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A SOCIO-PHYSICAL APPROACH TO TAKING DECISIONS IN SOCIAL CONFLICTS. SUITABILITY OF THE ROŞIA MONTANĂ PROJECT

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***Abstract**: Addressing prospective readers who are educated and socially involved, but whose basic knowledge of physics, acquired in high school, is no longer fresh, the authors briefly present, in the first part of the paper[1], the main categories of socio-physical models, which are then used as postulates in the socio-physical analysis of social conflict concerning the Roşia Montană Poject of Roşia Montană Gold Corporation. The models are based on: Dimensional Analysis, Dimensionless Ratios, Principle of Objectivity of the laws of physics,.Principles of Conservation, Newton's I, II and III laws (of inertia, of proportional action or proportionality, of action and reaction), Principle of Superposition of Forces, theoretical apparatus used in Physics Experimental Data Processing.The principles to observe in decisions in social conflicts are mentioned, as well as the ethics in public procurement, which are justified by the corresponding postulates of socio-physics. Roşia Montană Project is approached as a joint venture between Roşia Montană Gold Corporation and the Romanian State, as it was considered in the hearings of the Joint Special Committee of the Chamber of Deputies and the Senate of Romania, conducted in order to approve the draft Law on a set of measures related to gold-and-silver ore exploitation at Roşia Montană, and stimulate and facilitate the development of mining activities in Romania.The socio-physics investigation begins by analyzing some specific aspects of the current suitability and operational need of the Roşia Montană Project: possible uses of the gold-and-silver ore extracted from RM and the resource availability. The fundamental characteristic of gold ore is introduced as a dimension – i.e. it being **a non-renewable, finite resource**. Likewise, the temporal and spatial horizons of the resource are introduced: the future time horizon for the gold resource exploitation in Roşia Montană (comparable to the past one); the spatial dimension of resource ownership: an exclusively public[2], inalienable[3] property of the Romanian State [Art. 136, par. (3) and (4), Romania's Constitution, 2003] [1]. The owners of the gold resource are identified (and, more broadly, the owners of the gold-and-silver ore and of the underground historical heritage related to its exploitation): the entire living population of Romania, as well as the future generations, within the future time horizon considered. It is on that basis that the theoretical individual share of ownership of the gold mined in Romania is determined, as well as the rational average utilization rate of the resource, and the scale of useful projects can be objectively foreseen.The socio-physical analysis allows drawing a set of general conclusions concerning the exploitation of non-renewable resources, and, more particularly, conclusions regarding: the current utility of conducting Roşia Montană Project in the national interest, regardless of the scope of the future historical horizon considered, and the opportunity of currently exploiting the gold deposits in Romania, and particularly Roşia Montană deposit, based on the gold demand analysis for the domestic and international markets, using the Postulate of Action and Reaction and of Proportionality. Exploiting now the gold in the analyzed Roşia Montană Project is then correlated with the benefits and costs of the Project regarding the use or loss of secondary resources in the gold-silver ore, by means of the gold mining technology stipulated in the Project; the correct dimensional calculations allow the comparison of losses / gains ratios for the two partners, i.e. RMGC and the Romanian State, and highlighting the imbalances generated.The socio-physical models developed show that the initiatives connected to local and foreign investments in mining must be analyzed objectively and specifically, so they should not be supported or rejected on principle. These investments should be directed towards projects where the losses / benefits ratios are approximately balanced between the business partners, rather than strongly disproportionate at the expense of one of the partners.Then the possible effects of the Roşia Montană Project on the natural environment are analyzed. The ratios between subsequent losses due to pollution charges / contract-stipulated gains, calculated through Dimensional Analysis, appear, too, as disproportionate for the two partners.The terrorism risks generated by the Project are examined as well. The possible effects of RM Project on the cultural and historical heritage of the Romanian people, related to gold mining at Roşia Montană, are approached combined with the discovery, in the year 1961, in the same area, at Tartaria, of the oldest human inscriptions (~ 5300 BC), the whole heritage considered, from a socio-physical standpoint, as being (P II) an inalienable public asset of the Romanian state in its historical evolution, not as a local (temporal and / or spatial) asset; this legacy – globally important – has to be defended and included in sustainable development projects of Roşia Montană area, including projects supported internationally. In the last part, the possible effects of the RM Project on the social environment and the evolution of jobs in the Roşia Montană area are analyzed. From the socio-physics concrete, quantitative analysis, using the data in the Project, from the hearings in Parliament and those related to them, relative to the risks of the Romanian State compared to the benefits of the Romanian State and the imbalances that could be generated, it is drawn an overall objective, firm, nonpartisan, final conclusion on the adoption or of rejection of the Roşia Montană Project. The socio-physics method of analysis used by the authors is general, and can be used by those interested in analyzing, evaluating and solving social conflicts associated with other large projects, e.g. projects about regionalization, decentralization, subsidiarity, local autonomy, positive or negative discrimination of certain social groups, particularly those social conflicts relating to the exploitation of non-renewable resources (shale gas, etc.), as well as with respect to forecasting the social consequences of ongoing activities, at both macro-economic and micro-economic levels.*

Keywords: *Roşia Montană, project, suitability, decisions, socio-physical approach*

INTRODUCTION

If human society is considered as being composed of a set of members, people or humans – individuals relatively alike and equal between them, the principles of operation of such a society be somewhat similar to the *principles* of macroscopic

[1] The second part deals with "Socio-Physical Models in Negotiating and in Promoting Roşia Montană Project"

[2] **Note**: In some countries whose history as states is relatively recent (some nations in America, Africa, aso), mineral resources are private property, they strictly belong to the owner of the plot of land lying vertically above the mineral deposit, which is not the case in Romania. Socio-physical reasoning can lead to different conclusions for exploitations of mineral resources located in countries where the legal status valid for ownership of mineral resources is different from that in Romania.

[3] "*Inalienable*" has both spatial and temporal meanings.

classical physics, which apply to bodies composed of many molecules.

The laws of physics, as applying to social life, can be considered as acceptable *postulates* in the socio-physical analysis, being based on pragmatic verification by general and specific social experience.

Simple models of physics can thus be applied to the modelling of social life.

When applied to social life, these physical models may have some slightly different characteristics from those of the laws of physics. Socio-physics laws and the definitions for the conditions of space, location, entourage, time lag, resources and interactions are less rigorous, and approximations are less accurate, so they can be regarded as postulates, P; however the findings are still objective, quasi-independent from the observer or the assessor of social life.

The basic knowledge of classical physics, acquired as early as elementary school, and then enlarged in high school, is illustrated in the physics classes taught in high school and in college, along with applications in science and in engineering, and sometimes through the use of physical models in the objective analysis of social phenomena. However, physics models are rarely used in social life afterwards by legislators, decision makers, judges, official auditors, investigators, appraisers, politicians, media or citizens, although the procedure may allow an approach as objective, nonpartisan and quantitative as possible to social issues, especially to conflict-related issues, for the benefit of the whole society in its historical evolution.

Basic knowledge of classical physics models [9, 10], relying on: PO – *Principle of Objectivity of the laws of physics*; PC – Principles *of Conservation*; P I, P II and P III – Newton's I, II and III Laws (that of *inertia*, PI: that of *proportional action*, PP; that of *action and reaction*, PAR); PSF – *Principle of Superposition of Forces* allow, through the agency of DA – *Dimensional Analysis* [19], to correctly choose the significant quantities which then are used to generate DR – D*imensionless Ratios* and to easy operate in analyzing social life.

The richness of the possible models, powered by EDP – theoretical apparatus used in *Physics Experimental Data Processing*, provides extensive options for modelling social phenomena more precisely.

Socio-physical modelling enables those who are informed or who are moulded through training to get an easier, deeper understanding of social and economic phenomena; they help those who inform to inform correctly, fully understanding the phenomenon in question, and those who assess, audit, legislate, decide, investigate or judge, to draw a conclusion, or make a decision in a case, with an objective understanding of the nature of the implied phenomenon and its correlation (at best, quantitative) with other phenomena, observing the objective socio - physics postulates, which also may provide quantitative criteria.

The physicist is able, and as a rule tempted, to apply such simple physical models in almost every situation, and thus he/she can significantly help the sociologist and the practitioner to become more objective in modelling social reality.

Classical physics models, introduced by the authors earlier in the present paper, are then applied to discussing a few specific aspects of the current disputes concerning Roşia Montană Project (abbreviated RMP, and further shortened to "the Project") of the Roşia Montană Gold Corporation (RMGC), and, in a broader perspective, concerning mineral resources[4] relating to: the quantiy of the exploitable resource (which is, in particular, finite, non-renewable), the temporal and spatial horizons of the Au-Ag resource, the need for exploiting it, the profitability of exploitation, the recommendable rate of exploitation, the relationship between the resource being exploited and its close environment – the ores and the secondary resources existing in the ore, secondary resources that should not be wasted when exploiting the main resource; the consequences of the Project on: the natural environment, the social environment, the future generations, the cultural and historical heritage, and also the possibility of having, other side effect of the Project, like terrorist actions, with devastating effects.

In the second part of the paper, the socio-physics models are applied to the study of some aspects of the negotiating mechanism, depending on the socio-political, legal framework, and the financial context of the negotiation process.

Exploiting the mineral resource called "gold" is considered to be the extraction of the natural reserve from the natural environment, in phased (next - reversed) succession: gold (and silver) extracted from the ore (the mineral medium), the ore extracted from the deposit, the deposit extracted from the natural environment.

The impact of exploting the resource on the natural, human and social environments is assessed, in their historical evolution.

The authors creatively apply those socio-physics models to finding dimensionless quantities ratios, which allow the choice of objective evaluation paths with a plausible social support, providing nonpartisan, objectively credible solutions, oriented towards excellence, and in controlling those solutions for solving issues debated about Roşia Montană Project.

Socio-physical models allow interested people to emphasize the subjective or lobbying positions (which are more or less legal), and the partisan positions, in approaching this project (and others), environmentally friendly or not with respect to past and future generations, in an attempt to provide, if possible, those interested people with objective socio-physical, possibly quantitative, instruments for their potential appreciations, assessments, negotiations, decisions and actions, in order to find the best solutions to the current disputes, for present and future human society, especially for solutions regarding Romanian society in the European and the global contexts, nowadays and in nearer or more remote historical perspectives, in different areas of interest to society, in the natural, human, social and cultural environments, specifically and generally.

The authors, who have no political affiliation, expect by doing so, the proposed models to be understood as a set of scientific and practical working tools, and used accordingly by the participants in the debates, be they supporters, opponents or evaluators of the project, and will be glad to answer any criticism meant to improve the results of their research and make them even more usable and useful social-wise.

The socio-physics models proposed could be considered as instruments of social *common sense*, placed at a high level of objectivity and generality, possibly as quantitative models, beyond and above the subjective, local and mostly qualitative models used in other approaches.

[4] In the stock exchange literature, there is a distinction between the **resource** – the amount of substance existing in the ore, detectable at a given time in a particular place, and **reserve** – the amount of substance existing in the ore, detectable at a given time in a particular place and economically exploitable at that time.

I. THE CATEGORIES OF SOCIAL AND PHYSICAL MODELS INTRODUCED AND THE ABBREVIATIONS USED IN THE PAPER

DA (*Dimensional Analysis*) – the model of a social phenomenon based on the introduction of **basic dimensions** (*essential features of that phenomenon*), established by **dimensional analysis of the phenomenon**.

The most important consequence of dimensional analysis is that **only measurable quantities or magnitudes** (i.e. *which are of the same nature, having the same dimensional equation*) **can be compared, matched, ranked, added or subtracted**.

The social quanties (magnitudes) used must be properly defined, consistently used, and significant in every reasoning [18, 19].

The units used must belong to a **coherent system of units**, so as to enable a qualitative reasoning to become more easily a quantitative reasoning.

Adding to the basic measurements used in physics: length, **L**; mass, **M**; time, **T**; temperature, **θ**; electrical current , **I**; amount of substance, **μ**; light intensity, **J**, and their units as expressed in the coherent International System of Units: meter, **m**; kilogram, **kg**; second, **s**; kelvin, **K**; ampere, **A**; mol, **mol**; candela, **cd**, other magnitudes and ad-hoc basic units, for example, the magnitude "**currency**" with the symbol **C**, with the "**leu**" (for Romania), as a measuring unit and the unit symbol "**RON**", dimensional calculation may be applied in accounting in this country, and also in financial analysis and synthesis, as well as in economic decision-making [19].

Each area of application of a socio-physics models may require choosing appropriate fundamental dimensions.

The non-renewable resource, the resource associated with the main one, the secondary resource, the time horizon, future or past, the spatial, geographical or administrative horizons, public property, inalienable property, the hierarchical level of competence of the decision (local, national, European, world), legal immunity, negotiator's agent, terrorist opportunities generator, are examples of *fundamental dimensions* (quantities or magnitudes) that can help substantially to understand and objectively analyze, from a socio-physics standpoint, the different aspects of social conflict concerning Roşia Montană Project.

In more detailed analyses, a dimension can be branched, by taking into account an other dimension as well, e.g. national interest concerns the whole of Romania but may have different time horizons – a few hours (statements of politicians, a friendly soccer match), two successive year quarters (the EU definition of recession), a year, "until the end of the mandate", an entire election cycle, one generation, a future period equivalent to the historical period known by the prior existence for the respective social entity (thousands years, for the gold resource in Romania), that is, two different dimensions should be considered, simultaneously.

National interest, as invoked by politicians, must be properly defined in dimensional terms.

The dimension "*national interest*" can also have a different content, e.g. independence, unity, sovereignty, indivisibility, public property resource, mineral resource, surface resource, renewable resource, non-renewable resource, resources of known or as yet unknown uses.

Decisions on the use of a resource of a higher hierarchical interest, national (e.g. the mineral resources in Romania) cannot be made at a lower hierarchical decision level, either spatial (regional, local, group), or temporal (short time horizon), a lower level at which sovereignty over mineral resources, in own name and interest, wish be exercised. So, for example, *local "referenda"* concerning a number of national resources, which are subject to public and inalienable property, cannot be valid, because they are not at a necessary hierarchical level (i.e. national), and of a time horizon, required by dimensional calculation, based on Art. 136 of the Constitution of Romania [1].

Hierarchical levels are different, whether they apply to a competitor vs an arbitrator / judge (a superior level, preferably with two levels), and so the state cannot be, at the same level, simultaneously an arbitrator and a competitor in the same auction.

Another important dimension is solidarity, which may manifest itself in space, in time, in a field, in away aso; it is solidarity that has ensured, for example, the historical permanence of whole nations.

DR – a model based on the use of D*imensionless* ***R****atios*

These ratios allow calculations of the size of the multiplier effect (leverage or gearing) and meaningful comparisons between different groups of social magnitudes (quantities) in different areas, for example: the ratio *gain / loss*, and then *the ratio of ratios gain / loss for partners*; *cost of risk / benefit*; *proposed gain / potential ignored gain*; *effectiveness of bribery*; *value (cost to the decision maker) of a risk incurred / amount of money received by representatives of the decision-maker to stimulate assuming that risk*; *responsibility of elected representative / voter responsibility*.

PO (*Principle of Objectivity of the Laws of Physics*) – *"macroscopic physical phenomena are independent of the action of measuring them"*

This principle, applied as (social) Postulate of Objectivity (PO) is essential in the work of legislators, arbitrators, judges, investigators, evaluators, organizers of auctions etc. It allows, for example, to distinguish an operation of measurement (evaluation, assessment) from an action on the system being measured (when the action is accompanied by reaction). A measurement fails to generate a reaction by itself, as, f. e., it happens just after statistical reports of INS or EUROSTAT (or it happened with the 2013 assessment of corruption in Romania, by OCCRP, for example).

CP – a model based on ***Conservation Principles***

Many natural resources are **non-renewable quantities** (e.g., gold), other natural resources may be **renewable with a finite rate** (e.g. photovoltaic energy, wind energy, wave energy, biomass energy, oxygen from the atmosphere); dimensions (features) that are essential for understanding and modelling socio-economic phenomena, in particular those relating to development and investment.

In physics, the principles of conservation of non-renewable and indestructible quantities that characterize a conservative system ensure the *stability* of that system in its *stationary* evolution.

In mechanics, there are conserved: *total energy, total momentum* and *total angular momentum*: *"For an isolated body, the total energy E, the total angular momentum, L, and the total momentum, P, can be neither created nor destroyed."*

Newton's laws of motion are the result (as theorems) of the principles of conservation of non-renewable and non-destructive magnitudes in a conservative mechanical system.

In the socio-physics modelling of social and economic phenomena it is essential to *identify the non-renewable magnitudes and the regeneration rates (valid, locally, temporaly and spatialy) of the renewable magnitudes with finite rates*.

If the resource considered is a non-renewable magnitude or a renewable magnitude with a finite speed, conservation laws indicate *the need for organizing a competition* in using that resource in order to minimize its destruction rate until it can become replaceable.

P I – a model based on Newton's first law, **the law of inertia**:

"Any body maintains its state of rest or uniform rectilinear motion as long as other forces do not act on it, or while the sum of the forces acting on it is zero." If the resultant force is zero, the body maintains a constant speed.

For $\boldsymbol{F=0,\quad v=0}$ (1)

The first socio-physics postulate, P I, has a great role in the historical stability of: a nation, a culture, a language, a religion, to create a favourable climate for investment, projects development etc.

This law, the law of inertia, is also known in social life, for instance as **"status quo antem (*SQA*)"**.

P II – a model based on Newton's second law, the law of (proportional) action:

$$\boldsymbol{F}=m*\boldsymbol{a}, \qquad (2)$$

"For systems of constant mass, the acceleration produced by a resultant force is proportional to that force, vectorially, in magnitude and is acting in the direction and in the sense of the force".

In modelling social life, the second postulate (**P II**) is reflected as the "Principle of Proportionality" (**PP**), or the ***"Postulate of Action"*** (**PA**), or else the ***"Principle of Action"*** (PA), designations frequently used in law, economics, and management.

In social life, the effect of social measures appears not only just immediately, as in physics; it can also occur after a longer time: hours (in street riots), days, years, generations, etc., maybe when those who took that measure no longer have the right to decide, or do not even exist politically, physically, or even in current memory.

P II is very important because it recommends that a **decision-maker in a particular (private) matter should follow the general trend**.

For example: gold mining has moved from gold extraction by cyanidation to giving up cyanide gold extraction, followed by the recommendation of not using cyanide, and even banning the use of cyanide. Using, in Roşia Montană Project, of a process based on total cyanide treatment of the ore goes **against the trend in two ways**, as a **function** and as a **derivative** of the function (it does not eliminate cyanidation, on the contrary, it applies it in a generalized manner) and infringes **P II** twice.

A similar example is the extraction of shale gas by hydraulic fracturing with injection of chemicals that are hazardous to the environment, a field where France (a country with a high level of scientific research) and Romania's neighbour Bulgaria, among other countries that have reserves of shale gas, have actually banned the procedure.

The population of Poland and Romania become aware that the global trend, after the North American experience, is to avoid the exploitation of shale gas through the above-mentioned method in environmentally sensitive areas, until technological evolution be able to eliminate the long-term dangers and disadvantages of the technologies that are currently 'cost-effective' for temporary investors and tax collectors and other interested people which are aggressively promoting these technologies.

Taking into account the requests of the population must be made (PP) in proportion to the segment of the population that expresses that option from the total population entitled to that option (similarly, in optics, the number of photons that pass through a certain filter, out of the total number of photons incident on the filter [17], [19]); so, for example, hearing, for one day, a few dozen people interested in a particular option, such as the exploitation of gold at this moment in time (yet people who are not qualified to work with the new technologies) must had matched a hearing time, proportional to their number, allowed to those people who do not agree with the exploitation now, which did not happen [5, 6, 8].

The Principle of Proportionality also indicates that efficiency of bribery increases with membership in gangs, coteries, collegial groups, secret organizations and / or with the increase in the hierarchical level of those bribed; bribery can, at a higher level or through the agency of the other members of the gang, determine not only the guided action of the recipient of the bribe, but also the action of the apparatus at his/her orders or under his/her/their influence – administrative, economic, public order, military, legal, etc.

P III – a model based on Newton's third law, the law of **action and reaction**:

"When a body A acts on another body B with a total force $\boldsymbol{F_{A,B}}$ (called the task force), the second body, B, always acts, too, on the first body, with a total force

$$\boldsymbol{F_{B,A}} = -\boldsymbol{F_{A,B}} \qquad (3)$$

(called reaction force) of the same magnitude and in the same direction (co-linearity), but in the opposite way."

The law of action and reaction, as the ***P**ostulate of **A**ction and **R**eaction* (**PAR**) in socio-physics, is present and can model many social phenomena, for example [3]: the rights and obligations (appertaining to the people), supply and demand, benefits and risks, earnings and sacrifices, decision powers and immunities of decision makers, processes of dispensing juridical decisions, mediation, arbitration, negotiation, the conflicts between the rights of one group and the freedoms of other groups, corruption.

In some fields of activity and / or professions, observing **PAR** is essential, for example in research, legislative and judiciary fields, in auditing, while in other professions respecting PAR is neglected, for example by lawyers, lobbyists, the military.

In social models, the apparent nature of the reaction may be different from that of the action, the moments can be slightly uneven with respect to time, but essentially the socio-physics postulate of action and reaction (PAR) acts very much like Newton's third law in physics. The probability for the reaction and action to occur should be approximately equal.

Sometimes, in social interaction, attempts are made to oppose forces that have different probabilities of achievement; for example, it is claimed that the justification of a new mandatory tax on a good or service (probability = 1) can be made through the argument (option) that the price in the free market of that good or service will decrease over time, so, that the total price will not change by imposing that mandatory tax (probability << 1).

The existence of an apparent temporary equilibrium in the presence of two known unequal opposing forces involves the conclusion that the missing part of the smaller component or the additional part of the larger component should be looked for, although the socio-physical model does not indicate whether this force is legal or not, obtained by lobbying or by bribery, or, if we are referring to a budget, whether one has to

cut down expenditures or to increase the revenues through new taxes or a through better capture of the existing ones.

Lack of reaction of a public body to a statement that is external to it implies that the public body concerned does not consider the statement as an action, but as an external assessment.

The action of PAR may be temporarily masked in an involuntary manner (through an email connection deficiency, for example), or deliberately (secret marriage, for example), by various methods of classification, of imposing information lack of tranparency; but secrecy or opaqueness cannot last long, as they violate a principle of general application.

Classification of an agreement and secrecy testify to a weakness of the partners to that agreement, and can possibly mask the intent of the partner representatives to cheat, on the stock market, for example, the very basis owners – private shareholders, and respectively, public shareholders, concealing the imbalances between rights and obligations, between gains and losses, between supply and demand, at least temporarily, and possibly to enable them to speculate on the stock market.

Similar procedures apply to hidding electoral interests.

The names of institutions and legal documents, introduced during a period of imbalance between rights and obligations e.g., the Charter of Human "Rights" [11], enterprise of "ore mining", can generate, under the current circumstances of equilibrium required by PAR (equilibrium between action and reaction), an advantage at least psychologically (and also, practically) for those who are not going to comply with their obligations related to the rights demanded ostentatiously or abusively (e.g., the right to exploit the ore to extract a resource, without complying with the obligation to protect the environment and other resources in the ore).

PSF – a model based on **the principle of superposition of forces**

"If several forces are acting on a body at the same time, each force produces its own acceleration independently of the presence of the other forces, the resultant acceleration being the vector sum of the individual accelerations".

$$\sum_{i=1}^{n} \vec{F}_i = m\vec{a} \qquad (4)$$

PSF would correspond to a ***P**ostulate of **S**uperposition of **S**ocial **A**ctions* (**PSSA**) involved in a social process, a postulate that is very useful in the *multi-dimensional modelling* of various social phenomena and forms of cooperation or confrontation, negotiation, alliance, association between comrades, in understanding the actions of classification and maintaining secrecy, diversion or lobbying, activity of inner city gangs, peer groups, cliques, political parties, secret societies or Mafia-type gangs.

Multi-dimensional groups of power, interests, important locally, nationally or world-wide may be more easily modelled, understood and possibly tackled and combatted by analyzing their activity in terms of the **PSSA**.

PSSA paves the way to understanding the dimensionally multiple processes of action–interaction between two partners in an agreement, when opposing interests may occur not only between the two partners (e.g. joint stock companies), but also between shareholders and their representatives (e.g. between the State authorities and bodies and citizens who are owners, yet having different approaches to some actions), between the shareholders of a partner and the agents of the other partner, between private shareholders and public shareholders, between the undercover agents of the two partners, between local and central governments etc.

For example, for an action of diversion, a business of 1M$ in size, obviously very profitable for a company and having a psychological appeal for the shareholders (and a public, making monthly incomes of k$'), is aggressively promoted to the attention of the shareholders (and the public or voters) in order to mask a 1G$ business detrimental to the economic, collective interests of the same shareholders [15, 18].

The reverse situation is possible: for example, the state is encouraging a private business that is temporarily modest, but proves profitable for all parties involved, which can generate long-term strategic cooperation.

PSSA can model and explain the action of support of a leader who simultaneously represent two bodies of power that are theoretically independent, which are set by him in opposition at the same time, in the same social conflict.

It is through **PSSA** that multiplication ratios can be defined, as a result of a number of multiplier effects that are properly identified.

The ratios of multiplier levels and the ratios between the ratios between various levels of multiplication allow comparing and boosting the effectiveness of decisions or actions in very different fields.

Classification and secrecy regarding a number of components of social activities can mask huge multiplier effects. Choosing to register a company in a tax haven, for example, is important not only for the low amount of taxes and fees at the registration place (which increases the profit/expenses ratio), but also, and especially, for keeping the financial operations secret, which secrecy is not only important in terms of tax return, but also for concealing the operations of corruption, bribery, diversion – which have significant multiplier ratios, being conducted in other locations, which have much tighter fiscal supervision, etc.

Guaranteed secrecy of bribes offered to an official, the person bribed keeping the amount offered (unfair advantage), until that person leaves the public office supervised by anti-corruption authorities (or until retirement), which is practiced in some Eastern cultures, seems to be spreading in this country (Romania), too. It is based on a high level of trust between the corrupted and the corrupting persons, well above the corresponding corruption through undue advantage or bribery in the Balkan region. The previous creation of off shore companies and the opening of hidden accounts helps spreading this practice.

However, even in this case there appear errors of correlation between the corrupt and the corrupting persons, for example, bribery is discovered because of the poor organization of the payment and communications, transport and depositing chain.

The laws of classical macroscopic mechanics correspond to **causality** and model causality, which is the relationship between an event – the **cause**, and a second event – the **effect**, the latter being a consequence of the former, under such circumstances, in physics, that their temporal sequence is practically very close (simultaneity), while it is somewhat looser in society, like the scope of its area of application, which is broader than that in physics, with a less precise location and a context that can play a more significant role. This relaxed characteristics happen because the cause and effect can't be fully separated from the environment or the observer, which happens in physics.

The equations previously introduced (1, 2, 3, 4) observe the order of cause and effect even in their formal statement.

Although cause and effect are traditionally considered as being **events**, the quantities (magnitudes) used in modelling social life may include: **objects, resources, properties, variables, facts, rights, obligations, risks, benefits, processes, interactions**.

For example, one can model the effect of a financial liability, or of pollution generated by the current generation on future generations, the effect of the use rate on the depletion of a non-renewable resource, the possible effect of an official statement on the value of the shares on the stock market.

One can estimate, for example, the cost of guaranteeing the risks that are ignored (possibly, in a deliberate manner) by the public or private proponents and supporters of a project that generates, during its entire existence, of persistent dangers produced by that project, with the amounts paid (legally or illegally) to those supporters. We can model the effect of a decree to stimulate birth (1966, Romania) without stimulating correspondingly education, on future generations (. . 2014 . .).

A qualitative and then quantitative analysis of the causes and effects of a social phenomenon, based on the laws of mechanics (considered as social postulates) can quite successfully lie at the basis of any social analysis. For example, an external or international criticism leveled at a domestic collective body[5], in the absence of a reaction from the criticized body or its members (**P III**) cannot be considered an action (interference in internal affairs), but an assessment (**PO**), and from **PI** it can be finally inferred that, as long as a reaction is missing, the respective body and its members ignore the criticism and do not intend to change the aspect of their behaviour that was criticized (**SQA**). Of course, when a reaction does occur, the socio-physical characterization changes (**PAR**).

EDP – models based on the apparatus used in **experimental data processing** in physics [17, 21].

In general, a **quantity** (magnitude) **,** either physical or social), **A**, which has a **real value**, **a**, can be expressed, when using the **measuring unit** [**A**], by:

$$\mathbf{A = a\,[A]} \qquad (5)$$

The true value, **a**, is assumed to be unknown and must be *replaced by a knowable value*, conveniently defined, usually an *average value*, resulting from adequate processing (depending on the statistical properties of the group of data available) of data obtained from as many measurements as possible, from which the individual values, $\mathbf{a_i}$ **(i € 1, . . . , N)**, resulted.

For normal statistical distributions, the average error decreases with the increase of the square root of the number, **N**, representing the independently collected data.

If the true value **a** were known *a priori*, the **absolute error** (or uncertainty) of the result obtained on reading (determination of) **i,** $\mathbf{\Delta a_i}$, would be:

$$\mathbf{\Delta a_i = a_i - a} \qquad (6)$$

$\mathbf{\Delta a_i}$, the real, absolute value of the error of a measurement, is of the same nature as **a**, has the same dimensions and is measured with the same unit [**A**].

The relative error of the determination i, ε_{ai}, compared to the real value **a**, is expressed as the ratio of the absolute error $\mathbf{\Delta a_i}$ and the real value **a** (provided the denominator is different from zero):

$$\mathbf{\varepsilon_{ai} = \Delta a_i / a\ .} \qquad (7)$$

The relative error is a dimensionless quantity (magnitude), a number. It can be expressed as a percentage. Being dimensionless (without an associated dimension, a number), relative errors can be used for comparisons between types of behaviour in various domains by different populations, even when referring to different properties (different dimensions).

