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MOTIVAȚIA INTERGENERAȚIONALITĂȚII SENIORILOR UNIVERSITARI DIN ASEM

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Abstract: Organizația COST (Cooperarea Europeană în domeniul Științei și Tehnologiei – www.cost.eu) este cel mai lung cadru european care rulează și reprezintă o platformă unică în care cercetătorii europeni î-și pot dezvolta în comun ideile și inițiativele în toate disciplinele științifice prin intermediul rețelelor transeuropene de cercetare finanțate la nivel național. Aceasta este finanțată de Programul Orizont 2020 al Uniunii Europene (UE), prin care Comisia Europeană (EC) a încheiat un acord de parteneriat-cadru cu Asociația COST, care operează în conformitate cu instrucțiunile directe din partea COST Committee of Senior Officials (CSO). Activitățile COST sunt în mare parte aranjate ca acțiuni de COST. Normele și principiile care reglementează toate activitățile COST sunt stabilite într-o serie de documente aprobate de CSO: <https://www.cost.eu/cost-actions/how-to-participate/>. Dispozițiile administrative detaliate în acest document- COST Vademecum - direcționează punerea în aplicare a acțiunilor COST și sunt aliniate la normele și principiile menționate mai sus. În conformitate cu Activitățile COST 16226, la care este asociată ASEM, în prezenta lucrare se propune organizarea Asociației Seniorilor din ASEM cu scopul major – **continuitatea activităților seniorale de la o activitate productivă plătită de pre-pensionare, spre o activitate pensionară de tip part-time și, de acolo, la o activitate pensionară de tip asociere-afiliere la ASEM** – de conlucrare intergenerațională a seniorilor din ASEM, care formează 3 grupe de seniori universitari și cuprinde profesorii în activitate de pre-pensionare, profesorii-pensionari cu part-time activitate și profesorii-pensionari fără activitate.

Cuvinte cheie: asociație, senior, pensionar, intergeneraționalitate, profesori vârstnici, continuitatea activității

JEL Classification: C88, L86, M00, O31, L20.

Introducere.

Conlucrarea intergenerațională într-un colectiv se bazează pe activități spirituale, intelectuale și fizice a personalului compus din persoane de TOATE vârstele. Specificul interacțiunii componentei lucrative a Societății cu persoanele în vârstă și subiectul conlucrării intergeneraționale în general constituie activitatea permanentă și de perspectivă în Comunitatea Europeană [1]. În Uniunea Europeană în ultimele două decade de ani activează Comunități de Organizații

Științifice și Tehnologice (COST) compuse din colective comune de cercetatori și implementatori din Țările Comunității Europene, care **soluționează probleme de interes comun**. Una dintre aceste comunități este COST CA 16226 [2], care în special se ocupă de **soluționarea problemelor de conlucrare intergenerațională**. În această Comunitate activează colective de specialiști din 38 de Țări din EU și alte Țări ale Lumii, inclusiv din Republica Moldova. Republica Moldova este

reprezentată în Comunitatea COST CA 16226 de către ASEM, care a prezentat doua rezultate de cercetare la ultima seedinta a COST din Macedonia [3, 4]. Scopul major al COST CA 16226 [2] pentru anii 2018-2021 de activitate îl constituie:

- cercetarea și implementarea măsurilor de îmbunătățire a traiului oamenilor în vârstă,

- crearea Asociațiilor și Comunităților de bunăstare durabilă a persoanelor în vârstă de 65+ și de vârstă a treia, și - schimbarea radicală a corelației de activitate economică, intelectuală și spirituală intergenerațională în Societatea Europeană.

O Universitate angajată în viitor, cum se constituie ASEM, poate avea un viitor asigurat atunci când fiecare membru al ei **DISPUNE DE O REALĂ CONVINGERE** că ASEM îi **APARTINE**. Conlucrarea intergenerațională seniorală din ASEM cuprinde personalul în activitate și persoanele în vârstă (personalul senioral), care formează 3 grupe de seniori:

(1) **Prima grupă de seniori** este compusă din profesori pensionați, care sunt în continuare în activitate: seniorii cu activitate Part-Time în ASEM;

(2) **A doua grupă de seniori** este formată din pensionarii ASEM, care nu sunt în activitate în ASEM: post-pensionarii, majoritatea cărora nu activează în Societate nicicum;

(3) **A treia grupă de seniori** este compusă din persoanele active din ASEM, care urmează să fie pensionate în următorii 5 ani: **pre-pensionarii**.

Conlucrarea intergenerațională seniorală necesită cercetarea, analiza, dezvoltarea și implementarea unor metode inovative de susținere a durabilității

bunăstării profesorilor seniori din evidențiatele grupe de persoane din ASEM. Continuitatea activității intergeneraționale la trecerea persoanei dintr-o grupă de seniori în alta necesită și soluționarea stării psihologice a seniorilor: persoana este supraîncărcată psihologic, ea se găsește „la răscrucea” trecerii dintr-o categorie de activități în alta. **Crearea agendelor de activitate** spiritual, socială, economică, educațională și de cercetarea fiecărei din aceste 3 grupe de profesori este baza inițierii unei asociații seniorale în ASEM cu activității intergeneraționale. Pentru fiecare grupă de seniori din asociația seniorală este necesar de format cât a **Agendei de activitate** pe termen Scurt atât și a Agendei de activitate pe termen Lung, având ca bază activitățile propuse integral pentru asociația seniorală cu coordonarea și continuitatea lor.

Altă activitate a asociației seniorale o constituie **interacțiunea persoanelor din interiorul fiecărei** din cele 3 grupe de profesori. Activitățile specifice din interiorul fiecărei grupe solicită în cumul și starea fizică a persoanei, și starea spiritual, și cea intelectuală. Specificul persoanelor din interiorul grupeii, având ca bază domeniul de activitate a grupeii, definește Agenda de activitate cât a grupeii atât și a fiecărui din membrii săi.

Următoarea activitate a asociației seniorale de conlucrare intergenerațională este strâns legată de corelarea agendelor de activitate cât **extra-grupaționale** (de exemplu, a Agendei grupeii de pre-pensionare cu Agenda grupeii de seniori cu activitate Part-Time în ASEM), atât și **inter-grupaționale** (de exemplu, Agendele pe termen Scurt și pe termen Lung a pensionarilor din grupa de Post-pensionare).

Activitatea majoră a ASEM este cert conturată: pentru evoluțiile **ASEM spre o Universitate angajată în viitor** este arhi-necesar crearea unei Asociații de conlucrare intergenerațională a persoanelor „din jurul pensionării”, a seniorilor. Seniorii din grupele accentuate mai sus angajază activitatea ASEM în conlucrarea prestigioasă intergenerațională, care constituie baza unei Societăți cu asigurarea bunăstării durabile a personalului ei în cadrul ”casei lor” (**în cadrul ASEM – A UNIVERSITĂȚII CARE LE APARTINE!**). Pentru asigurarea bunăstării durabile a seniorilor universitari din ASEM se propune analiza, organizarea, documentarea și implementarea Asociației Seniorilor (a Profesorilor Pensionari) din ASEM (AS ASEM).

I. Premisele Asociației Seniorilor din ASEM

Programul de activitate ASEM pentru Anii 2017-2021, propus în anul 2017 de Domnul Grigore Belostecinic, Rector ASEM, prof. univ.dr.hab., Academician AȘM, înaintat, susținut și aprobat de Senatul ASEM, prevede” crearea unei asociații a persoanelor pensionate în vederea implicării acestora în viața academică și după atingerea vârstei de pensioare, cu crearea unor condiții bune, în care să-și desfășoare activitatea, la fel și identificarea unor posibilități de sprijinire materială a celor cu merite deosebite în dezvoltarea ASEM și creșterea prestigiului instituției noastre ...”. În concordanță cu activitățile, inițiate de ASEM și cu perspectivele de susținere a acestor activități ASEM de către Instituțiile Statale și Internaționale, inclusiv cu susținerea organizațiilor COST

din cadrul Programelor H2020 a Uniunii Europene [1-4], în Academia de Studii Economice a Moldovei este evidentă acțiunea de organizare a Asociației Seniorilor (a Profesorilor Pensionari) din ASEM (AS ASEM). Scopul major al AS ASEM: Sprijinirea eforturilor ASEM pentru evoluția către o instituție de tip Cercetare și Educație, cu perfectarea modelelor de conlucrare intergeneraționale a personalului ASEM. Asociația Seniorală a ASEM are drept scop mobilizarea și antrenarea persoanelor seniorale din ASEM pentru promovarea, sprijinirea, realizarea și coordonarea de activități, care să contribuie la dezvoltarea Academiei de Studii Economice a Moldovei din punct de vedere educațional, cultural, economic și social. Pentru realizarea acestui scop Asociația Seniorilor din ASEM va avea următoarele obiective:

- menținerea capacității creatoare la cel mai înalt nivel posibil;
- evoluția cercetării și educației intergeneraționale în ASEM;
- colaborarea AS ASEM cu ONG-uri, cu entități educaționale și de cercetare, instituții guvernamentale din Țară și niunea Europeană, firme private din Țară, state membre și state asociate UE și din întreaga Lume.

II. Misiunea AS ASEM

II. 1. Pentru diminuarea efectelor negative ale îmbătrânirii Asociația preconizează:

- 1) Promovarea și susținerea activităților de testare, validare și implementare a unor soluții bazate pe noi tehnologii pentru realizarea independenței (cu participarea la viața socială) și asigurarea bunăstării bătrâneții profesorilor pensionari din ASEM;

2) Promovarea și susținerea unor dezbateri intergeneraționale cu participarea persoanelor de vârstă a III-a, cu experiență în activitățile de cercetare, educație, tehnică, economie, etc., privind modul cum ele pot contribui la dezvoltarea durabilă a Academiei de Studii Economice a Moldovei. Aceasta dezvoltare va urma tradiția experiențelor anterioare ale ASEM, a Republicii Moldova și ale altor țări considerând și recomandările Uniunii Europene;

3) Propunerea de soluții și activități intergeneraționale pentru rezolvarea necesităților persoanelor de vârstă a III-a în legătură cu: - integrarea persoanelor vârstnice în activități utile ASEM și găsirea unor căi de atragere a lor la viața activă;- problemele legate de independența creativă a oamenilor în vârstă în scop lucrativ, divertisment, medical etc. ; - sprijinirea persoanelor în vârstă cu dificultăți material și cu probleme de sănătate.

