy with either the text or the context, lack of logical thinking or of insight into the SL text, poor knowledge of the vocabulary of both English and Romanian, or blatant lack of nuance in thinking and expression. Paradoxically enough, many professional translators sin against the accuracy of the rendered text by ignoring many of the commonest False Friends / Deceptive Cognates, which even undergraduates should be familiar with.

More often than not, usages and idioms (or else, various other linguistic stock components and habitudes of a diverse nature – e.g. collocation) from the SL can be "spilled over" into the TL. (Though, paradoxically enough, inter-linguistic "spillages" can at times be conducive to something useful – a number of calques and loanwords being imported into the TL, which previously lacked a certain concept or a conveninent expression for a concept). Some examples (mostly taken from the domain of economics) will be in order for the current status of Romanian neology. (1) Terms that sound foreign, and still are felt by specialists as being useful: *barteriza / barterizare, cash forward, contracte futures, floor broker*, *franchiser*, *franchising, full-cost, hedging, interdelivery spread, spread, stand-by*, *strategia win-win, swap*. (2) Words and phrases taken over by contemporary Romanian – some of which stand a fair chance of being integrated into the (broader) common vocabulary: *barter, brain-storming, broker, cash, clearing, holding, leasing, management, marketing, (post-)taylorist*, *sponsor, sponsorizare, taylorism*; some others, situated farther from full admittance into the representative vocabulary of the Romanian language: *public relations, consulting-engineering*, etc. Trying to conclude in a more generalized, theoretical manner, we should say that, if the category of the so-called "barbarisms" still exists – and most of these terms are currently coming from the specialized areas of knowledge approached via translation – then such terms, phraseological units and idioms (even those belonging to the mainly colloquial style) should be accepted by the usage of current Romanian: they should be adopted since they are used! (Incidentally, there are even some "technical metaphors" – which are used especially in *journalese* or in *translatese* – but the standard language should be more wary as to taking them over). The same goes for the related phenomenon of calque / *decalcomania* – if used, that use should be rather moderate, quantitatively and qualitatively.

It should be added that the felicitousness of one's specialized translation very much depends on sensing and grasping (as an "insider") both the text to be translated, and the context. One has to know how to cope with, and also circumnavigate among, the specialized terms and phrases (including the cases of synonymy or quasi-synonymy), how to show flexibility as to the entirety of the context, how to prove credible and creditable (so that the text translated may sound natural, precise and rigorously adequate, and its author be recognized as an "insider", or a "real professional").

Some of the hardest issues to address when translating specialized texts belong to the pool of the lexicon; for

instance, *carburator* will be consistently translated as *carburetor* (although the vocabulary of engineering or of general science and technology is by no means simple or univocal), but legal texts are far more difficult to translate; for example, *persoane juridice* can be variously translated as *corporate bodies, legal entities, artificial persons*; *societate pe acţiuni (S.A.)* may translate as *company*, but a *societate cu răspundere limitată* is not merely (or always / univocally) a *limited liability company*; similarly, there are usage and contextual differences between, respectively, *partnership* and Rom. *parteneriat*, or Rom. *societate (comercială)* and *company*, *firm*, *concern*.

Specialized translations are, in a way, cases of "intralingual translation", operating in-between different registers and manners of codification (in point of style, addressability, grammatical structure, etc.). If there are differences between the SL and the TL counterparts, it is also true that there are significant differences, inside the same language, between otherwise onomasiologically related terms, according to the specialized area each term is made use of, e.g. *motor* vs. *engine*, *load* vs. *charge*, *capacitor* vs. *condenser*, etc.

The pressure of the specialized term must also be reckoned with – as against the literalness of the text (especially when the dictionaries themselves are not very generous or clear in their explanations, or when the translator fails to take full advantage of their contents). Here are some examples: in a TV documentary, *breeze* was translated as Rom. *briză*, a terms which completely lacks the specialized description (cf. Eng. *breeze* "*Meteorol.* any wind ranging in speed from 4 to 31 miles per hour: see *Beaufort scale*" (Webster); "*Meteorol* a wind of force two to six inclusive on the Beaufort scale" (COLL). The term *rapids* "part of a river where the current is very fast and turbulent" (COLL) was rendered as "repezişuri"; similarly, *conning tower* ("Also called: *sail*; a superstructure of a submarine, used as the bridge when the vessel is on the surface" (COLL) was translated as "turn de observaţie", although *turelă* would have been much more appropriate. The zoological term *bull-frog* ("any of various large frogs, such as *Rana catesbeiana* (American bullfrog), having a loud deep croak" – (COLL) was literally translated as *broască-bou* (!), although the Romanian counterpart – *buhai (de baltă)* – should be a rather familiar term, even for non-specialist translators. Various other improprieties related to the literality of the ST lead to such infelicitous / debatable, rather jarring renditions as: *court music* (instead of *courtly music*), *profane music*, etc. Similarly, some translators seem to be too lazy or lacking linguistic inspiration to come up with decent renditions, e.g. *sunt în curs de coliziune* (cf. Eng. *they are on a collision course*); *cockpitul (maşinii)*.

But the most deplorable cases of mistranslation are represented, in our opinion, by those renditions featuring blatant lack of (specialized) overall culture, or else the trivia of the profession, e.g. *cross-examination* translated as "interogatoriu încrucişat" (cf. Eng. *to cross-examine* "*Law*. to examine (a witness for the opposing side), as in attempting to discredit his testimony" (COLL); *justice of the peace* translated as "judecător al păcii"; *Newfoundland* translated as such, when the geographical name used in Romanian tradition has long been *Terra Nova*; *Columbia River* mistranslated as "Districtul Columbia", etc.

And still, good translators seem to be doing their job unfalteringly, and felicitous (counter-)examples are relatively abundant, illustrating what one could even call hyperscrupulousness (in specialized contexts), e.g. *bump* rendered through *protuberanţă*, *warm-blooded* rendered through *homeoterm* (cf.*poichiloterm*, Eng. *poikilothermic*), *under the arm* rendered through *în zona subaxială*, etc.