The relative error is, in many cases, more significant than the absolute error. For example, in the annual reports of the majority shareholder of RMGC, GBU Ltd (GBU, Toronto Stock Exchange, STX), values are mentioned for the amount of gold that can be extracted by the Roşia Montană project (the reserve) that ranges between 215 t and 400 t, in the Technical Project – 218 t, and in the Memorandum – 262 t, that is an average relative error of about 10% (between the Memorandum and the Technical Project). The amount of ore which could be exploited is reported several times, though differently, ranging between 50 and 300 million tons, which is a relative error of the order of the mean size (about 100% error relatively to the mean size), a relative error ten times larger than the error concerning the amount of gold extracted (final size), calculated as ~ 10%.

In the reports concerning the costs of closing down the works, the variations are even greater (6-7 times), even between the limit values estimated by the same independent institution. For example, the American Environmental Protection Agency indicated a cost for closing down Roşia Montană Project works as ranging between $2.6 billion and $17.7 billion, which are huge figures if compared to the sum estimated by the majority owning firm, RMGC, which allows only $146 million for project closure and environmental restoration (a very precise figure as to be trusted!). These ratios in estimation (from ~ 16 to ~ 120 times) between the claims of an objective institution and the claims of the company concerned, should involve greater attention from assessors and decision-makers for still other data provided by the company, and especially for protection against environmental risks generated by the investment, risks that will be supported by the Romanian state (except for $ 25 million – guaranteed by RMGC) today, and many generations of Romanian population, some of the consequences, in case of accident, having to be jointly supported by our European neighbours.

It can be noted that the relative errors increase as one moves from profit for the majority partner (which are indicated more accurately) to losses for the associated partner (the Romanian State). If the figure expressing the costs of environmental rehabilitation were considered, which was required so of the majority partner by the Romanian state through the license (which was classified, but perhaps not for the special Parliamentary Committee for Roşia Montană) – **zero expenditures for rehabilitation stipulated in the license** – the relative error and the relative burden of the minority partner's spending – the Romanian State, relative to the majority partner in the profits, RMGC, are theoretically infinite, in keeping with the license mentioned.

If one examines the evolution of capitalization, at the Toronto Stock Exchange STX[6] of the majority company involved in the project (Gabriel Resources Ltd – GBU), a variation can be noted for market capitalization between $15 M and CAD$612 M after one year (2008/2009), i.e. an

[5] v. Report OCCRP.org, December 23, 2013

[6] Site GBU, Toronto STX. Currency used: CAD$

Year	Capital	Turn over	Total revenue	Total expenditure	Loss recorded	Total debt	Employees
2008	14,994,378	7,600	127,171,778	353,217,305	226,045,527	1,142,276,168	212
2009	612,674,374	12,864	52,227,503	215,034,974	162,807,471	733,513,436	193
2012	35,592,637	393,105	201,915,913	313,470,342	111,554,429	1,365,061,998	465

increase of ~ 40 times a year (partly due to the temporary increase in gold prices and reducing interest rate by the FED as part of their monetary policies), evolution used to make profit by the initial investors, who sold their shares, and then a decrease, from $612 M to CASD$36 M, between 2009 and 2012, i.e. a decrease of ~ 17 times in capitalization, over the three years subsequent to the previous explosive growth, leading to the hypothesis of a possible financial bubble. May be that the participation of the Romanian state in the debt of RMGC be even larger than the returns from the stock company's capitalization. This capitalization could still change, due to the evolution of the world market price of gold and other mining investment deals.

The actual size of a quantity, **A**, cannot be known with any amount of precision, but rather with an absolute error **ΔA**.

The **absolute error**, **ΔA**, **against the actual size, A**, must be defined accurately, after defining **A**. Defining **ΔA** can be done statistically in several ways, depending on the statistical characteristics of the studied phenomenon, and must be stated from the outset.

The **value** that replaces the true value **a** (the unknown element) in judgments is the **mean value a_{med}** (which can also be calculated in different ways, and the method chosen should be clearly defined).

The mean **value a_{med}**, respectively **the error Δa_{med}** (in units **[A]**) of a magnitude **A = a[A]** provide essentially different information about the same measured quantity, and complement each other.

The information provided for the public on the real value, **a**, the quantity **A** and the error on it, **Δa**, are often expressed only in value, eventually as **a ± Δa**, assuming the implicit use of unit **[A]**.

However, this expression, **a ± Δa**, is seldom used in social life, including accounting and statistics, areas where the **Δa** error is usually ignored, while it is thought, for convenience or out of ignorance, that the value presented as the true size, **a**, is accurate (up to the last digit rendered [7]).

Frequently, even the measuring unit, **[A]**, of the social quantity in question, **A**, is ignored (at least in speech), especially by the media and politicians, moving from example, from RON to EURO or the Canadian dollar to the American dollar without notice.

Another common error is the use of measuring units specific to different quantities. For example, annual incomes are compared with annual spending, while confusing revenues and, respectively, expenses for each single year of the duration of the exploitation (~ 18 years, at RMP) with the averaged annual ones, calculated for the total period of recovery after closure of a deposit (~ 120 years for RMP), ignoring the influence of the costs of the secondary resources wasted, the post-operating costs for environmental rehabilitation, those related to the possible exhaustion of the exploitable resource, the financial risk, those related to the protection of the historic heritage and of the social environment, or involved by anti-terrorist protection.

In some information materials (relating opinions that claim to be scientific!) about RMP, a concentration of **46 kg gold per tonne of ore** is mentioned, **instead of 0.9 - 1.4 gram of gold / tonne of ore** an error by ~ 10,000 to 40,000 times (of course a blatant mistake in the physical sense).

Annual amounts being exploited in ancient pre-Roman and Roman times are mentioned, which, often, are much above those calculated from the volume of ore mined (estimated by the volume of pre-Roman and Roman tunnels/galleries) and the concentration of gold in the ore (determined from samples of ore or silt preserved to this day), or reported by historically credible documents.

The true value of the future expenditures that making a contract will incure is also a non-knowable, inaccurate magnitude, depending on many factors, some of which have high variability.

The gnoseological apparatus introduced by experimental data processing indicates [16, 18] that one has to: address as many offers as possible (as the error decreases by the square root of the number of bids considered) for the grant of a license or a contract – *the principle of ensuring competition*, stipulated in most commercial legislation in the world; choose that offer providing the minimum value of the ratio of **total cost of implementation** (including environmental protection and the amount of resources wasted) / best **quality** (PAR); and set an upper limit to cost growth in further direct negotiations, which should be conducted out of competition, so that the errors to the cost should not be higher than the average ones, resulting from tenders received for auction.

A condition can be also imposed on the variation of the dimensionless ratio between the relative error on the profit and, respectively, the relative error on the final cost, so that their relationship should not be too wide apart from the unit.

The State, resorting to limiting relative errors admitted by a particular public procurement contract in making that contract through additional subsequent agreements on Δa_j values for the various values a_j of the cost parameters in the contract, can thus limit the leakage of "post-auction" funds and decrease the temptation for possible corruption in the implementation stage, when working with many subsidiaries.

The Δa_j errors allowable for each **i** parameter in a procurement contract or concession could be calculated as the average of the errors determined for each **i** parameter as compared to the offer accepted, which are contained in the tenders of the bidders. Of course these average errors could not be calculated in the cases when the contract was awarded to a single bidder, possibly even before the public launch of the auction, an event frequently met in corrupt social media.

Typically, these, often premeditated, violations of the procedure concerning the average values and the errors are masked by imposing secrecy on the negotiations and even on the final agreements, even when they concern a public good and the tender as well as the agreement should be tranparent to the public rather than secret.

If a quantity (magnitude) depends on several parameters, what must be considered is the *propagation of uncertainty* (or else, propagation or composition of errors on the parameters involved), which is the effect of cumulating uncertainties (or errors) as to each individual variable and the overall uncertainty of a function depending on those variables (used in social, economic etc. evaluations).

Uncertainty as to a function (the output value) is always greater than the uncertainties as to the variables that function depends on (uncertainty of input).

The estimates made on many magnitudes aggregated in RMP cannot be presented (described) by values with six or even three accurate significant digits, as can be seen in the RMP's text, because input errors can reach 50% – 5000%, so only, as early as the first significant digit.

The presentations of RMGC, sometimes assuming errors of <1%, shows lack of basic knowledge on experimental data processing from those involved in calculations, who call themselves, or are sometimes presented as "scientific researchers", or "well-known international experts".

In the analyses made, one must seek, for the sake of comparison, ratios between quantities determined with similar levels of relative error.

DLRMP – short for "Draft Law on measures related to gold-and-silver ore exploitation in the Roşia Montană area and stimulating and facilitating the development of mining activities in Romania", No. L475 / 2013. The draft law on the Project was recorded by the Senate, under no. B 560 (address nr.E171 / 03/09/2013), was debated by the Special Joint Committee of the Chamber of Deputies and the Senate of Romania for approval of the Project (2013), and rejected by the Special Committee and then by the first notified Chamber of Parliament - the Senate. The annexes have remained unpublished.

SPCDLRM – the **Special joint parliamentary committee** of the Chamber of Deputies and the Senate for approving the Draft Law on measures related to gold-and-silver ore exploitation in the **Roşia Montană** area and stimulating and facilitating the development of mining activities in Romania.

RMP (or only the **Project**) – the **P**roject submitted by Roşia Montană Gold Corporation on the exploitation of the gold & silver resource in the **Roşia Montană** area.

RSPCDLRM – short for "**Report** on DLRM of the of the **Special Joint Committee** of the Chamber of Deputies and the Senate for approving the **D**raft **L**aw on measures related to gold-and-silver ore exploitation in the **Roşia Montană** area and stimulating and facilitating the development of mining activities in Romania".

Many essential materials submitted to the Committee have not yet been released.

II. THE CURRENT SITUATION OF THE ROŞIA MONTANĂ MINING PROJECT[7]

The project of mining gold-and-silver ore at Roşia Montană may also be considered as a project of a private company, RMGC, which provides the Romanian State with services of gold-and-silver ore mining in the Roşia Montană area, and this provision of services can be considered as **procurement** from a **joint venture**, attended by the Romanian state; an **increase was stipulated** (compared to the previous agreement) of **royalty of 2%** (from 4% to 6%, as for all companies with mining concessions in Romania) and **a 5% increase in State's quota** (as declared, from ~ 20% to ~ 25%).

Public procurement represents the sum of all the processes of planning, prioritizing, organizing, advertising and other procedures, intended to achieve purchases by organizations that are funded, totally or partially, by public budgets (be they European, national, local, or international donors).

Public procurement, as an economic sector, is estimated by the European Commission as ~16.5% of EU GDP (2012). Harmonization of public procurement in the European Union is an important goal of the European Common Market, whose membership includes Romania.

European legislation has encouraged and encourages competition between firms by the use of transparent selection procedures (also required by **EDP**). Likewise, the European legislation contains provisions for coercive action against contracting authorities which do not fulfill their obligations (**PAR**).

European Directives (17/2004/CE and 18/2004/CE alongside of directives 1989/65/CEE and 92/13/CEE) are periodically reviewed in order to simplify existing legislation and encourage the use of electronic procedures.

[7] as of May 2014

The desired aim is that the public authorities that provide procurement for contract should try to make sure that the procurement process results in effective, efficient, ethical, fair and transparent consumption (**PA**) of the public funds allocated for that authority during a given period.

Principles to be followed in public procurement

In this respect, the European legislative framework (and, implicitly, the Romanian legislation) sets out seven principles of public procurement[8] (which meet all socio-physics postulates stated above, in their vectorial formulation):

1. Non-discrimination – Providing conditions for real competition, regardless of nationality. Non-discrimination means that all companies should have the opportunity to submit bids and obtain public procurement contracts. The rules according to which the proceedings take place are established from the outset and cannot be changed in the process.

***P II* (PA)** *regulates the constant proportionality constant in the procedures of bids, which must be the same for all competitors in the public procurement process* (in physics, the mass of the system, which connects the acceleration lent with the force applied, is constant).

2. Equal treatment – Compliance with this principle means establishing identical rules, requirements and criteria for all economic operators. This means avoiding preferential contracts, providing well established selection criteria (sometimes rules, and even laws) so as not to advantage some companies and disadvantage others.

P II – vectorial *– all directions are equivalent – the proportionality constant of interaction must be the same for all companies.*

3. Mutual recognition – Compliance with this principle implies acceptance of all *(PSSA)* goods, services and works provided legally in the European Union market. It also means accepting any certificates and professional qualifications issued in any EU member state.

PSSA *– all forces are equally acceptable*.

4. Transparency – This principle means that the contracting authority makes available, for all participants, all information relating to the procedure for awarding public procurement contracts. To help this principle the Electronic System for Public Acquisitions (SEPA) can be used.

P II *– the proportionality constant and the direction of interaction are known by all those interested*.

[8] Wikipedia.ro, "achizitii publice" / "Procurement", quotation:
a. Government Ordinance no. 34/2006 regarding the attribution of public procurement contracts, public works concession contracts and services concession contracts, approved by Law no. 337/2006, as amended by Law no. 128/2007 and GEO 94/2007, GO 942/2006 for approval of the application of Government Emergency Ordinance no. 30/2006, with amendments and additions by the GO 1083/2007.
b. Ordinance no. 155/2006 approving the Guidelines for attribution of public procurement contracts.
c. European Directive 17/2004 / EC
d. European Directive 18/2004 / EC

The principle of transparency is a basic principle of **Socio-optics**[9] [17].

5. Proportionality

Compliance with the principle of proportionality means ensuring correlation between necessity, the object of the contract and its requirements. In other words, each acquisition must be given due consideration when requirements are established.

P II (PA, PP) *– the constants of proportionality are the same for a particular requirement, for all the firms; the proportionality constants can be different (**PSSA**) for different requirements*.

The contracting authority will make sure that the contractor has the ability to carry out the potential agreement (P II, PSSA), but will not set onerous, excessive conditions, which could lead to the elimination of potential bidders.

6. Efficient use of public funds – This principle means using the system of free competition and the economic criteria for awarding contracts. It means getting an optimal ratio between quality and price, getting value for the money invested.

CP *– an optimum system tends towards a conservative system, minimizing (EDP) or even avoiding the losses*.

7. Accountability

According to this principle, there must be a clear determination of the duties and responsibilities of those involved in public procurement.

PAR and PSSA – each action in carrying out a task corresponds to a precise responsibility, which should not be passed, by the one who undertakes the action in keeping with the task agreed or imposed, on to a third party with a higher immunity, or who can cover an individual case by enclosing it in a whole category, conveniently regulated.

When a contracting authority fails to find in the law the specific issue they face in real life, they may appeal to principles. If none of the above seven principles is violated, then the actions taken by the contracting authority can be considered correct.

A checking procedure using the socio-physical models presented above is very useful.

On the procurement market, those who make the rules, under the law, are the contracting regulating bodies hierarchically superior to the direct contracting authorities. Once made, the rules should remain unchanged throughout the duration of the procedure. It is up to the bidders (**PII**) whether they wish to participate in the game by accepting these rules. Nobody will have optional or discretionary rules (**PII**). Nobody in this game will have undue advantages. It is also up to the bidders (**PII, P III**) to abandon the game at any time (no longer submitting an offer, or not signing a contract, which the bidder considers as being disadvantageous).

The contracting authorities must establish the rules in such a way as to ensure that there are enough bidders involved (**EDP** → large **N**) and all legal requirements and procurement principles are observed (**PSSA** vectorial – all directions are equivalent, (PP) there is the same interaction constant for all bidders).

From the perspective of the tenders, in order to make acquisitions from the public domain, a simplification of procurement procedures is desirable (unmediated interaction, **PII** – small interaction constant), and also reduction of the probability of failure, from the point of view of the contracting authority's acceptance (**PSSA** and **P II** – compliance with the equal action constants and equivalent directions for all competitors).

Ethics in the public procurement process. Observance of socio-physics principles

The ethical dimension should be considered from the very outset of the procurement process.

The Public Procurement Law has several provisions that lead to ethical behaviour in the procurement process, from the prohibitions considered normal – it is prohibited for firms that were involved in thechoosing of specifications, or the studies that they were based on, to be bidders (those who helped to define the interaction constants – **PAR, PA** cannot compete), up to regulating labour relations between companies and employees (evaluators may not be employed by the tenderers, at least 12 months after the conclusion of the contract; those who were involved in assessing interactions, which were the basis of attributing the contract, must not be employed as agents of one of the partners (**PAR, PA**).

The law regulates the concepts of "fairness" (**P II** and **PSSA**) and "privacy" (**P I**) for the bid evaluation committee of the contracting authority, and establishes the business relationships that should be avoided between committee members and bidders (committee members must not have had, in the last three years, employment or collaboration agreements with bidders, they must not own any shares in the companies bidding, etc. – those who were or are paid by competitors, i.e. are their agents, are not allowed to be evaluators – **P I** and **P II**).

Arbitrators of the procurement market

The procurement market has a number of specific regulations, as it involves operating with public money. The main initiator of these regulations in Romania is the National Authority for Regulating and Monitoring Public Procurement (NARMPP), which is actually the institution that oversees the national procurement market.

NARMPP develops, promotes and implements the national public procurement policy.

Checking the procedural aspects of public procurement market is the task of the Ministries of Economy and Finance, through their specialized departments.

Control is further provided by the Court of Auditors, which is the supreme audit institution for public procurement.

The misunderstandings and disputes that occur in public procurement procedures, between the contracting authorities and the tenderers, are solved by the National Council for Solving Complaints (NCSC). The Council's role is to resolve complaints made in the process of attributing, before the conclusion of the contract; the Council must rule on the legality of the procedures and operations of the contracting authority.

All these provisions must comply with the conditions of incompatibility between the capacity of evaluator, arbitrator, on the one hand, and that of agent of any of the competitors, on the other hand (**PO** and **PAR**).

The parties to a commercial contract can directly address the International Commercial Arbitration Court at the

[9] Radu Chisleag, Ioana-Roxana Chisleag Losada – *Socio-optics. Optical knowledge applied in modeling social phenomena*, Invited paper, "International Conference on Applications of Optics and Photonics", ed. Manuel F. M. Costa, Proc. SPIE Vol. 8001, 80012B , p. 1-8 © 2011 SPIE · CCC code: 0277-786X/11 · doi: 10.1117/12.894677.

Chamber of Commerce and Industry of Romania or in an other country, if so agreed by contract (**ICC Rules**).

The party that believes that its fundamental rights had been violated may, finally, address the **European Court of Human Rights** (which is now reviewing its status [11], while also organizing a public debate on this project[10]).

All those interested in socio-physics modelling applied to contracts may verify whether the mentioned socio-physical postulates are observed in any contract of interest to them, including the **RMP**.

Roşia Montană Project as a joint venture, RMGC-Romanian State

A **joint venture** (as it is known internationally, or a *joint company*, or else a share-holding association) represents an economic agreement between two or more companies, where the parties decide to form an economic entity (for a limited period of time), having their own assets, and capital obtained from the members of the association; equality of opportunity and treatment for all participants are provided by the contract.[11]

The **reasons for forming joint ventures** can be both internal (in terms of internal organization of firms), and relative to competition or strategic reasons.

Internal reasons (**PSSA**):

- Access to new technologies or markets.
- Promoting small companies in order to obtain a good image, and consequently attract new partnerships
- Sharing the risks with other the member companies of the association.

Competition reasons (PA, PAR)

- Getting an edge over the competition by forming a global network of companies and accelerating response time to competitive strategic movements.

Strategic reasons (PSSA)

- Getting a better technology transfer and taking advantage from the opportunities offered by countries with high or fastly growing economic potential.

Coverage, or failure to cover the reasons for forming the RMGC joint venture, meeting the criteria for a joint venture with a foreign company (GBU Ltd), the formation and activity of the RMGC joint venture, the equality of opportunity of the associated partner companies, and their evolution over time can be analyzed by all those interested (verifying whether **P II, PAR** and **PSSA** are observed), by consulting [5, 6, 7, 8], the official documents published by the RM Project partners, the studies and documents published by third parties, and in particular SPCDLRM documents, from which it has appeared, on brief examination that: the association of Romanian State was made with a modest company, financially weak and inexperienced in the mining of the gold-silver ores.

Hearings of the Joint Special Committee of the Chamber of Deputies and the Senate for approving the draft law on a set of measures related to gold-and-silver ore exploitation at Roşia Montană, and stimulating and facilitating the development of mining activities in Romania

SPCDLRM did not reply to the questions: what, exactly, is the association, whose is the Roşia Montană Project, and who is intended to be, according to the RM Draft Law, the owner of the Roşia Montană Project.

Roşia Montană Project Agreement and its annexes relating to the financial projections of gold-and-silver ore exploitation in the Roşia Montană area, and, respectively, the Schedule of implementation of the obligations related to the gold-and-silver ore exploitation in the "Reasons for forming **the joint venture in the Roşia Montană** area" could not be consulted by the authors, because it is still classified, not being published (including the annexes) by either SPCDLRM, or the bill debated in public, for which the special parliamentary committee has been established.

The Roşia Montană Project seems to be considered a joint venture between RMGC and the Romanian state, seeing the importance that is given at the State level (Government, SPCLRM, Parliament, the institution of the President), and at least one confusion is made in the Roşia Montană Draft Law. Roşia Montană Project is a project belonging to a company established as a majority private company (now called RMGC) with the minority participation of a state-owned company. A careful analysis, using the criteria for a joint venture, shows that the conditions are not met when the partners are RMGC and the Romanian State; maybe, and only partially, if the partners be GBU Ltd and Minvest Deva[12] .

During the hearing by SPCDLRM, **the minister who was the main initiator of** the RM draft law, which was being analyzed by the Committee, noted[13] that "the **Government was obliged** to take a clear decision on the mining project in Roşia Montană and that, through the bill **submitted to**

[10] Chisleag Radu and Chisleag Losada Ioana-Roxana, Jus-Physics models applied in improving ECHR and ECtHR functioning; Council of Europe, 2014 http://www.coe.int/t/dghl/standardsetting/cddh/reformechr/gt-gdr-f/Chisleag.pdf

[11] Thommen, Achleitner, *Allgemeine Betriebwirtschaftslehre*, VI th Ed., 2009, Ed.Gabler

[12] www.gabrielresources.com; On September 4, 1995 a contract was signed for cooperation between Autonomous Copper Deva (now the National Company of Copper, Gold and Iron "Minvest" – SA, Minvest further on) and Gabriel – then Starx Resources Ltd. (founded in 1986) – for **exploration** in the tailings lake near Gura Roşiei. The autonomous company in Deva (now Minvest) announced that the resources at Roşia Montană, as of 1 January 1995, contained about 29 million tons of ore, with an average concentration of 0.86 g gold / t ore and 10.64 g silver / t ore ([1997AR], pag. 8). Later, RMGC got as many as 6 licenses in the same gold mining area (the Gold Quadrilateral in the Apuseni Carpathian Mountains), 3 licenses (Certej, Zlatna and Bolcana) disappeared in the meantime from the company reports. Now (2014), the company GBU Ltd declares (the declaration is not fully covered by valid documents) they have three **mining** projects in Romania, in the Golden Quadrilateral in the Apuseni Mountains, at Roşia Montană (by RMGC, ~80%; exploitation 2,388 ha ~ 250 Mt of ore; very doubtful value, especially if we consider the fact that the proposed deposit proposed for exploitation was "discovered" by Gabriel **before** doing any exploration work (see. SPCDLRM, Ion Rădulescu, engineer geologist, former director of the Geological Institute of Romania), but the company fails to mention the existence of any exploration license!, Bucium (by RMGC, ~ 80%, exploration, 2,325 ha), Băişoara (100% through RomAur, exploring, 5,030 ha). In 2013, a project was introduced for partial division of the National Company of Copper, Gold and Iron "Minvest"–Deva 1939/19612/10.03.2013/Ministry of Economy/Minvest Deva, whose object is "0729-**extraction some non-ferrous metal ores**" (see http://www.onrc.ro/documente/proiecte/divizari/COMPANIA 20NATIONALA%20A%20CUPRULUI%20AURULUI%20SI%20FIERULUI%20MINVEST%20SA.pdf) related to the Roşia Montană Proiect, resulting the creation of the company MINVEST Roşia Montană, whose business concerns "0990 – activities of **services related to mineral extraction**", with a capital of 138,145 lei (~ 50,000 $! 53,258 shares of 2.5 lei), and **assets including the gold reserves** of Roşia Montană, unpublished)

[13] v. Report of SPCDLRM [5]

Parliament for approval, **the government** wanted a legal regulation intended to improve the position of the Romanian State, as the priority was the national interest, because the **license failed to provide**[14] (observing the order of the items in the declaration made by the initiator of the law, during the hearings):

– environmental safeguards;

– references to the cultural heritage;

– benefits to the community in Roşia Montană;

– obligations relative to eliminating historical pollution;

– guarantees for the Romanian State concerning the preservation of its equity share of the social capital;

– guarantees on the actual receipt of dividends;

– provisions of the existence and explotation of other metals that could be found."

All these obligations also arise from PAR, but were not observed by Romanian State when issued the (secret) license.

The heard minister did not say **what specifically the existing agreement(s) state(s)**.

Finally, the Minister said that, **in his opinion, "the Romanian state is vulnerable only in the event the project is not implemented, which might happen in case the company Roşia Montană Gold Corporation (RMGC) is in financial incapacity, or if it would not meet the environmental and cultural heritage protection, the license be canceled**."

SPCDLRM heard the parties to RMP (which were considered to be the **Romanian State** and **RMGC**), representatives of the public, as well as representatives of scientific fora ("within their power"[14]), presenting data and conclusions concerning the RMP and the implications of this project on present and future generations and the public, the pros and cons relative to RMP and the media that publish paid or not paid propaganda.

Upon **completion of the hearings**, SPCDLRM[14, 9]:

- "recommends the competent Ministries that the *statements* made by representatives of the Romanian Geological Institute (RGI), the Academy of Economic Sciences Group, the Romanian Academy and the representatives of civil society, *regarding the potential risks associated with the use of cyanide in mining, should be checked"*;

- "asks the Ministries of Economy, Environment and Climate Change, and respectively the representatives of Higher Education, Scientific Research and Technological Development, *to assess the possibility of using the alternative technology of cyanidation through flotation*";

- "recommends the competent Ministries that the *statements and alternatives proposed* by the representatives of the Romanian Geological Institute, the AES Group, the Romanian Academy and the representatives of civil society, *regarding the safety of the dam, the tailings tank and the seismic risks in the area, should be checked"*;

- "proposes that the Ministry of Environment and Climate Change should consider the suitability of conducting an independent study on the issue of the permeability of the basin of the tailings tank, and involve as observers, unless they are contract parties in the research project, the Romanian Academy, the Romanian Geological Institute (RGI) and the Faculty of Geology ";

- "considers the statements made by Mr. Ştefan Marincea (heard in his official capacity at the time, i.e. director of RGI), together with the statements of RGI employees who were part of the team sent to map the area, to be extremely serious, so these *statements must be investigated by judicial institutions*."

The authors consider that these stands have to be equally analyzed from a socio-physical angle (v. part II of the study)

At the end of the Report, in its **conclusions**[14]:

"- The **Committee** appreciates the changes to the conditions of the initial agreement (license) proposed by the Romanian Government, considering them to be a real improvement to the existing license (*unpublished, unidentified by the code as existing by the party the Committee called the majority owner, the manager of RMGC* – a. n.), and likely to produce economic benefits to the Romanian state.

- The Committee recommends that the license and the classified documents related to this project mining should be declassified (except for the maps and the documents relating to the deposit).

- The Committee urges the competent ministries and the institutions involved in the evaluation of the Roşia Montană Project to analyze all the aspects reported during the hearings conducted in the Committee and contained in this report, and to start procedures accordingly.

- The Committee draws attention to possible breaches of the legislation in force during the Roşia Montană mining project works. Therefore, the Committee will submit this report to the competent authorities in order to ensure full legality of Roşia Montană Project, and the investigation, where appropriate, of the facts alleged.

- The Committee, "given the deficiencies of existing legislation, which does not take into account the specific features of such large projects as the mining project in question", *recommends completing the legislative framework with measures apt to stimulate the implementation of mining projects of this magnitude.*

- The Committee considers it necessary to establish conditions of fair partnership between the major shareholder and the Romanian state-run company, in compliance with mandatory European Community standards and regulations and sustainable development principles for the areas where the project will be implemented.

- In this report, the Committee proposes a set of actions to establish a coherent legal framework, able *to support the negotiation position of the Romanian state in other projects of this scale.*

- The Committee considers that it is necessary to analyze a number of alternative scenarios for determining fees and rents, and state participation in the mining industry, following the example of other nations.

- The Committee believes that a legislative framework as broad as possible is needed, which should be subject to parliamentary debate, concerning gold-and-silver mining projects, in order to boost the development of the mining industry in Romania and to attract investors. "

The **Committee concludes** that "The draft law under examination does not cover satisfactorily all the complex requirements relating to the conduct of business of exploitation of mineral resources in Romania and, consequently, **proposes it should be rejected**."

Following completion of the debates, the members of the Special Joint Committee of the Chamber of Deputies and the Senate for approving the Draft Law on measures related to gold-and-silver ore exploitation in the Roşia Montană area and stimulating and facilitating the development of mining

[14] It is useful to socio-physically compare these Conclusions with the initial declaration at the hearings of the minister who initiated the Draft Law, with the Principles to be followed in public procurements and with objective data on GBU Ltd (http://www.macroaxis.com/invest/compare/STX,GBU.TO)

activities in Romania have decided **rejection of the draft law being examined**.