II. 2. În domeniul cercetării și educației în ASEM Asociația preconizează:

1) Să încurajeze editarea de materiale de specialitate de înaltă calitate (publicații, broșuri, pagini web, etc.) în vederea promovării cercetării și educației intergeneraționale în ASEM și să susțină campanii în mass-media pe aceste teme;

2) Să propună și să participe la proiecte inter-generaționale de cercetare și educaționale, cu finanțări proprii, sau cu accesarea de fonduri publice sau private, din Țară și din străinătate;

3) Să propună și să sprijine programe intergeneraționale legate de promovarea imaginii ASEM în Țară și în Lume;

4) Să sprijine propunerile și inițiativele de protejare și conservare a mediului

ambiant. În vederea atingerii scopului și obiectivelor propuse mai sus Asociația Seniorală a ASEM va desfășura programe și activități intergeneraționale de informare, consiliere, educație, și monitorizare.

II. 3. Forme de activitate

Principalele forme de activități desfășurate de Asociația Seniorilor din ASEM sunt următoarele.

II. 3. 1. Pentru combaterea efectelor negative ale îmbătrânirii Asociația preconizează:

1) Cercetarea, studierea, testarea și verificarea unor soluții pentru rezolvarea problemelor legate de îmbătrânire, elaborare de lucrări științifice, eseuri etc.

2) Organizarea de activități dedicate socializării seniorilor și aprovizionarea utilizării efective a tehnologiilor informaționale și de comunicare (TIC);

3) Organizarea de conferințe, simpozioane, seminare, mese rotunde intergeneraționale pe diverse teme de interes, pentru persoanele de vârstă a III-a;

4) Participarea la proiecte inter-generaționale fi nanțate prin: fonduri structurale, programe sociale, programe de cercetare naționale și ale UE, surse particulare.

II. 3. 2. În domeniul cercetării și educației în ASEM Asociația preconizează:

1) Participarea la campanii intergeneraționale în mass - media, va organiza și va participa la conferințe, simpozioane, expoziții, consfătuiri, workshop-uri și mese rotunde, va susține și va realiza materiale de specialitate (publicații, broșuri, pagini web, etc.) pentru promovarea educației de-a lungul întregii vieți;

2) Inițierea și derularea de proiecte intergeneraționale de cercetare și

educaționale, cu finanțări proprii, sau va căuta pentru accesarea de fonduri publice sau private, din țară sau din străinătate;

3) Inițierea activității intergeneraționale legate de dezvoltarea cercetării, educației, culturii și civilizației în spațiul european;

4) Inițierea și implementarea programelor inter-generaționale legate de promovarea imaginii ASEM în Țară, Europa și în Lume;

5) Popularizarea acțiunilor facultăților și departamentelor ASEM pentru promovarea cercetării, educației și instruirii de-a lungul întregii vieți;

6) Acordarea de consultanță în domeniile cercetării și educației intergeneraționale, în scopul ridicării gradului de profesionalism și competență a profesorilor cu activități recente și pe termen lung:

- Propunerea noilor direcții și teme de cercetare – implementare a întreprinderilor Mici și Mijlocii (ÎMM) – Baza evoluției Republicii Moldova;

- Cercetarea, studierea și elaborarea metodelor și modelelor inovatoare de proiectare a proiectelor de afaceri mici și mijlocii informatizate;

- Implementarea unui modul de studii cu tematica „Proiectare a proiectelor” în primul rând pentru persoanele seniorale ASEM, și, în rândul doi – implementarea modului în cursurile de specialitate ASEM, în special, pentru ultimii ani de studii în ciclul I de studii și în toate cursurile din ciclul II;

- Introducerea unui capitol special în tezele de an și, în special, în tezele de licență consacrat implementării rezultatelor cercetărilor obținute în diferite proiecte de ÎMM, necesare Republicii Moldova;

- Organizarea concursurilor de proiecte

de ÎMM pentru toate generațiile ASEM, în deosebi, pentru proiecte intergeneraționale și pentru proiecte de ÎMM a studenților ciclului I și II și a doctoranzilor cu invitarea sponsorilor și a personalului întreprinderilor evaluate din Republica și din străinătate;

7) Va instrui membrii activi ai ASEM și simpatizanții în sprijinul protejării și conservării mediului ambiant intergenerațional;

8) Va desfășura activități de promovare și educare a tinerilor;

9) Va realiza activități de consiliere profesională și îndrumare vocațională în favoarea tinerilor și absolvenților ASEM.

II. 3. 3. În domeniul de colaborare
Asociația Seniorilor din ASEM preconizează:

1) Colaborarea în primul rând cu Universitățile din București, Bacău, Iași, Cluj și Timișoara, care desfășoară programe de învățământ și cercetare ale fenomenului de îmbătrânire, pentru a facilita Asociației Profesorilor Pensionari din ASEM realizarea unor contracte de comodat privind:

- spațiu pentru desfășurarea activităților specifice intergeneraționale;

- împrumut de mobilier și tehnică de calcul, care nu este în prezent utilizat în diverse servicii, departamente și facultăți;
- acces la facilități: energie electrică, apă, căldură, telefon, internet.

2) Realizarea de parteneriate cu alte ONG-uri, cu instituții de învățământ, institute de cercetare, instituții guvernamentale, instituții ale UE, firme private din țară, din state membre UE și din state asociate pentru realizarea proiectelor intergeneraționale din ASEM;

3) Perfectarea parteneriatelor cu

instituții de cercetare, universități și firme care au ca activitate implementarea de noi tehnologii pentru sprijinirea persoanelor în vârstă și, eventual, pentru însoțitorii acestora;

4) Promovarea parteneriatelor cu instituții de cercetare și centre specializate pe îngrijire și de tratament al pensionarilor;

5) Colaborarea cu organismele publice, precum și cu persoane fizice și/sau juridice republicane sau din afara țării, care sunt interesate și pot oferi sprijin în vederea implementării scopului și obiectivelor AS ASEM;

6) Promovarea și organizarea schimburi de experiență cu alte asociații similare din țară și străinătate. Pentru realizarea activităților AS ASEM se preconizează:

- Formarea de personal, care să asigure desfășurarea în bune condiții a activităților de mai sus;

- Organizarea de manifestări (conferințe, simpozioane, expoziții, cursuri, manifestări culturale și științifice, concursuri);
- Realizarea de documente audio-vizuale, tipărirea de buletine informative, publicarea în reviste speciale, precum și alte mijloace de informare;

- Inițierea și desfășurarea schimburilor de experiență cu persoane, asociații și instituții cu activități similare, din țară și din străinătate;
- Inițierea și desfășurarea programelor intergeneraționale de cercetare și educaționale în scopul cercetării și învățării de-a lungul întregii vieți, în special pentru persoanele în vârstă.

Mulțumiri. Rezultatele actualei cercetări: **“Motivația intergeneraționalității seniorilor universitari din ASEM”** sunt susținute de acțiunea COST

CA16226 a UE, Îmbunătățirea spațiului de locuit interior: habitatul inteligent pentru vârstnici (SHELD-ON).

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Referințe.

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INFORMATION TECHNOLOGIES IN THE ADMINISTRATION OF PUBLIC INSTITUTIONS

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Abstract: Any economic analysis of a unit (in this case of the territorial-administrative unit) is based on information, viewed as a resource, and how it is distributed. Collecting, storing, processing, analyzing and transmitting information are activities that need to efficiently and effectively use information and human resources to achieve economic equilibrium. In these circumstances, the accounting requires the existence of an efficient accounting information system that complies with certain organizational and legislative requirements.

The purpose of this paper is to show the structure of budget revenues and expenses, define revenues and expenditure, and reveal the dynamics of the city (village) hall budget revenues over the last 5 years. The paper focuses on the practical application of the theoretical basis founded in the process of study, acquisition of some professional skills to solve public finance-related problems, development of the student's analytical and scientific research skills to be further used by a future employee / accountant. This study is carried out within the accounting department of the village hall in the village Cernoleuca, Dondușeni district [1].

Keywords: Computer Science, information system, revenues, expenditure, local budget.

1. Introduction

The budgets of the territorial-administrative units represent the budgets of villages (communes), cities (municipalities, except for Balti and Chisinau municipalities) made up of all revenues and expenses over a year. Any territorial administrative unit cannot exist without information and without communication. Obtaining and transmitting information assume existence of a system which ensure both data collection and processing, as their dissemination. The system that can provide the required information is the information system, a true producer and distributor of information. It is the one which takes the data from the internal and

external environment of the unit in which he operates, processes and distributes them to those who need the information obtained, in various forms, figure 1. Within an information system, most of the activities can be deployed using computing technologies. The primary data can be processed and then the result can be transferred further to another compartment for processing. The transfer can also be made electronically via a computer network. The set of elements involved in the whole process of processing and transmitting data by electronic means make up an **information system**.

A computer system includes computers, data transmission systems, hardware and

software components that exploit computing technologies, theories behind the processing algorithms, etc.

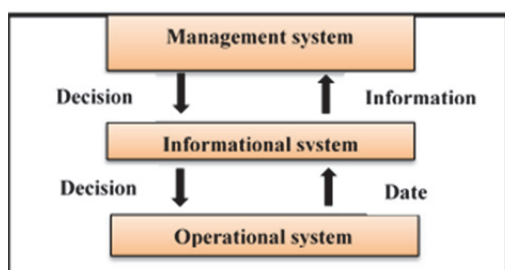


Figure 1. Information system producer and distributor of information.

Techniques and methods of organizing data have evolved impressively over time, driven by the need to have access to an increasing amount of information as quickly and easily as possible and the necessity to upgrade data collection, storage, transmission and processing equipment. One stage in this evolutionary process is marked by the emergence of databases and databanks.

A **database (DB)** is a structured set of files that groups the data processed in computer applications. Formally, the database is a set of data collections that are interdependent, together with the description of the data and the relationships between them. The most appropriate data structures for economic activities are files, databases, databanks and data warehouses.

Any entity, respectively a territorial - administrative unit as well, needs information to make decisions, especially in the field of accounting. There is usually a lot of data spread in the company's information systems, but turning these data into information that can be analyzed to make decisions is a tricky process. But the company Microsoft brings to life the paradigm "Business Intelligence to Everyone" through the Microsoft Business

Intelligence solution. The Business Intelligence systems are:

- SQL Server 2005 with Analysis Services;
- Office XP / 2003;
- Data Analyzer;
- MapPoint;
- SharePoint Portal Server
- Project Server 2003;
- Microsoft® SQL Server™

Accelerator for Business Intelligence.

The implementation of the project can be accomplished by its own forces with the help of the IT specialists of the respective company. In this case, the personnel implementing the project must have the necessary technical knowledge. I will continue to analyze the income and expenditure structure of Cernoleuca village hall using the analysis methods of the Microsoft Excel spreadsheet program [2].