In the present connection, it should be stated that *contextualization* (of a complex type) seems to be the absolute rule in this domain, and it operates on several levels: (1) the semantic-referential level (*what* is it we are referring to? *which* mechanism / device / process is the topic of the text? etc.); (2) collocation and style (is the phraseological unit or phrase/syntagm well inserted? is the type of expression recognized by the respective functional style / register, or by the standard normative glossaries, dictionaries, guidebooks and textbooks of the respective language?); (3) discourse-related (i.e. concerning the recipient: is the translated message appropriate to the reading public / audience in point of nomenclature – or is it felt as rather technical / contrived? – e.g. translating *arheoscheletologie* (cf. *arch(a)eozoology*) to render *studying old bones*).Then, there are some more "mundane" cases of mistranslation, also related to the phenomenon of *linguistic interference*, originating in the translators' shaky knowledge of grammar, semantic and WF structures, e.g. "În cadrul acestui capitol *au fost identificate formele* care…" translated as "…*there were identified* the…"; "instrumentele *de suflat populare*" translated as "the *popular blowing* instruments". Virtually all the technical and scientific papers translated by our engineering specialists "smack" of the Roumanized version of *translatese*, e.g. rendering various passive structures in a faulty manner: *There are to be* found…, *It is* sometimes *made use* of these…; failure to observe the English, fronted, place of the subject; invariable early placement of the adjective, even when it is derived from a past participle form, e.g. "the *observed* phenomena"; overuse of a number of typically Romanian (neologistic) verbs "of general meaning" / "of broad collocation", such as *a realiza*, *a executa*; obsessively using the *gerunziu* forms instead of simpler, coordinate structures, or using the demonstrative *acesta*, *aceasta*, even when there is proximal coreferential sequencing, a case where Rom. *el* / *ea* , or else the Ø 3rd person personal pronoun could have been used.

That (multidisciplinary) *translatese* operates in both directions can be proved by such Romanian structures (culled from some of my technical colleagues' scientific writing) as: "realizarea sistemelor actuale complexe de *conducere a proceselor* de alimentare-ardere la…" (cf. Eng. *to conduct a process / an experiment*, etc.), "…au demonstrat pentru câteva plante (…) că trihomii nu sunt distribuiţi *randomic*, între ei existând o distanţă minimă…" (cf. *random, randomly*).

Finally, let us have an illustrative glimpse at some of the absolute translation howlers and Anglicized terms, which have come to be integrated into a kind of happy-go-lucky linguistic globalization (sadly, the following hilarious, even grotesque, expressions are absolutely genuine):

(1) Sheer barbarisms: "*background*-ul pe care universitatea organizatoare îl are în *tutoring* şi *monitoring*", "Aceste activităţi sunt undeva în spate, în *background*", "*ghidanţă* [< Eng. *guidance*] şi consiliere… adică îndrumare…", "organizaţia *receptoare*" [= "care va primi studenţii pentru specializare" – cf. Eng. *recipient*], "ce anume *se fitează* cel mai bine cu obiectivele specifice", "printr-un proces de *matching* şi cuplare de interese…", "nevoi ale educatorilor *apte* să se *fiteze* cu nivelul adulţilor", "În aceste trei *boxuri* (= rubrici, căsuţe, casete) ni se cer: limba oficială a proiectului etc.", "să facă dovada *team-spirit-ului*", "să nu ne prindă *dead-line-ul* fără proiectul trimis", "*clamez* bani pentru sistemul de îmbunătăţire a *abilităţilor* din domeniul…".

(2) Internationalized terms, or terms bound to become internationally recognized terms: "formulare de *aplicaţie*", "*aplicanţii*" [instead of Rom. "solicitanţii, petiţionarii"], "informaţii despre *aplicant*", "am *aplicat* doar noi [pentru acest program]", "plan *educaţional*" [instead of Rom. "plan de învăţământ"], "exemplul acesta cu *mobilităţile* este cu totul altceva", "estimarea *abilităţilor achiziţionate*", "materialele *de referinţă*" [instead of "bibliografie, material(e) documentar(e)"], "instituţii de *educaţie vocaţională*" [instead of "de învăţământ (de tip) tehnic şi profesional"], "adulţii să *acceseze* [instead of "să aibă acces la…"] structurile educaţionale *non-formale*", "negociere care se face în mod *non-formal*", "un *set* de parteneri ne-au contactat", "ceri tu, ca şi coordonator, o *extensie* a programului", "căutăm acţiuni şi *locaţii* mai ieftine", "să dispună de *facilităţi ICT* de comunicare", "*cetăţeni seniori* – adică persoane pensionate …", "puteţi folosi afişaje, *postere, afişe*", "Un *mail* pe care să ni-l *forwardaţi* şi nouă", "să ne însuşim *achisul* comunitar", "Comisia Europeană nu mai acceptă termenul de «persoană handicapată», ci «persoană cu *dizabilităţi* fizice» sau «persoană *cu nevoi speciale*»".

(3) Various types of calque – as an intermediate category: "Să le şi normăm [= aceste activităţi] *în termeni de* bani", "*costuri* [instead of "cheltuieli"] pentru persoana *acompaniatoare*", "a *se discretiza*" [referring to *objectives* – in the sense of Rom. "a fi defalcate / departajate / distinse" – cf. *discret* / Eng. *discrete* "1. separate or distinct in form or concept; 2. consisting of distinct or separate parts"], "Ni se permite să *adiţionăm* noi parteneri din ţara *accedentă*", "ţară *accendentă*", "sesiune de evaluare" (cf. *assessment session*), "vectorul de la care pleacă în *ţările-ţintă*" [cf. Engl. *target countries*], "ce *expertiză* au partenerii noştri?", "acţiunea… X… se face în trei *paşi*" [instead of *etape*], "*vântul schimbării*", "atâţia euro pe *linie* pentru plata traducerii" (cf. Eng. *line* "rând"), "Despre *cum ideea capătă* formă", etc.

To conclude, we have to express our hope – as both linguists and (professional interdisciplinary) translators – that the essential channel of neologistic influence represented by translation will continue to do its job of "synchronizing" our language with the western European languages (including English, today's "global language"), as many seminal carriers of cultural information in the modern world – without however overdoing it, to the extent of the ludicrous and the disruptively ambiguous.

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CLOUDS OVER INFORMATION SYSTEMS DEVELOPMENT PROCESS

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Abstract. *Due to simplifications of reality there are problems and crisis in different scientific fields (economics, management, information systems, and others). Although this fact has been recognized for many years, the theories and practices continue to be based on those simplifications. That's why some models and frameworks for improving sense-making for decision support are necessary. The Confluence framework is a sense-making device which can help in considering the depth and the breadth of the situation. In this paper an example of cloud-like use of the Confluence framework for the information system development process is given and pointed out that this framework is instrumental in building understanding that human unreadiness to accept existence of unordered space and necessity to live and work in it is real problem in information system development process (and other disciplines).*

Keywords: *Confluence framework, Cynefin framework, sense-making, information systems development process*

1. INTRODUCTION

Different scientific fields have been faced with problems and crisis. Many high-level researchers and professionals have admitted the limitations and imperfections of current paradigms in their disciplines. It has been pointed out that underlying assumptions of these paradigms could not be universally acceptable, and that corresponding theories and practices simplify the reality.