The draft law was subsequently rejected by the first Chamber of Parliament that was notified.

The exact information did not appear on the site of GBU Ltd at the Toronto Stock Exchange (STX),[15] which the investors could consult until 14/03/2014, when GBU only announced they reduced the existing staff by 80% (400 employees), because the project "is delayed".[16] The project expenditures to date are declared to be CN$550 M, for a capitalization of only ~ CN$385 M (i.e. *free license for GBU, and a ~ CN$28 M debt for the Romanian State!)*.

Until 05/09/2014, GBU did not made public the financial situation for the first quarter of 2014.

By applying **P II** (of action), it follows that GBU intends to move the Roşia Montană project into conservation, perhaps not to scare the investors.

Further on in this paper, socio-physics models are developed, which should allow an objective, possibly also quantitative, analysis of the consequences of the Roşia Montană Project, those declared during the Parliamentary Committee hearings by the ministers who initiated DLRM and the leadership of RMGC, of the documents of GBU Ltd and the conclusions of the Parliamentary Committee.

III. CONCRETE ASPECTS OF THE CURRENT SUITABILITY OF THE ROŞIA MONTANĂ MINING PROJECT IN TERMS OF SOCIO-PHYSICS

In developing each socio-physics model, it is essential to identify the characteristics of the fundamental quantities (magnitudes) used that are specific to the social phenomenon under examination, and to conduct the adequate socio-physical reasoning, in order to be able to correctly introduce the dimensions (quantities) needed to objectively deal with the phenomenon and ensure the homogeneity of the dimensional equations (i.e. ensuring the very same characteristics of the nature of the magnitudes being compared), leading to objective, solid conclusions – if possible, of a quantitative type, eventually - dimensionless ones.

Next, some fundamental dimensions are introduced, determined by the characteristics of the resource involved, which are useful in objectively approaching the social conflict generated by the Roşia Montană Project (a project for which a number of interested people keep insisting), but with much wider possibilities for use in evaluating other joint venture projects of exploitation of non-renewable resources, not only in gold mining.

The name of the existing resource that is intended for exploitation: ***"gold-and-silver" ore***, named so in RM Project and in the RM draft law. We should note that the "resource" is sometimes considered to be the gold and silver extracted from the ore resource (the mass of gold being ~ a million times smaller than that of the ore), and in some documents there is a confusion between "resource" and "reserve".

The name of the main final product in RMP (the main resource): *gold ingot* "***boullion doré***", an alloy of gold, silver (and other precious or noble metals), deliverable by the mining company RMGC to a ***foreign*** refinery for refining.

A chemical analysis of the ore deposit at Roşia Montană, which was conducted in 1973 and then **published**, indicated a content (in grams per tonne of ore in the sample then analysed): Au = 1.50 gram/tonne ore; Ag = 11.70 g/t, and also numerous other elements, ignored in the published documents cocerning Roşia Montană Project, yet essential to modern scientific and technical progress as well as for future progress, and also for Romania's sustainable development.

More recent analyses (legally authorized or not) seem to have confirmed these results with relative errors of ~ 50%.

The **secondary elements**, which RMGC declared as having no commercial value, and ignored by the Romanian partner and the public in the current RM Project, are numerous.

From the hearings and interviews with the Committee, it appears that many chemical elements and substances are to be found, and possibly exploitable, which are more or less known, or not disclosed to the public (in the Parliamentary Committee report it is stated that the majority company could have identified 47 elements in the samples collected in the exploration already conducted).

Since it is explicitly considered in the Project that only gold and silver are exploitable, and, over time, the amount of silver extracted has varied between half and six times the amount of gold extracted, since, by way of tradition, silver price is ~ 60 times lower than that of gold, it follows that the value of the silver extracted is approximately proportional to the that of the gold, representing less than one tenth of the total value of the final production (in the *dore* ingot), so, in the socio-physics analysis that follows, we can talk, for the sake of brevity, about the "**gold resource**", considering the main resource – fine gold, but also implying silver (not, however, the noble metals that may, and will, exist in the boullion doré ingot, and **not declared** in the project).

Uses of the gold-and-silver extracted from the ore processed in RMP:

- The **declared use** in the Roşia Montană Project: ***to obtain gold and silver alloy*** *(Fr – bouillon doré)****, which will be*** **sent abroad** ***to be processed in order to extract fine gold***, because Romanian customs authorities lack the *technology needed for the determination of noble metal contents in the ingots exported*.

- **Possible use** (though **not declared** publicly): ***recovery of secondary materials, simultaneously (noble metals in the ingots or bullions) or at a later date, from the sludge*** remaining after extracting the primary resource (as stated in the initial license given to MINVEST Deva [12] and in the licenses for Aurul Baia Mare and Eldorado Australia, for the sludge of closed exploitation sites).

- **Historical use** of gold from Rosia Montana deposits: **since ancient times** (> **6 millennia**), Roşia Montană gold was **used for jewelry** and coins, with the ***layer thickness of 1-2 mm***.

- **Uses of gold now**: the **traditional uses**, such as value deposit, currency, jewels, and also for technical and scientific purposes: in catalysis processes; for plating, in ***layers with a thickness of 50-100 nm***. With the same amount of gold a surface ~ 20,000 times greater can be covered than that traditionally covered, in coins or in gold jewelry. 3-D printing may benefit of gold characteristics.

Of course, in a future time horizon of several millennia, other alternative uses of gold and silver will possibly be much more important from scientific, technical and social standpoints, many of which are not even imagined today.

In general, as far as the finite, non-renewable resources are concerned, the possible uses that are alternative to the main current use will be even more important in the future, and

[15] http://investing.businessweek.com/research/stocks/snapshot/snapshot.asp?ticker=GBU:CN

[16] "as the assessment and permitting approvals for the Rosia Montana gold-silver project have been delayed".

therefore require, as a rule, saving the non-renewable resources.[17]

- **Possible future uses of the secondary chemical elements** that have been declared as non-exploitable, but co-exist in the existing ore at Roşia Montană: *for superior performance in IT, in devices necessary to capture solar energy, in sustainable development process control, in semi-conductors and super-conductors, in securing banknotes and installations, in special alloys*.

*Radioactive elements (*as thorium, uranium) and rare earths, which could be present in the ore, and the concentrations of which has not been published, are used in many areas in development.

Availability of the resource

A resource can be, in point of availability (depending on the size of the deposits available, or as the case may be, on the rate of regeneration of the resources available):

- ***Renewable, at a rate and with a local superficial density that are detectable and measurable*** by current scientific and technical means, such as, for example, among the natural resources: solar energy considered in sustainable development projects [18], consisting of: solar radiation, captured directly, by photovoltaic, photothermal or photochemical methods, plant or animal biological resources (biomass), wind energy, flowing water energy, sea (waves, absorbed with thermogradient) energy; mineral waters.

Creative human resources, **information, scientific, technical, artistic** resources can can fall into the category of **renewable resources**.

Sustainable development projects (of **ZOE** type) are based on the use of renewable resources.

- ***Non-renewable (finite) resource***, such as gold or small depth fossil fuels in already investigated geologic perimeters.

Additionally, ***a rate of replacement of production*** is defined, which is determined by new discoveries of known resources that are currently considered as non-renewable resources.

Historical heritage is a **non-renewable resource**.

Some **sources of pollution** or **hindrances to sustainable development** can be seen as "**negative renewable resources**" created by man, which are sometimes indefinite with respect to duration in time, and having a destructive nature.

It should be noted that some non-renewable resources can be replaced, for some uses, by renewable resources having similar uses – for example, fossil fuels (oil, gas) or radioactive substances can be replaced with green energy, for energy purposes (biomass, which is renewable due to solar energy). Biofuel from **jojoba** is already (2013) competitive, price-wise, with aeroplane fuel extracted from mineral oil. Several types of renewable energy of solar origin can successfully replace the energy use of fossil and radioactive fuels. Of course, there would be necessary to ensure its transport, its storage and the distribution of energy, the consumption and generation, as instant flows of energy being very different in space and in time.

The future of the "solar energy" resource is, on the scale of human society, virtually infinite in time (while having finite local, spatial and temporal flows).

A. It is therefore necessary to introduce **a *fundamental characteristic (dimension) of gold* – gold is a "non-renewable resource", a finite resource,** dimension which allows us to compute its availability to society, as a function of space and time.

Temporal and spatial horizons of the resource

The "gold-and-silver" ore, and in particular the ***gold*** and silver contained in the ore from Roşia Montană, ***the main resource declared in RM***, is not infinite, nor is it renewable at a noticeable rate.

It is a ***finite resource*** with a time horizon for exploitation that can be scheduled and planned, which horizon should be chosen so as to last the longest possible, to fit a policy of **sustainable development of its owner**.

This exploitable resource (Au + Ag, or in short **gold**), a ***finite resource***, is estimated by RMGC, in the Roşia Montană project, to 400 tons in the deposit, of which 314 tons exploitable (reserve), of which RMGC estimates the total extractable, through the mining method chosen (full cyanidation of ore and refining the ingots abroad), is ***242 tons of fine gold*** [19] from the deposit that the RMGC project will intendedly exhaust in 16 years (and, at times, in the documents, 15 years). So, the gold resource has, in RMGC and the Government's vision, a **finite exploitation time horizon**, about **half a human generation**.

Overall, Romania's known gold ore reserves are estimated at ~ 700 metric tons (or, broadly, within the range of 500-1,000 tons of exploitable gold, as more precise data have not been published), part of which is in other mines than Roşia Montană, some of which have been granted for exploration to the same external private partner, GRLtd (GBU, at the Toronto stock Exchange).

It is also possible that the gold main resource might be present, in deep ores, in higher concentrations than those left in deposits of lesser depths, after several thousand years' exploitation.

The future time horizon of a resource is characteristic of that resource and may be, depending on the availability of that resource: *infinite* (for a renewable resource), or *finite* (for a non-renewable resource). Time horizons may be such as: tens

[17] In this regard, for example, we need to rethink exploitation of fossil fuels – oil, gas, whose uses in chemistry, in pharmacology, bioengineering, can become much more valuable, in future, than for power generation use.

[18] Economic development vs protection of non-renewable resources and protection of the natural environment are not necessarily allways present; they may be compatible in the sustainable development. "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".* The concept of sustainable development was consolidated under the UN, starting with the "Brundtland Report" (1987), and continuing with the conferences in Rio (1992) and Johannesburg (2002). Speaking in SCLDRMP, the President of the Romanian Academy said that the Academy is not against the exploitation of natural resources of Romania, including the mining activities, but believes that it must be done intelligently, since national interest should prevail. Intelligent use is defined as the fulfillment of three conditions: **the country's benefit should be maximum, environmental impact should be minimal, and it should be consistent with sustainable development principles**. The Romanian Academy concluded that, in its current form, RM Project cannot be accepted.

[19] The statement reads "**242** tons", but the very precision of the expression proves that the people who state that ignore the methods of processing data; the figure has a relative error of 0.5%, being grounded on initial information provided by the same sources with a relative error many times higher, as can be seen in other sections of the PRM, or the presentations (http://www.gabrielresources.com/site/reserves.aspx), or the previous reports of the company to the shareholders.

of minutes (stock exchange speculators), tomorrow, next week, next payday, one month, one quarter of a year, one year, one election cycle, one human generation, a century, a national historical horizon (millennia, etc).

In forecasting the future time horizon of a resource, one must consider the **past horizon** of using that resource and the **historical heritage** left, because a mineral resource, or a cultural resource ensuing from the exploitation of that resource, belongs not only to the present, not only to the future, but also to the past, to our parents and the parents of our fathers, that we respect and venerate through the cemeteries, books, museums, palaces, and through their technical achievements – mine tunnels, operating systems, dams, mills etc.

The future time horizon of the gold resource: the resource being non-renewable, this horizon **is finite**, and its size depends on the past time horizon of the resource, on the known size of the resource, the rate of exploitation and the pace at which new deposits are discovered in the area considered.

The past time horizon

The **gold** resource has been exploited, ***in the Apuseni Mountains Gold Quadrilateral, particularly in Roşia Montană, for at least seven millennia***, a period comparable to that of the first written texts in the world – **the Tărtăria clay tablets** (~5300 BC), discovered near a village also located in the Apuseni Mountains Gold Quadrilateral.

The spatial and temporal correlations of civilization among **the first known written texts in the world**, **the Tărtăria tablets**, and **the first gold jewelry** made from the gold found in old-day **Romania** are on the list of similar temporal and spatial correlations – for example: the Sumerian civilization, or later, in that of Europe's Renaissance.

Seven thousand years may be considered as the *"historical time horizon of gold mining, in Romania, in the past"*, beginning (in Neolithic, Early Bronze) with getting gold by washing sand from silt and its export to the Middle East (documented by isotopic analysis), then by gold mining from the underground veins of ore, by heating and spraying water and vinegar on gold ore lumps (as early as the Agathyrsi, ~ 800 BC), and continued with over *two millennia of systematic exploitation*, starting with pre-Roman mining, then developed significantly under Roman rule, by extraction of ore from typical tunnels/galleries dug deep under the ground (many tunnels still exist, available yet, while others, those under the former Cetate hill, were destroyed as early as the 1970's, due to historically irresponsible decisions of the government of that time, appreciated like so from national and world cultural standpoints).

For a long period of time (between AD ~ 270 and 1400), gold mining has not been intense, and so it has left no important traces, in that time gap.

Lately, no significant new resources of gold have been discovered (or at least, made public) in Romania.

In view of a past horizon of exploitation of ~ 7 millennia, of which about two millennia since the beginning of systematic exploitation, considering a **future horizon of systematic exploitation of at least two millennia** seems both plausible and necessary to the authors (applying **Postulates I** and **II**, "status quo antem" and "action"). The technical, scientific and arts importance of gold is likely to increase over time, unlike other finite resources, which are likely to be replaced.

A **multi-millennial future horizon** in approaching the mining of the gold not yet exploited from the ores, corresponding to the vision of the future of Romania, is officially stated, be it implicitly, in the Romanian Constitution, 2003 [1],

Art. 136 (3) "The underground riches of public interest (*minerals, and particularly gold and silver ores* – n.m.)… are exclusively public property.

(4) Public property is inalienable"[3].

The multi-millennial horizon is permanently stated and supported by the Romanian state, for example, by the official name "Ministry of Environment and Climate Change", where "climate change" can only imply very long time horizons, and which also correlates with the concept of sustainable, long-term development, also accepted as strategic national policy of the country in its quality of member of the European Union.

That long future historical horizon, similar to the one inferred in socio-physical terms, is implicitly supported, through specific arguments, by the Romanian Academy, the religious communities, the Geological Institute, the universities, the Academy of Economic Studies, the Union of Romanian Architects, part the locals, many national and international NGOs.

It should be noted that such individuals or organizations as those who live or work **at subsistence limit**: basic (existential – food, housing); fiscal (a major budget deficit); politics (election – loss of majority representation) etc have **a very short historical horizon**: today; from one day to the next; from one year to another, election cicle, etc., which is totally different from a national historical horizon.

RMP is divided into several stages: preparation for mining – 2 years (initially – 3 years), actual exploitation – 16 years (currently, 15 years), closing and cleaning the area – 2 years, followed by monitoring.

Those various parties in the social conflict interested in substantial short-term profits, or their official or undercover agents, have also approached the RMP conflict with a very short historical horizon: **one day** ("When I know that **tomorrow** I must have all the money for pensions, salaries, highways, hospitals, operation of institutions,…"), **one year** (" If we drive everyone away from Romania, **in a year** even those few young people protesting are not going to have a school to go to, because there will be no school or university subsidies"); one **election cycle** ("we need to be re-elected with a reassuring majority"), etc.

Some promoters of RM Project, although using the argument of Roşia Montană's past horizon, as a historical, multi-millennial horizon, inadvertently fail to correlate it with similar future horizon, agreeing with a strictly limited, short future horizon, i.e. the one envisaged by the RM Project (which is shorter than a human generation). Maybe they implicitly correlate the time horizon for the RM area, promoted in the RM Project, with the horizon resulting from the duration of existence of the local society in Roşia Montană after the spread of environmental pollution caused by the mining method selected (generating deforestation, desertification, diverting the course of a river, total cyanidation, open storage of cyanide and heavy metals in a giant pond), and the possible accidents at the dam or terrorist attacks.

The future time horizon of the resource exploitation, as declared in the Roşia Montană Project, is 15-16 years, i.e. < 1% of the time horizon of the logically assessed national historical necessity of ensuring the resource, and less than half the average length of service necessary to obtain a seniority pension for the future workers, who, after the RM deposit is depleted, will have to find other work, elsewhere, no less than their descendants for many generations.

The RM project time horizon also corresponds to a time horizon spanning less than half the time (currently, > 42 years) elapsed since the leakage accident at the Certez pond (24 October 1971), where the fluid sludge from the previous mining works in the area had been dumped.

Certez 1971 accident resulted in 89 deaths and massive material damage, which was cushioned by the (then) government, and now ignored.

That time, in Certez, it was ~ 2500 times less sludge than it will be expeted in the RMP, which had a much lower concentration of cyanide than that provided in the pesent Roşia Montană Project. The time horizon for the shareholders' profit is, in the Roşia Montană Project, 15-16 years, i.e. 7-8 times shorter than the time horizon for the losses caused by pollution, which will be sustained by the Romanian state, a horizon spanning at least 120 years (that period is declared by the PRM itself as being necessary for neutralizing cyanide, and it is considered by many experts as much underestimated).

B. In conclusion, from multi-dimensional considerations, it follows that, the correct figure for the magnitude **future time horizon** in so far as the exploitation of the Roşia Montană gold resource is concerned could be two to three millennia (so, one hundred to two hundred times greater than the horizon considered in the RMP).

The **spatial horizon of ownership** for a resource can be (in terms of social organization): individual, family, local, county, regional, national, European and global.

The **nature of ownership of gold resources**: in Romania, minerals (particularly gold and silver ores) *are exclusively public and inalienable property* (**Constitution of Romania**, 2003, *Art. 136 (3), (4)*).

The inalienable current and future owner of the resource is, according to the Constitution, **the Romanian state in its historical perspective**.

From the Postulate of Proportionality it follows that, similarly, ***the whole cultural and historical heritage*** *connected with the exploitation of subsoil resources has the same status of* **ownership: public and inalienable.**

C. Therefore, from dimensional considerations (**AD**), it follows that the gold resource has as ***spatial and temporal dimensions of the property***: **public property**[20] and **inalienable property of the Romanian state in its historical evolution, past, present and future (**"*inalienable*" has both a spatial and a temporal meaning**)**.

Consequently, the *decisions* on using the gold resource property (moment in time, pace, method, protection, etc.) and the historical heritage related to the resource exploitation *cannot be taken by the owners of the land at the surface of the deposit exploited*, but by the Romanian state, as an entity, as the sole owner of the deposit and the historical heritage related to its exploitation, bearing responsibilities for the 3 generations present, for hundreds of future generations and of the past generations

Of course, the exploitation must observe the principles of sustainable development, the quality standards for the natural environmental, for the human environment and the cultural and historical heritage, the rights of the owners of the plots of land above the deposits, to both soil resources and access, the rights of more or less proximal neighbours of not being affected by the mining operations and post-service operations, their right to access to water, the rules of safety and insurance against pollution and accidents of human or natural origin, the measures to avoid creating, even by the project, the opportunity of a terrorist attack etc.

From the ***time horizon in future***, the ***spatial horizon of property*** and the ***principle of proportionality applied to the gold resource in Romania*** the following conclusion can be derived:

D. The gold-and-silver ore and the historical heritage connected with its exploitation belong to both the entire living population of Romania and the future generations, within the time horizon considered (~ 100 human generations).

So, the right to decide on how to use the gold resource belongs to the *Romanian State, who must responsibly also consider the rights of the future generations, without disinheriting them or imposing an onus on their lives, in the form of obligations undertaken by a present generation that might manifest themselves irresponsibly*. The specific principles of sustainable development, applied to the historical and spatial horizons considered, must be observed **concretely**.

The decision right on gold mining does not belong to the local administrative units or a section of the local population (willing to impose a solution by a "local referendum"), whose powers are constitutionally limited, by the law and by the principle of proportionality, to the sole decision on those goods fully belonging to the respective local community at this moment in time (e.g., the use of the land surface vertically above the mining deposit, which is owned by the community).

Deciding on **mining the resource to depletion now**, through the Roşia Montană Project, **could only be done if**:

- the Au-Ag ore entirely would belong to only the present generation,
- all the owners of the resource (i.e. all Romanian citizens, including those from diaspora) would agree,
- the historical cultural past and the history of accidents would be ignored (e.g., in Romania, the cyanide spill at Certez, Bozinta Mare, etc.) and
- a future national horizon were considered that would be shorter than one half of a generation (corresponding to the deposit depletion period envisaged in the RMGC project), and the rights of future generations be deliberately ignored[21].

By the full exploitation and the depletion of the RM deposit in less than two decades, not only will all the other Romanian people in the present who do not agree with Roşia Montană Project be deprived, but the heirs and descendants of the current generation will be dispossessed of their rights, including the descendants of local people and decision makers who opted for the RM Project, for all the future historical horizon considered, in keeping with the past horizon of exploitation, and the current social vision, both state-wise and European, of the future of Romania.

No one can legally sell goods that do not belong to him.

[20]**Note**: In some countries whose history as states is relatively recent (some nations in America, Africa, etc), mineral riches are private property, they strictly belong to the owner of the plot of land lying vertically above the deposit, which is not the case in Romania (or, previously, in Austria-Hungary). Socio-physical reasoning could lead to different conclusions for exploitations of mineral resources located in countries where the legal status valid for ownership of mineral resources is different from that in Romania. This difference in the status of the ownership of mineral resources could explain why the bonds were issued by the author of the RM Project on the American market, at the stock exchange in Vancouver and then at the Toronto stock exchange (where the investors in GBU Ltd projects tend to think they are also the owners of the resource being exploited), not in the home country of the resource in question – Romania.

[21] Corresponding to the motto: "**After us, the Deluge**".

A historical future horizon shorter than one generation, such as that stipulated by the RM Project, would be eventually justified for a resource owned by a population considered unreproducible, unable (or unwilling) to procreate, to undertake durable human and social development, for whom there were no such thing (because it did not matter) as future generations, and therefore no resource (either renewable or not)[22] should be preserved for the future.

E. The theoretical individual share of ownership of the gold that can be mined in Romania

Since the gold-and-silver ore is a **public**, **inalienable property**, *it belongs to the whole (renewable) population of Romania, to both the present one and the future generations, within the time horizon considered*.

Considering ~100 generations of ~20 million people each, the potential owners of the RM resource would be approximately **two billion** ($10^2 * 2 * 10^7 = 2* 10^9$) **people**.

For a known reserve of fine gold of ~ 500-1,000 metric ton, in Romania, **each potential owner is entitled** (applying the Proportionality Postulate) **to a quarter to half a gram of gold from the ore** (500-1,000 tons = 500-1000 million grams, equally distributed between the 2 billion potential owners with equal rights).

Each member of the current generation of Romanian citizens (including those who are not locals) could decide ***now*** (without engaging other living fellow-citizens, or those in the future generations, who are themselves equally entitled to the property of the resource), on exploting only an amount of gold-and-silver ore (several hundred kilograms) which contained 0.25-0.5 g gold, which might come as their personal share of the property.

If a 6% royalty were considered (not yet endorsed by the partners in the RM Project, the present value of royalty being 4%), **each living owner** would get **15 to 30 milligrams of gold** from the deposit, in accordance with the Roşia Montană Project. The **few dozen grams of gold** that were due to all the approximately 1,000 residents interested in the RM Project could easily be collected through donations, by an NGO, in one Sunday, possibly by giving them a gold bracelet.

Of course, if there should be a subsequent discovery of significant additional deposits of the resource considered (and also according to the evolution of the contractual provisions between the State and the operator of the future resource, which provisions are currently classified for the Roşia Montană Project), the socio-physical model presented shows that the property per individual could grow, and so the quantitative findings might indicate, after major discoveries, the possible choice of a different solution.

Pace of the resource exploitation

The **average pace of the utilization of the resource in the past** can be calculated considering the sizes "spatial horizon of property" and "past and future time horizons in exploitation".

A document containing certified statistical data, owned by the National Archives of Alba county, and called "Table concerning the production of the Roşia Montană mining exploitation between 1852-1938", helps us to know what quantities of precious metals were produced by Alburnus Maior (the antique name of Roşia Montană):

Between 1852-1938 (a period of documented intense exploitation) the extraction output of the mine Roşia Montană in the Metaliferi Mountains was 2,473 kg of gold, i.e. on average <29 kg fine gold annually (however, with a maximum variation of extraction pace of ~ 10 times during this period).

Mining of gold ore, in parallel, by private associations and by the state, continued after 1938 until 1948, when the exploitation of the ore deposit was fully taken over by the state. It was then that the state company "Roşia Montană Mine" was set up, which operatesd **until 2006 when the mine have closed** as **unprofitable** (in fact, it had **operated with losses from 1970**, which were incurred by the state budget).

Extrapolating, over the last two millennia of past mining, some a few hundred tons of gold could have been extracted (including the Roman age, when there was intense exploitation, but also the great migration period, when the mining was reduced), about as much as there is now left, or maybe, more than the amount left. If, until now, 2,000 tons had been extracted (as is sometimes said), the relative depletion of the reserve should had been much more significant.

Rational pace of average resource use

Conservation principles have wide applications in the policy regarding the society's resources. If a resource is non-renewable (e.g., fossil fuels or gold), its exploitation should be strictly limited, in order to ensure the portion of the resource to future generations who are entitled to it, for a time horizon considered as adequate by the decision makers.

The maximum pace of non-renewable resources exploitation

*A future mining law should include a provision concerning the **maximum value of non-renewable resources exploitation** rather **than a minimum value**, the latter provision, based on temporary profit, being detrimental to the historical interest and the policies of national sustainable development. The euphoric elation of "scale exploitation" is contradicted by socio-physics*.

Using renewable resources – photo-voltaic, -thermal, -chemical energy, wind energy, water energy, bioenergy based on photosynthesis – is not strictly limited to the needs of society currently, but it may become specifically (for green energy, for example) limited – locally and/or according to the future needs of society.

F. Rational pace of gold mining in Romania for a future national horizon of 2000 years

Considering *the estimated values of the characteristic sizes (size of the resource, spatial and temporal horizons, past and future)* and applying the Postulate of Proportionality, it follows that it is advisable to extract one quarter up to half a ton of gold per year (500-1000 t/2000 years), extracted from ~ a quarter of a million – half a million tons of ore annually.

The recommended amount of ore to be extracted from the Roşia Montană deposit would be 0.25 t to 0.5 t gold annually from that point of view, and only if the total cost of operation were acceptable and buyers for the gold could be found. This value is scores of times smaller than the 15-16 tonnes/year provided and publicly announced in the RM Project, whose historical time horizon is short, a project which aims to exhaust the resource in 15 to 16 years and a project wich will also **waste the secondary resources** and leaving environmental destruction that could be, possibly, restorable only, in the coming centuries (involving a land reclamation

[22] Such as, for instance, a population entirely made up of individuals who are sterile, or unwilling to perpetuate human society themselves.

horizon scores of times longer) and **irreversible destruction of the cultural and historical heritage.**

Temporary pollution of the environment, acceptable for a mining project, should be reduced (**PSSA**, **PAR**) to the limit of reclaiming the environment in real time. desirably, **at the same rate as the exploitation, with the same deadline**. The past exploitation at Roşia Montană, discontinued in 2006, which was much less polluting in terms of technology than that provided in the RM Project, has already left heavily polluted groundwater in RM area.

Considering the ratio of post-mining rehabilitation period chosen by the company (2 years), the operation period of 16 years (equal to 2/16), and the corresponding ratio for the Romanian state – where the rehabilitation needs at least 120 years (considered in the Project) for the toxic tailings tank (i.e., 120/16 = 7.5), the result shows that the Romanian state is 60 times ((120/16) /(2/16) = 60) at a disadvantage compared to its business "partner". If we consider the royalty of only 6% accruing to the Romanian state, the ratio of the properties over the gold extracted (94/6) / the ratio of the periods needed for the rehabilitation of the environment, corresponding to the two project partners (2/120), becomes (94/6)/(2/120), so the Romanian state is disadvantaged ~ 940 times (120/2*94/6 times = 940) as compared to the RMGC partner, a significant ratio, which massively violates the ethical principles of business partnership and the principle of equality of partners's risks in a joint venture.

G. The overall conclusion to the issue of the non-renewable resources: maximum limitations for pace of exploitation

The Constitution, the legislation, the implementing rules and the association or concession contracts must enforce ***maximum rather than minimum limits*** **for exploitation of non-renewable resources**, *so, in particular, the size of the projects concerned with exploitation of mineral resources*.

Unconditional support of, and encouraging "large-scale" economic projects, which aim to quickly exploit the entirety of any non-renewable national resource, is contrary to the national interest, and the legal framework should be amended to protect and enforce the national interest in a sustainable development perspective.

It is necessary to look for resources that are renewable, to replace the non-renewable resources, such as, in energy production, replacing fossil fuels with green or other energy based on solar energy, to gain real energy independence, more than the one (calculated for the current fossil fuel deposits in Romania) equal to one to two decades.

Large support might apply only to projects concerning the use of renewable resources, whose exploitation pace is smaller than their regeneration pace, and whose operation does not destroy the environment or any other finite secondary resources.

Only those investors are fair to the Romanian state and people, who offer to invest in renewable resources useful for sustainable development (the investments being usable long after the site is closed): education, research, development of information technology, green energy, the energy of sunlight, of water, of wind, energy transport, energy storage (in biomass, by pumping water upwards in accumulation tanks, by dissociation of molecules), road infrastructure, agriculture, tourism.