2. The structure of the public financial resources (Cernoleuca village hall, Dondușeni district)

The public financial resources represent the social relations of economic nature, in monetary form that arise in the process of collecting the financial funds available to the state, necessary for the achievement of its objectives; the overall incomes for the last 5 years are represented in Table 1 [3]. As we can see, in the last 5 years, the revenues have changed considerably, analyzing the chart, Figure 2 and the data from Table 1, we concluded that the revenues are lower in 2013 than in the previous years (2011-2012) by -46, 1%, which means that the revenues have fallen too much, and this is the consequence of the social, cultural, educational and demographic factors, while the emigration abroad reduces the number of taxpayers too. But later, we see a considerable increase in 2014 by 27. 9%

plus 8. 00% in 2015 compared to 2014, and as the range of businesses, enterprises, peasant farms is increasing, the number of taxpayers goes up as well, and, in their turn, both current tax and non-tax revenue increase.

3. The structure of the public expenditure

Public spending refers to all public sector expenditure made by public institutions, which is covered either by the state budget or by their own budgets, based of earnings. These expenses are shown in Table 2.

Budget expenditure refers only to those expenses that are covered by the state administration budget, local budgets or the state social security budget [4].

Table 1. Overall incomes for the last 5 years

Nr.	Years	Overall incomes(lei)
1.	2011	2603562. 06
2.	2012	2650052. 47
3.	2013	1553168. 98
4.	2014	2602681. 26
5.	2015	6411769. 42

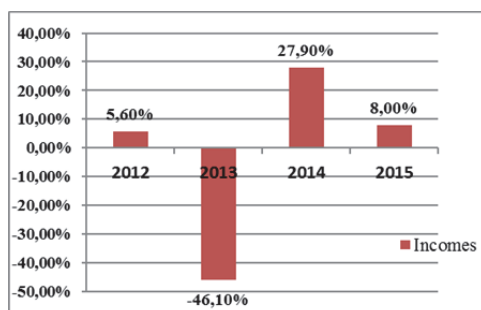


Figure 2. Analysis of the income dynamics

Table 2. Overall expenses for the last 5 years.

Nr.	Years	Expenditure (lei)
1.	2011	2791944. 37
2.	2012	2574924. 37
3.	2013	1520110. 44

4.	2014	2650537. 01
5.	2015	6955955. 31

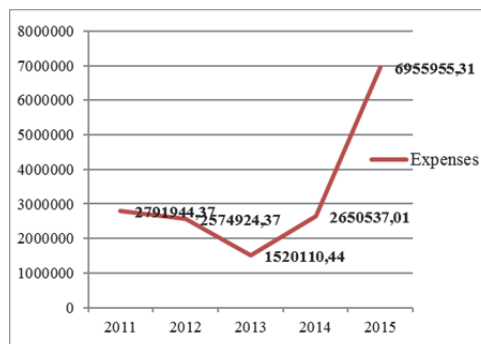


Figure 3. Evolution of expenses for the last 5 years.

Analyzing the data in Figure 3, we conclude that in 2011 the expenses amount to 2791944, 37 lei and in 2012 they decreased by 217020 lei reaching the amount of 2574924. 37lei. Expenditure declined in 2012 as spending on goods and services including food, utilities and labor costs decreases. In 2013 expenditure decreased by 1054813. 93 lei as compared to 2012, because the expenditure allotted for education is reduced due to the depreciation of the national currency. In 2014, spending increases as money is earmarked for state social security contributions and the number of workers increases. In 2015, the expenses also increase by 43054118. 3 reaching the amount of 6955955. 31 lei, because the expenses for goods and services, especially food and utilities, increase [4].

3. 1. The structure of the public expenditure for social and cultural activities

The public spending for social and cultural activities is designed for services delivered by public authorities or public institutions that respond to the social needs of individuals, are free of charge, at discounted fees or in the form of money

transfers. There are a number of social needs such as education, culture and sport that require state intervention to meet these requirements through public institutions. The data on public spending for education over the last 5 years is shown in Table 3.

Table 3. Spending for education over the last 5 years.

Indicators	2011	2012	2013	2014	2015
Total expenditure	1909868.66	1844746.50	649108.65	502526.97	561108.71
Pre-school education	300141.92	279074.92	393006.65	494047.35	551309.43
Secondary education	1582074.95	1571200.00	256102.00	8479.62	9799.28
Education institutions or activities not referred to other groups	27651.79	27163.91	-	-	-

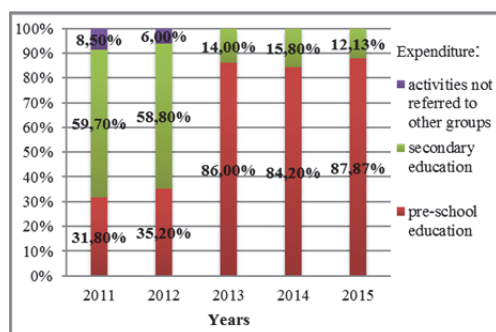


Figure 4. Analysis public spending for education over the last 5 years.

Following the data analysis (Figure 4 and Table 3), during 5 years, we see that education undergoes several changes in the village Cernoleuca. In 2011-2012, the education funding covers costs in three different domains, such as pre-school education, secondary education and education institutions or activities not referred to other groups. Later in 2013, the field of education was not provided too much funding as compared to previous years. In addition, all expenditure on education institutions or activities not referred to other groups is eliminated, so in the following years 2013-2015 more focus is placed on financing pre-school

education which reaches about 88%. It represents practically the largest share of the expenditure and the secondary education accounts for about 12% out of the total amount. Education has undergone significant changes in the last 3 years as a new education code «The Education Code of the Republic of Moldova» is developed as of 17. 07. 2014.

Another category of the public expenditure for social and cultural activities entails those ones that are designed for culture and art (Table 4).

As of 2011 to 2015, spending on culture and art has grown considerably (Figure 5), with an ever-increasing spending each year aimed at developing the society, especially young people's professional growth.

Table 4. Expenditure for culture and art.

Indicators	2011	2012	2013	2014	2015
Total expenditure for social and cultural activities	99468.95	80853.08	105779.33	104019.58	116715.76
Activities in the field of culture	91968.95	79253.08	102579.33	104019.58	113715.76
Sport	7500	1600	3200	-	3000

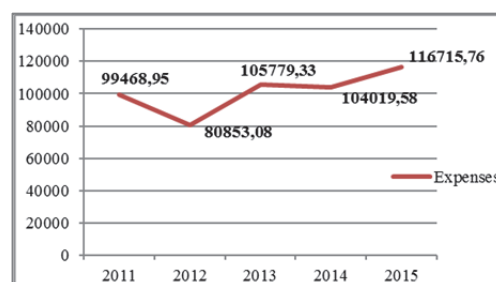


Figure 5. Evolution of expenses for culture and art.

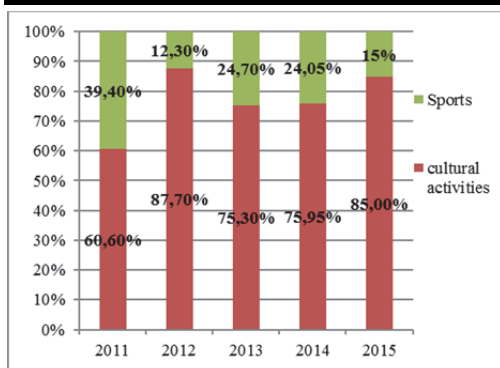


Figure 6. Analysis public spending for culture and art.

The chart in Figure 6 shows the radical changes that have been made in the last 5 years from 2011 to 2015. The data reveals that most spending is made on cultural activities, reaching 85.00% in 2015 and then on sports, reaching a much lower level of 15% as compared to 39.40% in 2011. Other youth activities are not funded due to lack of finances [6].

Conclusions

1. On the basis of the analyses carried out, we conclude that the accounting information system has a leading role in the economic activity, because the accounting is a complex system of collecting, identifying, processing, recording, calculating the accounting elements on the basis of which financial reports are drawn up to facilitate the budget analysis during the current period and its next year planning.

2. In addition, a well-grounded scientific approach to revenues and expenditure provides support to the entity's management and enables sound and reasonable management decisions, as the type of expenditure and the ultimate benefits are to be known when approving decisions.

3. The work is accompanied by reliable data provided by the Accounting policy of

the village hall of Cernoleuca, thus the results of this paper can be useful for public institutions, village or city hall accountants, statistical analysis and forecasting institutions, the tax inspectorate, the public administration (the state), etc.

References

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- [6] Decision of the Parliament of R. M. "On Amending and Completing the Budget Classification", no. 79 of 20. 06. 2014.

AGE-FRIENDLY RURAL ENVIRONMENTS IN MOLDOVA

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Abstract. It is well recognized that the Small and Middle Enterprises (SMEs) are important for well-being of rural habitants and, firstly, for the older adults. The demographic shift puts an increased level of stress on worldwide healthcare systems. The older people's stress is concerned with the migration of working-free citizens mostly from the country fields of human activities. One way to support older people to live the life they wish to live is through the age-friendly initiative, a world-wide program to make cities and rural areas better-tuned to the needs of older citizens and through the solution of migration problem of the working-free citizens. Making country area more age-friendly can be done through dedicated corresponding rural and urban SMEs for working-free and age-working citizens. The age-friendly communities using these SMEs is paramount to the success of the proposed and implemented solutions. The observational studies of country area were carried out. Results indicate that age-friendly communities in rural area depends mostly from the successful creation of different level of Micro, Mini, Middle, and Regional Ecologic, Education, and Health SMEs with teams composed from working-free and age-working citizens. The study emphasizes the importance of SMEs that provides older adults with meaningful activities and stimulates them to be active and use the social environment to its full extent.

Keys words: migration, small and middle enterprise, age-friendly community, rural sector, poverty, project

Introduction.

The European Union is currently faced with manifold challenges within and beyond its borders. Internally, growing inequality undermines its potential to create prosperity and provide stability. Six million European people lost their job during the crisis, more than 120 million people are at risk of poverty and fourteen million youth (15-29 years) are not in education, employment or training. Old population constitutes fourth part of population at risk of poverty; they can participate in the process of creation Age-friendly communities in urban and rural areas. Beyond the need to find new sources of growth and employment, the need to deliver quality public services and renew the legitimacy of public policy-

making across Europe put additional strain on governments. At the same time, the inclusion of fairness in the objectives of the European Commission means that social dialogue should be enhanced in order to meet the social demands of inclusive growth.

The innovation divide is evident, private investment in research and innovation is falling short of the target, while there is a growing brain drain mostly from regions strongly hit by the crisis and the austerity that followed. Externally, the Union's neighborhood has become an area of high risk with an increasing number of open conflicts challenging Europe's security. Developments like the crisis in Ukraine and the increasing influence of radical

Islam in the Middle East and Africa put the EU's reactive capacity to a test. They pose immediate threats to Europe's security and trigger asylum seeking and immigration that puts pressure on EU external borders and relevant policies - from migration to humanitarian assistance and development cooperation.