For example, it has been challenged the paradigm Rational Expectations Hypothesis /Efficient Markets Hypothesis in economics, the functionalistic paradigm in information system field, as well as scientific management as a theory of management.

But it seems that many researchers and professionals have ignored or have not cared about these challenges. The same errors and problems have been repeated many years. In information systems development, it might be even said that many organizations have not only failed to learn, but they have also learned to fail ([10]).

It is easier and safer for researcher (in his struggle for acquiring some academic rank) to participate in a study that follows dominant paradigm and focuses on a limited domain than to venture in distant and unknown territories ([1], [11]). That's why many professionals do not only know how to think and work in different way, but they are not even aware that the problems they have are so widespread in practice.

One reason for inadequacy of challenged paradigms is their neglect of complexities of the real world or treating them as they are negligible ([10], [11]). However, complexity caused by the number of interaction within and between systems is increasing. That's why a more realistic view of systems is needed. There is a need for a view which recognizes that besides ordered systems there are unordered ones. Since patterns are unpredictable in unordered spaces even in the presence of perfect information, traditional methods for decision support are not appropriate in these spaces. Understanding of the current situation has been recognized as a critical foundation for successful decision-making across a broad range of complex and dynamic systems. There is a need for some new models and frameworks for improving human capacity to make sense of the world in all its complexity and uncertainty in order to make decision ([7]).

The Confluence framework is a sense-making device which can help in considering the depth and the breadth of the situation. Its brief description is given in the next section. An example of its cloud-like use for the information system development process is given afterwards in this paper.

2. THE CONFLUENCE FRAMEWORK

In this section some desirable characteristics of a sense-making device for decision making are given, as well as a description of one such device - the Confluence framework. This section is based on writings of C. F. Kurtz, the author of the framework ([5]-[9]).

2.1.Sense-making devices for decision making

Successful decision making requires ability to see both the breadth and the depth of the situation at once. The utility of a sense-making framework lies in its ability to help in building a rich, multi-view picture of the situation which enables emergence of new understanding. A sense-making framework has to help building understanding how the situation is seen from different points of view, how it is changing, what might have happened if things had gone differently. A useful sense-making framework has at least two dimensions because the essential activity in sense-making by using some framework is the mapping relevant elements onto the space of the framework. Framework dimensions have to be value-free and to represent a meaningful space. In other words, the framework must resonate meaningfully with the people who use it – it must work in practice, not just in theory, and there is no one position in the space more desirable than any other.

The Confluence framework is a sense-making framework approved in practice. It has been represented several years as the Cynefin framework i.e. as a version of the Cynefin. Indeed, D. Snowden, the author of the Cynefin, and C. F. Kurtz, the author of the framework which she has recently named the Confluence, merged their frameworks into the Cynefin framework in 2001. Some aspects of Kurtz's framework have been described as extensions of the Cynefin, but it has been said recently that two versions of the framework nevertheless represent the same framework, but two complementary ones.

The difference of the Confluence and the Cynefin frameworks are shown on figure no. 1. The Cynefin framework distinguishes domains of decision making: known, knowable, complex and chaotic, as well as disorder domain in the middle of the framework which points to lack of information and understanding for mapping the issue onto some other Cynefin domain. There are boundaries between these domains. On the other side, the Confluence framework has two dimensions of variation: hierarchy and meshwork, and no boundaries.

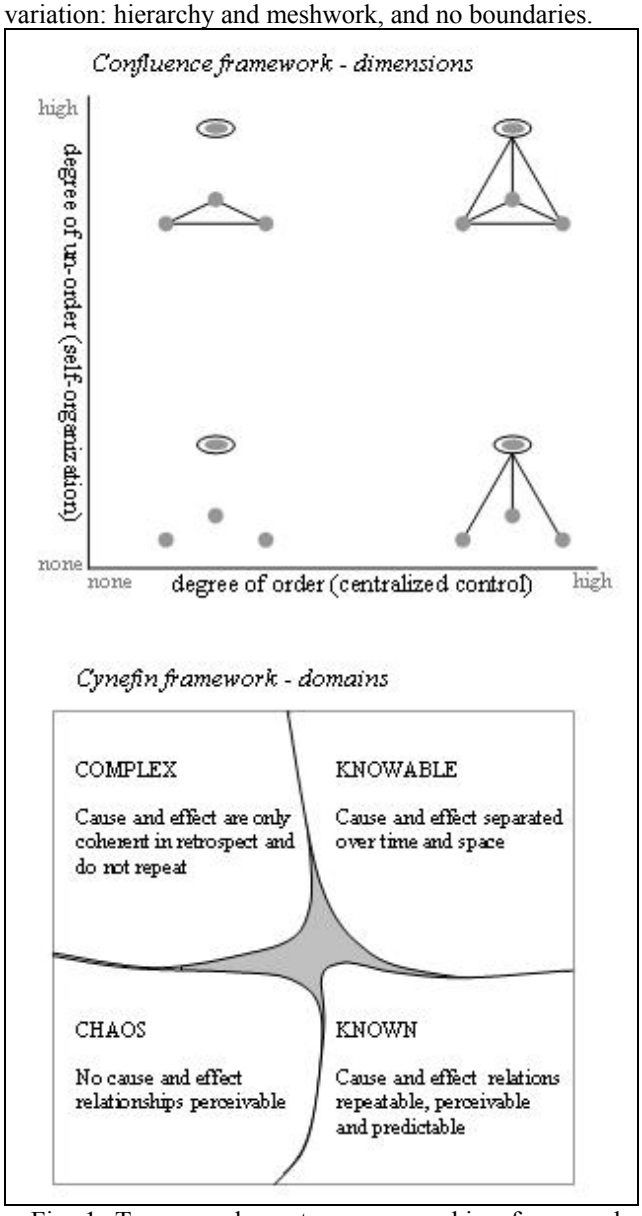

Fig. 1. Two complementary sense-making frameworks for decision support
Source: [6], [9] (with negligible modifications)

The ideas underlying these frameworks aren't unique. C. F. Kurtz has discovered that some old tools, for example (at least several thousand years old) the medicine wheel, had been also based on the similar ideas.

2.2.Description of the Confluence framework

As it was said above, the Confluence framework has two dimensions (axes) of variation. They are: (1) the degree of imposed order, and (2) the degree of self-organization. The choice of axes has been made by the criterion what axes are reasonable to use when decisions are being made.

The first dimension represents the degree of hierarchy i.e. the strength of central connections. It is the central directorate who looks out over everything and tries to organize others. It stands not for people, but for tendencies within the people and situations and their combinations. The degree of hierarchy grows from left to right in the framework.