Romania will become stronger and more competitive by developing renewable resources and by saving non-renewable resources, irrespective of their nature.

The demand for the gold from Roşia Montană

PAR requires that the decision concerning the annual volume of ore extracted, and thus the rate of depletion of the resource (within the limits calculated), **the supply of gold**, should be made only in competition with Romania's gold **demand** (or necessary quantity required), in real time and only if it could not be obtained elsewhere (the **offer**); the resource is non-renewable and must be kept as long as possible for future generations, together with secondary resources, and by preserving the environment.

Today's Romanian national requirements for gold usable in financial system is practically zero.

The National Bank of Romania (NBR), which is independent from the executive, legislative and judicial powers, ceased to buy gold from Minvest Deva (which used to exploit the Roşia Montană mine) as early as 2000, and repeatedly declared that, at present and in the foreseeable future, Romania **does not need to buy gold for the central bank reserves**, despite insistent exhortations by those interested in promoting the RM Project to boost such purchase of gold by the Romanian state, to be stored by the NBR as fine gold bullion. So, from **PII and PIII**:

H. The Roşia Montană Project is NOT useful to the national interest now, even independent of the scope of the future historical horizon considered.

The gold should be left in the ore ("status quo antem") and exploited only when this would become absolutely necessary.

Profitability of exploiting the gold at Roşia Montană now

Roşia Montană gold mining proved more and more **unprofitable** for decades, with production costs surpassing the market value of the production, in this case (in spite of the fluctuations of the price of gold), three times on average (statistics after 1970); the mine at Roşia Montană being finally closed in 2006, as the Romanian State could no longer afford to bear the losses of gold mining at Roşia Montană.

Gold prices rose 5 times between 2000 and 2011[23], and, in September 2011, the price reached the level of $1,923.7 per ounce, a historic high. Since 2011 gold prices began to decline rapidly; in 2013 they decreased steadily, by one fifth compared to early 2013 (in December 2013 the price dropped below $1,200/ounce). The forecast for December 2014 is $1,050/ounce, although in the first quarter the price was higher.[24]

After 2000, when needed, the **central bank have bought gold on the international market at a fair price, implicitly proving a responsible attitude in national and historical terms, and thus protecting not only a non-renewable national resource, but also the secondary components**

[23] The price of gold rose more slowly before 2008, then the increase was accelerated in the period Decembrie 2008 – June 2011, as a consequence of the world financial crisis, the recession and the quantity relaxation programme adopted by the US Federal Reserve, which simultaneously reduced the interest of currency policy to a historical minimum, within the range 0 – 0,25%.

[24] **Jeffrey Currie,** research director for markets of goods, with Goldman Sachs

found in the national ore resources and the natural and cultural-historical environments.

The RM gold is not useful to the country in order to make up the optimum gold reserves of the NBR, and the consumption of gold for high technology purposes is covered by existing resources.

In terms of **PAR**:

I. *There* ***not being demand*** *for the the offer of Romanian gold on the domestic or the international markets, the Action and Reaction Postulate compels the* **conclusion that the gold deposits in Romania should not be exploited currently**.

The ratio, announced by RMGC, between profit and investment by the Company ($2G/8G$ = 25%), for 2-3 years of massive initial investment and 15-16 years of recuperation, and an estimated average sale price of CAD$1,200/ounce, appears as unattractive, well below the relative average of the profit/initial investment ratio in bank loans. ***Other reasons may be acting.***

J. Final conclusion on the unsuitability of exploiting the Roşia Montană gold now

The gold must be left in the ore, as a national resource, and exploited when this would be absolutely necessary and cost-effective, using the technologies that will be developed in the meantime, meant to protect the historical, natural and human environments, with additional recovery of the elements that are now considered secondary, which are to be wasted by the destruction subsequent to the current RM Project.

A major additional and plausible conclusion **– other, unsaid and classified, factors, caused the RMGC leadership to insist on continuing the Roşia Montană Project**.

To better understand the socio-physical model just presented, let us consider the following **questions**:

1. How would the current generation comment on the depletion of Romanian gold by the previous generations, if the previous average mining rate had been only 2-3 times faster than it actually was and no gold had remained in Romania? What about a pace of expoiting of a few scores of times faster (for the entire gold reserve in Romania) than that computed as adequate, proposed now for the mining rate in the RM project?

2. Why extract all the gold now, and possibly preserve only a few percent of it for Romania, when we do not need it now?

3. Why not buy gold from elsewhere, cheaper than from the domestic production, thus avoiding destruction of a non-renewable resource that still exists in Romania?

Let us make an analogy (before approaching other consequences of the RMP) and compare the management of the gold resource provided in RMP with another resource – a river, using the model non-renewable resource/renewable resource.

A river has as basic dimensions a bed (or a channel) and an average flow of water.

The flowing water is a renewable resource, the bed (channel or course) of the river is a non-renewable resource. The draft law on the RM Project would correspond to altering the bed of a river, leaving the future generations in that area without the water of the river.

Making a parallel with Romania's fresh water resources and considering the weight of the gold reserve from Roşia Montană compared to the total gold reserves of Romania (1/2 – 1/3), the situation would corresponds, for example, to undertaking the **diversion to the South of the Danube River** after Calarasi, instead of flowing north from Calarasi, a deviation that would lead to the isolation of Dobrogea and the current Danube Delta from the water of the Danube, in order, possibly, to make it easier to build a highway from Calarasi to Silistra, on the ground, on the bottom of the river bed, instead of building a bridge over the Danube or a tunnel under the Danube.

The current generation is attentive to the privatizations that have so far led to the nearly total destruction of renewable sources existing in 1989, for example, a number of means of production, which had a maximum life horizon of one generation. But, at the same time, the current generation ignores, after paying attention to the depletion of renewable resources having a time horizon of life of the order of one generation, the destruction of non-renewable resources with a future horizon of hundreds of generations, actions which, seen as a process of **destructive alienation**, are likely to be subject to severe criticism by future generations.

All mineral resources, the exploitation of which can be replaced by using renewable resources or imports, should be preserved and protected from the aggression of individuals or groups eager to make quick profit, who, under the excuse of *__profitable__* current investment, are actually investing in the destruction of future generations of Romanians, supported by local corruption, or due to ignorance.

The real useful investment (in particular, in Romania) are in the area of using renewable resources through sustainable development projects, some of which have been mentioned above.

The losses sustained by Romania do appear even more important if the consequences (for close and historical horizons) of the technology chosen for the mining of gold and silver in Roşia Montană are considered the (s. foll. chap.): wastage of secondary resources in the ore, destruction of the natural environment, destruction of the historical and cultural heritage, elimination of jobs, generation of opportunities for.

IV. USE OF THE SECONDARY RESOURCES IN THE GOLD-AND-SILVER ORE AT ROŞIA MONTANĂ

The chemical analysis of the Roşia Montană deposit, which has been already mentioned, was conducted in 1973, with the kind of equipment existing at the time, on 300 kg of ore (a very low amount, relatively) by ICEPIMNR (a state researsch institute) in Baia Mare, the results being published by engineer Aurel Sântimbreanu, showing the following composition of the sample (in descending order of the concentrations that could be determined then, if greater than 1 ppm = 1 gram per ton of ore, for the elements for which the analyses could be done, and for which publication of results was approved):

S = 3.89% = 38.9 kg/ton; As = 5,000 g/t; V = 2,500 g/t; Ti = 1,000 g/t; Ga = 300 g/t; Cr = 50 g/t; Co = 30 g/t; Ni = 30 g/t; Ag = 11.70 g/t; Sn = 10 g/t; Mo = 10 g/t; Bi = 10 g/t; Au = 1.50 g/t; W = present.

The analysis bulletin fails to include many elements, which were ignored in 1973, but are essential to modern scientific and technical progress, in the future and for sustainable development, and maybe some data that were considered state secrets.

During the period 1999-2013, geological development work was conducted by **RMGC** for research into the extent of the deposit and to get a detailed knowledge of it. The director of the National Agency for Mineral Resources said, when heard by the **SPCDLRM**, that the assessment and all the geological prospections were made by companies **managed**

and/or funded by Roşia Montană Gold Corporation (**RMGC**), which companies were certified in Romania and abroad.

During the **SPCDLRM** hearings, it was reported that 1,253 drilling were made and 65,782 samples were collected in underground mining. RMGC said that 47 chemical elements had been analyzed (starting, for gold, from concentrations of 0.4 g/t for the separation level between resource and reserves), not only gold and silver, and the composition of each block in the underground was known[25].

According to the studies conducted by the experts hired by RMGC, the geological resource of useful ore is 231,578,000 metric ton [26] , containing approximately 1.46 gram of gold per ton[26], and 6.85 gram of silver per ton[26].

The exploitable industrial reserve of ore (existing in the resource of ore), which underlies the feasibility study is 214,905 thousand tons[26] ore having the same concentration as the resource. It was declared that it was found that there were 247,053 kilograms of gold[26] and 904,883 kg of silver[26]

From these published values t is possible to compute the masses in the reserve: of gold: 1.46g/t *215kt = 314 t gold and of silver: 6.85 g/t * 215 kt = 1473 t of silver . That means rates of extraction from ore of: 247 t / 314 t = 78.7% for gold and 905 t / 1473 t = 61.4 % for silver; proportion of gold in the final product being 247/1152 = 21.4% and of silver 905/1152 = 78.6 %, rates obtained by the proposed processing procedure in RMP. But, the content of the final product, which can be sold, is estimated by RMGC at 17% gold and 83% silver[27].

RMGC director said during the hearing that the results of that geological programme had been submitted to National Agency on Mineral Resources (NAMR), and they indicated that "**only gold and silver are commercially exploitable at Roşia Montană**" [3-8].

In 2013, a Vice-President of the **SPCDLRM** declared that, in recent years, about 142,000 tons of gold-containing material were taken out of Romania under the guise of analyses conducted by RMGC and transported to Canada and Australia, and the results of those analyses were not known.

In the **SPCDLRM** hearings, it was shown that the method proposed by the current RMGC project for extracting the main resource, i.e. **full cyanidation of the ore**, involves very little opportunity for, and possibly annuls any future exploitation of other rare mineral resources contained in the ore; the extraction method leads to losing all the copper and large amounts of antimony, germanium, tantalum (which are critical raw materials, according to the current European definition), tellurium, zinc (raw materials which are very important economically by European standards), and large quantities of potassium feldspar (adularia), considered to be important in economic terms by the European Union.

According to representatives of the Romanian Geological Institute, RMGC selecting the technology that takes into account only the recovery of gold and silver could extend (possibly stimulated by the new draft laws promoted) to other similar mining projects (some conducted by the same GBU Ltd), which would deny Romania the advantage of becoming the first potential producer of antimony, tellurium and germanium in Europe.

High concentrations of arsenic, cadmium, selenium, nickel and sulphates were found in surface waters. Also, concentrations of lead and chromium which were above the ecological limits were identified in some waters. Concentrations of arsenic, nickel, cadmium and occasionally, mercury and chromium have been identified in groundwater. At a certain level of technological approach, even these components, which are now wasted and causing pollution, could be used in the national interest for the future generations.

A table containing a documentary synopsis of the elements announced so far as existing in the ores at Roşia Montană, also containing the concentrations of the most common chemical elements in the Roşia Montană ore, which have been made public, as well as their stock prices (in $/g), from which their value in dollars per ton of ore ($/t) was calculated, was published[28] in October 2013:

[25] There is no express mention to the errors in the determination of concentrations

[26] Reporting a final result with six significant figures (relative error ~ 0.0001%) when the input data have errors of ~ 1% indicates the lack of competence or intention to cheat in data collection and processing the experimental data of the publishers of the studies.

[27] There is no explanation for there being, in the ingots, 4.9 times more silver than gold (83%/17%) in an estimated production of only 3.7 (905 t/247 t) times larger for silver compared to the one of gold. Where is the gold lost? Or, where does the silver come from? Or maybe there was a public, official leak of information (due to a lack of data correlation) on the proportion of noble metals in the *bouillon doré* (4.9 -3.7 = 1.2 times of gold, approximately 300 t of noble metals which noble metals are not detectable in the *bouillon doré*, by Romanian customs?

[28] M. E*ng. Doru Apostol* - "Deci ce facem cu biblioteca Roşia Montană?" ("So, what about the Roşia Montană library?") *(apostoldoru.blogspot.ro). The author only considers the total value of the resource, ignoring the current cost of mining.*

No.	Atomic number	Element	Chemical symbol	Price:$/g element	Concentration g/t ore	Value: $/t ore
1	3	Lithium	Li	0.27	-	-
2	4	Beryllium	Be	7.48	-	-
3	21	Scandium	Sc	4	-	-
4	22	Titan	Ti	6.61	1,000	6,610
5	23	Vanadium	V	2.20	2,500	5,500
6	24	Chromium	Cr	0.32	50	16
7	27	Cobalt	Co	0.21	30	6.30
8	28	Nickel	Ni	0.07	30	2.31
9	31	Gallium	Ga	2.20	300	660
10	32	Germanium	Ge	3.60	20	72
11	33	Arsenic	As	3.20	5.000	16,000
12	34	Selenium	Se	0.61	-	-
13	37	Rubidium	Rb	12	-	-
14	38	Strontium	Sr	1	-	-
15	39	Yttrium	Y	4.30	-	-
16	40	Zirconium	Zr	1.57	-	-
17	41	Niobium	Nb	0.18	-	-
18	42	Molybdenum	Mo	0.44	10	4.40
19	44	Ruthenium	Ru	14	-	-
20	45	Rhodium	Rh	130	-	-
21	46	Palladium	Pd	58.33	-	-
22	47	Silver	Ag	1.20	10	12
23	48	Cadmium	Cd	0.46	-	-
24	55	Cesium	Cs	11	-	-
25	57	Lanthanum	La	8	-	-
26	58	Cerium	Ce	3.80	-	-
27	59	Praseodymium	Pr	4.70	-	-
28	60	Neodymium	Nd	4.20	-	-
29	62	Samarium	Sm	3.60	-	-
30	63	Europium	Eu	1.350	-	-
31	64	Gadolinium	Gd	4.50	-	-
32	65	Terbium	Tb	50.40	-	-
33	66	Dysprosium	Dy	4.50	-	-
34	68	Erbium	Er	5.40	-	-
35	69	Thulium	Tm	70	-	-
36	70	Ytterbium	Yb	14	-	-
37	72	Hafnium	Hf	1.20	-	-
38	73	Tantalum	Ta	4.50	-	-
39	76	Osmium	Os	77	-	-
40	77	Iridium	Ir	42	-	-
41	78	Platinum	Pt	130	-	-
42	79	Gold	Au	55.40	1,5	83.10
43	80	Mercury	Hg	0.48	-	-
44	81	Thallium	Tl	0.48	-	-
45	83	Bismuth	Bi	0.39	20	7.80
46	90	Thorium	Th	-	-	-
47	92	Uranium	U	-	-	-
TOTAL Value resource per t ore						**28,973.91 $/t ore[26]**

From the above published table it follows that:

- the value of the amount of (Au + Ag) / t ore is 83.10 + 12 = 95.10 = ~ 95 $/t ore

- the value of all existing resources in the ore mined by the Roşia Montană Project = 28,973.91 = ~ 29 k $/t ore

- the value of the resource that would return to Romania / t ore is 6% (Au +Ag)/t ore * 95.10 = 5.76 = ~ 5.8 $/t ore.

- the total value of the resource (Au + Ag) ceded to RMGC and operated commercially / t ore is (94% Au +Ag)/t ore, i.e. adica 94% * 95 = ~ 89 $/t ore

- the value of all the resources wasted by the Roşia Montană Project / t ore: 28973.9-95.1 = 28878 8 = ~28.9 k $/t ore = ~29 k $/t ore

- the industrial exploitable reserve, which underlies the calculations in the feasibility study of RMGC (s. http://www.gabrielresources.com/site/reserves.aspx), is 214,905 ktons of ore[26] ~ = 215 Mt ore

- the total amount of the resources used by the Roşia Montană Project for the RM deposit

~ 95 $/t *215 M t = ~ 20.425 10^9 $ = ~ 20 billion dollars

- the total amount of the resources wasted out of Roşia Montană deposit due to RM Project =

= ~ 29 k $/t *215 M t = 6.235*$10^{12}$ $ = ~ $6*10^{12}$ (six thousand billion dollars).

How much is the Romanian State going to **gain** from the business proposed by the Canadian company that wants to exploit the riches of the subsoil at Roşia Montană?

How dangerous is the exploitation going to be to the environment?

These are questions that, in the last 16 years, have divided Romania into two sides: for and against the exploitation.

We should add here the question concerning **how much is the Romanian state going to lose through wasting the secondary resources?**.

The cumulated value of the secondary elements contained in the ore at Roşia Montană, which will be wasted by this project, is ~ $ 6,000 billion, i.e. about 6000/20 = ~ 300 times the value of the resource extracted, and about 300/(6%) = ~ 5,000 times the estimated share of gold that goes to the Romanian State as royalty (6%).

What are missing from the table are the data about the concentration or prices for many of the 47 items reported to have been found by the contractor, for radioactive elements, and some rare earth involving classified information. On the other hand, the table does not contain the estimated costs of extracting those elements from the sludge, which lower the profit. The estimated cost of gold and silver extraction and processing was, according to RMGC, ~ 50% of the production (~ $10 billion), which would lead to only $600 million royalty for the Romanian State.

If we calculate the ratio: the cumulative value of the secondary elements contained in the ore at Roşia Montană, wasted by the current project (~6,000 billion dollars) / value of the gold that the Romanian State will receive as royalty ($600 million) = ~ 10000.

So, the wasted values in secondary elements are ~10,000 times greater than the recoverable value due to Romanian State. Of course, the Romanian State will win something more from taxes and duties on mining operations.

Even with a 100-fold errors in computation due in exaggeration in the estimates in the table, even over time, the potential losses by wasting secondary metals appear to be of the order of one hundred times higher than the total royalty; however, to that value should be added the losses for Romania, in time, by: altering the natural environment, destruction of the historical heritage, the risk of terrorist acts, the loss of any jobs after closing the project, and blocking sustainable development in the Roşia Montană area.

For a future historical horizon of the same magnitude as the past horizon, it is possible that technological progress in the extraction of secondary products in the future can lead to a level similar to the extraction of gold at the present time (~ 80%).

Choosing the methods of exploitation will be based on the concentrations of the elements in the ore, the interest for certain elements that would be much more precious than gold and silver, and would be deficient in the global market, the peculiarities of extraction for these elements (other than gold and silver), which can make **gold and silver to then appear as secondary products**.

The Postulate of Proportionality (PP) and Dimensional Analysis (DA) help us to calculate the dimensionless ratios for the RM deposit: used value/value wasted (Vu/Vw), overall and for each of the partners.

When computing the ratio used value fructified by the Roşia Montană Project, overall (including the cost of extraction) / value of the secondary resources wasted, overall (waste that affects the Romanian State, only): Vu/Vw = ~ 2.10^{10} / 6 * 10^{12} = 1/300 = 0,3%.

The value of the resource used / total value of existing resources available per one ton of ore is highly different for either sides:

For the Romanian State: : $(Vu/Vw)_{RO}$ = ~ 5,8 $/t ore/ 29 000$/t ore =1/5000 = 0,02%

For the partner company GBU Ltd: $(Vu/Vw)_{GBULtd}$ = ~ 89,34$/t min / 95,10 $/t m = 94 %

If we calculate the size of the ratio of resources used / total resources available to the Romanian state compared to the ratio of resources used / total resources available to the business partner, GBU Ltd, we get: 0.02% / 94% = 1/4700, i.e. the partner, GBU Ltd, has a gain / loss ratio about 4,700 times higher than that of its partner Romanian State.

If we calculate the ratios between the value of the resource used / total value of the unused available resources, for each of the two partners, we get:

For the Romanian state, for the extraced gold from ore in Rosia Montana: $5.76 /t min/ ~ $29,000/t ore =1/5000 = 0,02 %

For GBU Ltd, for its part from the extracted gold): 94% / 6% = 15.67 ~ 16 times.

The ratio of these ratios – resources used / resources, for the two partners, the Romanian State and GBU, is ~0.02% / 16 = ~ 0.0012%, meaning a favourable ratio by ~ 80,000 times to the business partner GBU as compared to that of the Romanian state.

This value is even undervalued, because this estimate ignores the reduction of the value of the Romanian State's royalty by the compensation for expropriation, paid from the royalties, and the costs of pollution control and ecological rehabilitation, which remain uncovered by the project, which will go, in a large majority, to the Romanian state

In **conclusion**, through **the Roşia Montană Project, the Romanian State has a gain / loss ratio of about 80,000 times smaller than its business partner (or, vice versa, a loss / gain atio ~ 80,000 times higher than its business partner)**.

The Action and Reaction Postulate and the Equity rules requires equality of the ratios calculated above for the two partners.

Thus, the Roşia Montană business appears to be highly **damaging** to one of the two partners – **the Romanian State**.

K. Correctly dimensional calculation recommends not to undertake such a joint venture project in which one partner (Romanian State) has a ratio of gains to losses several tens of thousand times (~ 80 000-fold) lower than its business partner.

Even with a 100-fold exaggeration in the input data concerning the potential losses by wasting the secondary metals alone appear as unacceptable, let alone the uselessness of extracting the resource, gold, at present.

As a general conclusion, the Roşia Montană project divides the benefit between the two partners, GBU Ltd and Minvest, but the losses resulting from wasting the secondary resources, whose value is much higher than the total benefit stipulated in the project, are going to be sustained entirely by the Romanian state, as a result of its decisions at the highest levels.

The **Postulate of Superposition of Social Actions** (**PSSA**) and the **Postulate of Proportionality** (**PP**) indicate, for the current situation in Roşia Montană, the possibility of first **exploiting the by-products from previous exploitations**, left undamaged by processing the ore (cyanidation of the concentrate) by the combination of the companies GBU and Minvest, of Aurul and Esmeralda, etc., as many as there are left, which still exist in the waste dumps at Roşia Montană and the sludge and tanks (partly discharged accidentally) at Baia Aries near RM, and at Bozinta Mare in Maramures.

Studies and effectiveness calculations made and published by other independent researchers indicate a possible gain much greater obtainable from processing the secondary resources left from previous exploitation than by RM Project, a solution that is also devoid of the some of the unwanted side effects of the project, with an additional resulting gain for the environment due to reducing pollution by eliminating the heavily polluted sludge. But, this exploitation has to take account off the calculations taking into account secondary resources, just exposed for RMP.

No doubt, those who have more accurate information may use the presented model to calculate more precisely the benefits and losses of the partners and might, eventually, reach other conclusions.

The 2002 report of the Academy of Economic Studies confirmed, by many other reasons, that this RM Project is not of national interest, or economically viable.

L. In conclusion, **PSSA does not recommend adoption of the Roşia Montană Project**, but perhaps only the exploitation of the secondary resources left from previous exploitation, as originally intended by the foreign partners, GBU, Esmeralda – but in better conditions of safety and with superior recovery of secondary resources.

M. The socio-physical model developed shows **that local and foreign investments in mining should not be rejected in principle, but they should be oriented to projects where the benefit / loss ratio be equal for the partners in the business**, not grossly disproportionate, i.e. thousands to tens of thousands times to the detriment of the Romanian State.

The further evolution and **the current situation** – Roşia Montană Project in the form submitted to Parliament – are the adapted response of the foreign partners to the Romanian state's action (or inaction) and the characteristics and performance of the Romanian negotiation and decision-making milieu[1].

V. EFFECTS OF THE ROŞIA MONTANĂ PROJECT ON THE NATURAL ENVIRONMENT

The **Postulate of Action and Reaction** and the **Conservation Principles** suggest that, because previous gold mining technology by digging tunnels/galleries and flotation proved ***unprofitable, other causes (forces) that led to the promotion of PRM by its authors must be looked for (individually or in combination)***, such as:

- The possibility (**P II**) that, in the analyses conducted, could have been found in deeper layers of the deposits **gold concentrations much higher than publicly announced**, or **other** (**PSSA**) valuable **materials (precious metals, radioactive elements, rare earths)**, ignored by the Romanian partner, which are not referred to in the Project or the Memorandum, or elements (mentioned in the documents) such as tungsten, vanadium, tellurium, indium, gallium, selenium (elements that should be preserved for the future needs of the country, under new scientific and technical circumstances, maybe still unknown), which could have been found in the ore in concentrations many times higher than that in the upper layers.

- It is possible to consider (PII, PSSA) secret technological processes, intentionally concealed for approval and inclusion in economic recovery (and taxation), which could lead to making and exporting more complex *boullion doré* (since it has been so far impossible to verify the content of other noble metals by the Romanian customs) and particular fractions of the sludge, followed by processing them elsewhere, etc.

- It would also be possible (PSSA) for the holding company to present the exploitation of the secondary resources, made possible by renouncing the cyanidation option, as an acceptance (PAR) by popular opinion, to rejecting the exploitation by cyanidation.

- It may also be that stock speculation is envisaged (PSSA), or preventing (PAR) other investment projects in the area.

If the bidder company, RMGC, seeks to exploit (as stated explicitly) only gold and silver, to be found in the concentrations the company has declared publicly, by applying conservation principles (CP), it follows that ***other mining technologies*** than the traditional technologies are needed, which are much less expensive for the operator, this implying also (from the Postulate of Action and Reaction) with ***a lot more loss of secondary resources and increased damage to the to the environment, that is for the partner***, the Romanian State.

In Roşia Montană Project, the option was made for:

1. **full exploitation**, until **exhaustion**, of Au and Ag in the ore from the deposits in the Roşia Montană area (in the Roşia Montană Project, **Au** and **Ag** being declared as the only elements having commercial value);

2. **large-scale**, **mechanized** operation, abandoning the traditional technology, through mining involving digging underground and flotation;

3. the use of **high efficiency equipment**, an option that will not provide a lot of jobs to the local people, whose past experience, certified qualification and current authorization do not make them competitive for employment in jobs that they do not know, and which will leave them unemployed, like their children, after the closure of the intensive surface exploitation;

4. recourse to **surface extraction by open shaft**, by means of conducting **hundreds of thousands of open-air explosions**, followed by **grinding** the entire amount of ore (a quarter of a billion tons) into particles between 70 and 150 micrometers in diameter, using thousands of tons of explosives annually (**tens of tons of explosives detonated daily**), thus producing a large quantity of toxic dust, raised into the atmosphere by the explosions, which could destroy the existing natural environment to desertification (four hills and their surroundings, dams, flora, fauna, etc.), the millenary

archaeological objectives[29], elimination of tourism and sustainable development in Roşia Montană and surrounding areas, for generations;

5. **full cyanidation** of the whole quantity of gold-and-silver ore (including the sludge, and thus abandoning the previous technology through which the usable ore was separated from the sludge by flotation)[30], a past- oriented procedure, without regard to the evolution and changes in mining technologies, in violation of the 10.10.2001 Berlin Convention, which recommends prohibiting the use of cyanide in mining operations in the EU, **against the recommendations of EU**,[31] **and so cutting off any possibility of funding from the EU and excluding, from the very outset**, any **possibility of sustainable development** in the area.

Although **SPCDLRM** concluded that, during the hearings of the Committee, potential risks to flora and fauna were indicated, due to:

- the release of hydrogen cyanide,
- emissions of dust from the activity of purification,
- the activity of technology transport,

however, the **SPCLRM** does not mention the European recommendation not to use cyanide, *while recommending the competent ministries to check the declarations made by the representatives of the Romanian Geological Institute, the ASE Group, the Romanian Academy and the civil society representatives regarding the potential risks associated with the use of cyanide in mining*.

The Committee has chosen the option of cyanidation and asks the Ministries of Economy, Environment and Climate Change, and, respectively, the Higher Education, Scientific Research and Technological Development to assess the possibility of using the alternative technology of flotation and cyanidation.

6. losing, by complete cyanidation, the **secondary mineral resources**, which are destroyed by the extraction to exhaustion of the main resource. The secondary resources are to be fully wasted, although, *if they were not be wasted* but preserved, they could come to be much more valuable than the main resource (Au & Ag), currently said to be the only exploitable resource;

7. intensive use of the water resources in the area, **at the expense of traditional consumers**; the flow of water to be consumed in PRM is not mentioned in the Committee documents;

9. open-air storage of cyanide compounds (many of which containing heavy metals, which are very toxic);

10. forming a lake of discharge and open-air storage of those cyanide compounds, with a volume of a quarter billion cubic meters, and an area of ~ 4 square kilometers, lake having clay walls, with faults in the natural walls considered, and intense circulation of underground water, without a single-piece dam, yet a 600 m wide and 186 m high dam, not set in a hard rock, lake built by **changing the course of the Corna river.**

During the hearings, it was stated by the experts present that such a dam is dangerous considering the international experience [32] and the domestic experience.[33]

[29] The Union of Architects of Romania warns of the effects of the planned explosions on archaeological objectives *"It is a pure illusion that the archaeological objectives will withstand the explosions planned and the dust caused by the explosions, or the trepidation produced by the 14, 150-tonne dump trucks that will run at Roşia for 16 whole years, 365 days a year, 20 hours a day, as the RMGC project stipulates."*

[30] **In Romania, there is currently no more mining operation using cyanide**. Rosia Montana Project is expected to use 12 to 13,000 tons of cyanide per year (i.e., in 15 to 16 years of operation **600 billion human lethal doses** will be used [0.2g is the human lethal dose] to produce 15 to 16 tons of gold annually for a period of about 16 to 15 years, with a specific cyanide consumption per unit of product ~ 50 times higher than the world average (a huge consumption, which is left unexplained in the Project). This enormous amount of cyanide would amount to about one third of the global consumption of cyanide for a single, rather modest exploitation (PRM), and the cyanide will remain in the Apuseni Mountains, stored in an open air reservoir with no treatment system, an open, unstable lake, and it is the Romanian state who, in the future 120 years, is going to neutralize the the cyanide, at the expense of the same Romanian state, destroying the local natural environment and posing risks to the population in case of earthquakes, accidents or terrorist attacks, with risks of even partial destruction of the dam, risks that are not significantly covered by the operator.