Migration is one of the stringent problems [<http://www.statistica.md/>] that Republic of Moldova is facing today. According to World Bank data, in our country about 700 thousand citizens are working abroad, which constitute about half of the working population. Old population constitutes fourth part of population at risk of poverty. Meanwhile, the sociologists consider that the real number of Moldovan migrants exceeds one million. Around a quarter among them decided not to return to home [http://web.worldbank.org/archive/website01419/WEB/0__CONTE-12.HTM].

worldbank.org/archive/website01419/WEB/0__CONTE-12.HTM].

From the above presented we conclude the negative impact of migration such as family breakdown, brain migration, the abroad money transferred dependence of Moldovan young, crisis in the rural sector, rapid liquidation of Small and Medium Enterprises (SMEs) which can be supported by working-free (20 - 65 year old) and age-working (65 year age and older) citizens.

In this way, mass migrations contribute to a demographic decline, economic potential decrease of the country that leads to devaluation of the national currency, predominance of imports, narrowing of the manufacturing sector. The main reasons for population exodus are considered population low-income in the country (45%), lack of jobs in the country (24. 5%) and poor condition of rural localities (15. 6%). One of the Moldovans migration reason is considered also the

lack of professional career opportunities (10. 2%). The study reveals that the majority of respondents would prefer to work in EU countries (53. 4%), but also in Canada and the US (27. 4%) and in CIS countries (13. 7%) and 5. 5% (37 people) - in Australia.

The information presented above shows the timeliness and the need for a project to improve the migration crisis in the Rural Area of the Republic of Moldova and to solve the Age problem in country area. Implementation methods of progressive thinking can be used in the process of creation different level of Micro, Mini, Middle, and Regional Ecologic, Education, and Health SMEs with teams composed from working-free and age-working citizens. At the same time such activities may be considered the basis for creation the Age-friendly communities in the Rural Area of the Republic of Moldova.

Most people of average intelligence can be used in the process of creation different level of Micro, Mini, Middle, and Regional Ecologic, Education, and Health SMEs. Teams composed from working-free and age-working citizens, given data or some problem, can figure out the expected conventional response to the problem. Typically, we think reproductively [1], on the basis of similar problems encountered in the past. When confronted with problems, we fixate on something in our past that we worked before. Then we analytically select the most promising approach based on past experiences, excluding all other approaches, and work a clearly defined direction toward the solution of the problem. Because of the apparent soundness of the steps based on past experiences, we become arrogantly certain of the correctness of our conclusion.

In contrast, geniuses think **produc-**

tively [1], not reproductively. When confronted with the problem, they ask themselves how many different ways they can look the problem, how they can rethink it, and how many different ways they can solved it, instead of asking how they have been taught to solve it. They tend to come up with many different responses [2] some of which are unconventional, and probably, unique. With productive thinking, one generate as many alternative approaches as one can, considering the least as well as most likely approaches. It is the willingness to explore all approaches that is important, even after one has found a promising one.

We propose teaching productive thinking in our training process in lieu of reproductive thinking. The creative-thinking techniques [3, 4, 6] will show the working-free and age-working specialists from rural sector SMEs how to generate the ideas and creative solutions they need in their business and personal life. Each technique contains specific instructions and an explanation of why and how it works for Micro, Mini, Middle, and Regional Ecologic, Education, and Health SMEs. When the specialists use the techniques, they will rethink the way they see things and will look at the world in different way.

1. Migration problem.

Today we have a crisis in the Republic of Moldova, a catastrophic situation of the republic's population especially in rural sector: an exodus huge of the population from the villages, it is a situation of deep crisis, a situation of the Republic of Moldova pre-default. The number of older adults in the Republic of Moldova is increasing rapidly, and this demographic shift puts an increased level of stress on worldwide healthcare systems. The vast majority of older adults wish to age in

place. One way to support older people to live the life they wish to live is through the age-friendly initiative, a world-wide program to make cities and rural areas better-tuned to the needs of older citizens. Making rural sector more age-friendly can be done through dedicated corresponding rural and urban-rural Micro, Mini, Middle, and Regional Ecologic, Education, and Health SMEs.

With advances in technology, the domain of engineering and design offers a wide range of solutions that support daily function, activities, and participation, facilitates the provision of healthcare, and offers means for leisure to older people. Too often, end-users of architectural and technological solutions are not consulted in the design processes and the implementation of the solutions in practice, in creation corresponding SMEs. Their inclusion in these processes is paramount to the success of the proposed and implemented solutions.

One of the pillars of the Republic of Moldova crisis solving is involvement of members (most of which are old people) of Its First, Democratic Parliament, represented by the "Parlament 90" Association. The First, Democratic Parliament established the State of the Republic of Moldova declared state independence, and initiated development of a new state in Europe. These are not statements or "strong words", but a cry of the unsatisfied soul regarding the country's evolution that was created by the First, Democratic Parliament of the Republic of Moldova. Social Association "Parlament 90" must intervene to improve the crisis of the Republic of Moldova. Mostly the rural area of the Republic of Moldova is affected at Micro, Mini, Middle, and Regional SMEs such as: „Home Ecology, Education, and Health”, „Small Rural Industry”, „Rural Middle

Industry”, and „Regional Industry” Sectors.

1.1. The „Home Ecology, Education, and Health” Sector In this sector are affected different branches of human rural activities of the types: - local ecology; - human, ground, water, and air micro ecological SMEs;- barber shop;- bathroom;- library;- science, school, kindergarden;- culture, theatre;- medical & pharmacy place;- Post & Multimedia. For such directions of rural sector human activities can be supported by the SMEs of Micro types.

1.2. The „Small rural industry” Sector

In this sector are affected different branches of human rural activities of the types: - the small industry sector;- human, ground, water, and air mini ecological SMEs; - security;- oil mills;- mills;- bakery;- collection of individual households production (IHP);- processing, drying, storage IHP;- distribution of IHP;- shoemaker workshop;- tailoring;- garbage. For such directions of rural sector human activities can be supported by the SMEs of Mini types.

1.3. The „Rural Middle Industry” Sector

In this sector are affected different branches of middle rural activities of the types: - middle industry;- human, ground, water, and air ecological SMEs; - mechanization of rural activities such as: sowing, harvesting, territories preparing; - collective households production (CHP);- processing, drying, and conservation CHP;- storage, distribution CHP;- series and its planting and monitoring;- fruits, planting, care, orchard monitoring;- winemaking, planting, care, vineyards monitoring;- vegetables, initiation, care, monitoring;- water supply;- fishing, local resources monitoring;- cattle occupation, local resources monitoring;- swine, goats,

local resources monitoring;- shepherd, local resources monitoring. For such directions of rural sector human activities can be supported by the SMEs of Mini & Middle types.

1.4. The „Regional Industry” Sector

In this sector are affected different branches of human middle rural regional activities of the types: - ecology in the regional industry sector;- human, ground, water, and air ecological SMEs;- water monitoring: pools, lakes, rivers;- solar, water and wind power;- bioenergetics;- dump goods energetics;- roads;- irrigation;- fishing, local resources monitoring;- cattle, local resources monitoring;- pigs, goats, local resources monitoring;- sheeping, local resources monitoring. For such directions of rural sector human activities can be supported by the SMEs of Middle, Regional, Republican and International types.

2. Objectives

The Consortium directed by Social Association “Parlament 90” has to intervene to improve the crisis of the Republic of Moldova by initializing the Horizon 2020’s Project “Anti - migration management in the rural field of the Republic of Moldova”. For the better evolution of the Project the Consortium sets five major objectives that have to be achieved. These objectives are:

2.1. Studying problems of migration crisis in the rural sector of the Republic of Moldova with the support of the AO „Parlament 90”. It includes:

- consolidation of AO “Parlament 90” and consortium group, - creation the „Anti-migration Center of Consulting and Project Management”,
- data collection,
- international collaboration of AO “Parlament 90” in order to involve the developed countries in the society and

economy of the Republic of Moldova,

- involvement of AO "Parlament 90" in creation of the European projects of small and middle enterprises (SMEs) for the rural sector of the Republic of Moldova,

- consulting due the evolution and sustainability of the European projects of **SMEs in rural sector of the Republic of Moldova**

2.2. Monitoring suspension of labour force migration from the Republic of Moldova. It includes:

- analysis of the entire situation and the demographic aspects in the rural sector of North-East-West-South (NEWS) regions of Republic,

- making correlation between the basic labor force and the population which is not capable to work: elders, handicapped, children,

- creating a data base for evidence of the employed, free, in search of work, periodic labor force,

- evidencing of the skilled labor force: unqualified, in perspective of qualification,

- ensure the sustainability of the project.

2.3. Monitoring process of returning of labour force in the Republic of Moldova. It includes:

- registration the labor force working abroad with periods of their work evolution of the foreign labor force ("foreign") with its periods of evolution: (the year of foreign work beginning, country of activity, constant occupation, temporary occupation, vagrancy),

- ensuring the possibility of returning labor force from abroad in the Republic of Moldova,

- fitting the work activities in the already created SMEs,

- fitting in creation of SMEs,

- manage the processes of returning the

labor force in the rural sector of the Republic of Moldova,

- ensuring sustainability of the project during the implementation of this objective.

2.4. Monitoring process of creation of small and middle European enterprises in the rural sector of the Republic of Moldova. It includes:

- creation SMEs in the "Home Ecology, Education, an Health", the "Small Industry", the "Middle Industry", and in the "Regional Industry" sectors of Republic of Moldova;

- insuring sustainability of SMEs

- organizing creation process of work places with European remuneration

- manage process of work places occupation into the European SMEs in the rural sector of the Republic of Moldova.

2.5. Organizing and management process of creation and occupying of places of work in the European SMEs in the rural sector of the Republic of Moldova. It includes:

- creating of places of work in the European SMEs in the rural sector in such sectors as:

- the "Ecology, education, health",

- the "Small Industry",

- the "Middle Industry"

- the "Regional Industry";

- ensuring sustainability of places of work in the SMEs with European remuneration in the Republic of Moldova.

3. Work programme

The project expects to protect people that are affected of migration finding out information and solutions. The proposed solutions have a complex and varied function, providing essential support, defining rules in the rural society. It also contains improvement of public administrations, public services and policies due the studies that will be made

in the process of project implementation.

Simultaneously, the project has a benefited impact on economic, cultural, educational and social sectors by increasing and ever more complex expectations from citizens and businesses. Also the project will find the ways to create more effectively EU standard workplaces, educate people to collaborate with foreign organisations and attract funding for economic right projects. Addressing these complex issues requires holistic responses, which in turn call for the transformation its role in society.

The project main issue is to stop the process of migration and growth the level of societal well-being by educating citizen to collaborate with other state structures or citizens. The process of stopping the migration will start with education of local administrative structures about how to create good live and work conditions in order to ameliorate the number of migrants. The one of the aims of this project is not only to bring people back home, but to create new competent businesses in rural sector, to make researches the running of the more good rural sectors to be developed in each area of the Republic of Moldova. Of course, these facts will have a good impact on the society, migration policy of the country, development of the rural sector and creating the European work conditions.