The second dimension relates to meshwork i.e. the strength of constituent connections. The degree of meshwork grows from bottom to top in the framework.

These generic patterns of central and constituent connections are shown on the figure no. 2. Pure hierarchy or pure meshwork only pertains to the corners of the space. Besides that, non-human aspects rarely go to extreme hierarchy and human aspects rarely go to the pure isolation. All sorts of mixtures are possible between extremes of hierarchy / meshwork.

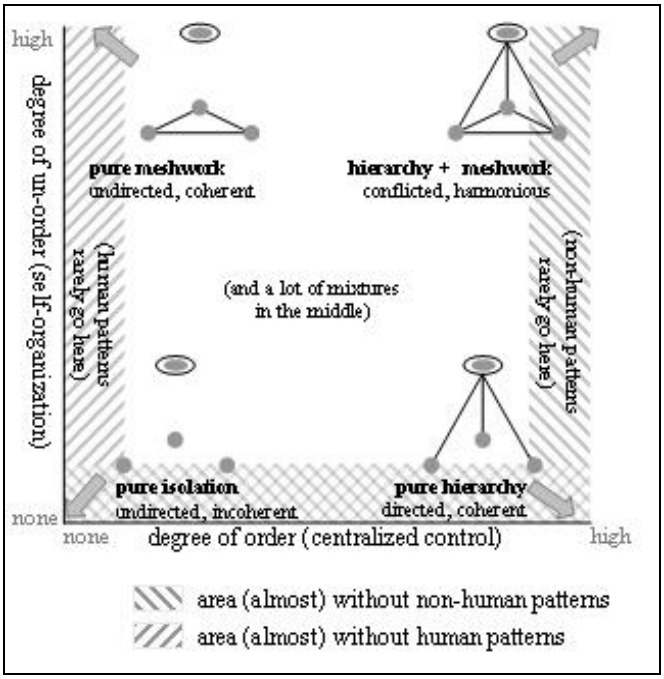

Fig. 2.Confluence framework - generic patterns
Source: [6] (with negligible modifications)

The issue under consideration may be represented on the space as a shape and so be over one or more areas of the space, not only at one location (or in one domain). The size of shape may show the quantity of internal diversity in it. Preferred shape for an issue representation should be a cloud (or more of them) because of its internal structure. Different clouds, with different density, thickness and heights, may represent different situational aspects. For example, concentration of some situational aspect over different spaces and gap between them could be represented in the cloud; the thinness of the cloud could represent lack of knowledge.Qualities useful for sense-making are: identity interaction, multiple perspectives and movement in meaningful space.It is useful to consider identities as determinants of behavior. In any aspect of life there are human identities flocking around it. Paying

attention to the identities and their flocking are very useful. Considering multiple identities broadens scope by introducing factors and influences which are usually neglected, and also deepens focus by examining in greater detail factors and trends that are so obvious they are usually overlooked.

It is useful to consider categorical, relational and positional aspects of identity. Categorical aspects of identity concern with what a person is or has. Relational aspects of identity have to do with a person's connections. Positional aspects of identity are based on its placement in the whole.

In order to determine identity interaction, it is meaningful to consider selection, mobilization and commitment processes. The selection process draws on categorical aspects of identity and characteristic-based evaluation of identity safety. The mobilization process is concerned with relational aspects of identity and membership importance evaluation. The commitment process involves utility evaluation of positional aspects of identity according to the placement in the whole.

Identity interaction can be mapped on the space of the Confluence framework. Different types of identity interaction have different sizes and cover different areas of the two-dimensional space of order – un-order (figure no. 3). They may be represented by different shapes or clouds.

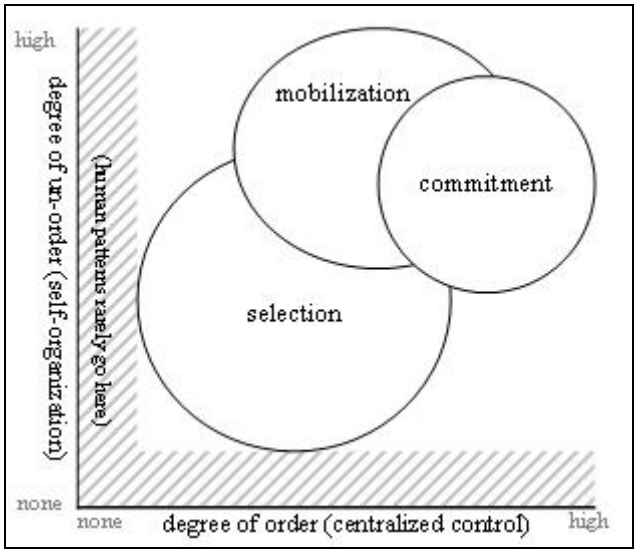

Fig. 3. Confluence framework-identity interactions
Source: [5] (with negligible modifications)

Perspectives of relevant identities on situation can be presented on separate layered frameworks, floating in vertical space like a geographic information system, or on the same landscape, overlaid and even interacting. It is particularly useful to show dynamics of situation under consideration in some way. Dynamics can include speed and acceleration as well as location. For example, there can be repeated patterns of movements that only appear in some circumstances or from some perspectives. Beside action-identity layer of the framework, it is possible to form alternative fictional layer representing dynamics of what-if situations.

The Confluence framework is complementary tool to the Cynefin framework, and vice versa. In some situations, considering the Cynefin domains[21] and the Confluence clouds in parallel may be more fruitful than pursuing only one approach.

3. AN EXAMPLE OF THE CONFLUENCE FRAMEWORK USE

In this section an example of the Confluence framework use is given. The framework is used to represent some situations in Water information system development for one public water management company in Serbia in order to explain some misunderstandings and some decisions in the information system development process in retrospect. An observed pattern of organizational behavior is also presented, as well as a what-if situation.

4. 1. Situational description: information system development – in general

Information system development (ISD) is a high-risk undertaking. Failures in ISD remain common despite advances in development tools and technologies. One reason for this is the collapse of organizational intelligence required to deal with the complexities of ISD ([10]).

The dominant paradigm in ISD is the functionalist one. It has been used for decades in ISD. Most research is focused only on it ([1], [4]).

The functionalist paradigm is concerned with providing explanations of the status quo, social order, social integration, consensus, need satisfaction, and rational choice. Functionalist systems development is primarily a technical process. An expert for information systems (IS) has primarily to be expert in technology, tools and methods of system design, and project management. These methods help to make ISD more formal and rational. But, it seems that this concern with method is the true origin of crisis in information systems field ([2]).