The authors of the RM Project do not specify the other substances involved in the technological process, the quantities used and their degree of hazard, and many other risk details.

[31] **In 2010, the member of the European Parliament passed, by 488 votes in favour, 48 against and 57 abstentions, a resolution that called for a general ban on the use of mining technologies based on cyanide in the European Union**. Unfortunately, the European Union has left it to the Member States to implement the provisions of resolution in their national legislation.

The Czech Republic, Hungary, Bulgaria, Germany, in Europe, as well as Costa Rica, several provinces of Argentina and the US states of Montana and Wisconsin have banned the use of cyanide.

[32] Some of the **causes** of accidents at dams may be:

- Cheap building materials and technologies under standards (e.g. Gleno dam in Italy, whose destruction caused 356 deaths);
- Design error (South Fork Dam in the USA, which, by its failure, caused the killing of 2,209 people);
- Human errors and deficiencies in design and operation (failure of Dale Dike Reservoir in England caused 244 deaths; Buffalo Creek dam failure resulted in the death of 125 people);
- Geological instability during operation, due to filling and emptying the dam lake, or in situations of prolonged torrential rain (the Malpasset dam in France failed, causing the death of 423 people); or the existence of active streams that will flow into the lake, as the initial river was diverted;
- Landslides that can displace large amounts of water from the dam, that subsequently spilled over the height of the dam (e.g. Vajont Dam in Italy, where the resulting tide was almost 200 m high, causing the death of 2,000-2,500 people);
- Deficiencies in the maintenance of the dam and the related facilities (the failure of the Val di Stava dam in Italy caused 268 deaths);
- Extreme rainfall (the failure of the Shakidor dam in Pakistan caused about 70 deaths; the failure of Banqiao dam in China, in 1975, killed 170,000 to 230,000 people, about 6 million buildings being destroyed, and 11 million people left homeless);
- Seepage and erosion, groundwater sources, particularly in the dams made of earth (the failure of the Teton dam in USA has caused 11 deaths);
- Earthquakes, like the surface one in 2013 at Izvoarele (Galati county, RO);
- Theft
- Acts of sabotage
- Terrorist attacks.

[33] *Several Romanian dams built for lakes of sludge discharge or for tailings tanks, intended for water amounts thousands of times smaller than that provided in RMP, failed after a few decades, and so Romania is known as the country with the most severe accidents in Europe due to the loss of integrity of dams of cyanide sludge lakes: Certej (1971) and Baia Mare (2000). The accident at Certej*

There are not to be forgetten the effects of explosions on the subsoil, the fissures, the faults, or the existing course of groundwater on the stability of a dam. The representative of the Geological Institute of Romania, during the **SPCDLRM** hearing on 8 October 2013, reiterated the precarious geological situation of the proposed site of the sludge tank, which is to be built in the basin of the Corna Valley, a dangerous situation kept secret by RMP; other specialists emphasised, during the same hearing, the local hazards similar to the international examples above. That is why the Romanian Geological Intitute proposed a detailed preliminary geological mapping (scale 1: 1000) of the entire basin of Corna Valley, using complex, geological, geophysical, tectonic, hydrogeological, geotechnical methods, intended to establish, in detail, the quality of the ground on which the pond would be located.

11. Because of the alteration and pollution of the environment through the chosen in RMP technology, **the damage will be enormous**, both during the exploitation, in total, 15 to 16 years (desertification, explosions, toxic aerosols generated by explosions), and especially, in time (after the exploitation is finished, at least 120 years as declared in the RM Project) through the hydrogen cyanide aerosols generated by the open-air cyanide sludge pond, and due to the simultaneous presence of pyrite and sulfuric acid. Owing to the cheap constructive solution chosen, the pond is considered to be unstable by the independent geologists (who were not hired by RMGC and are not acting as its paid agents).

Storage of the by-products of operation in mine tunnels/galleries, in the same galleries after extraction of the main product (the ore) from them, was not considered.

In contradistinction to the RMP offer[34], **the existing natural environment could provide sustainable development in the area**, in much the same way as other collectivities nearby opted, instead of full but short-lived and toxic exploitation, with future major hazards and wasting the by-products of the gold-and-silver ore (the mono-culture in the RM Project), with temptations for terrorists. The taxes and fees collected by the government could be, in time, much larger from sustainable development activities, than those from the RM Project.

The huge collateral damage generated by the Project is not the result of turning to account a major and urgent national interest, but the result of draining to exhaustion a main resource, the exploitation of which can be dispensed by the Romanian state now.

The dam and its contents can constitute the source of major terrorist opportunities even in the long term (a long historical time horizon), a challenge for all kinds of terrorists, while specific anti-terrorist protection can cost by itself the Romanian State, during the period of use of the cyanide dam, more than it can gain by the RMP joint venture.

Terrorism at Roşia Montană can be dangerous not only by pollution and destructive discharge or leakage, but also through the unauthorized use of possible secondary resources. For example, the elements europium, terbium and thulium are now being used to produce fluorescent security features for euro banknotes and the 100 dollars banknote; if they come into possession of money counterfeiters, the world financial markets and banking could be, at some point, flooded with tens or hundreds of billions of counterfeit euros, dollars and other currencies. Such a situation can be equated with the notion of financial and banking terrorism, and may cause havoc on world financial markets, imbalance in the economies of industrialized nations, and can feed real money into international terrorism.

The secrecy surrounding the Roşia Montană Project, the lobbying and promotion in media, the ownership doubts, the involvement of many MPs, ministers and people whose obvious intentions are to support the project, the lack of transparency surrounding the project, the hasty and questionable decisions regarding approval, and even trying to avoid approval of this project, cause the project to be surrounded by an aura of uncertainty concerning the safety and security of exploitation, as well as vulnerable to various types of terrorist attack.

It will be worth mentioning that the Roşia Montană Project does not stipulate total rehabilitation of the area destroyed.

The Project provides financial guarantees of only $146 M for closure and rehabilitation works (of which $M25 to $M30 for dam maintenance and surveillance operations), for a period of 2-3 years, and guarantees of environmental liability that could reach $25 M[35], although the Environment Agency of the

(http://adevarul.ro/locale/hunedoara/exclusiv-certej-1971-tragedia-uitata-89-vieti-ingropate-300-mii-metri-cubi-namol-atenTie--fotografii-Socante-_50aea54a7c 42d5a6639eb6b8/ index.html) is considered the worst peacetime tragedy of the 1970s. The dam broke and the sludge flooded, 300,000 cubic meters of mud leaked from the sludge deposited between 1936 and 1971, causing 89 deaths and 76 wounded people.

No guilty person was found!

Following the accident at Bozinta Mare, near Baia Mare (http://documents.rec.org/publication/Cyanide _spill_June2000_ROM.pdf), 100,000 cubic meters of waste, 70-100 t of cyanide and heavy metal waste poisoned the waters of the Somes and the Tisza rivers and the Danube River, the death of aquatic fauna along 400 km, the disappearance of five species of fish and the contamination of sources of drinking water for 2.5 million people, with major effects felt in Hungary (which subsequently prohibited the use of cyanidation as a mining method, and also got EU support). An EU report condemned the poor design of the exploitation. There were protests, and international damage has been requested of Romania, amounting to 100 million Euros in compensation.

Five weeks after the accident at Bozinta, 20,000 cubic meters of water contaminated with Zn, Pb and Cu, leaked through the dam of a sludge lake at Baia Borsa, in Maramures, flowing into the Tisza. Esmeralda Exploration acknowledged no responsibility. The Aurul *(Gold) Company did not receive any sanction, and the shareholders declared the company bankrupt and left Romania to invest their earlier profit elsewhere. Since the 2000 disaster in Baia Mare until 2013, at least 25 accidents (http://www.rainforestinfo.org.au/gold /spills.htm) caused by cyanide spills were reported, in mining areas worldwide. Two of these accidents occurred in mines that are, however, signatories to the International Cyanide Management Code, a voluntary initiative meant to reduce cyanide spills.*

[34] GBU, the contracting company, is financially volatile, and its stock value at the Toronto Stock Exchange ranged, for example, in 2003, between CD$2.92 and CD$ 0.41 per share (in the past it had as much as CD$18/share); the capitalization value on the stock market is < $400 million, while its debt is > $500 million, which suggests a speculative approach, which is undesirable for a strategic investment of the Romanian state, which is now in financial liability, though ***having given the license for free****, with no provisions for environmental safeguards. The documentary "OPEN PIT", which deals with the disaster left by shareholders and Gabriel Resources in Peru's Yanacocha gold mine, is revealing ([39] www.openpitdoc.com).*

[35]SPCDLRM declares that two such types of risk are identified, the risk of financial failure and the risk related to the environment, while

United States evaluated the costs of closing the mine between 2.6 to 17.7 billion dollars (i.e. 18 to 130 times higher than the value stated by the interested company, RMGC). However, if the remediation costs are considered for the mining sites, per cubic meter of rock dislodged, they were estimated by the United States Environment Protection Agency between $13.38/cubic m and $119.81 cubicm. For 230- 300 Mt dislodged, the cost would be between 3 and 30 billion dollars.

Of course, that huge damage would be almost entirely incurred by Romania, and payment will be supported by the Romanian state, which will only receive from RMP $ 600M in royalties and a possible profit of the same order of magnitude.

Neither the NGO's, nor the Romanian state's bodies, or the foreign bodies that made recommendations for the Roşia Montană Project, bound themselves materially for the recommendations made!

O. From the Dimensional Analysis, we can calculate a ratio **loss by subsequent expenditure due to pollution / gain by contract**: for the Romanian State: about 5-50 times ($G3-30 / $G0.6), and for its business partner, RMGC, $0 / $G1.8 = 0 (because the $M 25 expenditure for environmental guarantees, and $M 146 guarantees for rehabilitation and maintenance of the dam are already deducted from the value of the gold on the termination of the contract), where 1,8 billion dollars is the estimated profit of RMGC.

By comparing the two loss/gain ratios for the two partners, the Romanian state and RMGC, it can be concluded that the Romanian state is at a total disadvantage compared to its business partner, considering only the **total gains** and **losses due to environmental pollution** (and ignoring, in the calculation, the losses through wasting the secondary resources, the water and damages in the event of casualties).

Estimating, by the potentially affected population: ~ 10,000 people – directly and immediately, plus millions of people up to the discharge of the cyanide waste into the Black Sea (a lot more compared to the previous cases of breaking of discharge dams in Romania) and the reports from other dam accidents in the world, the damages that might be required (1-2 million dollars per person killed or destroyed real estate, etc.) could be (PP) is on the order of $10-20 billion, to be supported by the Romanian state.

The assurance should eventually guarantee protection against such a damage, but this is not the case with the current warranty stipulated[36], which is of the order of $25M (which could maybe cover two to three years ensurance of the residents downstream of the river Corna, while leaving the massive damage to be dealt with by the Romanian state long after the business liquidation and closure of Roşia Montană exploitation (~ 120 years).

A major risk is related to the lack of experience in gold mining of the business partner, who regards everything from a strictly financial point of view[7] and in the short term.

To the direct damage will be added the indirect damage, through the failure to develop a number of sustainable development programmes, which would otherwise have been likely to fund by European programmes, and which could ensure the preservation of the natural environment and local cultural history, as well as jobs for future generations.

The future horizon of the pollution generated by the mining (120 years, as estimated by the Company) goes far beyond the future horizon of the Roşia Montană Project (operation, closure and rehabilitation – ~ 18 years).

The time horizon of the damage due to pollution after closing / time horizon of the benefits for Romania = 120 years / 16 years = 7.5. The ratio of the horizon of post-closure costs / the horizon of the benefits for RMGC: 2 years/16 years = 1/8

The ratio of the ratios of the horizon of closing expenses to the horizon of benefits: (120/16) : (2/16) = 60 times to the disadvantage of the Romanian party as compared to the benefit of the foreign investors.

The project appears as having huge ratios of the losses for the future generations of owners as compared to the gain of the current promoters of RMP.

Even without accidents, spills from the Corna dam could generate a situation like that in the village of Geamăna[37] or in the mining exploitation at Yanacocha[36] in Peru.

failing to mention how their values were estimated. Let us quote from the SPCDLRM Report: For environmental risk, the agreement would stipulate, in Article 6, para. (2), letter (d), "establishing financial guarantees, by RMGC, for closure and rehabilitation, through a financial instrument agreed with the environment authority, in accordance with the provisions of the European Directive on mining waste and the corresponding legislation in Romania. […] The current estimated total cost of closure and rehabilitation of the mine site is estimated at $146 million by the company, and the investor admits its obligation to regularly update the value of the collateral, starting from the base value, under the regulations applicable in Romania and the EU." Similarly, Art. 6 para. (2) letter (f) of the Agreement would also provided "the establishment by RMGC of the guarantee for environmental liability, currently estimated at $25 million, through a financial mechanism agreed with the environment authority; this warranty is intended to cover the risk scenarios analyzed as part of the environmental impact assessment".

[36] See the documentary film http://www.openpitdoc.com

Panoramic view of the centre of the village of Geamăna, with the church seen from the valley (δH = ~ 100m) – in **1977**, before starting the copper exploitation at Roșia Poieni.

Panoramic view of the the village of Geamăna, now flooded, seen from the hill – **2013**

VI EFFECTS OF THE ROȘIA MONTANĂ PROJECT ON THE CULTURAL AND HISTORICAL HERITAGE OF THE ROMANIAN PEOPLE

The **Quadrilateral of Gold** in the Apuseni Mountains, which includes the Roşia Montană area (a perimeter whose boundary was required by the Parliamentary Committee in 2013 !) has a long history.

It is in this Quadrilateral that **the Tărtăria tablets** were discovered in 1961, dated (by the radioactive carbon method) as far back in time as 5300 BC; these tablets being believed to be the oldest writings in the world discovered so far. They have not yet been deciphered.

The civilization that developed this writing was possibly, in a way, linked to the presence of gold in the Apuseni Mountains Quadrilateral of Gold; gold mining in the area has been continuous, going back over 6000 years (an age which has been already proved), and it is possible that the two categories of findings could be closely related: maybe gold was used as a durable medium for writing, being therefore a piece of evidence of the level of culture and wealth attained.

It is likely that, in addition to Roman political and military interests, the Dacian gold and the Dacians' related language (linguistic kinship can be deduced, among other things, from the fact there are no representations of translators on Trajan's Column in Rome) could have attracted the conquest of Dacia by the Roman Empire, which was completed under Emperor Trajan in AD 106, after many wars, waged by the Roman Empire for two decades.

Because of the betrayal of *Bicilis*, a confidant of the Dacian king, the Romans managed to find Decebal's treasure hidden in the river Sargesia/Sargetia – estimated by Jérôme Carcopino to 5 million ounces (~ 165 t) of gold and 10 million ounces (~ 331 t) of silver. Later on, the Romans exploited themselves, systematicaly, the gold and silver here, by digging tunnels and processing mills.

Due to the weakening of the Roman Empire and because of the geographical location of Roman Dacia, which left it exposed to the numerous attacks of the barbarians, Emperor Aurelianus was obliged to take measures to reduce the defensive front, which implied leaving *Roman Dacia*, between AD 271-275, and ceding a large part of the province to the Goths as "foederati", who now turned into allies and borderguards, as well as establishing a new province, *Dacia Aureliana*, south of the Danube.

Gold mining under Roman rule, by extraction through tunnels/galleries, was supported by the most advanced technologies of the time. Traces of gold mining have been found in many places in Roşia Montană, and, being underground, they are well preserved in spite of the passage of time.

This civilization of gold, now declared by international specialists as unique in the world, has not yet been sufficiently researched, with many archaeological areas that can be important (by their gold, technical or written documents) not even mapped.

Part of the historical archaeological heritage has been destroyed due to the 1970 irresponsible decision of the then Romanian leadership to exploit gold through an open shaft, thus erasing the entire **Cetate hill**, including the ancient galleries.

PP and **PSSA** show that, since historical heritage has a **multi-millennium** past horizon and it is **a non-renewable resource**, the **future time horizon** must be considered **multi-millennium**, as well.

Specialists who were independent of the authors of the project, so not being subsidized by RMGC, mentioned the likelihood of destruction, by RMP, of monuments of the history technology related to gold mining along at least two millennia, which are rarities world-wide; that destruction will be generated by the changes in relief, in-depth scraping up of four hills, hundreds of thousands of explosions, cyanidation and the huge lake that changes the geological equilibrium of the area, all part of, and stipulated in RMP.

Again, from the **PP,** it can be deduced that, because gold ore is public property, inalienable of the State property, exploitation of gold heritage is on the same footing with respect to property.

In accordance with the Charter of Venice, the Romanian State has a number of environment obligations with respect to its historical heritage which is of world-wide importance; it must rehabilitate the environment partially degraded by the irresponsible previous exploitation, invest in historic heritage area (the galleries in the area have to be consolidated, the springs drained, etc), or else the heritage will be further degraded. During the hearings, the Director General of RMGC expressly pointed to the Romanian state's obligation to rehabilitate the environment: in the next few years, 430 million dollars (costs estimated by RMGC experts) will have to be invested in the heritage of the area, otherwise it will be degraded.

Recent evolutions show the appreciation of the world scientific and cultural communities for the unique *historical heritage of Roşia Montană*, which, correlated with the 1961 discovery in the area of the *oldest human inscriptions (the Tărtăria, ~ 5300 BC)*, will possibly lead to declaring the inheritance as a *World Cultural Heritage*.

Since the international scientific community requires protection of the historical heritage in the Roşia Montană area, and the UNESCO listing of protected monuments could protect this area and attract not only, European funding, **PP** recommends a request for protection by an institution, e.g. UNESCO, representative of the level of the significance of RM historical heritage, which would pave the way and facilitate access to various external resources, for example, the funds for the Regional Operational Programme of the EU, in accordance qith the European and global importance of this unique historical heritage.

Since the **gold ore is the exclusively public, inalienable property of the State**, and the historical heritage connected with its exploitation is **the exclusively public, inalienable property of the State**, the decision regarding requesting UNESCO protection belongs to the State (PP), not to local authorities or entities, according to the idea that the agents interested in the project, who are financed by RMGC, are trying to accredit, directly and media-wise, centrally and locally, in exchange for their wages.

Implementing RMP may destroy monuments of the history of technology related to gold mining over at least two millennia, which are world rarities, to the elimination of sustainable development in the primary and adjacent areas, and failing to achieve a possible major tourist attraction.

Moreover, some bodies (not just local ones), interested in momentary benefits (including personal gain) allegedly confuse the world-important archaeological heritage for the local "cultural heritage" (**PP**, **PSSA**), i.e., to them, the yet unsold local homes should be repaired by others, who

would get instead Romania's whole historical gold reserve, arguing that UNESCO protection should be declined.

The irreparable cultural loss implied by the mining technology chosen (PP) in the RMGC project is a strong argument against the project.

The gold ore and the part of yet unexplored archaeological site at Roşia Montană may well remain under the ground to wait for better times, when Romania can afford to do truly profitable business, when developing technology will allow clean mining, without losing the secondary resources and generating opportunities for terrorists, and maybe a decrease in the level of corruption will eliminate suspicions about the approvals given and will strengthen the authority of public institutions.

During the hearings, the specialists showed that a future inclusion of the Roşia Montană area in the tentative UNESCO list would bring economic benefits (PP), meaning that national and international budgets could be allocated for rehabilitating and preserving the heritage in the area, and the possibility would be created of forming a tourist circuit, from the exploitation of which the funds for the maintenance of that cultural heritage could be derived. After the hearings, the Special Parliamentary Committee recommended the Ministry of Culture to **initiate a national public debate on the appropriateness and eligibility of including Roşia Montană in the UNESCO list of protected sites.**

VII EFFECTS OF THE ROŞIA MONTANĂ PROJECT ON THE SOCIAL ENVIRONMENT. EVOLUTION OF LOCAL JOBS THROUGH RMP

Overall, the number of people employed in mining itself is declining, given technological progress and productivity growth.

Large-scale gold mining, which is the technology chosen in the Roşia Montană Project, involves **intensive use of capital, rather than of labour**. The gradual in-depth penetration, by blowing through the surface layer, aided by successive explosions, makes possible to achieve the mechanization of all operations, with a high share of material costs at the expense of wage expenses, which are low, i.e. an inverse relationship as compared to the classical mining using galleries. The analysis of the technological flow demonstrates that all qualified operations (blasting, cyanide processing, electrolysis and smelting the alloy obtained) can be outsourced to companies approved by the majority shareholder, with expenses that do not remain in the area for the benefit of local people.

What the locals would be left with will be **a few hundred jobs** for at most two decades.

The **use of high efficiency equipment** will not provide the locals with many jobs; and, since their past experience, their certified qualifications and current authorization do not make locals competitive for hiring in jobs that they do not know, with a temporary company, they will remain unemployed. When the intensive surface exploitation closes down, the jobs for locals will disappear for them and so will be for their children.

The technology chosen by RMP also leads to elimination of sustainable development in the primary and in the adjacent areas – the destruction of the natural environment, affecting the water sources, destruction of monuments of history of technology, which represent world-wide rarities connected with mining gold for two millennia, reducing tourism up to disappearance (maybe except for morbid tourism), instead of becoming a possible major **future tourist attraction**.

The implementation of RMP will also lead to **dismissal of local people employed in tourism** (**currently ~ 4,720 people, so about ten times more than the people who will be hired locally through RMP**), people who are now making a living from promoting the Dacian fortresses, the mediaeval sites and other destinations that can be considered part of ecotourism, and, in the future, by promoting speotourism.

In contrast to the RMP offer, the existing natural environment could provide a **sustainable development of the area**, very much as other neighbouring communities chose to do, instead of full but short-lived exploitation, incurring toxicity, major subsequent dangers and temptations for terrorists, and wasting the by-products of the gold-and-silver ore (the mono-industry stipulated in the RM Project).

The taxes and fees collected by the government from the area subjected to sustainable development ,would be, in time, much higher than those stipulated by the RM project.

In the **SPCLRM hearings** it was repeatedly declared that:

"Civil society has shown it has the capacity, skills, energy and will to support an alternative development of Roşia Montană, that other ways of development in the area can be generated, rather than mining or using cyanide."

"The benefits of the Roşia Montană Project will not make us richer, but the future generations will surely be poorer, as a result of resource depletion, destruction of landscape and the environment, cultural destruction and, not least, by destroying local community cohesion" .

"The RMGC project does not meet the objectives of sustainable development and delays seeking truly sustainable economic solutions for the area. The project is opposed to the concept of sustainable development, it produces a sustainable disaster, which is another major argument against the project ".

What should be considered instead are the substantial potential benefits that might derive from **alternative projects** – such as the projects based on agriculture and tourism development, one of social conversion, one of declaring the area an "evolution cultural landscape" and its listing as such in the UNESCO World Heritage. Experts have calculated that the Roşia Montană Project is not justified, by any comparison, even considering only starting such projects for sustainable development, of a social, agricultural, forestry and tourism nature, instead of depleting the gold resource in 15-16 years.

P. Conclusion: The conservation laws, PP and PAR, in socio-physics, as applied to the local labour market, require **refraining from exploiting** now the gold deposits in Romania, as the living standards of the few hundreds of potential miners can be improved by developing farms and investment in environmental and tourism, which are much more useful in environmental and historical terms.

The **correct solution**, in both social and legal terms, for the mining area is the **sustainable development of Roşia Montană**, an area with local resources, to which the locals can adapt more easily, who are now being given perverse incentives into believing that they could get highly qualified jobs, though they were not prepared for such professions.

But this option, that of sustainable development, has been deliberately closed by the local bodies who are variously subsidized by RMGC, by declaring the area as mono-industial, which is actually interpreted as a single-use economic area, by staging social protests in the interest of a group potentially

deriving profit from that protected mono-industry – extraction of gold and silver, and maybe, secretly, of other elements; these protests are conducted by people who fail (or do not want) to understand the mechanisms of social pressure exerted from private interest, which is contrary to the national interest, both contemporary and in a historical perspective.

VIII ROMANIAN STATE'S BENEFITS VS. ROMANIAN STATE'S RISKS

Overall, the Romanian state aims to achieve, through the draft law, 6% of the royalties and ~ 20% of the profit, but incurs nearly all the costs related to environmental protection after the project.

Considering, as in the RM Project, an average selling price of $1,200 / ounce (~$39/gram), what could be obtained by selling the main product (242 t of gold) ~ $9 billion in gold (or $10 billion with the silver), of which Romania would get $ 600 million, as a fee of 6%, which is going to be accepted.

RMGC estimates the total cost of exploiting this deposit to something like $7-8 billion, including investments. So, the profit of RMGC[29] could be $2-3 billion, out of which the Romanian state would get one fifth, from which it would have to pay interest on loans for the share and expenses.

The taxes, fees etc. collected by the Romanian state during the exploitation, which are of the order of several billion euros, are comparable to those that could be collected through sustainable development projects in the area, but the damage by wasting the by-products through RMP will be much more expensive to correct. Damage due to pollution would be also huge. These costs add to the costs of environmental risk by terrorist attacks. Moreover, in the last 16 years, the RM project has divided Romanian in twoparts: those in favour of, and those opposing gold explotation.

Even one single terrorist act would be disastrous.

At the present moment, **it is not necessary** to exploit gold in Romania, even by the most evolved present methods.

At some future point in time, better, alternative, methods to extract gold from ore will be developed, which will prove to be much more friendly to the environment, and also apt to extract some other substances from the ore, methods such as (to cite some of the methods mentioned by specialists during the Parliament hearings): extraction with sodium thiosulfate and ammonia, bio-mining, the method based on the use of corn starch, the Gold Haber procedure, the Jack Goldstein procedure, gravity separation, flotation, or combinations of the above, as well as other developing methods.

It is not the national interest that imperatively urges NOW to resort to dangerous methods of mining, involving loss of the secondary resources and huge lasting pollution.

"The project evinces huge ratios of damage to the detriment of all future generations of Romanian owners as compared to the profit made by the current Romanian and foreign promoters of the project (acting as agents of the foreign partners, and subsidized by them); factual data about these reports begin to appear (the enquiries initiated after the Roşia Montană Parliament hearings); criminal liability and prosecution of those who have taken action to undermine the national economy, corruption, influence peddling, association to commit crimes, high treason", as was stated during the hearings.

The huge, "far-reaching" investment in exploiting non-renewable resources, considered as beneficial in the Parliament, seem so advantageous just because the state is not the owner of the lives and property destroyed by pollution, and private shareholders do not care about the future generations

The best investments are those where profits in time have a long historical future horizon and exceed the costs, for example in education, health, renewable energy (for example, wind energy, biomass, photosolar), rather than investments that generate great damage now, and also in future, for one partner – the Romanian state in our case (connected with non-renewable resources extracted by massive pollution and wastage of secondary resources and cultural historical heritage).

IX THE OVERALL CONCLUSION OF THE SOCIO-PHYSICAL INVESTIGATION ON THE SUITABILITY OF THE ROŞIA MONTANĂ PROJECT

Q. The analysis based on socio-physical models does not recommend the Roşia Montană project.

The socio-physical analysis conducted demonstrates that **RMGC project is not necessary or useful to the Romanian state now, from any standpoint.**

"It is not fair to **penalize future generations** with several simultaneous penalties, depletion of the the main resource, wasting the secondary resources and desertification of the area exploited, cyanide poisoning in the area, destroying the local historical heritage, disappearance of jobs, creating opportunities for terrorist attacks."

"Today's policymakers can be seen as the disinheritors of the future generations."

Exploitation of non-renewable resources under the motto "**after us, the Deluge**" cannot be supported or advocated scientifically.

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Q. The analysis based on socio-physics models does not support Roşia Montană Project.

The Romanian language version of the present study has been published as:

[Part 1] Chisleag Losada, Ioana-Roxana; Chisleag, Radu – "O abordare socio-fizica a luarii deciziilor in situatii conflictuale sociale. Oportunitatea Proiectului ROŞIA MONTANĂ" ("A socio-physical approach of taking decisions in social conflicts. Roşia Montană Project") , May 2014 http://www.esmsj.upit.ro/modificari%20Denis/CHISLEAG%20Oportunitatea%20Proiectului%20Rosia%20Montana%20_RO_.pdf.

[Part 2] Chisleag Losada, Ioana-Roxana; Chisleag, Radu – O abordare socio-fizica a luarii deciziilor in situatii conflictuale sociale. Partea a II-a: Modele socio-fizice in negocierea si in promovarea proiectului Roşia Montană (A socio-physical approach in taking decisions in social conflicts. IInd part: Socio-physical models in negotiating and in promoting Roşia Montană Project), May 2014 http://www.esmsj.upit.ro/modificari%20Denis/CHISLEAG%20Oportunitatea%20Proiectului%20Rosia%20Montana _Partea%20a%20II-a.pdf

RESEARCH ON COOPERATION AND COMMUNICATION WITHIN INTELLECTUAL DIASPORA NETWORKS: A CASE STUDY FROM SERBIA

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Abstract: *The process of globalization and rapid development of information technologies, innovations in transport and telecommunications, as well as the internationalization of business, increase the intensity of migration of highly-skilled individuals. The conversion of loss of the intellectual capital into new possibilities and opportunities has become a topic of great interest in many countries of the world, including the Republic of Serbia. Cooperation, networking and institutional organization among members of Serbian diaspora, especially among a great number of academics, scientists, experts, business people and students, are crucial issues for the preservation of national identity and help the economic and cultural development of the motherland. The paper emphasizes the importance of formulating and implementing appropriate communication strategies within the intellectual diaspora in order to improve the relationships within the target group, and establish contacts and solid networks. The results of the survey, which is an integral part of this work, represent the assessment of the existing level of internal coherence and cooperation among members of the intellectual diaspora, and could be further used as a basis for related studies in future.*

Key words: *intellectual diaspora, internal communication, cooperation, networking*

1. INTRODUCTION

International migration of intellectual labor in recent years anddecades hasbecome a subject of many scientific considerations, theoretical and practical researches and analyses. Recent studies indicate that this phenomenon still shows an upward trend, and, therefore, issues related to migration are, to a large extent, the focus of interest for countries of origin and for destination countries, as well as for communities of migrants within diasporas around the world (Ozdenand Schiff, 2006). Kuznetsov (2006) notes that: "This trend is especially characteristic of developing countries – there is a growing international mobility of talent from these countries, and consequently rapidly growing diasporas of highly skilled people". Numerous studies have been carried out in order to account for this phenomenon, its causes and consequences. Although migration of intellectuals, scientists and experts is mostly treated as an economic category, it also has a significant social impact, so "the challenge for governments today is how best to manage mobility, multiple identities and diversity in a way which can maximize diaspora engagement both in home and host societies" (Usher, 2005, p.48).