4. Concept

Prospects of EU accession have created the need for the legislative and executive powers of the Republic of Moldova to review its migration policy and to reorganize the government institutions responsible for its implementation.

The concept of the project is to reduce the unemployment rate as well as to reduce the number of migrants from the

country. The aim of our project is to reach an increase of the number of employees and employers in the rural sector including old people with a goal to create Age-friendly rural and urban-rural communities.

According to some statistical data men were more affected by unemployment than women because many industrial plants and factories where male labour force was dominant, such as the technology-intensive and machinery industries, disappeared [<http://www.statistica.md/>]. In contrast, women gained easier access to new activities developed in the services sector. So, this project is going to change this situation due to creating new workplaces, educating people to work according to the EU standards, as well as implementing different projects in collaboration with local mayoralities and foreign partners in order to increase the cultural and ideological level of citizens including old people with a goal to create Age-friendly rural and urban-rural communities.

During the project will be done researches on such factors like:

- developing rural economic sectors in order to achieve the best results in anti-migration project and rising the live standards of the researched area;
- decreasing reasons of people to go abroad;
- developing strategies and tactics for the stopping of this detrimental process of Moldavian public and private sectors;
- including old people in jobs with a goal to create Age-friendly rural and urban-rural communities.

The concept of the project strives to reduce the unemployment rate as well as reduce the number of people who are under-utilized because of hardships in the economic sectors. Increase in the number of employees in the private sector and

decrease in the number of unemployed in the public sector. The number of employees in the public sector has decreased due to lower salaries that led to the migration of a part of the former employees.

Another target of the project is to start labour migrants returning. So, this project is going to change this situation due opening new European work places, educate people to work according to EU standards, implement different projects with local mayoralities, increase the cultural and ideological level of citizens, including old people with a goal to create Age-friendly rural and urban-rural Republican communities.

5. Methodology

The implementation methodology of project's concept firstly reports to analytical and statistical data collecting, organization of activities in consortium groups and between the groups and another private or governmental organizations. It means creation of a tight schedule of all congresses, conferences, meetings, activities and events. For the better informational interpretation and increasing the number of trained people will be created the „Centre of Consulting and Project Management”. The purpose of Center is to monitor the processes of stopping the migration and returning the citizens from abroad, provide trainings and consulting about how to write and implement an EU project according to all EU standards.

In order to achieve high results in anti-migration management of this project the „Centre of Consulting and Project Management” will consult SMEs in the rural sector of the Republic of Moldova during the whole evolution of the desired project in order to reduce the percentage of economic scams, vagrancy and to

increase the percentage of well-skilled labor force, programs with European wages, creation of European type SMEs in the rural sector of the Republic of Moldova by:

(1) studying problems of migration crisis in the rural sector of the Republic of Moldova with the AO „Parlament 90” support,

(2) monitoring suspension of labour force migration from the Republic of Moldova,

(3) organizing process of returning of labour force in the Republic of Moldova,

(4) organizing process of creation of small and middle European enterprises in the rural sector of the Republic of Moldova including enterprises with work places for old people with a goal to create Age-friendly rural and urban-rural Republican communities,

(5) organizing and managing process of creation and occupying of places of work in the European SMEs in the rural sector of the Republic of Moldova including enterprises with work places for old people with a goal to create Age-friendly rural and urban-rural Republican communities.

The major ambition of the project is to implement new technics and strategies based on Cracking Creativity Thinking Method for suspending the migration process of the nation. The Consortium of project strive to increase the cultural and educational levels, to introduce in the rural sector of the country European standards, to create new work places with European salaries and to make people return to their Motherland.

6. Impact

Based on Cracking Creativity Thinking Method during the project's evolution it will be increased the level of education in rural area of Moldova and as a result it

can find solutions for our tasks independently. Also based on Cracking Creativity Thinking Method during the project will be introduced the European work style. Will be obtained experience due to collaboration with European partners that are successfully proceed after the termination of the project through the Europeanization of the rural area. Will be found external and local financing sources after signing the individual and collective contracts. Will be raised the qualification level of employees and employers.

The anti-migration project has benefic impacts on national identity that is couched in ethno cultural fixtures, to one based more on civic values and responsibilities. Also, the project satisfied the need for the legislative and executive powers of the Republic of Moldova to review its migration policy and to reorganize the government institutions responsible for its implementation and made possible the process of integration in EU. Finally, the discussed project has impacts on national cohesion.

Much more significant impact for society is the return of labour migrant from EU countries, Russia and other CIS countries. So, the number of migrants can be reduced. The small and medium enterprises acquire knowledge and skills about drawing up draft of local, regional and national projects and the attraction of investments into the country in order to increase the economic, cultural, technological level and increasing the quality and quantity of the products for export. All these skills will be obtained following the development of the project in question. This will contribute to raising the living standards and wage increase, will open the perspective of increasing the market share at nationally and

internationally level of domestic production. Likewise, the project provides raising the living standards in the rural area of Republic of Moldova.

With the increasing number of medium and small enterprises (SMEs) of European type in the rural area of Republic of Moldova, the chances of adhering to EU space will grow and will open up new perspectives for the entire Republic including old people with a goal to create Age-friendly rural and urban-rural Republican communities. There will be organized a Congress at the start of the project, where will be involved more than 200 participants from different regions of Moldova. Congress will create „Centre of Consulting and Project Management”. The Consortium will make studies and analysis of the situation and will monitor the processes of migration stopping and citizens return. The „Centre of Consulting and Project Management” will instruct each mayor and people from local administration (more than 1500 people) how to write a good, competitive, international project in order to rise the rural sector by opening new SMEs and create new workplaces according to EU model. Present project will raise level of knowledge in project management. Creation of new workplaces with European conditions will influence positive the rural sector by stopping migration.

Well-instructed people will have more chances to find funding for their projects and ideas. So, this instruct will help them to collaborate on a high level with international organizations from worldwide. During the project will be elaborated reports, tactics and strategies which will be submitted for the government approval. The project

consortium will collaborate with other national and international organizations.

7. Sustainability.

The process of goods creating is more complex than it seems on the surface [1]. It involves the use of complex capacities of the human brain in all stage of its production. In the case of Future Conscience Society, we must take into account the existence of space energy and its relationship with humans, as a common and infinite source of goods creation and idea generation as result of physical work, intellectual work and especially, spiritual work. In perspective of implementation the Cracking Creativity thinking Method there have to be done supplementary next activities in rural sector of the Republic of Moldova.

7.1. Organizing and managing the Euro-peanization process of Moldovan society: society, economy, education, culture, ecology.

The sustainability of Europeanization the Moldovan society of the Republic of Moldova depends of Social, economic, cultural, educational, medical and ecologic European evolution of the Republic of Moldova towards the European Integration, by creating European Micro enterprises in the "Home Ecology, Education, an Health" sector, by creating European Mini enterprises in the "Small Industry" sector, Middle European Enterprises in the "Middle Industry" sector, and Middle and Regional European Enterprises in the "Regional Industry" sector. Development, management, evolution and their sustainability is coordinated and consulted by deputies of the "Parlament 90" Association through the „Centre of Consulting of Parlament 90”.

7.2. Organizing and managing the process of raising of the living standards in rural areas of the Republic of Moldova

The sustainability of the process of raising of the living standards in rural areas of the Republic of Moldova depends of the Strategy of social, economic, cultural, educational, medical and ecological, European evolution of the Republic of Moldova towards its integration into the European Union through the Continuous European Education of rural inhabitants from the Republic of Moldova, organizing contacts and meetings with their counterparts from EU countries, organizing partnerships of Micro rural enterprises from the Republic of Moldova and from EU in the „Home Ecology, Education, and Health” sector, of Mini rural enterprises in the „Mini Industry” sector, of Middle rural enterprises in the „Middle Industry” sector, and of Regional rural enterprises in the “Regional Industry” sector with Europeansalaries.

The development, management, evolution and sustainability of the salary, Europeanization and of raising of living standards of the inhabitants in the rural area of the Republic of Moldova are coordinated and consulted by the “Parlament 90” Association through the „Anti-migration Center of Consulting and Project Management”.

7.3. Organizing and implementing of the correlation of Moldovan society and culture with the European society and culture

Basic activities: highlighting the basic areas of European culture, the human and nature ecology, the barber shop, the bathroom, the library, the education and the science, the Theatre of Culture, libraries, the medical point & the

pharmacy, the internet & the European mail, studying the European culture on basic areas, the schooling and the education on European culture areas, and the approximation and the collaboration of Moldovan and European cultures in the rural area of the Republic of Moldova. The sustainability of the process of **correlation of Moldovan society and culture with the European society and culture** on the commune, village and mayoralty level will consist in correlations, meetings, social and cultural exchange of experience of school, dancing, coral and crafts collectives, communal twinning, European joint study programs in communal schools, mutually social and cultural travel and tourism. On the municipalities and counties level **the correlation of Moldovan society and culture with the European society and culture will consists in** correlations, meetings and social and cultural exchange experiences of municipal and county of school, dancing, coral and crafts collectives, municipal and county twinning, European joint study programs in general education schools and trade schools, mutually social and cultural travels and tourism, and in organizing seminars and conferences on social and cultural topics.

The sustainability of the process of **correlation of Moldovan society and culture with the European society and culture** on the regional and republican level will consists in correlations, meetings and social and cultural exchange experiences of regional and republican of school, dancing, coral and crafts collectives, regional and republican twinning, European joint study programs in general education schools, trade schools, colleges and high schools, mutually social and cultural of regional and republican travel and tourism, and in

organizing seminars and conferences on social and cultural topics.

7.4. Organizing and implementing of the European ecology, economisation and industrialization of rural area in the Republic of Moldova

Basic activities: highlighting of the basic areas of the European rural industries, the human and nature ecology, the education and the economic and instrumental cleverness, the small, middle and regional industry, the European industrialization of the rural area in the field of ecology and education, and the European industrialization of the rural area of the Republic of Moldova in the field of small, middle and regional industries. The sustainability of the process of **organization and implementation the European ecologic, economic and industrial sectors of rural area in the Republic of Moldova** on the commune, village and mayoralty level will consist in correlations, meetings and exchange of economical, industrial and ecological experiences of small economical, industrial and ecological enterprises; communal twinning of small economical, industrial and ecological enterprises, European joint study of economical, industrial and ecological programs in communal schools, mutually economical, industrial and ecological travels and tourism at the commune, village and mayoralty level. On the municipalities and counties level **the organization and implementation the European ecologic, economic and industrial sectors of rural area in the Republic of Moldova will consists in** correlations, meetings and exchange of economical, industrial and ecological experiences of SMEs economical, industrial and ecological collectives at the municipality and county level; municipal

and county SME economical, industrial and ecological twinning, European joint study of economical, industrial and ecological programs in municipal and county schools; mutually economic, industrial and ecological travels and tourism at municipality and county level.