The implicit assumption of the functionalist paradigm is that the ends are agreed. But in reality, ends are controversial and the subject of considerable disagreement and debate. That's why theories in use very often differ from the 'espoused' theories, which reflect orthodox practices. It has been argued that, even in highly structured organizations, improvisation is very important process in situations where rules and methods fail.

On the other hand, it has been pointed out that beyond great successes of information technology there are phenomena of strategic importance for everyday life, such as bricolage, heuristics, serendipity, make-do, rather than the idealities of methods ([2]).

[21] The Cynefin domains known and knowable belong to ordered systems, in which patterns tend to repeat on. Repeatability allows predictive models to be created. Causes lead reliably and observably to effects. The main difference between the known and the knowable domains is in what is already known and what has yet to be found out.The complex and the chaotic domains of the Cynefin nest into a set of unordered systems, in which patterns are unpredictable even in the presence of perfect information. Patterns in the complex space depend on interactions. They apear and disappear there. When and how complex patterns will stabilize or disintegrate is imposible to predict. In the chaotic domain there are no perceivable relations between cause and effect.

Deeply rooted in the web of common-sense beliefs and background knowledge which serve as implicit theories in use, some alternatives to the functionalist paradigm in ISD have been developed: social relativism and radical structuralism. Besides these ISD paradigms, there is a theoretically based one - the neohumanism ([4]).

According to the social relativist paradigm information systems (IS) are part of the continually changing social environment and should help to identify which ends are desirable and feasible. Information systems objectives emerge as a part of organizational construction of reality, the sense-making process. The IS developer is a facilitator of ISD process. His role is to interact with management to find out what type of IS makes sense, but there is no objective criterion that distinguishes between good and bad IS.

According to the radical structuralist paradigm ISD is dialectic materialism, and the IS developer is a labor partisan. A fundamental social conflict exists between the interests of owner of the sources of production and the interests of workers. The IS developer is faced with a choice: to side with management and become their agent, or join the interests of workers.

In the neohumanist paradigm ISD is a process of radical change, emancipation, and potentiality. Since the concepts of work, mutual understanding, and emancipation are the three fundamental domains around which society and other forms of social organization are arranged, IS developer must have these three knowledge interest in mind. Information systems would have features to support work related to knowledge interest of technical control of natural objects, forces, and people and these would be similar to those developed under the functionalist influence. Other features would support the creation of shared meanings and reflect the knowledge interest in mutual understanding. This is similar to systems inspired by social relativism. Finally, there would be a comprehensive set of features to support emancipatory discourse between different social and organizational forces. The discourse has to remove all unwarranted constraints to social freedom and personal growth by social criticism and by application of technical knowledge and shared understandings. That's why IS developer needs to act as an emancipator in an attempt to draw together, in open discussion, the various stakeholders. He must genuinely participate in the situation in order to acquire an appreciation of the different viewpoints, existential situations of the different stakeholders' groupings and many obstacles to human communication and understanding.

3.2.Application of sense-making frameworks for ISD

Some initial researches recognize the importance of the Cynefin framework for information systems field and particularly information systems development.

In some respects the Cynefin domains signify different ISD paradigms. The Cynefin allows understanding that complexity within the IS field mirrors reality. It is just what gives credibility to the field. The Cynefin message to IS field is to accept diversity and change as strengths and to use the framework to support realistic research and practice ([3]).The Cynefin framework brings into the design process the issues of disorder and chaos and accepts that there are contexts that include unpredictability and uncertainty ([13]). Failures and problems of the information system development process are caused by a lack of situational understanding and by non-understanding that the problems of complexity and chaos could not be solved by rigid methods and geometric representations ([12]).Complementarity of the Confluence and the Cynefin frameworks indicates the Confluence framework importance for IS field and ISD process.

3.3. Situational description: Water information system

In this section the author of this paper attempts to explain some decisions made in development process of Water information system (WIS) for one public water management company in Serbia by the cloud-like use of the Confluence framework. The explanations are based on deep situational understanding which the author has been built actively participating in the ISD process[22].

The interpretation of the viewpoint underlying WIS development planning framework is given first. After that some dynamics of WIS development process is shown, including an observed pattern of undesired organizational behavior. Besides that, the fictional situation which represents what would be happen if it was being used some other ISD paradigm is given.

3.3.1. Water information system development planning framework

The interpretation of viewpoint given in WIS development planning framework is based on consideration of key elements for decision making related to this framework.

Any paradigm, with its implicit and explicit assumptions and associated methods, determines human behavior and roles of people. In other words, every paradigm determines possible identities in given situation. Due to the importance of thinking on identity interactions in building the Confluence framework, it seems that it is desirable and convenient to consider existing relevant paradigms and their usability in the situation. Besides the paradigms, the key elements for making the decision are those which enable determining paradigm usability in the situation. They certainly include other relevant plans, as well as already achieved results.

As it has already been said in this paper, four ISD paradigms could be considered: functionalism, social relativism, radical structuralism, and neohumanism.

Since the WIS has to serve company responsible for water management, it is convenient to consider different paradigms / approaches to water management too. Two different approaches to water management can be distinguished: sectoral approach and integrated one.

Integrated Water Resources Management (IWRM) is an integrating, cross-sectoral policy approach, designed to replace the traditional, fragmented approach to water resources management that has led to poor services and unsustainable resource use. It is a great challenge. It needs institutional changes, new institutional capabilities. Some

[22] Project documentation is in Serbian and abundant, so the references to it are not given.

fundamental principles are universally acceptable, independently on the context and the degree of economic and social growth, but there aren't universal 'patterns' for transforming these principles into the practice. In other words, IWRM practice is emerging one.The areas of the Confluence framework covered by ISD and water resource management paradigms are shown on figure no. 4. The ISD functionalist and the radical structuralist paradigms assume that objective reality exists i.e. there are some considerable degree of order. The reality is knowable if it is not already known. The radical structuralistic paradigm requires from IS developer to satisfy either needs of managers or needs of workers. That's why its cloud is over the area with less degree of order in comparison with the ISD functionalist paradigm cloud.Other two ISD paradigms assume subjective reality i.e. insignificant degree of order. The key difference between them is in the degree of self-organization. The neohumanist paradigm emphasizes the need for radical change, so its cloud is over the area with less degree of self-organization in comparison with the ISD social relativist paradigm cloud.

The author of the paper use different types and colors for clouds to show different height and density of related ISD knowledge. For example, the functionalist paradigm cloud is very thick, very dark and with big shadow, but the neohumanist paradigm cloud is thin and very wispy.