The term "brain drain" is one of the most visible forms of manifestation of the international migration of talents. More and more skilled individuals seek international career opportunities and expatriate themselves (Carr et al., 2005). *Brain drain* designates "the movement of human capital, in which the flow of expertise is predominantly in one direction" (Salt, 1997), usually from developing to more developed economies. The use of the word *brain* pertains to any skill, knowledge, scientific potential, competency or characteristic that is valued as a potential asset. The term *drain* indicates very high, usually undesirable, outflow. Coupled, the two label the loss of the most talented people (Bushnell and Choy, 2001). Two key facts about this phenomenon are: 1) the existence of a large number of highly educated people who originate from developing countries, and live and work in some of the developed ones, and 2) these educated people can be a significant source of development of their countries of origin (Kuznetsov, 2006).

From a historical point of view, Serbia is one of the well-known emigrational areas in the world, with one of the largest Diasporas. Any individual who leaves the country of origin inevitably represent a loss, with the emphasis on experts in various fields, academics and many young people going to study or work abroad. It can be said that Serbia suffers from a chronic "brain drain". Although the state and its institutions work on development and implementation of strategies to motivate the return of expatriates to their country, it is evident that the results do not meet the expectations. Taking into account the poor economic situation in the country, high unemployment rates and low average wages, it is understandable why. The conversion of loss of the intellectual capital into new possibilities and opportunities has become a topic of great interest in the world, including Serbia. Networking of members of the diaspora scattered around the world, their institutional organization and action towards realization of common goals is crucial for this. Intellectual diaspora networks are characterized as "associations of highly skilled expatriates willing to contribute to the development of their origin countries" (Meyer, 2007). Only by increasing their internal connectivity, based on effective communication process, important goals can be reached, not only for individuals, organizations or associations in diaspora, but also for the Republic of Serbia. This paper attempts to highlight the current situation in the area of internal connectivity among members of Serbian intellectual diaspora and to identify adequate channels of communication with the target group consisting of members of the intellectual diaspora. Fazal and Tsagarousianou (2002, p. 16) write: "With the spread of new technologies, diaspora communities have often developed virtual connections and a host of Information and Communication Technology-premised resources". The Internet and the new technologies certainly help towards the creation of new communication channels and improve relationships within the target group, establishing contacts and networking.

2. THE ROLE AND IMPORTANCE OF INTELLECTUAL DIASPORA NETWORKS

In the broadest sense, Diasporas are understood as self-identified cultural communities living outside the country of origin, while remaining connected to their home countries (Fullilove, 2008). A simple and concise definition of diaspora

could be: "The population scattered for any reason, in several places of residence" (Yossi and Aharon, 2003). In scientific literature, intellectual Diasporas are defined as self-organized communities of expatriate scientists, engineers and professionals living in developed countries and working to impact development of their home country or region, mainly in science, technology and education (Barre et al., 2003).

The features that distinguish diaspora from other communities are a very strong connection among members of the same nationality outside the home country, a strong sense of nostalgia about the country, in the pursuit, even irrational, to return to their country and the desire to participate in the events which characterize the home country. "Diaspora can contribute to its motherland financially, socially and emotionally" (Nielsen and Riddle, 2009) and networking of diaspora members plays a significant role in that. Networks have been increasingly considered as the most promising response to the need for new kinds of organizational structure. The importance of networking of intellectual and scientific diaspora around the world has intensified since the 1990s. Emphasis is placed on a process called "brain gain", which is based on the idea that educated expatriates should not be necessarily viewed as a definite loss to the country of origin. In fact, scientists, engineers and students who live, work or study abroad are an important human resource, both for the country they now live in, and their country of origin. The essence of the brain gain hypothesis is that the intellectual and technical elites who emigrated from developing to developed countries represent a valuable human resource potential, instrumental for the socio-economic progress of their homelands (Kuznetsov, 2008, p. 275).

According to Meyer and Brown (1999), there are two types of benefits from the experts in diaspora (*brain gain*): return of displaced professionals in the country of origin (return option) and their mobilization from "distance" and participation in the development of the country of origin (Diaspora option). Mobilization of this latent national resource, as Gamlen (2005) calls it, through such connectivity programs, does not require a large infrastructural investment, which is the advantage of any diaspora option. This way, the country of origin can have access, not only to individually merged knowledge, but also to the social-professional networks in which these individuals are included in foreign countries. As developed countries often provide far better working conditions and training, those who have decided to migrate to one of these countries rarely decide to return. However, they can remain concerned with, and interested in, the development of their country of origin, due to familiar, cultural, ethnic and other ties and relationships. From this point of view, a need to connect them to motherland scientific community arises, in order to effectively and productively engage them in the process of development of their native country without temporary or permanent physical return. This type of cooperation is possible through various forms, most of which refer to international research projects based on cumulative knowledge and collective group practice and multinational corporations. The ability of expatriate talent to effect change in their home country stems from a combination of three features: (1) High professional success and reputation, which allows diaspora members to create search networks facilitating reforms and investment in home countries; (2) Intrinsic motivation – their desire to be a part of a larger project, to get involved with the home countries and change it to the better, and (3) Strong motivation to advance professionally and economically (Kuznetsov, 2008, p. 268). This so-called "network access", extensively used in the formation of migrant networks in the past two decades, benefits the countries of origin, and brings many benefits for individuals in the diaspora. These networks are presented as a great help to the migration process. Those who have already emigrated provide significant sources of data to those who intend to do the same. Those personal links can be used to avoid or reduce the risks and costs of migration: legal and technical information on the procedures, financial aid, prospects for employment, administrative assistance, physical accompaniment, emotional solidarity, and so on. The impact of these networks on migration flows is also one of their roles, as immigrants are a "bridge" for newly arrived immigrants – both in geographical terms (receiving country), and in terms of fields of work (employment conditions) and housing.

2.1. Characteristics and activities of the intellectual diaspora networks

The main objective of these networks is the usage of highly skilled migrant communities in different receiving countries in order to contribute to the process of motherland development. According to Meyer (2003), intellectual diaspora networks should meet the following criteria:

- Members must be of the same nationality and live and work or study abroad;
- Members must be highly qualified, active in some of the professional fields, with emphasis on science;
- The network must consider economic and social development of the country of origin as its main purpose,
- There must be some degree of funding or connecting among network members, and among network members and their partners in the country of origin.

The emergence of most of these networks is generally initiated by a group of students or scientists and researchers who have recognized the need for this type of initiative. The Internet is the main tool that is used for their establishment, promotion and availability to all existing and potential members. A number of web-based diaspora networks now facilitate commercial investments and public service by members for the benefit of their home country. It is through this type of creative global exchange of information and ideas that new and exciting initiatives are developed (Usher, 2005, p.48). The networks of intellectual and scientific diaspora are intended to improve and speed up communication and exchange of information and resources among members living dispersed from each other, as well as among members and their associates in the country of origin. The main priority is the educational, social, cultural and professional advancement of network members, which is closely connected with the main objectives of this type of networks, since they are important for the economic, commercial, political and social development of the country of origin.

Network members engage in various activities, such as organizing conferences, seminars, workshops, group discussions and various social events – dinners, Christmas and New Year holidays, picnics and so on. In order to ensure economic and social progress of the country of origin, members engage in various joint developmental projects at the level of the network itself, or in cooperation with numerous government agencies and profit and non-profit organizations in the homeland. All networks have their own newspapers (newsgroup or newsletter), published in paper and / or electronic form, as tool of improvement of internal communication among network members and updating on

project plans and the latest developments in the country of origin, as well as publishing the results of current researches. This method of disseminating information enables the influx of new ideas, dialogues and discussions among members and among them and their counterparts in the homeland.

2.2. The *alumni* model of networking

Alumnus (pl. *alumni*) is a Latin word that means a guardianship or a ward. All those who are bachelors, masters or PhDs at some college or university can become members of such associations. Among the sectors of modern society, the university sector has been probably the most successful in congregating its members, known as academic, scientific, intellectual or expert Diaspora, and mobilizing their intellectual, social and financial capital to advance its mission (Mitra et al., 2007). The purpose of alumni associations is providing valuable, timely and reliable communication links among graduates and faculty where they have earned a diploma, as well as the mutual communication of members of this organization. The main goal is the unification of knowledge, strength and power of the people who now work in various fields, in order to benefit all parties. Throughits alumni organizations, academics achieve a nd maintain links with the parent educational institution and communicate with ex-colleagues. Alumni organizations most often have their CV databases, collect and distribute information of common interest to their members, organize meetings, seminars, scientific conferences, open up their websites,usually edit their own newspaper, cooperate with other organizations. Members of an alumni association can, with the help of the organization, continue their own education, influence the development of their faculties and remain in contact with colleagues and friends from university days. The mission of the alumni organizations is creation, development and promotion of mutually beneficial relationships among current and future members and their educational institutions. By the way of acting, commitment and tradition, alumni create strong relations, loyalty and sense of pride in the educational institution in homeland where their members have acquired academic titles. This model, based on simple but strict requirements, has proven to be very instrumental in utilizing precious intellectual capital of academic diaspora. They can be used as the backbone, and can serve as the springboard from which many diaspora activities can be launched. Such activities include financial contributions, but most importantly, engagement of diaspora's intellectual and social capital for the benefit of the entire nation (Filipovic and Putnik, 2009).

3. SERBIAN INTELLECTUAL DIASPORA

Due to the fact that diaspora is a complex phenomenon, it is often difficult to obtain reliable information on the exact number of displaced people and their places of residence, and therefore the number of those with higher education. As most of the diasporas of the world, Serbian diaspora has been formed as a combination of voluntary and forced migrations, which occurred in several waves, four of them in the last hundred or so years. Serbian diaspora communities dispersed around the world, together with Serbs who live in the territory of former Yugoslavia and countries in the region, count almost four million people. Sadly, Serbia has no valid statistics on emigration of highly educated people because the Institute of Statistics of the Republic of Serbia is not qualified to produce this type of evidence, but it is estimated that their share in the total number of emigrants ranges from 12 to 15% (Grecic, 2010). Besides young people who had acquired their academic titles in Serbia and after that went to work abroad, a significant number make those who graduated and stayed abroad. The reasons are numerous: lack of possibilities to find an adequate job, poor state of the economy, job insecurity and complicated and lengthy procedure of diploma validation. Also, a great number belongs to the generation of highly and medium-educated people who went abroad because of the war and mostly did not return to their homeland. In Filipovic's (2011) database of over 6,400 Ph.Ds and doctoral students who live abroad, a large number are significantly represented within professional specialization fields, as well as other areas – academia, research, cultural, entrepreneurial, sport. Filipovic noted that the largest concentration of Serbian Ph.Ds is in three parts of the world: the West coast and the eastern part of the North American continent (USA and Canada) and Western Europe. The largest number of identified Serbian Ph.D's in Diaspora lives in the USA (39 %), 15 % live in Canada, 10 % in the UK and close to 7 % in Germany. The largest number of them works in academia (around 40%), around 33% are in some business, close to 13% do research, and around 14% are in some other areas. Close to 40% of the identified Serbian Ph.D's in diaspora are women.

4. CHANNELS OF COMMUNICATION WITHIN THE SERBIAN INTELLECTUAL DIASPORA

Internal communication plays a very important role in the networking of the intellectual diaspora community members around the world. Communication activities are usually carried out by various organizations, either at the level of individual countries, or at the global level. In order to pursue planned strategies and activities of this type, it is necessary that, first of all, each of the organizations and associations determine target group of the public. The Diaspora, by itself, covers a large human capital, so every organizational subject must determine the criteria to perform the segmentation of the target groups. For organizations that are limited exclusively to territories of certain countries or continents, geographic segmentation is relevant, if their potential membership does not require certain profile and they want to address only to the target public on a particular territory. Demographic segmentation is the key determinant if the segmentation is based on age, gender, or, for example, the time of immigration. In addition, psycho-graphic segmentation is also an essential element and shows common characteristics of groups based on education, membership of social class, occupation. Thus, the primary target group of organizations and associations within Serbian intellectual diaspora are persons with higher education, university, masters or doctoral degrees, acquired at home or abroad, living and working outside of the motherland borders, as well as students of Serbian origin who are enrolled in basic or graduate studies at one of the world's universities. The main task of any institutional form in the diaspora is to determine the communication habits of its target group and reconsider the possibilities of restoration of communication link or improvement of existing relationships.

Tsagarousianou (1999, p.57) states that media in diaspora: "might be a valuable cultural and political resource available

to minority groups, by instituting public spaces of representation and participation and creating an opportunity structure for cultural and political expression, dialogue and self-definition by members of ethnic communities." Research about media in diaspora, conducted in 2007 by the Serbian Ministry of Diaspora, shows that most respondents access media content via the Internet. This category includes Internet radio and television, websites, blogs, magazines, newspapers that have on-line form, social networks. One third of the diaspora members cited say that print media also have an important place. The most frequent topics of the Serbian diaspora newspapers are actual happenings in Serbia, then topics related to the local Serbian community or country in which the Serbian minority lives.

Results of previous researches suggest that it is necessary that diaspora organizations form their own sites, which will provide potential members and other parts of interest with accurate information about their own activities, goals and plans, and any other information of relevance. Sites must be regularly updated, and there must be people in charge to communicate with all stakeholders. Communication with members must be regular, conducted by telephone, e-mail or personal contact, to ensure their commitment to joint tasks. In addition, by using modern technologies, organizations can create content of mass communication and reach a much wider audience with a significantly lower cost than by using of traditional media. Organizations can communicate with its target audience through email, online forums and other interactive media. Interaction as the way of presenting information from various perspectives builds a sense of community among users, in the same way people share their life stories and experiences. Opportunities that social media provide to an organization are: careful listening to their target group, objective insight into its reputation, understanding the target audience, direct communication with individuals, releasing them of an impression of the faceless crowd, getting positive feedback and immediate identification of crisis situations, the use of e-learning activities. For all these reasons social media are a very important communication tool among members of the diaspora network who are spatially far apart.

Preferably, organizations should issue internal sheets, brochures or leaflets, available to all interested parties. Organizing special events, such as various conferences, celebrations and mass gatherings of the similar type is also a significant aspect of development and improvement of internal relations within the intellectual community abroad. Organizing conferences and special events in wich diaspora members take part is a possibility of direct communication among members, sharing ideas, planning and finding ways to improve cooperation. These events are organized once or several times a year by the individual organizations and require preparation of several months, as the planning agenda, and all other elements (to make a list of guests, making a call, informing the media, providing space, materials preparation, etc.). Many special events of this type take place in Serbia. The advantage of organizing events in Serbia is that it allows gathering of the diaspora members with relevant interlocutors in the country and their compatriots from other states. Such events, which bring together among 500 and 2,000 people, usually take place during the period of summertime – June and July, when representatives of the diapora mostly visit their home country, and during the winter period around Christmas and New Year holidays. Planning and oganization of these special events is mostly conducted by individuals within a specific organization, in charge of these tasks, and rarely specialized agencies are being engaged. The objectives of organizing diaspora special events are the following: improvement of the image of the organization, establishment of contacts among certain groups of people, making the public familiar with the activities of an organization, the intent to engage participants in special events in some project, creating a positive echo in the media, etc.

5. METHODOLOGY AND RESEARCH OBJECTIVES

In an attempt to determine the level of existing internal connection, members of the Serbian intellectual diaspora were asked to fill in a questionnaire. It was administered to a representative sample of respondents during the period February-June 2014. The survey was conducted in two stages. The first stage included personal contact with respondents at two special diaspora events, held in Belgrade. 56 respondents were interviewed this way. The second stage included sending electronic versions of the questionnaire to e-mail addresses of respondents. 68 members of the diaspora were interviewed in this stage. The questionnaire contained questions relevant to the field of internal communication, and the results of this study portray the current state of internal coherence from the perspective of the respondents, a possible correlation of key concepts and variables, as well as conclusions concerning the possibilities of improving the current situation and improving the internal connections and relations.

5.1. Sample description

The sample includes 124 participants – members of Serbian intellectual diaspora. Thirty-seven respondents (29.8%) of the sample were female, and 87 respondents (70.2%) were male. The larger number of the male respondents is due to some limitations – the majority of the participants in two special events, interviewed "face to face", were male, as well as the majority of those who responded through the electronic version of the questionnaire.

The subjects were classifed into four categories according to age, as follows: 50 respondents (40.3%) were younger than 30 years; 40 respondents (32.3%) were aged 30 to 40; 18 respondents (14.5%) were aged 40 to 50, and 16 respondents (12.5%) were older than 50. The highest percentage of women in the sample (38%) is under the age of 30, while the majority of the men (82.5%) were aged between 30 and 40.

The subjects were grouped into four categories by level of education: students – 11 respondents (8.9%); with a university degree – 60 subjects (48.4%); with the title of Master – 36 respondents (29%); with the title of PhD – 17 respondents (13.7%).

For easier data processing, the respondents were categorized by the regions of the world where they are based, in the following way: European countries (36.3%); countries in the region (autochthonous population (see Filipovic, 2011) – Slovenia, Croatia, Macedonia – 13.7%); United States, (17.7%); Australia (21%); Canada (8.9%); Africa (1.6%); Asia (0.8% of the sample). Young people from Serbia more often choose to study in the United States, Canada, or western European countries – UK, Germany, France and Italy. The remaining three educational categories most significantly move to Europe, rather than the United States, followed by Canada and Australia. Seen from the perspective of gender, the majority of both men and women choose to move to Europe, USA, and Australia. Based on the length of living

abroad, most of the respondents answered "more than 15 years" (45, 2%), while the remaining three categories were relatively uniform: 21% answered "10 to 15 years"; 17.7% "from 5 to 10 years", and 16.1% "less than 5 years".

5.2. Results and discussion

The results imply that gender has no impact on the number of people of Serbian descent they are in contact with (χ^2=1.786,df=2, p<0.05), and most women and men are connected with more than 50 people of Serbian descent who also live abroad (see Table 1).

Number of contacts of people of Serbian descent by gender
Table no. 1

		Number of contacts			
		Less than 20	From 20 to 50	More than 50	Total
Gender	Female	6	8	23	37
	Male	8	26	53	87
Total		14	34	76	124

The results of the survey show that the majority of the respondents, regardless of the age, are in contact with more than 50 people of Serbian origin in the country where they live and work. By comparing the education level of the respondents and the number of people of Serbian origin with whom they have regular contact, a statistical significance has been found (LR=19.905, df=6, p<0.01). The results indicate (see Table 2) that the number of contacts rises with levels of education and, therefore, supports the idea of building large and solid diaspora networks of higly educated individuals.

The number of contacts of people of Serbian descent by education level
Table no. 2

	Number of contacts			Total
	Less than 20	From 20 to 50	More than 50	
Student	0	7	4	11
University degree	6	12	42	60
MSc	6	13	17	36
PhD	0	2	15	17
Total	12	34	78	124

As for the frequency of meeting the other Serbs in the countries they live (see Table 3), the results show there is no significant difference by gender (χ^2=4.623, df=2, p<0,05).

Frequency of meeting other Serbs in diaspora by gender
Table no. 3

		Frequency			
		Once a week	Once a month	Several times per year	Total
Gender	Female	12	15	10	37
	Male	44	31	12	87
Total		56	46	22	124

Further analyses indicate (see Table 4) that age categories have no impact on the frequency of meeting other Serbs in the countries in which the respondents now live (χ^2=11.452, df=6, p<0,05). Opposed to that, education categories (see Table 5) do have an impact on the frequency of meeting other compatriots in the diaspora (LR=21,361, df=6, p<0,01).

Frequency of meeting other Serbs in diaspora by gender
Table no. 4

		Frequency			
		Once a week	Once a month	Several times per year	Total
Age	Less than 30	25	18	7	50
	From 30 to 40	17	12	11	40
	From 40 to 50	5	12	1	18
	More than 50	9	4	3	16
Total		56	46	22	124

Frequency of meeting other Serbs in diaspora by education level
Table no. 5

	Frequency			
	Once a week	Once a month	Several times per year	Total
Student	4	4	3	11
University degree	25	29	6	60
MSc	16	7	13	36
PhD	11	6	0	17
Total	56	46	22	124

Research has shown that the frequency of meeing with other people of the same origin differs by region. For the largest number of respondents who live in European countries the frequency of seeing is reduced to once a month (55.5%).

Serbs living in the region mostly rounded out "once a week" (59.2%). This applies also to the United States and Australia, although the dispersion of those diaspora segments is large. It is in this way the 45.4% of the respondents from the U.S., and up to 80% from Australia answered.

As regards Canada, the same number of respondents, 36.4% , voted for option seeing "once a week" and "several times a year". The respondents who come from Africa rarely arrange meetings with other Serbs, once every few months or several times per year. A respondent from Asia marked "once a week."

Furthermore, this survey shows that male respondents in a much greater number join up various organizations and associations of Serbs (77%) than female ones (23%), so it can be concluded that gender has an impact on decision weather to be part of some Serbian organization abroad (cc=5,485, x^2=6,535, df=1, p<0,05).

Membership of respondents by gender

Table no. 6

		Membership		
		Yes	No	Total
Gender	Female	20	17	37
	Male	67	20	87
Total		87	37	124

Most of the respondents of all ages are members of at least one such organizations – 64% younger than 30, 75% of respondents aged 30 to 40, 72.2% of respondents aged among 40 and 50, and 75% older than 50, so age category does not have a significance when corelated with membership (x^2=1,569, df=3, p>0,05). Unlike that, examination of the correlation between education and membership shows statistical significance (x^2=12.236, df=3, p<0,01).

Membership by age groups

Table no. 7

		Age				
		Less than 30	From 30 to 40	From 40 to 50	More than 50	Total
Membership	Yes	32	30	13	12	87
	No	18	10	5	4	37
Total		50	40	18	16	124

Membership by education groups

Table no. 8

		Student	University degree	MSc	PhD	Total
Membership	Yes	10	38	22	17	87
	No	1	22	14	0	37
Total		11	60	36	17	124

Looking at the regions of the world, 80% of the respondents living in one of the European countries are members of Serbian associations or organizations; and 64.7% of the Serbs in the region; 54.5% in the U.S; 76.9% from Australia and 63.6% from Canada. None of the subjects from Africa was a member of any organization. A respondent from Asia answered positively. The results of this study clearly reflect the positive situation when it comes to the intellectual segment of the diaspora, since all categories of respondents mostly identified themselves as members, indicating a high level of connectivity, networking and acting towards common goals.

As for business cooperation with other Serbs in Diaspora from the angle of education level, the results were the following: 54.4% of those whose studying abroad was still in progress so far achieved business cooperation with fewer than 10 people; 56.7% of the persons with university degrees cooperate with up to ten other Serbs, as well as 47.2% of those with MSc degrees. Finally, 64.7% of PhDs quoted business cooperation with more than 30 Serbs abroad. The fact that the respondents with a PhD are pointed out in this regard can be explained by the fact they mutually associate and jointly engage mostly in the field of scientific and research work. The largest number, 72% of respondents with less than 30 cooperate with fewer than 10 Serbs. 10% of this age group have no cooperation with any person of Serbian origin. 35% of the respondents aged 30 to 40 do some business with more than 30 people of Serbian descent, while 10% do not cooperate at all. 59% of the respondents aged 40 to 50, also do some business with more than 30 people of Serbian origin, while 16.6% do not cooperate at all. All respondents from the age group over 50, pleaded business and cooperation with other Serbs, 56.25% of them even with more than 30 people of Serbian descent. It was shown that younger respondents, who were still students or just started their careers did not have extensive business networks of cooperation with other Serbs, but the number of business contacts increases significantly within the remaining three age groups. 64.5% of all subjects who participated in this survey work in an organization / institution that employed other Serbs.

Regarding the collaboration with organizations and institutions in the motherland, 56.5% of the respondents answered positively, while the remaining 43.5% did not achieve that kind of cooperation. The fact that there was a large number of those who actively cooperate with the mother country tells us that our displaced intellectuals are willing to help their homeland and contribute to its development. From the standpoint of educational level groups, 36.4% of students stated working with various organizations and institutions in their home country, as well as 60% of university graduates, 44.4% of masters and 82.3% of doctors. Considering things from the perspective of years of age, 26% of those who are under 30 cooperate with organizations and institutions in the state. The percentage increases with the remaining age groups from 30 to 40 (up to 77.5%), from 40 to 50 (77.7%) and over 50 (75%).

As far as the institutions they most commonly cooperate with are concerned, the respondents stated the following: Ministry of Religion and Diaspora, Ministry of Foreign Affairs, Serbian Chamber of Commerce, National Bank of Serbia, state agencies, local government authorities, youth and cultural organizations, Matica Srpska, the Serbian Orthodox Church, as well as different companies. In terms of cooperation with institutions and organizations in the Republic of Serbia in the future, 71% responded positively, 27.9% negatively, and 1.6% declared nothing. Even 90% of the students from abroad intended to restore collaboration with Serbian institutions in the future, as well as 65% of university-educated respondents, 69.4% of masters, and even 93.7% PhDs. The results are optimistic toward the possibilities of mobilisation of human resources from the intellectual diaspora, which will certainly have a positive effect on the state of Serbia.

The types of cooperation which surveyed members of the intellectual diaspora intend to achieve with the motherland were following: economic cooperation (46.3%), cultural cooperation (54%), scientific collaboration (32.5%), investments (23%), humanitarian assistance and grants (6.4%), cooperation with educational institutions (21.6%), cooperation with political parties (16%), cooperation with sports clubs, youth associations, and so.

6. CONCLUSION

As a result of the many economic and political factors and the impact of globalization, the migration of people from all continents has increased. The directions of migration are mainly focused on less developed countries, from which people migrate to industrialized nations. This phenomenon is clearly present in Serbia, which is, in historical terms, a traditional emigration country. A significant number of professors, scientists and researchers left the country of origin and continued their work in the United States, Canada or Western Europe, where they found much better working and specializational options. The students of Serbian origin who chose to study abroad, according to research findings, usually remain to live and work there. "Brain drain" is, inevitably, a huge loss for the countries of origin, but on the other hand, little is done so that the situation can change. However, in recent years, the state of using the resources from diaspora, not only in economic terms but also in the intellectual sense, has been highly supported.

Establishing and development of diaspora networks, as well as different types of organizations in all parts of the world where Serbian diaspora exists, should be strongly supported. Understanding the basic form, manner and process of communication flow is the key to successful exchange of information among members of the internal public within the diaspora organizations. The objectives of internal communication should be based on developing awareness of the importance of networking process, precise and comprehensive definition of mission, vision and strategy of such organizational form and continuous improvement incentives. The initial phase of this process includes defining the current state of the system, identifying obstacles, delays and strain point of the process of communication, with an analysis of key barriers to communication. Improved internal communication can be achieved by combining existing, or establishing new communication channels. It is vital that organizations regularly and promptly monitor and implement the latest technologies, because it is an important factor of efficiency and effectiveness of communication.

The results of this research reflect the existence of a positive attitude among members of Serbian intellectual diaspora in terms of their internal connecting and joining forces. Most of the respondents of both sexes, all ages and levels of education regularly contact and cooperate with their compatriots in diaspora, but also with many institutions and individuals in Serbia. It is necessary to use the available resources in the best possible way, by uniting and gathering as many people of Serbian descent throughout the world, not only for financial aid programs, but also for establishing a wider range of cultural, educational and economic ties with the homeland.

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BRAIDING AND KNOTTING THE PRICES OF STOCKS

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***Abstract**: A simple and elegant arrangement of stock components of a portfolio (market index-DJIA) in a recent paper [1], has led to the construction of crossing of stocks diagrams. The crossing stocks method revealed hidden remarkable algebraic and geometrical aspects of stock market. The present paper continues to uncover new mathematical structures lying in crossings of stocks diagram by introducing topological properties the stock market is endowed with. The crossings of stocks are categorized as overcrossings and undercrossings, and are interpreted as generators of braids that stocks form in the process of prices quotations in the market. The topological structure of the stock market is even richer if the closure of stocks braid is considered, so that it forms a knot. To distinguish the kind of knot that stock market forms, Alexander-Conway polynomial and the Jones polynomials are calculated for some knotted stocks. These invariants of knots are important for the future practical applications topological stock market might have. Such application may account for the relation between Jones polynomial and phase transition statistical models to provide a clear way to anticipate the transition of financial markets to the phase that leads to crisis. The resemblance between braided stocks and logic gates of topological quantum computers could quantum encode the stock market behaviour.*

***Keywords**: crossing of stocks, braiding stocks, knotted stocks, Jones polynomial, topological stock market, topological quantum computer.*

1. INTRODUCTION

The recent paper [1] proposes a way of interpreting the behaviour of market indexes as a multivariate time series that results by arranging the index stock components in a simply particular manner. Prices of the stock index components are arranged in a table in ascending order starting from smaller stock prices, on the left, to companies having higher stock prices, on the right. Colouring every stock prices time series in a different colour is the way for keeping track of each stock price quotations in the arranged table. Although simple, this technique of arranging the stocks encodes immense mathematical potential and unlocks some remarkable mathematical objects such as permutations, polytopes, braids and knots, appearingwithin the financial frame.