The sustainability of the process of **organization and implementation the European ecologic, economic and industrial sectors of rural area in the Republic of Moldova** on the regional and republican level will consists in correlations, meetings and exchange of economical, industrial and ecological experiences of SMEs collectives at regional and republican level, European joint study of economical, industrial and ecological programs at regional and republican level, mutually economic, industrial and ecological travels and tourism at regional and republican level.

Conclusion

In many European cities and communities, citizens, together with public and private sectors, are engaged in jointly identifying issues and needs, trying to solve problems through innovative and inclusive responses. They co-create the future through new solutions that have the potential to ensure sustainability, participatory governance, openness and transparency in policies and markets, the respect of the rule of law and social cohesion. At the same time, the vast majority of older adults wish to age in place, and many make use of long-term care services, including homecare, rehabilitation services, and social support. Inside the Union, this process could lead to more inclusive, collaborative and participative societies via greater engagement of all involved parties. In the same vein, it could also help to reinforce the necessary measures to reverse

inequalities within societies, including reviving social dialogue. For the Union's role in the world, the above mentioned external risks can be faced effectively, and the external opportunities can be better implemented if the EU's foreign policy players possess insightful knowledge and are fully empowered to jointly address risks, and if international research and innovation dialogue and cooperation are enhanced. All these efforts to make Europe a more resilient continent internally and in its external relations will be greatly helped if informed by reflections of Europe's cultural and social diversity and a thorough understanding of its past.

One way to support older people to live the life they wish to live is through the age-friendly social initiative, a world-wide program to make cities and rural areas better-tuned to the needs of older citizens. Projecting based on Cracking Creativity Productive Thinking Method [1, 2], which implements the strategies, based on the Secrets of Creative Genius, is used in elaboration of the Project "Anti-migration strategies for the rural sectors of South-East European country area" for the Horizon 2020 European Community Program [3, 4].

At the end of the project will follows to decrease the number of labour migration from Republic of Moldova by creating new working places and the grafting of abilities of working according to European and international standards. Under the project will raise the ideological and cultural spirit of the citizens. The small and medium enterprises acquire knowledge and skills about drawing up draft of local, regional and national projects and the attraction of investments into the country in order to increase the economic, cultural, technological level of all the rural communities, inclusive the

older citizens ones, and increasing the quality and quantity of the products for export. All these skills will be obtained following the development of the project in question. This will contribute to raising the living standards, the wage increase, will open the perspective of increasing the market share at nationally and internationally level of domestic production. Likewise, the project provides raising the living standards of older citizens in the rural area of Republic of Moldova.

With the increasing number of SMEs of European type in the rural area of Republic of Moldova, the chances of adhering to EU space will grow and will open up new perspectives for the entire Republic. Making cities and rural sectors more age-friendly can be done through dedicated housing facilities, home modifications and adaptations. The project is going to do a detailed analysis of the progress achieved, the identification of the project's strengths and weaknesses. With advances in technology, the domain of engineering and design offers a wide range of solutions that support daily function, activities, and participation, facilitates the provision of healthcare, and offers means for leisure to older people. As a result of the detection of weak points will be elaborated programs to remove the drawbacks thereof. Its inclusion in these processes is paramount to the success of the proposed and implemented solutions will be: (1) obtained the raising level of education in rural area and as a result - the finding the situation of assessment independently; (2) acknowledged the European advancements in the field and the work are carried out in European style; (3) obtained practice from interconnections with European partners which will has a continuity of progress in the cities and rural area through the globalisation of the field; (4) found new

means of financing from local and external sources by concluding the individual and collective contracts with older people communities; (5) obtained the raising of the qualification of employees and those from the hiring process; (6) achieved the internal process of transmission of the experience of older people with the participation of schools, colleges, relatives to the rural trades developments; (7) opened in schools and colleges new specialties and crafts with active participation of older people communities in the rural area; (8) emphasized the local specificity (village, commune, district, region) to be proud with local affairs and customs: skilful potters, weavers of national fabrics, cobblers and national style Fashion designers, stylists - extra class hairdressers, rural tourism with houses, streets, slums, villages with ecological fauna and flora, and (9) will be initiated rural festivals and evening sittings of village women with wool teasel and spinning based on older people knowledge, troubleshooting of distaff, carolling of girls, taking out the maiden for the first dance, have been renewed and Europeanized horas, choirs, entertainments, and national holidays and international forums.

Intellectual qualities of age-friendly communities such as inspiration, images, imagination, intuition, insight, improvisation, and incubation of evolved older people activities through the stages of acquisition of knowledge, development of curiosity, becoming interested, passion, dedication, and professionalism of individuals will be implemented in Creative age-friendly intelligences [5,6], in development of Emotional and Sensual age-friendly intelligences, and will develop the main directions of modern R & D projects of H2020 Program.

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NEW NEUROSCIENCE TOOLS TO STUDY ITCH AND PAIN

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Abstract: Recent advances in neuroscience methodology allow researchers to directly assess the effects of manipulating identified neural circuits on behavior. Our laboratory has implemented two methods, optogenetics and chemogenetics, to investigate how the brain modulates itch and pain sensation. Both methods involve insertion of an actuator into genetically-specified neurons. In optogenetics, the actuator is channelrhodopsin, a light-sensitive ion channel that is opened by illumination with blue light to excite (depolarize) neurons. In chemogenetics, the actuator is a Designer Receptor Exclusively Activated by a Designer Drug (DREADD). A common DREADD is the human muscarinic receptor that has been genetically engineered to only bind clozapine-n-oxide (CNO), a drug that binds to the receptor but is otherwise inert. We have investigated pathways descending from the rostral ventromedial medulla (RVM) of the brain to the spinal cord that modulate pain and possibly also itch transmission. Chemogenetic activation of RVM neurons expressing the receptor (NK-1R) for the neuropeptide substance P potently inhibited itch behavior. Channelrhodopsin was targeted to RVM neurons expressing the NK-1 receptor. RVM neurons identified by their response to blue light were discovered to be ON-cells, which are thought to enhance pain; our findings show that they have an opposite, inhibitory effect on itch. Itch is affected by stress, anxiety and other psychological states. Our results show that a substance P-sensitive neural circuit in RVM descends to inhibit the spinal transmission of itch signals, explaining how psychological factors might influence the perception of itch.

Keywords: itch; pain; optogenetics; chemogenetics; DREADDs

1. Introduction

The human brain consists of approximately 100 billion individual nerve cells or neurons. Each neuron makes synapses with many other neurons for an estimated total of one quadrillion synapses. Many methods have been developed to investigate brain function at different levels: interconnected groups of neurons (networks), populations of neurons, individual neurons, synapses, and subcellular constituents such as nuclei containing genetic material, or ion

channels and transporters in the cell membrane. Each method has limitations in terms of spatial and temporal resolution. For example, functional magnetic resonance imaging (fMRI) can identify active brain areas with fairly low spatial resolution and limited temporal resolution (seconds to minutes) since the method depends in blood flow changes. In contrast, electrophysiological methods such as microelectrode recordings afford high spatial and temporal resolution by registering action potentials (millisecond

resolution) in single neurons. Patch clamp allows extreme spatial and temporal resolution by recording ionic currents (sub-millisecond resolution) from individual ion channels.

Recent years have seen the advent of new methods that allow investigators to manipulate individually targeted neurons embedded within circuits of interconnected neurons, and to observe the effects on behavior. Two of these methods, optogenetics and chemo-genetics, are becoming standard approaches in neuroscience research and have been adopted by our laboratory to investigate itch and pain mechanisms.

2 Optogenetics

This method involves the expression of light-activated ion channels in the membrane of targeted neurons [1]. When the photosensitive ion channel is excited by light, it opens to allow positive ions to flow into the neuron to depolarize it and elicit action potentials. The light-activated ion channel channelrhodopsin (ChR2) was first isolated from algae [2] and within a few years was genetically expressed in mammalian neurons. The genetic construct includes a promoter to drive gene expression, and genes for ChR2 and a reporter (fluorescent marker), which are packaged in an adeno-associated-virus (AAV) and injected into a target brain area. To target neurons expressing a specific marker, the cre-lox system is often used. A construct is made that includes a stop codon flanked on either side by lox-p sites (“floxed”), inserted between the promoter and ChR2 gene.

When the construct enters into the specific neurons containing cre-recombinase, the lox-p sites are cleaved to remove the stop codon, allowing the promoter to initiate gene transcription of ChR2. In order to activate ChR2-

expressing neurons, an optic fiber must be implanted in the injected brain area to illuminate ChR2-expressing neurons with blue light (473 nm) (Fig. 1, upper left). Halorhodopsin, a light-sensitive ion pump that inhibits neurons when illuminated with yellow light, can be expressed in neurons in the same manner (Fig. 1, upper right).

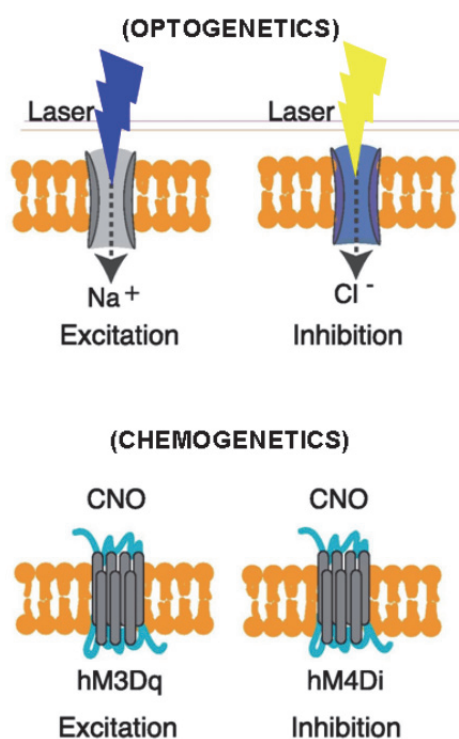


Figure 1. Optogenetics (upper row) and chemo-genetics (lower row). See text for explanation.

3. Chemogenetics

This method involves the genetic expression of Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) into targeted neurons [3]. DREADDs are activated by an inert chemical (usually clozapine-N-oxide, CNO) to either excite (Fig. 1, lower left) or inhibit the neuron (Fig. 1, lower right).

A commonly used DREADD is the human muscarinic receptor that has been engineered so that it no longer binds its natural ligand acetylcholine, but instead only binds CNO which is otherwise biologically inert. The methodology to express DREADDs in targeted neurons is essentially the same as described for optogenetics, above. A main difference is that no other instrumentation is required, since the DREADDs are activated by drinking CNO or injecting it into the bloodstream. When CNO accesses DREADDs-expressing neurons in the brain, the neuron will either be excited or inhibited depending on the type of DREADD.