Clouds thickness represents quantity of relevant ISD knowledge, their color represents opinion how danger they are and shadow how much consequences they have brought. So, the cloud for the ISD functionalist paradigm is very thick because existing ISD knowledge is mainly in it. Its dark color and great shadow denotes that it has brought many problems and undesired effects and may be a dangerous, thunderstorm cloud.

The positions and the 'structure' of two clouds for water resource management approaches have been chosen in a similar way.

There are some other clouds over selection process of fundamental issues for WIS development planning framework (figure no. 4). Their labels are: relevant development strategies, attempt to use traditional ISD approach on previous project, documentation of previous project, and unused developed software.

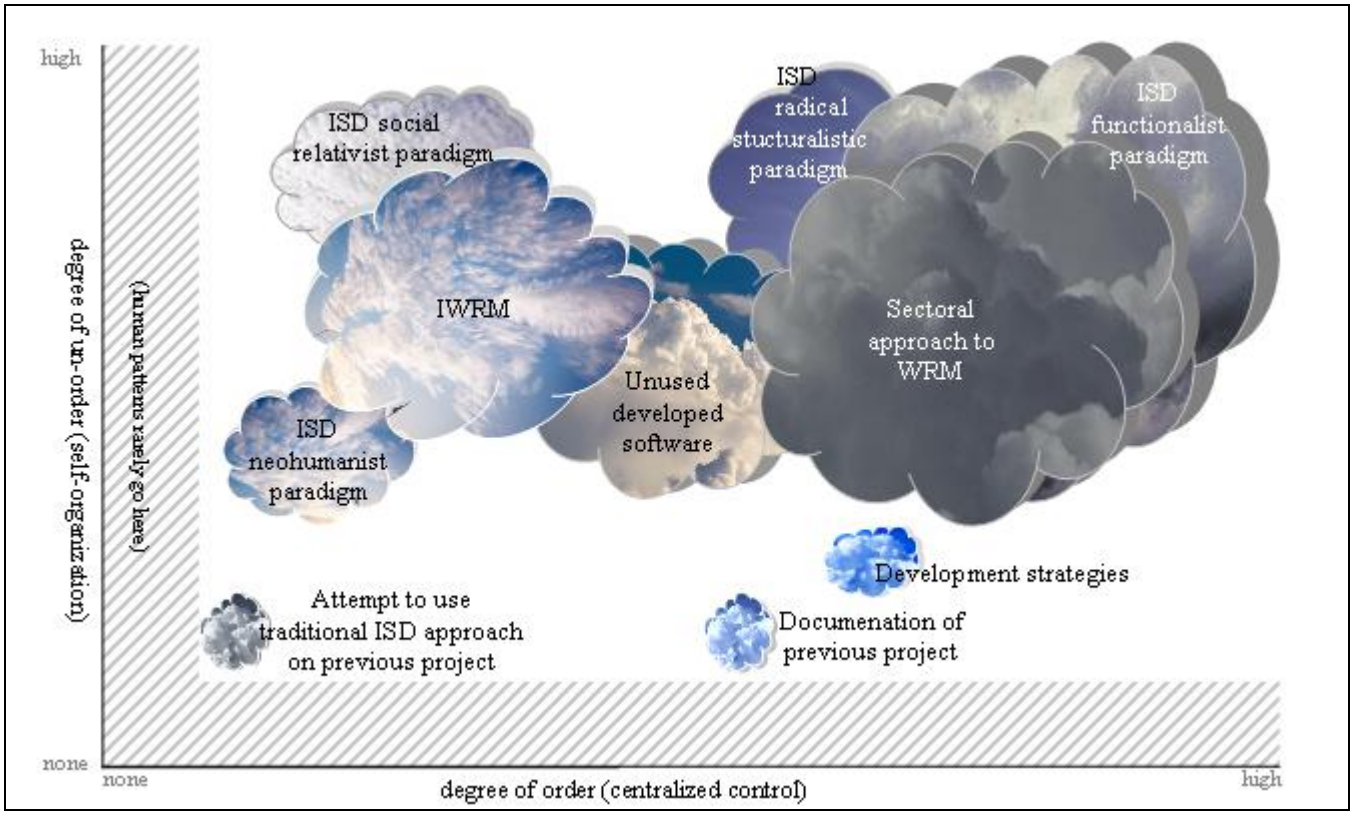

Fig. 4. The clouds over selection process of fundamental issues for WIS development planning framework

Relevant development strategies[23] give some directives for strategic information systems development, as well as natural resource information systems. Also they determine that water resource must be managed in the context of sustainable development.

The previous project related to integrated enviromental information system development[24] has brought some new experiences – traditional ISD methods completely fail because IS investor, organizational management and the main users didn't want to take part in the ISD process. That experience, due to suddenly arrival to haotic domain (in the Cynefin terms), has induced searching for a problem solution, and building knowledge on different ISD paradigms. The need to use the neohumanist ISD paradigm in that situation has been documented.

The fact that software developed according to the best / good ISD practices and world experiences in water resource management has not been used is particularly worrying. That failure has never been studied. It has been probably caused by insufficient quantity of both order and un-order in the situation where the software was implemented.

It may be said that the main criterion for selection WIS development planning framework key elements was what approach to water resource management would be acceptable into the future. According to accepted directive of sustainable development, IWRM approach was chosen. It determined acceptable ISD paradigm. Since IWRM requires radical change - breaking out of old ways of fragmented thinking and considering problems of water resource management in new ways, the ISD neohumanist paradigm was chosen.

The ISD neohumanist paradigm requires knowledge interests in technical control, mutual understanding and emancipatory discourse. That's why 'learning' clouds cover big area of the Confluence meaningful WIS space (figure no. 5). Beyond choice of 'sunrise' pattern for these clouds is the opinion that learning would bring bright future.

The area of clouds with label 'learning' is much wider than the area of existing knowledge. Big area is covered with clouds related to knowledge interests in: (1) mutual understanding, and (2) emancipatory discourse. The area of existing knowledge partly overlaps the cloud relating to knowledge interest in technical control (existing knowledge would be either used in the future or replaced by new one). Satisfying knowledge interests in mutual understanding and in emancipatory discourse requires not only IS developers, but all concerned with WIS and water recourse management to learn.

That means that learning is a must for all. Commitment to learning is particularly required of all responsible for establishing WIS.