The most important concept lying in this particular arrangement of the market index is the crossing of stocks. Following the coloured stock time series in the arranged table a stocks crossing diagram can be drawn. The crossing of stocks diagram explicitly shows the moments when the price of a stock comes over or under the price of its neighbouring stock in the table.

To exemplify the stocks crossing diagram with examples from the real stock market, in the section 2, the market index is chose to be Dow Jones Industrial Average (DJIA) with its components. Prices of a fraction of all 30 components of DJIA are arranged in the manner explained above, starting from CSCO, which is the lowest priced stock, up to the highest, PG, for the market reference date 5/15/2013. To simplify the understanding of these particular diagrams, only 4 stocks are retained and will represent the main constituents to exemplify the new mathematical concepts.

Section 3 introduces the notions of overcrossing and undercrossing of stocks as generators for the stocks braid formation. Braids are known since the old times, but their powerful algebraic properties were first revealed last century in the work of Emil Artin [6]. Intermediated by the generators the crossing of stocks diagram is transformed into a braid diagram. The properties of braids as algebraic objects, such as the formation of a group, remained unchanged in the stock market application.

Another important aspect of stocks braid generators is explored briefly along the section 4. In their time succession generators, noted according to financial needs, form words that could "whisper" some important market information to investors and traders.

An important theorem directly connects braid with knot, another remarkable mathematical structure. Accounting for this theorem the braiding of stocks in the market can be represented as stocks knot. Knot formation in the stock market is explained in section 5. Once the stocks are knotted an important question arises: How to distinguish between the various knot types the stocks can form in the process of price quotation in the market?

Answering this question is still an open issue in mathematics, but some remarkable steps forward were taken in the work of Alexander, J. Conway, V. Jones and recently by many other researchers. The answer, to stick to our discussion, is to calculate some polynomials that appear when a skein relation is applied to the crossings of a knot in order to reduce them to none. Section 6 is dedicated to exemplify the calculation for Alexander-Conway polynomial and Jones polynomial, two of the best known and used knot invariants, for knotted stocks.

Having the stock market all knotted and the polynomial invariant calculated it is easy to say what kind of knot is by taking a look in the table of knots. A fragment of the knots table, classified by their Alexander polynomial, is shown in the annex.

Apart from the beauty of the idea of a topological stock market the practical applications of this concept must be questioned. We should emphasize here that the present paper ispart of a broader research project designed to apply geometry and topology to stock market, and many aspects related to practical applications are not yet explored. Still some hints of methods knotting of stocks prices could be of help in financial practice are presented in section 7. The connection of Jones polynomial with statistical mechanics of phase transition models can be exploited to anticipate flash crashes that high frequency trading generates and, to a larger extent, financial crisis. In such scenario the financial crisis is nothing else than a phase transition from a market having a smooth behaviour to a market of a regime prone to sharp, with virtually discontinuous price movements.

The resemblance of the braiding stocks with the logic gates of the topological quantum computer is a second hint about the

ways braided and knotted stocks topology could be applied to financial realities. Under this scenario the Jones polynomial of some stocks knot would represent qubits that encode the stock market quantum states in the way quantum computers operate. It might be a simple speculation, but at the dawn of the cryptographic money era, opened by bitcon, it could have some important connotations.

Leaving aside these speculations, a lot of work is still to be done to uncover the remarkable mathematical objects hidden behind the simple crossing of stocks diagram.

2. CROSSING OF STOCKS DIAGRAM

One of the most important finding in [1] is the prescription to arrange the stock components of a market index (Dow Jones Industrial Average – DJIA) in a manner that allows the presence of relations between stocks to show up as crossing of stocks. Itsuffices to tell that could represent a way to analyse the multivariate time series. Although simple, this technique of arranging the stocks encodes immense mathematical potential and highlights some remarkable mathematical objects such as permutations, polytopes, braids and knots, to appearwithin the financial frame.

Although the crossings of stocks are of crucial importance, the paper [1] has not devotedthis subject the attention that it deserves. This section constitutes an attempt to right this "injustice" by presenting in more details the crossings of stocks diagram and its powerful mathematical advantages.

The index of interest is choosing to be the Dow Jones Industrial Average (DJIA). A fraction of price quotations for some DJIA components are shown in table 1 as daily closing prices for a period in 2013 between 5/15/2013 and 6/7/2013.

A fraction of the DJIA index components sorted by price quotations from left to right at 05/15/2013

Table no. 1

	CSCO	GE	INTC	PFE	MSFT	T	KO	MRK	VZ	JPM	DD	DIS	NKE	UNH	AXP	HD	WMT	PG
6/7/2013	24.5	23.9	24.6	28.3	35.7	35.5	41.4	48.2	50.2	54.3	55.4	64.9	62.8	62.6	78	78.7	76.3	77.8
6/6/2013	24.6	23.4	24.7	28.1	35	35.8	40.8	48.6	50	53.5	54.8	63.1	62.2	61.9	76.2	77.3	75.6	76.8
6/5/2013	24.3	23.3	24.7	27.5	34.8	35.3	40.7	48.7	48.3	53	54.6	63.1	61.8	61.8	74.8	75.1	75.3	76.7
6/4/2013	24.4	23.7	25.4	27.7	35	35.7	41.4	49.4	48.8	54	55.8	64.4	62.8	62.4	76.1	76.6	75.9	77.4
6/3/2013	24.4	23.6	25.2	27.8	35.6	35.1	40.8	48.5	48.7	54.5	56.1	63.8	63	62.8	76.5	79.1	75.7	77.7
5/31/2013	24.1	23.3	24.3	27.2	34.9	35	40	46.7	48.5	54.6	55.8	63.1	61.7	62.6	75.7	78.7	74.8	76.8
5/30/2013	24.4	23.6	24.2	28.3	35	35.5	40.8	47.1	49.1	55.6	56.3	64.7	62.4	64.7	76.1	79.4	75.6	79.1
5/29/2013	24.1	23.6	24.3	28.3	34.9	35.9	41.4	46.9	49.6	54.7	56	66.3	62.9	63.4	75.8	79.5	76.2	78.9
5/28/2013	23.9	23.6	24.1	29	35	36.2	42.6	47.6	50.8	54.6	55.9	66.7	63.3	63.3	76.2	79.8	77.3	80.9
5/24/2013	23.5	23.5	23.9	29	34.3	36.8	42.2	47.2	51.4	53.7	55.4	65.5	62.8	62.1	75.3	79	77.3	81.9
5/23/2013	23.5	23.7	24.1	29.1	34.2	36.7	41.9	47.3	51.9	53.4	55.4	65.2	63.3	62.4	74.7	78.9	76.3	78.7
5/22/2013	23.3	23.9	24.1	29.3	34.6	36.6	42.3	46.7	51.5	53.6	55.6	65.6	64.5	62.3	74.4	79.7	77	78.8
5/21/2013	24	23.7	24.2	28.8	34.9	36.9	42.3	47.3	52.1	53	56.4	65.8	65.2	62.9	75.1	78.7	77.4	78.8
5/20/2013	24	23.6	24.1	28.7	35.1	37.2	42.4	45.2	52.7	52.3	55.9	66.1	65.3	62.6	74.4	76.8	77.4	79.1
5/17/2013	24.2	23.5	24	29	34.9	37.4	43	46	53.4	52.3	55.9	66.6	65.3	62.8	73.3	76.9	77.9	80
5/16/2013	23.9	23.3	23.9	29.3	34.1	37.4	43.1	46.4	53.2	51	55.5	66.5	64.4	62.1	72.2	76.8	78.5	80.2
5/15/2013	21.2	23.2	24.2	29.6	33.9	37.5	42.9	46.7	53.6	51.1	55.6	67.7	65.8	61.6	72.8	77.9	79.9	80.7

It can be easily seen that the DJIA stock components in the table 1 are arranged in ascending order, from the stock with the smallest price quotation (CSCO), on the left, to the stock with the highest price (PG) on the right, at the starting date 5/15/2013.This will be a rule of arranging the stock components of the DJIA index.

Notice that for otherrows of the table this rule is not applied, such that the next day, on 5/16/2013, for example, the price of CSCO came over the price of GE.

To simplify the exposition only four stock components of DJIA are retain further, AXP, HD, WMT and PG. The number of stocks is chosen so that the discussion should be neither trivial, nor too complex.

The price quotations for the chosen four DJIA components are arranged in ascending order, from the stock with the smallest price (AXP) on the left to the stock having the highest price (PG) on the right, at the starting date 5/15/2013. The time series of prices for every stock is coloured in a different colour, as is shown in figure 1 a). The arrangement of stocks fromleft toright in ascending order of prices is preserved for every row in the table, say for every trading day. In this manner the stocks prices will be shifted from their initial positions (see figure 1 a), at the right or left, every time the price of one of the four stocks comes under or over the price of the neighbouring stock, put it in other words every time the stocks are crossing. Figure 1 b) depicted the sorted prices of stocks in ascending order from left toright, and the crossings of stocks become very clear by following the stocks colours.

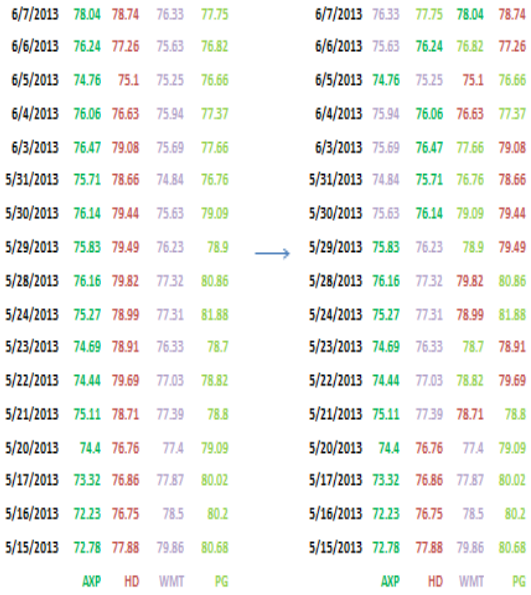

Figure no.1. a) The initial arrangement of stocks b) The prices of stocks are sorted out, and show the crossing of stocks

Notice from the figure 1 b) above that from time to time stocks are crossing. As an example, it can be seen that at 5/21/2013 the closing prices of HD and WMT are crossing. As it was stated earlier the impact of the crossing on the total value of DJIA is, for now, neglected and the attention is focused only on the coloured trajectories the stocks prices take in the DJIA components table.

Bearing in mind only the coloured trajectories of stocks prices, totally neglecting the values of quotations, the figure 1 can be transposed in the picture bellow, where the crossings of stocks become very clear:

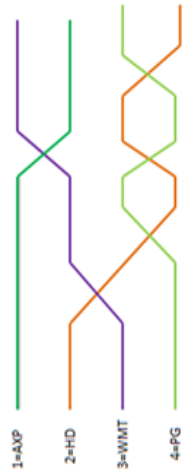

Figure no. 2. Crossings of stocks diagram.

The crossing of stocks diagram, although simple, hides remarkable mathematical properties, which will be explored in the next sections.

3. THE STOCK MARKET BRAID

Braids are known in the day by day experience since the old times. Emil Artin was the first to reveal the powerful mathematical structure of braids, in his paper written in the middle of 1920's. He refined the initial mathematical approach to braids in a series of articles written before 1947.

Generally, braids consists of strands having fixed ends that cross which other. To stick to the four stocks example, an arbitrary 4-strands braid is depicted in the figure below:

Figure no. 3. A representation of a general braid.

It can be immediately noticed that this picture is essentially the same as the figure 2, the remarkable difference is that two types of crossing, overcrossing and undercrossingof the strands, are distinctively highlighted. To relate the crossing of stocks diagram with the braid image, a simple convention designed to clear the issue distinguishing between the two types of crossing in the case of the stocks time series of prices, has to be made. For every crossing of two neighbouring stocks there isa difference between the price after and before the crossing are calculated for both stocks. The differences are taking in modulo since only the net amounts are considered, so that:

$$\Delta_{Stock\ i} = \left|P_{before\ crossing} - P_{after\ crossing}\right|, \quad (1)$$

$$\Delta_{Stock\ i+1} = \left|P_{before\ crossing} - P_{after\ crossing}\right|, \quad (2)$$

where P is the price of the stock. The stock with the higher difference will come over, and the stock with the smaller difference will be under in a stock crossing.

The two cases that can arise are:

$\Delta_{Stock\ i} > \Delta_{Stock\ i+1}$ - the stock i is crossing over the stock i+1, in which case the stocks crossing will be called to be an **overcrossing of stocks**,

$\Delta_{Stock\ i} < \Delta_{Stock\ i+1}$ - the stock i is crossing under the stock i+1, in which case it will be called to be an **undercrossing of stocks**.

The two situations in discussion for the crossing of two stocks are exemplified infigure 4:

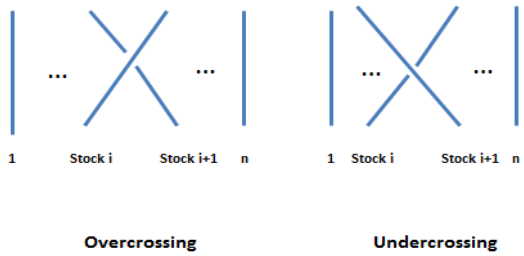

Figure no. 4. Overcrossing and undercrossing of stocks.

The explicit functionality of this schema can be shown in a simple example, coming from the real market price quotations of stocks. Let us get back to the figure 1 b) and analyse the first crossing of stocks that appear as of 05/21/2013 between stocks HD and WMT. Their Δ differences are:

$$\Delta_{HD} = |77{,}39 - 77{,}40| = |-0{,}01| = 0{,}01$$
$$\Delta_{WMT} = |78{,}71 - 76{,}76| = |1{,}95| = 1{,}95$$

so that $\Delta_{HD} < \Delta_{WMT}$, and there is an undercrossing between these two stocks.

Evaluating all the crossings of stocks in the diagram in figure 1b) the representation of the stock market (here only for 4 stock components) as a braid is shown in figure 5.

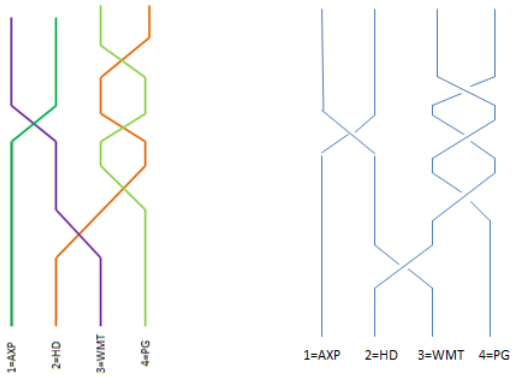

Figure no. 5. The crossings of stocks diagram and its braid diagram counterpart for 4 stocks components of DJIA index.

Mathematically, braids form a group under concatenation, which remains true in the stock market circumstances. The concatenation of two braids is shown in figure 6.

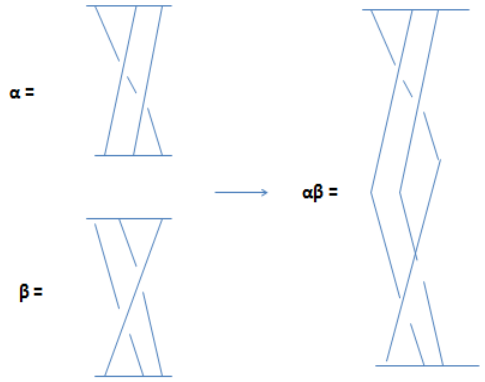

Figure 6.Concatenation of two braids.

Not entering into the algebra of braid group, the picture in figure 6 simply states that two braids can be added, which is a matter of common sense when it comes to stock market.

4. THE STOCK MARKET "WHISPERS" – STOCKS BRAID WORDS

It was stated in the latter sections that braids of stocks can be represented by n-strands that intertwine to form two types of crossing, overcrossing and undercrossing. The convention is to note the overcrossing with σ_i in case the strand generated by the price quotations of stock i passes over its right neighbouring strand i+1 and the undercrossing with σ_i^{-1}, in a reverse situation. The two types of crossings become the generators of the stocks braid, and are sketched in figure 7.

Figure no. 7 .The braid generators.

The ordered succession in time of σ_i and σ_i^{-1}generators constitutes a braid word. To illustrate with an example the notion of braid word let us consider the generators for every crossing in figure 8. The braid word that results is:

$$W = \sigma_2\sigma_3\sigma_3\sigma_3^{-1}\sigma_1^{-1} = \sigma_2\sigma_3^2\sigma_3^{-1}\sigma_1^{-1} \quad (3)$$

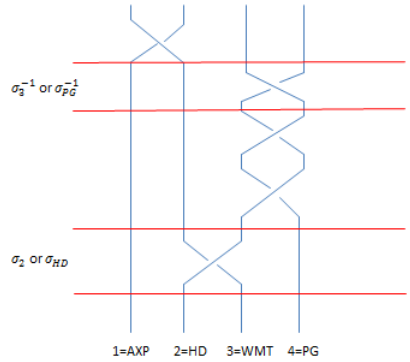

Figure no. 8. Braid generators in the notation adapted to stock market.

In the stock market activity the finance professionals are interested in moving stock prices so that the notation of braid generators changes to account for the needs in financial information.

Assuming the convention of stock notation for braid generators the braid word for the diagram in the figure 8 becomes:

$$W = \sigma_{HD}\sigma_{HD}\sigma_{PG}\sigma_{PG}^{-1}\sigma_{WMT}^{-1} = \sigma_{HD}^2\sigma_{PG}\sigma_{PG}^{-1}\sigma_{WMT}^{-1} \quad (4)$$

What does the market "whisper" to investors by the word above? Actually, a market analyst can extract valuable information from this "weird" braid word formulation. It can be immediately noticed that stock HD formed two overcrossings, meaning that its price follows a bullish trend. PG after some crossings with HD finally find a bearish path and so the WMT stock. Taking a look at figure 1 b) just to compare these results with the real price quotations it could be seen that:

- The price of PG went up from 77,88as of 05/15/2013 to 79,08 at 06/03/2013;
- The price of PG went down from 80,68 to 77,66 in the same period of time;
- The price of WMT fell from 79,86 to 75,69 for the same period,

which is in a perfect accord with what the market "whispers" to investors in the simple word (4).

5. BRAIDS CLOSURE – KNOTTING THE STOCKS IN THE MARKET

According to Alexander Theorem, every closed braid is a knot. A closure of a braid can be obtained by simply gluing together its ends, as shown in figure 9.

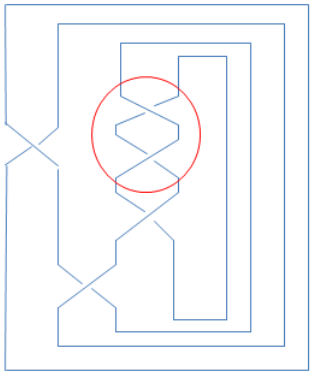

Figure no. 9. Closure of the stock market braid that lie in the formation of a knot.

There are some methods to simplify the diagram of a knot that consist in removing the series of crossings that leave the knot unchanged. The simplifying methods are called Reidemeister moves (see [11], [12]), and there are 3 types of such moves. In the approach to stocks knots only the Reidemeister move II will be used and the figure 10 shows a diagram of it.

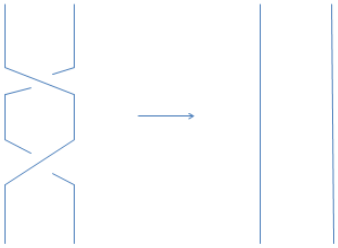

Figure no. 10. Reidemeister move II.

In the red circle in figure 11 it can be noticed that a Reidemeister move II is suited to simplify the knotted stocks, such that after applying the move the knot diagram can be depicted as:

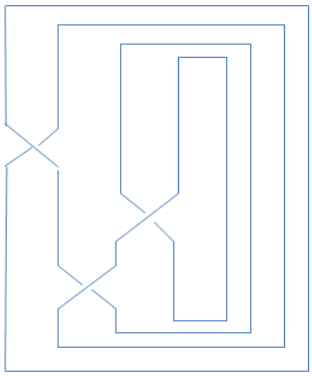

Figure no. 11. Simplified diagram for knotted stocks.

Having the stocks knotted is important to know what kind of knot stock market created in the process of price quotations. The next section will provide the algorithm to distinguish between diverse knots that stocks could create.

6. DISTINGUISHING BETWEEN KNOTTED STOCKS – POLYNOMIAL INVARIANTS

The attempts to ask the important question of distinguishing between knots find the first response in the work of J. Alexander. Alexander's method was largely used, but a surprisingrelation found by Conway made the knots theory a fashion in mathematics. The relation that Conway found is called the skein relation, and it is a polynomial that calculated could segregate between types of knots. The knots theory flourished in the mid-80s, when the most celebrated polynomial scheme was discovered by V. Jones. The applications of Jones Polynomials are vast, and spread over numerous branches of research, from quantum physics to biology, and now to finance.

There are many other, more complicated, knot polynomials, but in this paper the discussion is restricted to the two prior issue mentioned because there are simple and suffice to explaining the stock market behaviour as a knot.

Prior to entering deeper into the description and calculation of knot polynomials a small adjustment to the crossing of stocks interpretation should be made. Since knot polynomials refer to oriented knots an orientation should be given to the knotted stocks. The orientation is naturally that of the time flowing so that an oriented crossing of stocks is that sketched in the figure 12.

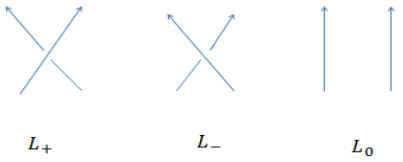

Figure no. 12. Types of oriented stocks crossing.

It could be notice from the figure above that, for convenience in exploring further the stock market knots the crossings were labelled L_+ for an overcrossing, L_- for the undercrossing and L_0 when no crossing appear. This notation is the usual in knot theory being useful in defining the skein relation for the knot polynomials.

The **Alexander-Conway polynomial** $\nabla_L(z)$ of a knot K, as stated earlier, is based on the skein relation Conway discovered. The polynomial is obtained by applying the skein relation to every crossing of a knot until only unknots remain. This method of analysing the type of a knot remains valid also in the case the Jones polynomial.

The skein relation for the Alexander – Conway polynomial is:

$$\nabla_{L_+}(z) = \nabla_{L_-}(z) + z\nabla_{L_0}(z) \quad (5)$$

where z will be shifted to t in the classical Alexander polynomial $\Delta_L(t)$ by the change:

$z = \left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)$ so that the skein relation will be :

$$\Delta_{L_+}(t) = \Delta_{L_-}(t) + \left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)\Delta_{L_0}(t) \quad (6)$$

The **Jones polynomial** $V_L(t)$ of a knot K is obtained by

following the same method as in the case of Alexander polynomial but this time using a skein relation of the type:

$$\frac{1}{t}\mathrm{V}_{L_+}(t) = \mathrm{tV}_{L_-}(t) + \left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)\mathrm{V}_{L_0}(t) (7)$$

From this skein relation it is trivial cu calculate the two types of knot as:

$$\mathrm{V}_{L_+}(t) = t^2\mathrm{V}_{L_-}(t) + t\left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)\mathrm{V}_{L_0}(t) (8)$$

$$\mathrm{V}_{L_-}(t) = t^{-2}\mathrm{V}_{L_+}(t) + t^{-1}\left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)\mathrm{V}_{L_0}(t) (9)$$

These skein relations are accompanied by an important axiom stated that in the case of the trivial knot (the unknot):

$$\Delta_L(t) = \mathrm{V}_L(t) = \mathrm{V}_O = 1 (10)$$

For Jones polynomials we will add another result, which will help in calculation further some knots coming from the stock market configuration. The result, however easy to be calculated, is:

$$V_{OO} = -\left(\sqrt{t} + \frac{1}{\sqrt{t}}\right) (11)$$

and is the Jones polynomial for two unknotted.

Having said all that, for the sake of completeness and exemplification the polynomial for some knotted stocks is calculated. It may not be obvious, but the stocks knot in figure 13 is nothing else than the trivial knot.

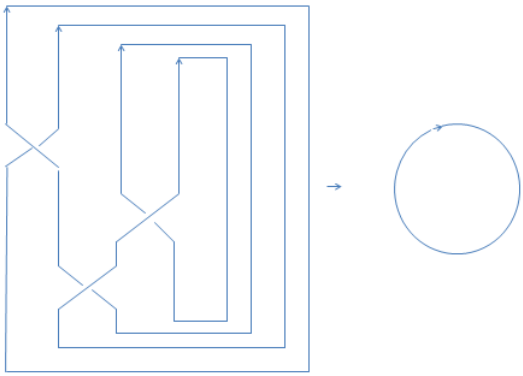

Figure no. 13. The unknotted stock market.

In this case the relation (10) applies, and although it looks complicated, the stock market is unknotted.

Let's get back to the initial stock market configuration in figure 1 b) and choose this time the interval from 5/15/2013 to 6/7/2013 for the quotations of the stocks prices. After applying the Reidemeister move II for some crossings of stocks the final knot diagram is shown to the left of figure 14 along with a more intuitive picture representing the same knot shape to the right.

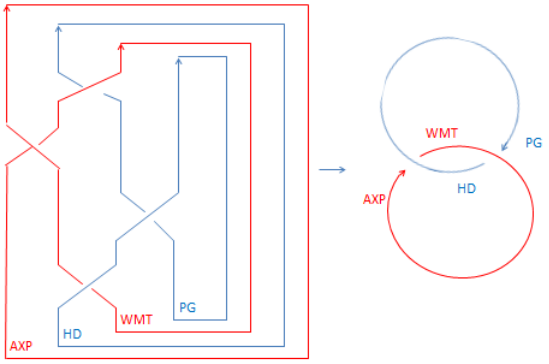

Figure no. 14. The stock market is linked.

The last crossing of the knot in figure 14 is decomposed according to the Jones skein relation

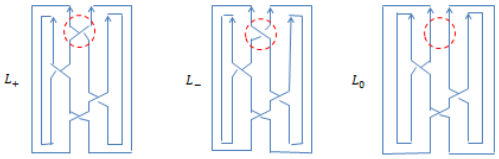

Figure no. 15. The representation of Jones skein relation.

Such that the Jones skein relation is:

$$t^{-1}V_{L_+} - tV_{L_-} = \left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)V_{L_0} (12)$$

From the image of the knots in figure 15 it should be stated that L_0 is unknot as it was said latter and L_- is formed by two unknots, one in top of the other, such that $L_- = L_{OO}$. The skein relation (12) becomes:

$$t^{-1}V_{L_+} - t\left(-\sqrt{t} - \frac{1}{\sqrt{t}}\right) = \left(\sqrt{t} - \frac{1}{\sqrt{t}}\right) (13)$$

After some simple calculation the Jones polynomial for the stock market (in the chosen formation of 4 stocks) is:

$$V_{L_+} = -t^{5/2} - t^{1/2} (14)$$

The representation of the stock market in this case is the **positive Hopf link**.

The Alexander polynomial will slightly differ from the Jones polynomials since in for this knot invariant $\nabla_{OO} = \Delta_{OO} = 0$. The scheme for calculation is shown in the figure 15 and is the same as in the Jones polynomial exemplification.

The calculation according to the Alexander-Conway skein relation is as follows:

$$\nabla_{L_+} = 1\,\nabla_{OO} + z\,1\,\nabla_O$$

$$= 0 + z = z \quad (15)$$

and in classical Alexander notation:

$$\Delta_{L_+} = t^{1/2} - t^{-1/2} \quad (16)$$

This result is trivial in the mathematical literature, still for knots having more crossings there are tables containing polynomials at which a polynomial that result in calculating the market stocks crossings can be compared with. In such way a polynomial can be assimilated with a certain knot. The appendix illustrates a fragment of a knots table taken from the Encyclopedia of Mathematics site.

7. RELATION WITH STATISTICAL MECHANICS AND QUANTUM COMPUTING

Now having the stock market all knotted and the resulted knot find itself classified in tables, the question is what is the good of such a representation. Leaving aside the beauty of the idea of a topological stock market, the eternal Wall Street "show me the money!" aspect remains. The question boils down to "how can I profit from this knots, braids or geometric shapes?"

We would like to stretch out from the beginning that the mathematical aspects in this paper are part of a larger research project looking to apply topology and geometry to financial realities and much work is still to be done in this particular field. As a result, large parts remained yet unexplored. Still, some speculations about possible applications of stocks topology can be made.

We will emphasize here the remarks of V. Jones about the connection of the Jones polynomials to statistical mechanics. Although, not explored yet as we stated earlier, it looks to be a promising candidate in forecasting mini-flash crashes and to some extent financial crisis.

Many financial analysts came to the conclusion that flash-crashes and by extension financial crisis are the market phase transitions from a smooth behaviour to a regime marked by discontinuities in prices movements.

We will quote here a short section of an article Mark Buchanan wrote on his personal blog:

"…a key determinant of market dynamics is the diversity of participants' strategic behaviour. Markets works fairly smoothly if participants act using many diverse strategies, but break down if many traders chase few opportunities and use similar strategies to do so. Strategic crowding of this kind can cause an abrupt phase transition from smooth behaviour into a regime prone to sharp, virtually discontinuous price movements. One fairly recent study suggested that high-frequency trading may be pushing modern markets through such a phase transition, with the breakdown of the continuity of prices movements (lots of mini-flash crashes) being one major consequence. The underlying phase transition phenomenon may therefore be quite relevant to policy. I know of nothing in traditional equilibrium economic analysis that describes this kind of phase transition."