4. Itch and pain

Chronic itch and chronic pain are common and economically costly problems that significantly reduce the quality of life in the sufferer. It has been estimated that the two most common itchy dermatoses, atopic dermatitis and psoriasis, affect upwards of 10% (or more) of the general population with annual costs of healthcare and associated loss of work in the billions of dollars [4-7]. Skin conditions associated with itch have been estimated to affect 1/3 of Americans with annual costs approaching \$100 Billion (in 2004 dollars) [8,9]. For comparison, chronic pain was recently reported to affect approximately 116 million American citizens at annual costs of \$560-635 Billion [10].

Itch and pain sensations arise when sensory nerve endings in the skin are activated by itchy or pain-evoking stimuli, respectively. A wide variety of chemicals, such as histamine, elicit itch by binding to their corresponding receptors that are expressed in the nerve endings of itch-signaling afferent fibers (“pruriceptors”) in

skin [11]. Pain is elicited when a presumably different subset of pain-signaling afferent fibers (“nociceptors”) encounter potentially damaging mechanical, thermal or chemical stimuli to the skin. However, there appears to be significant overlap in that many sensory nerve fibers respond to both itch and pain mediators. Pruriceptors and nociceptors transmit itch and pain signals to the spinal cord, where the information is processed and sent to higher centers in the brain for the perception of itch or pain. Given the substantial overlap between itch- and pain-signaling pathways, it has long been debated whether itch and pain have shared or separate dedicated pathways.

5. Descending modulation of itch and pain

It has long been recognized that the experience of pain varies considerably, depending on the situation. Examples include soldiers or competitive athletes who do not experience pain following injury, or the “runner’s high”. Of patients admitted to an emergency clinic after sustaining everyday types of injuries (lacerations, fractures etc.), 37% did not report any pain for as long as 9 hours afterward [12]. The effectiveness of a drug to relieve pain depends on the patient’s expectations; even dummy drugs can relieve pain, a phenomenon known as the “placebo” response. By the 1970s it was clear that there is an endogenous system connecting the brain to the spinal cord that can modulate the spinal transmission of pain signals (Fig. 2) [13]. For example, activation of this descending pain modulatory pathway can render animals insensitive to normally painful stimuli, a phenomenon called “stimulation-produced analgesia” [14].

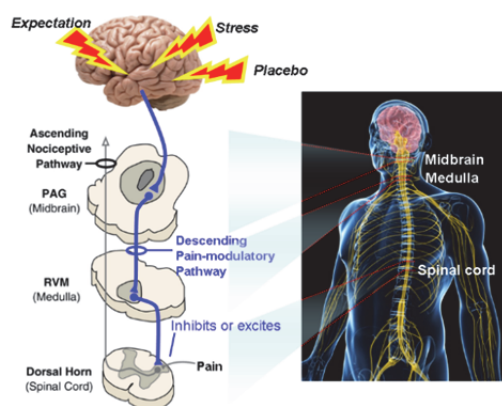


Figure 2. Ascending pain transmission and descending pain modulatory pathways. Abbreviations: PAG, periaqueductal gray; RVM, rostral ventromedial medulla.

Descending effects on spinal pain transmission are bimodal. It is currently accepted that two classes of neurons in RVM- ON cells and OFF cells- exert facilitatory and inhibitory effects, respectively, on spinal pain transmission [15]. ON cells become activated just prior to a defensivelimb withdrawal elicited by a strong stimulus, while OFF cells exhibit ongoing activity that is inhibited just prior to stimulus-evoked limb withdrawal. Increased pain (hyperalgesia) is associated with increased activity of ON cells elicited by local application of substance P [16].

In contrast, morphine analgesia is associated with increased activity of OFF cells and absence of the pause in OFF cell activity normally evoked by painful stimuli [15]. Moreover, we recently showed that ON and OFF cells are respectively excited and inhibited by intradermal injection of itch mediators [17]. Itch intensity also varies as a function of anxiety, stress, and other psychological states [18]. This variability may be mediated via descending modulation of spinal itch transmission, but there is currently little experimental

support for this idea. We therefore sought to investigate if itch, like pain, is subject to descending modulation by ON and OFF cells in the RVM using optogenetic and chemogenetic approaches.

6. NK-1 receptor-expressing ON cells in RVM inhibit itch

We injected a genetic construct containing genes for an excitatory DREADD and a red fluorescent reporter into the RVM of anesthetized “NK-1-cre” mice in which neurons expressing the NK-1 receptor also express cre recombinase. This procedure resulted in the expression of the DREADD and the red fluorescent protein in RVM neurons that express the NK-1 receptor. This was verified by showing that neurons that expressed red fluorescence also were immunohistochemically double-labeled with an antibody against the NK-1 receptor. Administration of clozapine (the DREADD actuator component of CNO) to these mice resulted in a marked suppression of scratching behavior elicited by the itch mediators histamine and chloroquine, an antimalarial drug that elicits itch sensation (Fig. 3). These results indicate that neurons in RVM that express the NK-1 receptor- presumably ON cells- exert a descending inhibitory effect on spinal itch transmission to reduce itch-related scratching behavior.

To investigate if the NK-1 receptor-expressing neurons in RVM are indeed ON cells, we used a combination of optogenetics and single-neuron recording. An example is shown in Fig. 4. AnAAV containing the genes for ChR2 and a reporter (enhanced yellow fluorescent protein= eYFP) was injected into the RVM of NK-1-cre mice, resulting in fluorescent labeling of RVM neurons (Fig. 4A).

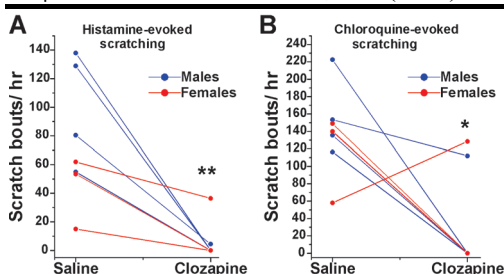


Figure 3. Activation of NK-1 receptor-expressing neurons in RVM inhibits itch-related scratching elicited by intradermal injection of histamine (A) or chloroquine (B). Graphs plot the number of hindlimb scratch bouts directed toward the injection site in DREADD-expressing mice. Each mouse received saline as a control (Fig. 3, left-hand dots) and in a separate experiment at least 1 week later systemic administration of clozapine (right-hand dots). Connected dots represent individual mice. Blue: male mice; red: female mice. *, **: $p < 0.05$, 0.001 , respectively for scratch bouts following clozapine compared to saline administration (ANOVA).

Under general anesthesia, the RVM was probed with a recording microelectrode attached to a fiber optic cable (Fig. 4B) to search for single neurons that responded to blue light stimulation. Fig. 4C shows an example in which each optic light pulse (lower trace) faithfully elicited an action potential in the recorded neuron (upper trace). Fig. 4D shows that this neuron exhibited an increase in action potential firing (upper trace) that started just prior to contraction of a hindlimb muscle (EMG, lower trace) that drives the hindlimb withdrawal reflex elicited by a strong pinch stimulus to the hindpaw- the classic signature of an ON cell. To date, all light-sensitive RVM neurons tested have proven to be ON cells.

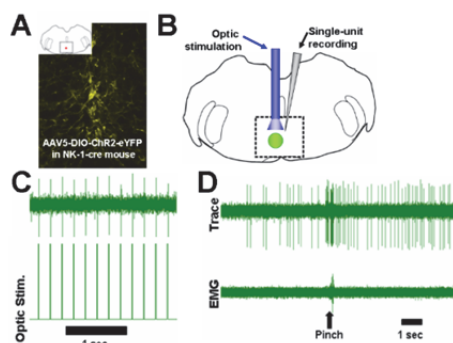


Figure 4. Combined optogenetics and single-neuron recording. A: DREADD expression in RVM neurons. B: Method. C: Upper trace shows recorded action potentials of RVM neuron that faithfully followed 10 Hz optic stimulation with blue light (lower trace). D: Upper trace shows action potentials that increase in firing rate just prior to electro-myographic activity (EMG; lower trace) in hindlimb muscle driving paw withdrawal elicited by strong pinch. See text for details.

7. Discussion

RVM ON cells facilitate spinal pain transmission, while our data show that ON cells inhibit spinal itch signalling. This implies that pain and itch are under opposing descending modulatory influences, consistent with a recent study from our laboratory [19]. Itch and pain are opposite in other respects as well. For example, pain inhibits itch. This is exemplified by scratching, which can be mildly painful but relieves itch, at least temporarily. Also, the analgesic drug morphine reduces pain, but has the opposite effect of eliciting or enhancing itch. Considerable evidence indicates that the inhibitory effect of pain on itch is mediated by spinal inhibitory interneurons. These interneurons (black in Fig. 5) are excited by pain-evoking stimuli via excitatory spinal pain-signaling neurons (red in Fig. 5), and directly inhibit itch-

signaling spinal neurons (blue in Fig. 5). Conceivably, descending facilitation of pain-signaling spinal neurons by ON cells activates the inhibitory interneurons, such that ON cell firing increases pain but inhibits itch as observed presently. Of course, there are other potential mechanisms and it is still uncertain what effect OFF cells have on itch.

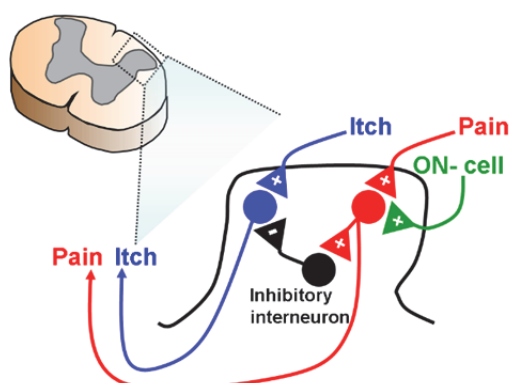


Figure 5. See text for explanation.

+, excitatory synapse;

-, inhibitory synapse.

8. Conclusions

Our present study has used the recently-developed neuroscience methods of optogenetics and chemogenetics. These tools allow investigators to selectively target genetically specified neurons within neural circuits, and to determine how activating or inhibiting these neurons affects the animal's behavior. Our aim was to better understand the molecular biology of modulatory circuits in the brainstem RVM that descend to the spinal cord to gate pain and itch transmission. We found that neurons in the RVM that express the NK-1 receptor are ON cells, and that activation of these neurons inhibits itch-associated scratching behavior. These findings support the idea that the situational variability of itch may be due to a descending pathway from the brain to the spinal cord that can modulate the

transmission of itch signals. A better understanding of the itch- and pain-modulatory circuits, and the neurotransmitters and receptors involved, has potentially important translational significance in terms of developing new ways to relieve chronic itch and pain through mechanisms-based interventions.