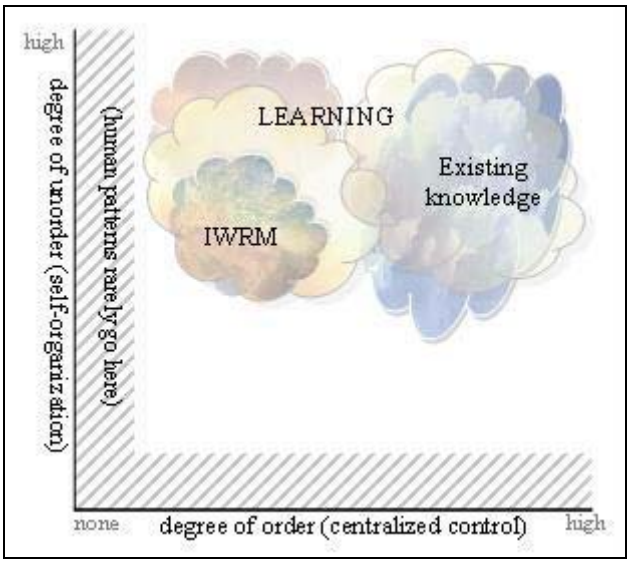

Fig. 5.The clouds over WIS according to WIS development planning framework

3.3.2. Water information system development process

WIS development has been started with making strategic plan. But, some dark, dangerous clouds appeared very quickly. Clouds over WIS development process are shown on figure no. 6. Different layers of the Confluence framework, which present selected situational aspects of the ISDP, are given on the figure. Arrows between these layers point to dynamics of the situation.

The first discussion between IS experts and organizational managers about the situational aspects pointed to great uncertainties in organizational environment. But, in a later interview one manager very categorically stated that there was no uncertainty for the organization, and that 'organization knows what it needs': data, a supervision system and a video projector. He was in ordered space. He attached no importance to un-order one. He had knowledge interest only in technical control.

Acquired appreciation of the different viewpoints in the organization and of some viewpoints outside the organization pointed to serious problems on the project. Organizational activities were very often in un-order space, but the organization was not aware of that. Dominant 'black-white' viewpoint disabled not only emancipatory discourse, but it even disabled any effort to build mutual understanding.

ISD developer tried to facilitate problem understanding by building some systems dynamics diagrams showing observed patterns of significance for the project. But, those diagrams were not used. The organization had made decision how to solve problem before the diagrams were presented.

The decision was to reduce scope of the work. The scope would not be management of all water resources, but only of drainage resources. IWRM principles were not abandoned. That means little reducing size of clouds relating to existing knowledge and learning, not their disappearing. In other words, the main problem remained.

[23]Strategy for Development of Informatics in the Federal Republic of Yugoslavia, Resolution on Environmental Protection Policy

[24]Conceptual Design for Integrated Environmental Information System for the Federal Republic of Yugoslavia

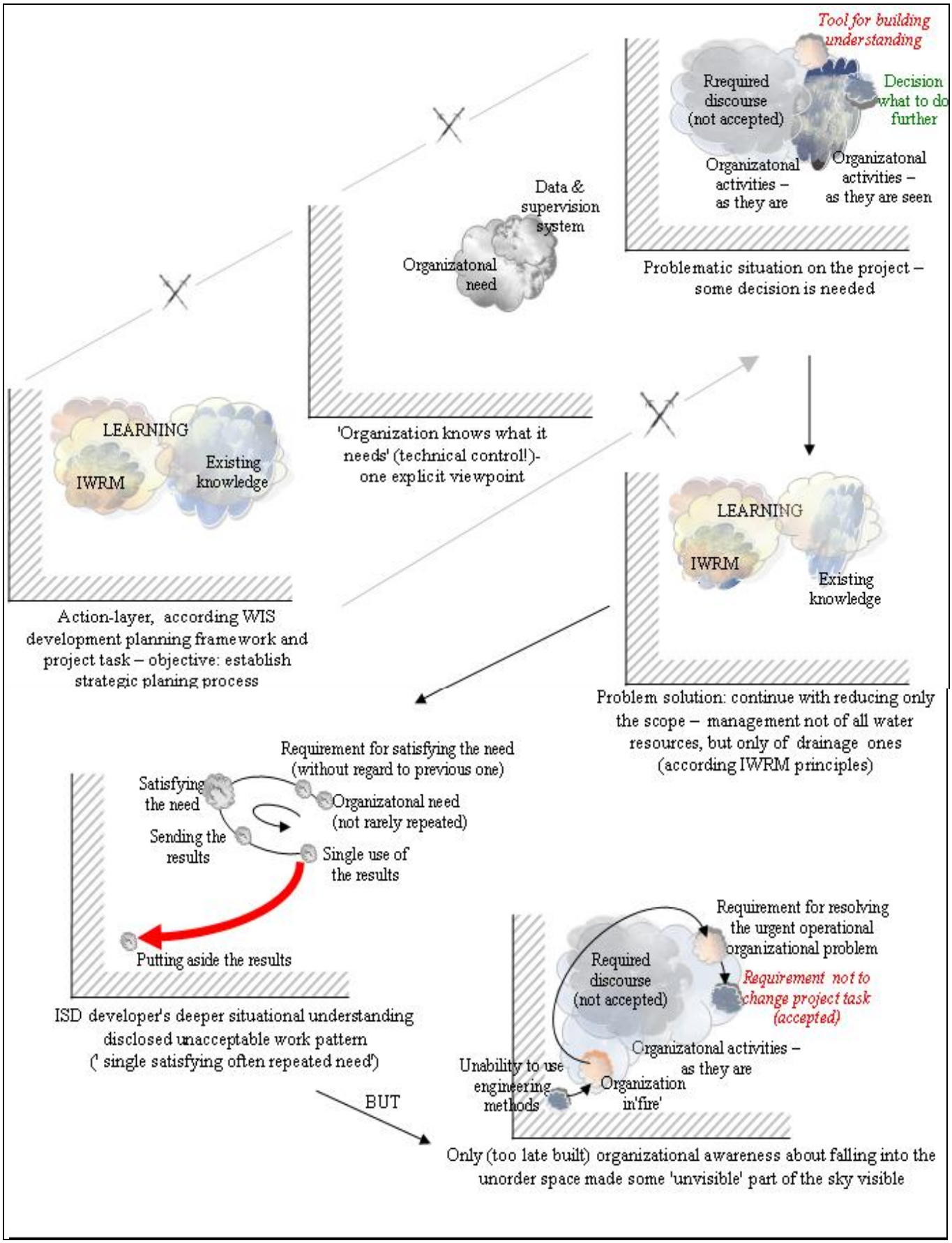

Fig. 6. The clouds over WIS development process

Further work on the project enabled deeper understanding of organizational situation. Some patterns of undesirable behavior were discovered. In fact, they showed that the organization sometimes itself fell into the chaotic space.

Again, there were no attempts to improve the situation. It seemed the organization didn't hear anything about that undesirable unordered space into which it has been entering itself.