Turning to Jones polynomial, as V. Jones puts it in [4], [10], referring to phase transitions models (Potts and Ice-type) in statistical mechanics:

"*thus the Jones polynomial of a closed braid is the partition function for a statistical mechanical model*" and

" *It is a miracle that the choice…gives the Jones polynomial of the link defined by D as its partition function* ".

Knowing the Jones polynomial for knotted stocks in the market could directly define the partition function of a Potts model associated to stock market, so that it could anticipate the mini-flash crashes related to market phase transitions generated by high-frequency trading activities. It also at a larger scale, anticipates the financial markets phase transition to a crisis like the one experienced in 2007-2008.

Anticipating the stock market phase transitions is equally important to market participants, and also to market regulators that could create policies to prevent financial crisis.

We would not end this section without mentioning an intriguing resemblance of the braided stock market with the newly discovered Topological quantum computer. As the topology of the stock market is constructed from braiding the stocks, the quantum circuits in the topological quantum computer are constructed from braiding of anyons (see [5], [8], [9]), so that their invariant polynomials (the Jones polynomial) are the qubits. This association of facts led to the astonishing conclusion that the stock market states could be quantum encoded by qubits resulted from braiding the stocks, so that the stock market itself is a topological quantum computer. Leaving aside these simplest speculations, it should be said that at the dawn of cryptographic money era, opened by bitcoin, this result might have more important connotations then the speculations above shows.

These issues remain open for now, and they will be explored in future research.

8. CONCLUSIONS

The paper [1] proposes a new method of interpreting the behaviour of market indexes or a particular choice of a portfolio of stocks. In the above-mentioned paper the stocks composing the DJIA index are arranged in a table in ascending order of price quotations from the right to the left. To keep track with the original time series of any stock every stock price quotation time series is coloured with a different colour.

Under this scenario of arranging the stocks prices, a beautiful diagram showing the crossings between neighbouring stocks can be depicted. This particular vision of stocks unlocks some remarkable mathematical objects, such as permutations, matroids, braids and knots.

The present paper introduces a topological approach of the stock market intermediated by braids and knots that stocks form in the process of price quotation. The crossings of stocks are categorized as overcrossings and undercrossings, and form the generators for the building the stocks braid.

The braid generators in their time succession "write words" that could give investors important insights about stock market state.

Gluing together the ends of a stocks braid it lead to the formation of a knot, a beautiful topological structure that became a mathematical fashion at the end of the last century once V. Jones discovered its polynomial invariant (see[2]). The Jones polynomial and Alexander-Conway polynomial are used here to distinguish between knotted stocks. Knots are classified by their polynomial in tables and a fragment of such table is shown in annex.

The topological aspects stock market could appear in many financial applications but only two of them are briefly sketched in the present paper. Taking into account a remark of V. Jones that Jones polynomial of a close braid is the partition function of a statistical mechanical phase transition model the polynomial of knotted stocks could provide a clear way to

anticipate the transition of financial markets to the phase that leads to crisis.

The resemblance of the braiding stocks with the logic gates of the topological quantum computer is a second hint about the ways braided and knotted stocks topology could be applied to financial realities. Under this scenario the Jones polynomial of some stocks knot would represent qubits that encode the stock market quantum states such a way that only topological quantum computers could decode. It might be a simple speculation, but in the down of the cryptographic money era, opened by bitcon, it could have some important connotations.

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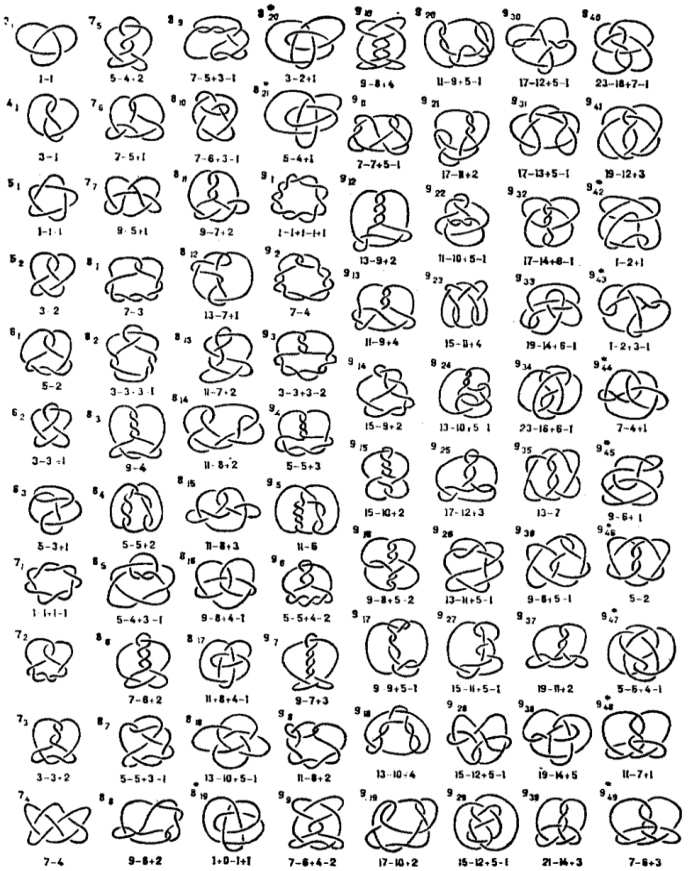
APPENDIX

Classification of knots by their Alexander polynomial – a fragment of the knots table.



A SOCIO-PHYSICAL APPROACH TO TAKING DECISIONS IN SOCIAL CONFLICTS. 2nd PART: SOCIO-PHYSICAL MODELS IN NEGOTIATING AND IN PROMOTING "ROŞIA MONTANĂ" PROJECT

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In order to model the negotiation processes occurring between the partners to a contract (e.g. in a joint venture), and promotion by the partners of the project that is the object of the agreement, and in monitoring these processes of negotiation and promotion, it is useful to make use of the Dimensional Analysis (DA) of the respective processes, through the following Postulates: of Inertia (PI), of Proportional Action (PP), of Action and Reaction (PAR) and of Superposition of Social Forces (PSSA), as well as models of Experimental Data Processing (EDP).

To begin with, there will be considered that two partners of the contract are involved in the negotiation process considered, the buyer and the seller of the goods or services for which the agreement is concluded, in our case, the exploitation of gold-and-silver ore at Roşia Montană.

In negotiating a contract or in finding a solution, it is to start from the different positions of the two partners to the contract, who try to promote their conflicting interests, and then, gradually, the two positions are altered through negotiation and compromise, until equilibrium is reached, at a common, intermediate position, resulting from the negotiations, which corresponds to the equality of the resultant forces, that of action and that of reaction. The final situation is recorded in the contract(s) (the general agreement, or the partial agreements, for example, on: licensing, pricing, environmental protection), which are signed by the partners and bind them in order to implement the project in question, during its life: debut, implementation, up toits completion and the liquidation of all the consequences of the project in time.

As a rule, many other forces besides the main forces, forces which overlap the main forces (PSSA), are involved in achieving the equality of the active and reactive main forces (PAR).

Such influence forces could be: the estimated earnings, the risks taken, the resources used, the lobbying actions, the actions of buying agents who will act (legally or not) against the force opposing the agent's employer, media intervention, the intervention of politicians having bearings at various levels of decision, the rules of the auction, the constitutional framework, the legal provisions, party interest groups, collegial interests, local interests, the accountability and immunities regime, costs of environment protection (natural, human, cultural, historical environments), cost of anti-terrorism, anti-subversion or anti-sabotage protection etc.

We may consider the partners to the Agreement, the Company (abbreviated as C) and the State (abbreviated as S), as opponents or adversaries in the meaning used in sports, and also in terms of the Postulate of Action and Reaction: opponents have opposing interests in matters of "zero sum" that are negotiated between them (as well as certain interests to third parties, with different weights for each part).

In the interval where nothing is changed in the agreement on the project, and no further action, not provided in the agreement in force, occur, according to the first postulate, that of "inertia"[38] (PI), the project follows the course agreed on (*status quo antem*).

The evolution established by the agreement is also maintained if the additional actions of the partners on the project, stipulated in new agreements, are correlated, being equal and contrary, thus not altering the equillibrium and the progress of the project (PAR)[39].

If, in the course of the implementation of the Project, additional unequal actions coming from the two opponents (C and S, the Contracting Parties) occur, diversifying (PSSA), increasing or decreasing the forces involved in generating the partners' respective actions under the contract, the project may change its course, and a new resultant force is involved, which can possibly be determinative, a force that applies to the project, which determines the sense, direction and magnitude of the acceleration or rate of project change, in keeping with the Postulate of Proportionality[40] (PP).

Socio-physics models can be very useful to the parties, auditors and objective assessors of the agreement in question, the investigators etc. Being general, the models introduced in the paper are useful in many other conflict situations involving decentralization, regionalization, subsidiarity, local autonomy, positive or negative discrimination of social groups etc.

Even if it they are not informed by the opponent, having noted a change in the course of the project (a deviation from the *status quo antem*), the interested party, the partner to the agreement or the external evaluator of the project, a third party, the media, can conclude that a new force is acting, a force not stipulated in the contract, and, applying PP, after the vector evaluation of the intervening force, the direction, sense and magnitude of the change observed in the field, may determine a number of characteristics of the force applied and the generator of the action – the opponent, for the partner,

[38] The first law of Newton, the law of **inertia**: "*All bodies remain at rest or in uniform rectilinear motion as long as other forces do not act on them, or as long as the sum of the forces acting on them is zero.*" $\boldsymbol{F = 0}$ >>$\boldsymbol{v = v_0}$= *constant. If the resultant force be zero, a body maintain a constant speed*. This law of inertia is known in social life as the postulate of inertia – **"status quo antem".**

[39] **P III**, **PAR** – the model is based on Newton's third law, the law of **action and reaction**, "*When a body A exerts on another body B a total force* $\boldsymbol{F_{A,B}}$ *(called the active force), the second body B always exerts on the first body a total force* $\boldsymbol{F_{B,A} = -F_{A,B}}$*, (called reaction force) of the same size and in the same direction (co-linear), but in the opposite sense.*"

[40] Newton's second law, the principle of **proportionality or of proportional action**: $\boldsymbol{F=m*a}$, "For systems of constant mass, the acceleration produced by a resultant force is proportional to that force in magnitude and acting in the same direction and sense as the direction and sense of the acting force".

respectively – the party that violated the agreement, for the external assessor.

This new force, which was not stipulated in the contract, may be due to the direct action of one of the two partners to the agreement (identified as C or S), the action of an agent of one of the partners, a third human party (T), an external entity (accident, unforeseen action from the environment); PP can indicate on which side the party agent or the outside entity had intervened.

COMPLEXITY OF NEGOTIATION AND PROMOTION PROCESSES

The negotiation process in social life is not a simple, one-dimensional process, but rather a complex, multi-dimensional one (DA), involving many components: financial aspects, material resources, protection of the natural environment, protection of secondary resources, protection of historical heritage, finding an alternative way for sustainable development, economic propaganda, political propaganda, nationalistic propaganda, environmentalist propaganda, so that it is necessary to consider that there are multiple simultaneous ways of competing actions, which can modify, with specific and total costs, and with different effects, the negotiation of an agreement, the final agreement, the dynamic stability of the evolution of compliance with the provisions of an agreement, the effects subsequent to the termination of the agreement.

In such situations, models based on the Principle of Superposition of Social Actions can be used– a principle which derives from the principle of superposition of forces in physics[41].

The magnitudes that enter the socio-physical equations introduced must be defined so that (DA) the dimensions that characterize them are fundamental and be able to assume descriptions that are comparable not only qualitatively, but also quantitatively (by using the same sistem of units), when comparing the relevant costs.

AGENTS OF THE PARTNERS

The agent that promotes the interests of a partner can be legitimate or not, paid to make lobby, or bribed. The agent acting for a partner can be a double agent, who simultaneously acts also as a representative of the opponent of the partner he/she represents or even a triple (multiple) agent representing (a) third party (ies). The representative of a partner can act as representative of the opposing partner, not being informed or being misinformed, being incompetent or corrupt, and thus acting to the detriment of the partner that he/she is officially representing, that is in opposite direction from what may be assumed from his/her affiliation or commitment.

In social phenomena, the owners do not interact directly with each other, but rather in a mediated manner, through their representatives – for example, private shareholders are acting, through a registered company, on the stock exchange, and the public shareholders (citizens) through public bodies (company, trust, department, ministry, government, etc.) who are their representatives, and it is these representatives who negotiate, sign and conclude the contract on behalf of the shareholders. The violations of the social action-reaction equilibrium may occur, not only between the representatives of the two partners, who negotiate, decide and implement, but also between the owners (shareholders) of the two opposite sides, between owners and their representatives of the same party, or between the owner and the representatives of the owner of the opposing party.

Third parties can influence the interaction of the two partners, of the two groups of shareholders, and thus influence the agreement between them, in a direct or a mediated manner, through their representatives or agents.

RECOGNIZING THE AFFILIATION OF AN AGENT

The affiliation of the agent of a party can be recognized (by applying PAR) through the direction and purpose or sense of his/her action, because, for example as an agent of party C, he/she can, in order to convince the opponent S, underline and exaggerate the possible loss of party C, which he/she is representing, while exaggerating the possible gain of opponent S, if the contract or its modification by negotiation could be done as C wants, and threatens that C, the party that he/she actually (and secretly) represents, will gain at the expense of the losses of opponent S (which he/she greatly exaggerates) if S did not respond to requests by C. And the other way round, for the other side.

An undercover agent of a party, for example C, may even be the representative (evaluator, negotiator, and decision-maker) of the party S.

Representatives of the parties of a contract, C and S, can also be agents of a third party T, who is supposedly nonpartisan, but more often than not is a "smart guy", a third party who would benefit (as a possible go-between) from both sides, to the detriment of both initial partners, who are mutual opponents when it comes to making a profit, yet partners in the damage generated by the third party.

Judging by the criticism the agents express, the solutions they propose, the approaches they use, the actions they undertake to change the contract or the very legal framework to allow the modification of the contract they want, the affiliation of the initiators of the modification can be easily determined, by analyzing, in a careful and well-correlated manner, the sense of the changes proposed, thus estimating in whose favour, and which opponent (and partner in the project) will benefit from the changes proposed and obtained and eventually, how large be the benefit.

NGOs, and even bodies of the state power[42], or representatives of foreign states or of international organizations, can act as corporate agents of one of the parties, who can go as far as arranging diversions in important moments.

The press, or the media in general, who say they are "neutral", conducting "unbiased" debates, but actually acting as agents of one party, are relatively easy to recognize by the dissymmetry of the advertisements they publish as to the options described, even though these advertisements are not directly paid by one of the opponents, but rather via NGOs, for example, NGOs which are funded by the interested party.

[41] **PSF** "*If several forces are exerting on a body at the same time, each force produces its own acceleration independently of the presence of the other forces, and the resultant acceleration is the vector sum of the individual accelerations*". $\sum_{i=1}^{n} \vec{F}_i = m\vec{a}$

[42] According to the opinion stated before the Special Parliamentary Commission by a minister initiator of the draft law on Rosia Montana Project, "the Romanian state is vulnerable only if the project is not implemented". Who's agent be him?

Because, sometimes, the State, when it is the sole owner of a resource (e.g., mineral resources), is the only entity entitled, by the agency of an organ of the executive branch of power of the state, to conclude an agreement (of exploration or exploitation, for example), it is necessary that the arbitrator should be external to the two partners, i.e. to be a body independent of the contracting executive at the level where the State is a party, or as the case may be, even independent of the executive, i.e., and internal legislative or judicial body, or an international authority, competent in Romania, which could be competent to act as a neutral arbitrator.

LIABILITY OF THE REPRESENTATIVES OF THE PARTNERS

The representatives of the contract partners are remunerated at the expense of the public or private shareholders, and in keeping with the PAR, they are answerable for their actions and decisions to the shareholders, who pay their salaries just to be represented by them.

The wages (or compensation) paid to the management executives of the exploiting company are public. They range between CAD$ ~700,000 and a few thousand $, a year. Their material liability is regulated by the Rules of the Toronto Stock Exchange and the shareholders agreement.

The wages of the representatives of the public shareholders in Romania are seldom published and, moreover, their material liability is not completely known.

As far as the Romanian partner is concerned, various ways to alter, mitigate, pass over liability of representatives have been attempted, and are still being attempted:

- Concluding the initial agreement at the lowest decision level possible, for example – that of the enterprise.
- Delegation of signature right at a lower fevel and pressure on the subordinated people by hierarchical blackmail for committing an illegal, act as required.
- Passing it over horizontally, between state bodies, in various stages of negotiation – between departments, or between ministries, when different ministerial responsibility is in place.
- Sending a contract that is prejudicial to the State for approval (e.g. Rompetrol, Roşia Montană), vertically, up to competent entities who are protected by immunity – Parliament, President of the country, and possibly even submitted to a referendum voted by the sovereign people.
- Imposing terms, by law or other regulations, which exclude a possible activity alternative to that stipulated in the contract, which would disadvantage the Company.

One of the solutions at all levels, in which representatives of the two partners (opponents) are protected from their own shareholders and third parties for their actions and create their leeway in future, unmonitored by shareholders or third parties, is **classifying the agreement** (and, of course, the negotiations), the representatives being thus defended against third parties, but also against the shareholders of the respective party, whom they actually represent, and who, not having access to information, having no knowledge of the real facts, can easily be misled about the meaning of the subsequent actions of their representatives of their actions, declared as being in the interest of the shareholders they represent, and not, as it actually frequently happens in actual fact, purely in the interest of those representatives, who are possibly easy to corrupt directly by the opponent, or by that's visible or undercover agent, who can sometimes be found even among the representatives of the injured party.

By classifying documents, one can hide, from one's own shareholders and from third parties, the real reasons of some amendments to the contract generated, required or imposed by the adversary.

In considering the balance between rights and obligations, important roles are played by the law of public servants' liability, the law of ministerial responsibility and the Constitution.

Since, under the Constitution, deputies and senators are elected directly by the people, they enjoy immunity for their actions as members of Parliament – vote, political statements etc. Because MPs cannot be punished, there are attempts at transferring some decisions, which would clearly violate public interests and should be made by the executive – at various levels, by the latter, upwards in the hierarchy, and even to the legislative, in different ways.

Since the legislative cannot decide on an individual contract proposed to become a law (DA), an initial individual contract is changed so that it becomes and emergency ordinance or directly a draft law, which could appear to open access to any candidate as a contractor, while also including in the text of the document one or more clauses dedicated to the interested company, which would exclude other contractors from the outset.

Since an agreement is not a public rule that can be adopted by a legislative body, attempts are made at establishing a rule or a standard, apparently of general applicability, but in fact allowing to conclude such agreements (for Roşia Montană, for non-renewable resources) with a sole bidder selected beforehand, for example by imposing restrictions of minimum scale, restrictions of technological monopoly etc., which are contrary to the present and future historical national interests.

For example, the content of noble metals in the final product, defined in the Roşia Montană project as "boullion doré", cannot be detected by the Romanian customs authorities, and the detection device may only be approved internationally if the annual amount of the product being inspected exceeds 10 tonnes of fine gold, an amount which is virtually less possible to achieve through the Project. Therefore, the legal premise is created that the noble metals in the final product cannot be checked when exported for refining, very much as the numerous samples sent for detailed analysis abroad have not been checked as the noble metals content be concerned.

This method of breaking free competition by dedicated clauses in the legal frame is taken over from the auctions at lower level, where dedicated clauses are commonly included, and those who make the bidding rules often elude their liability for the content of the regulation in question, which vitiates free competition among bidders, *ab initio.*

EFFICIENCY OF THE AGENT OF A PARTNER

The efficiency of an action by the agent of a partner can be defined as *the ratio between the gain expected by the partner, accruing from that activity of the agent / total price (including taxes and brokerage) paid so that the agent performs that action in favour of that partner*, legally or through or corruption.

For example, knowing the gain through amplification (leverage, gearing) that is usual for bribery, in the given social context, it may be possible to get indications to determine the size of bribery, in addition to its direction. Conversely, learning the amount of bribery one can estimate the estimated illicit gain of the bribing party (in Romanian actual context up

to hundred times the bribery value). From the Postulate of Action and Reaction we can determine the intensity of the action that is to be undertaken by the partner who is adversely affected by the modification observed, which is generated by the action of the opponent, so that a new agreement be concluded, through which the actions of the two negotiating partners, the opponents, could be re-balanced, so as to have the resultant reaction force equal to the resultant action force (PAR), and the, now stable, system might subsequently evolve to reach a new state of equilibrium.

In most cases, each partner acts by means of multiple forces (PSSA). For instance, evaluating the specific cost of each type of action involved in reaching the agreement (although this may sometimes be very difficult) and the relative weight of each action, a party to the negotiations may greatly increase the absolute magnitude of an action that is cheap, e.g. aggressive media propaganda, decisions of local decision-makers, and by so, changing the resultant of the forces and having total costs that are much lower than if a different kind of action be used, on account of the huge differences between specific costs – for example, between the total cost of propaganda (e.g., money paid to support the false idea that the technology applied is safe rather than cheap and outdated, being banned, or about to be banned, world-wide) - a cheap one, and the cost that would have go into the effective protection of the natural environment, the conservation of secondary resources while extracting the main resource, and the historical cultural heritage environment - a huge one.

The efficiency of the action of the agent of a partner in a centralized structure depends on:

- The hierarchical level the action takes place at, the efficiency increasing with the hierarchical level, for example, the agent of partner C, acting in the decision structure of S, situated at a superior level in S, can cause issuing a binding decision to be carried out at lower levels to S (for example, oral "indications", possibly sanctioning the subordinate staff, in case of disobedience)
- The moment of the action (a provision is more effective than a corrective, or last-minute, intervention),
- By bribing decision-makers situated in as high places as possible, who should be opinion leaders, and be publicly visible and appear easy to identify as supporters of Part C, in order to increase the value of the shares purchased on the stock by people forewarned of the upcoming public interventions,
- The relative price of the intervention on the legal or illegal lobbying market,
- The connection with various organized (multi-power) groups of interests, for example, colleague groups (peer groups).

Also, effective actions are the following:

- Accreditation of a contract term, possibly non-existent legally, through subsequent legal acts [43],
- Classification of the law, which refers (even if only in the annex) to secret or top secret documents,
- When the substantive law cannot be changed conveniently, one can have recourse to amending the procedure so as to favour one party,
- Creating judicial precedents,
- Issuance of another law, which could be invoked in a possible "fraud to the law" case.

One can also use the drafting of dedicated laws, which could allow fraud to the law in the interest of one party, by creating deliberately caused conflicts.

Legally (DA), the draft law should not provide public rights transferred to a private entity (e.g. the right to expropriate land).

Another source of profit, e.g. for party C, is when party S, situated at a higher hierarchical level, is still negotiating with the party S (itself) at a lower level, subordinate to the higher party S, when S is at the same time a minority shareholder in the project, also being partner to the contract and the creator of the normative framework, which is created to regulate the agreement (for instance, the State is both an arbitrator and a minority shareholder to RMGC, striving to create advantages for the contracting parties, that is, specifically for the majority shareholder, against the State itself).

The models and methods presented so far are useful for the investigators who try to find the illegal or undercover agents of the parties in the negotiation, and especially those opposing the State.

THE AUCTION

The auction is an instrument that should ensure fair competition in the process of attributing the implementation of a project (EDP), so that the party offering the project is sure to benefit from the most advantageous offer in point of both total price (which should be minimum), and protection (maximum), which should also be convenient to those who bid for the attribution of the project.

In accordance with the position or the capacity of the organizers, auctions may assume several forms (that can be found in the Roşia Montană project):

- Tenders for the sale of goods,
- Tenders for purchase of goods, facilities and award of operations of construction and assembly.

When the owners are disseminated and act indirectly, through their representatives, bidding or attending the auction by making decisions, PAR suggests that these representatives can also act in opposition to their public or private shareholders, and try to obtain personal gain at all stages of a project by:

- Preparing and conducting an auction, in drafting the specifications so as to include conditions achievable only by a particular tenderer, who secured the protection of the representative of the opposing party. Of course, depending on the relative importance of the project and the amounts paid to the agent of the tendering party acting to the detriment of the party that they represent, the level of the conditions that occur in the specifications can be raised to higher levels, as far as issuing (sometimes in advance, and, at other times, during or after the approval of the auction) ministerial instructions, instructions for enforcing the law, amending an existing law, amending several existing laws, a new law allowing the selection of the winner *ab initio*, and even amending the Constitution[44], to create advantages to the participant preferred.

The highest efficiency will be reached when the regulatory framework is changed or planned with a preferential destination, stipulating conditions that can be met only by one

[43] concerning the license holder, the license content, f. e.

[44] *"**One way to solve the problems associated with mining (in Romania) is the reform of mineral rights**"* (n.m.: that is, amending Art. 136 of the Constitution), Walter Russell Mead (interview, 10/13/2013), acting as agent for companies interested in extracting non-renewable mineral resources (gold, shale gas, etc) in Romania, heavily popularized by the media in Romania, during the debates in the Special Roșia Montană Parliamentary Committee.

candidate, who is the preferred candidate (Part C) to enable the auction or the modification of the agreement, and thus eliminate competition, or even a comparative evaluation, before a decision by party S. So, rules and standards can be modified, such as: the specific rules for the auction, regulations for auctions of the same type, the ministerial rule, an Emergency Ordinance, existing legal provisions, by a new law, going as far as amending the Constitution, for example, in order to change the property regime of mineral resources[7],

- Attributing the project, which was apparently bidden in a correct manner, before achieving the condition of advertising compliance.

- Drafting the specifications, apparently not having in mind a particular bidder, but, such as to ensure the granting of the license in undemanding conditions to a go-between bidder, who does not appear as being protected by the specifications, and then,

- Transfer of the license, possibly free of charge, to an associate of the licensee, which has completely different interests,

- Transferring the negotiation of the project at horizontal levels (between enterprises, between trusts, between departments, between ministries), or even vertically, upwards (to boost immunity of the decision-maker), and possibly downwards (delegation etc.), in order to limit the material liability of the decision-maker and the existence of better and better-structured group relationships, which are easier to influence, aiming at masking the responsibility of the decision-makers. Transferring the decision downwards (by also invoking decentralization) is required, in terms of the law, by the strengthening of the central judiciary power, in Romania, as local decision-makers are convinced that they will be able to negociate more easily with the local judiciary bodies, because local groups of stakeholders are, locally, relatively much stronger than they are at the central level,

- **Involvement** of third parties – NGOs, "scientists", and even subsidiary bodies of the state(s) authorities – to intervene in order to ensure the promotion of the project, without any of interveners engaging their (material, administrative, criminal) liability for the damage subsequently generated by the dedicated intervention,

- Requirement by the law (rules, regulations) that the measurements and studies that are to be conducted by independent bodies should be provided and paid for by the very body concerned.

The function of auctions in international trade practice lies in turning to account the commodities that will not fall into the types commonly used in the stock exchange. That is why the goods auctioned should be viewed by the potential buyers, advisors, evaluators – but yet most of the Roşia Montană Project documents are classified.

As a form of commerce, auctions have the advantage that they can provide a large amount of offers, help to know the foreign market, and facilitate making an objective, cost-effective decision.

Limited or unlimited liability of contractors in a contract for the transfer of the license shall be governed by that contract, while the partners in the Roşia Montană project preferred limited liability, and sometimes they even failed to regulate liability by the contract.

Liability of directors, advisors and suppliers also depends on the rules that are established by the departments or ministries that control that responsibility or liability: in terms of decision-making in production; to the workers' safety; to the natural environment, the human, social, cultural and historical heritage milieu; currently, many responsibilities are unclear, secret or non-existent.

It happens that the possible parasites of the State be the very people who must act as antibodies.

Optimizing the auction in the Roşia Montană project, a joint venture, appears to be negative, and in this respect (PAR, PP, EDP) can be invoked: the contract was attributed before signing the license agreement, and even before launching the tendering; the license to exploit the Rosia Montana ore was given free of charge; the false idea was accredited that RMCG already has a valid exploitation license, license granting a monopolistic exploitation after an unregulated previous exploration, instead of ensuring competition after different explorations; allocation of equity shares that are inversely proportional to the financial strength of the parties; failure to regulate the responsibility by time horizons (deadlines) characteristic of the effects of the project, extending the company's benefits by disseminating the detriment to the State; failure to provide certain terms regarding compliance with the legal purchase requirements.

Noting the existing uncertainties in the negotiations and the promotion of the draft Law on the Roşia Montană Project, the Parliamentary Committee (at last) proposed defining the phrase "the Roşia Montană perimeter", by a narrative description of the territorial boundaries and annexing a map of that perimeter, and found that it cannot be determined with certainty, from the documents attached to the draft law, whether the formalities relating to declaring the public utility of the project were met, so the Committee does require the authorized institutions to clarify that issue.

At the end of the procedures, the Parliamentary Committee notified the Prosecutor General of Romania on the irregularities found[45].

The advantages of applying socio-physical models can be a handy instrument usable by investigation bodies, and then legal authorities, which could apply them fruitfully.

Acknowledgement

The authors thank to professors Gheorghe SĂVOIU and Ion IORGA-SIMĂN, the editors of ESMSJ and the organizers of EDEN I-VI workshops, who strongly encouraged them to develop the topics of the present work and especially to professor Constantin MANEA who kindly prepared the English version of this work intially addressing Romanian social activists, by providing them with objective, quantitative, socio-physics, simple models in approaching social conflicts, particularly on the Rosia Montana Project.

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Bucharest, December 21, 2014

[45] The Roşia Montană project can be called "OMNISHAMBLES", a term which refers to a project that has failed completely due to a series of mistakes and failures. The term first appeared in a British skit series, and was recently included in dictionaries.