But, 'invisible' parts of the sky suddenly became visible after the organizational sudden falling into the chaotic space when engineering methods had failed. But, that was not enough to admit unceratinity in work activities and the need to change some work plans and project tasks and adjust them to complexity of organizational life. The wish for technical control of the project was too strong.

3.3.3. What-if situation: traditional ISD paradigm in use

The non-traditional ISD paradigm has been used on the project. The question which appears is: "What ISD process would have been if the traditional ISD paradigm had been used?'.

In this what-if situation, WIS would be a technical system, and IS developer would be an expert in information technology (IT) field.

Two cases of possible WIS development by the functionalist ISD paradigm will be considered relating to two different approaches to water resource management: (1) integrated, and (2) sectoral. These examples of what-if presentation are given on figure no. 7.

As it was said, IWRM approach need radical change in water resource management i.e. it requires changes in existing work activities and introduction new ones. The changes are not yet knowable, they have to emerge. WIS development would require movement from unordered space to complicated one.

The same problem would appear in the case of sectoral approach to water management because some organizational activities were in the unordered space. But, that fact wasn't known (it was discovered during WIS development process). In other words, problems would be discovered during the project. IS developer would probably make some improvisations in ISD methodology. In the case of success, IT solution would mostly determine the way of organizational work. But, since the organization thought that it was working differently, the success would not be expected.

It seems that only case without problems might be building IT support for well established work activity (if such existed).

3.4. Some considerations on the Confluence framework use for ISD process

In this paper the author represents her own initial attempts to use the Confluence framework for ISD process. The author thinks they are very encouraging. Issues in ISD could be clearly visually represented. The cloud appearance may indicate how much the issue in the cloud is difficult / important / dangerous according some viewpoint. Given example points out that human unreadiness to accept existence of unordered space and necessity to live and work in it is real problem in information system development process.

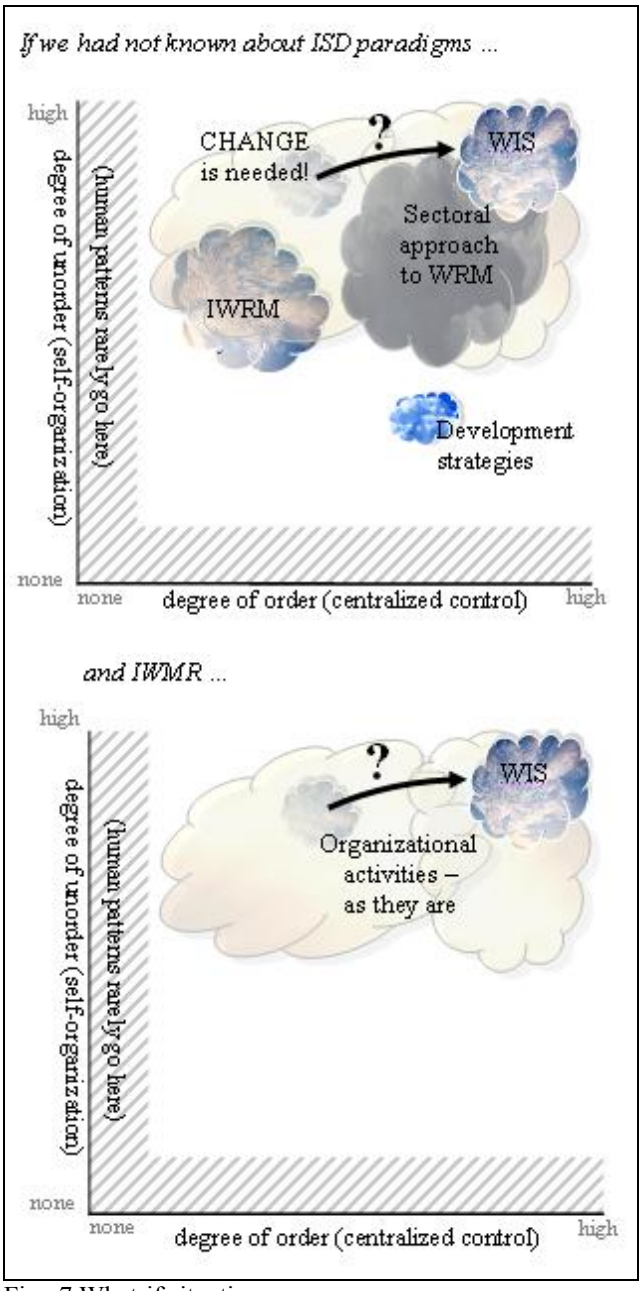

Fig. 7.What-if situation

Of course, there is a need for further investigations how to use Confluence framework for ISD. But, the key issue is the real wish to solve observed problem or dillema. Without the wish, without the power to force problem solving, without capability to liberate ourselves from unwarranted constraints, clouds over the framework could be easily neglected and treated as they are bad (social, political) 'weather' forecast.

But if there is the wish, the 'clouds' probably could help IS researchers and experts to understand, together with experts from other relevant disciplines, some phenomena in IS field which are really spoken about.

4. CONCLUDING REMARKS

In this paper some problems in information systems field are touched. But, we are witnesses to crisis in many other disciplines too.

If crises are somehow connected to forgetting ([2]), we should ask ourselves what and why we have forgotten (in economy, management science, information systems field, environmental protection, etc.). It seems that we have forgotten that we live and operate in a complex world full of imperfections and unpredictabilities. We have forgotten it because we have formed idealized geometric universe, safe space full of straight lines and boxes, world of formal methods. But, with increasing complexity of the real world, these two worlds become more and more distant, connections between them are breaking down. Through this breakdown we encounter the world, possibly with different eyes.

The example of information systems development process given in this paper just points that forgetfulness is very great, as well as that breakdowns helps in 'changing' eyes. The cloud-like use of the Confluence framework is an attempt to present the conflict between real and ideal world (in the field in which the author had expierence) in order to prevent some breakdowns and depeer crisis.

But, since it seems that crisis in different fields have the common causes, ideas on cloud-like use of the Cynefin framework might be useful for researchers and experts in other fields. It may a stimulus for better understanding of the real world and possibilities for using / merging different knowledge in solving real problems.

In fact, we can try to back to the real world before new breakdowns and to understand not only how much it is complicate, but also how much it is complex and uncertain. In that process a sense-making framework which allows both order and un-order is welcome. It could help to appreciate possible connections between different spaces, as well as possibility to use knowledge from one space to another, or to merge knowledge from different spaces. Probably much hard multidisciplinary work would be necessary under clouds caused by our ignorance of real world. Knowledge about sense-making frameworks and consideration about their instrumentality is just the first small step on that way.

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