Acknowledgments

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ȚINTIREA CONVERGENȚEI – CONDIȚIE INDISPENSABILĂ A CREȘTERII ECONOMICE OPTIMALE

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Abstract. Studiul propune conceptul construirii indicelui sintetic unic de evaluare a procesului de convergență cu ajutorul analizei comparative, în care compararea se efectuează cu un etalon, iar categoria distanță de la etalon se utilizează în calitate de criteriu de măsură. O atare abordare definește o nouă metrică a convergenței și o intercalează în procesul de evaluare a integrării.

Cuvinte-cheie: convergență, divergență, UE, model de regresie, model de optimizare

1. Introducere.

Regula de aur a prosperității unui sistem economic este cum nu se mai poate de simplă: a lucra, a acumula și a investi azi astfel încât generațiilor ce vor veni să li se asigure un viitor cel puțin la fel de bun [1]. Marea majoritate a savanților economiști consideră că în epoca globalizării la baza regulii de aur trebuie să stea teoria creșterii optimale, care include: integrarea de durată în circuitul economic mondial, stabilitatea sustenabilă a sistemului economic, competitivitatea sustenabilă, etc. **Stabilitatea sustenabilă** presupune acceptarea creșterii economice ca motor al dezvoltării, fără renunțarea însă la echilibru, iar **competitivitatea sustenabilă** este definită ca set de instituții, politici și factori care determină nivelul de productivitate, asigurând în același timp capacitatea generațiilor viitoare de a-și satisface propriile necesități. În diferite sisteme economice acest principiu este implementat prin strategii și proiecte proprii. Specificul economiei a mai multor țări, inclusiv a **Republicii Moldova**, constă în faptul că alături de problemele enunțate mai sus se adaugă cele legate de **integrare** cu tot conținutul acestui termen: scop, funcționalitate, proces în spațiu și timp, instrumente, politici și instituții, etc.

Vectorul politic al republicii este orientat spre Uniunea Europeană (UE), deci și dezvoltarea țării în viitor va însemna dezvoltare prin integrare. În atare situație se impune măsurarea continuă, în dinamică a **convergenței** reale către spațiul comunitar, de aceea este necesar de a cunoaște modelul distinctiv european, mai ales a celui de perspectivă. Proiectul World Bank [4] prevede restaurarea gloriei și strălucirii de altă dată a UE, implementând teoria creșterii optimale prin intermediul modelului economic european cu genericul „Creșterea de Aur”, propulsat de *mașina de convergență* și vizează Comerțul, Finanțele, Întreprinderile, Inovațiile, Munca, Guvernarea. Cu toată diversitatea modelelor naționale de dezvoltare la nivel comunitar există o viziune comună asupra progresului și creșterii economice, cu elemente distincte: integrare regională fără precedent, supraputere economică, tradiție, tendințe și atașament față de tehnologiile avansate. Per ansamblu, viziunea comună se referă la: legislație, taxe și impozite, proceduri vamale, control financiar, bugetare, circulație capital, uniune economică și monetară, etc. Ca obiectiv, pentru anul 2020 se prognozează că economia UE va fi una inteligentă, sustenabilă și social orientată. Din punct

de vedere metodologic marea problemă a cercetării economice este că până în prezent în UE nu există un concept unic, un indicator **sintetic** unic de evaluare a acestui proces de convergență [2], ceea ce generează o mulțime de ambiguități, cu toate că acestei probleme îi sunt consacrate numeroase studii în care se aduc și calcule concrete pentru anumite segmente ale procesului integrationist (a se vedea [2-3]), iar diferite instituții de specialitate efectuează permanent monitorizarea integrării comunitare. În concordanță cu principiile Protocolului de Convergență al UE [13], urmărind scopul evaluării finalității mașinii de convergență în prezentul studiu se încearcă rezolvarea acestei probleme introducând mecanismul de țintire a convergenței, bazat pe analiza comparativă, în care compararea se efectuează cu parametrii uniunii, anume aceștia servind drept etalon pentru dezvoltarea economică și socială a multor țări, inclusiv a Republicii Moldova, iar categoria distanță de la etalon se utilizează în calitate de criteriu de măsură. O astfel de abordare definește o nouă metrică a convergenței și o intercalează firesc în procesul de evaluare a integrării. În model se evită agregarea datelor, totodată acesta poate fi utilizat pentru efectuarea analizei curente a problemelor în materie de convergență precum și la prognoza proceselor integraționiste.

2. Descrierea metodelor existente.

Prin definiție, un sistem economic se caracterizează printr-un set de indicatori, notat prin vectorul x , acest vector fiind determinat de structura economică a sistemului, care însă nu întotdeauna este cea dorită. În rezultatul implementării politicilor economice, indicatorii economici ai sistemului pot fi modificați astfel încât structura să tindă către o altă structură, dinainte stabilită x^0 , numită structură-etalon. Logic, apare problema

evaluării cantitative a modificărilor structurale ale vectorului x , mai precis, a apropierei componentelor acestui vector de componentele respective ale vectorului x^0 . Teoria generală a convergenței spune că dacă aceste două sisteme sunt în proces de dezvoltare economică avansată, atunci acest proces este convergent, de la un caz la altul mai rapid sau mai lent, deseori cu anumite condiții specifice, dar, totodată, în mod obligatoriu neliniar. În [3] sunt prezentate elementele caracteristice ale unui astfel de proces prin descrierea metodelor privitoare la stadiul de realizare sau respectiv intenstatea convergenței și aduse numeroase calcule numerice.

Metodele de măsurare a stadiului de realizare a convergenței se referă la: omogenitate, gradul de concentrare, polarizare, complementaritate bilaterală, etc., iar metodele de apreciere a intensității sunt relevante mai ales pentru țintirea obiectivelor convergenței, se desfășoară în timp și spațiu și pot contribui la apropierea de o anumită stare a sistemului. De menționat, în legătură cu cele expuse aici, metodele și modelele care exprimă distanța dintre un indicator economic al unei entități și nivelul mediu în sistemul întreg. De exemplu, mai întâi se determină distanța în raport cu media la valori per capita pentru $PIB_{percapita}$, $INVESTITII_{percapita}$, $CONSUM_{percapita}$, etc., după care se poate aprecia indicele necesar de creștere în entitate a indicatorului respectiv pentru a asigura o convergență mai rapidă. Un loc aparte revine aici modelului lui P. Krugman [6] care a propus un model de apreciere a gradului de convergență a economiei unei țări față de o altă structură economică, ideologia căruia se utilizează mai jos la eloborarea și formularea unui nou model.

3. Modelul creșterii economice optimale [5].

În cercetare deseori **optimizarea** reprezintă suportul principal

și determină luarea deciziilor. În problemele de optimizare valorile variabilelor se determină neunivoc și atunci apare posibilitatea alegerii a acelor valori care corespund celor mai bune intenții. În economie acest lucru se reflectă matematic sub forma de funcții obiectiv, legături funcționale, limite de variație, care descriu eficacitatea economică a soluției.

A) Limite de variație a indicatorilor.

Cu referință la problema dată, în primul rând, urmează să fie stabilitate limitele de variație a indicatorilor economici, de exemplu, pentru parametrii x_i în forma $a_i \leq x_i \leq b_i, i = \overline{1, n}$. Dar indicatorii caracterizanți ai convergenței nu sunt o simplă listă, ci formează o structură bine încheată. Structura economică leagă mai multe categorii economice, care reprezintă abstracții științifice și reflectă relațiile economice împreună cu derivatele și noțiunile aferente, astfel respectiv fiind definite structurile propriu-zise, ierarhii ale structurilor, agregarea structurilor, distanța dintre structuri, măsurarea distanței unei structuri date de la un etalon dinainte stabilit. Din alt punct de vedere, structura indicatorilor caracterizanți ai convergenței conferă trăsăturile fundamentale ale sistemului economic concret - UE, iar fiecare element al structurii date participă la evaluarea stării socioeconomice a sistemului, deci structura nominalizată reprezintă un invariant al sistemului economic analizat. În al doilea rând, se determină legăturile funcționale $g_j(x)$, $j = \overline{1, m}$ dintre indicatorii structurii, neliniare prin natura lor.

B) Variante de legături 1. În această variantă nemijlocit se consideră drept structură caracterizantă a convergenței $PIB_{percapita}$ [7], care se construiește **implicit** prin transformarea ecuațiilor simultane într-o singură legătură funcțională.

C) Variante de legături 2. În perioada

ultimilor ani tot mai des se afirmă că $PIB_{percapita}$ nu este indicatorul cel mai indicat pentru problema dată. Mai jos se descrie o altă abordare a indicatorilor caracterizanți ai convergenței. În continuare se examinează legătura funcțională pentru problema dată în forma **explicită** a indicatorilor, care îi transformă în **factori de impact** și permite **țintirea convergenței**, anume

$$C = \exp(c_1 x_1 + c_2 x_2 + \dots + c_n x_n),$$

adică legături stabilite de o funcție exponențială, c_i - coeficienți, sau combinații de astfel de funcții. Coeficientul c_i - reprezintă ponderea factorului i , C - este o valoare totală a indicatorului dat. Funcția exponențială este monotonă și strict crescătoare pentru $\exp > 1$ și strict descrescătoare pentru $0 < \exp < 1$ (a se vedea graficele). Acest lucru este foarte important deoarece pe termen lung funcția respectivă exprimă destul de adecvat comportamentul procesului de convergență în dependență de măsurile eficiente întreprinse. Pe de altă parte, prin logaritmare în cele mai simple cazuri ecuația exponențială de mai sus poate fi redusă la una liniară față de variabile. Pe termen scurt, la diagnosticarea situației curente, legătura examinată devine strict liniară

$$C = c_1 x_1 + c_2 x_2 + \dots + c_n x_n.$$

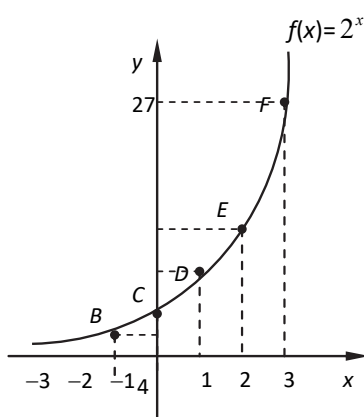
O variantă de determinare a legăturilor funcționale $g_j(x)$ după schema de mai sus, constă în următoarele. Se consideră vectorul sumar al părții drepte a ecuației de mai sus

$X_i = (x^{(1)}_i, x^{(2)}_i, x^{(3)}_i)$, pentru fiecare i din țările-membre a UE: $x^{(1)}_i$ - parte a vectorului ce corespunde ecuației pentru $PIB_{percapita}$, $x^{(2)}_i$ - partea corespunzătoare inflației, măsurată prin descompunerea pe factori [9], $x^{(3)}_i$ - parte a vectorului ce corespunde competitivității, măsurată prin caracteristicile indicelui competitivității sustenabile (GCI) [8], toți acești indicatori

considerați cei mai importanți ai creșterii economice optime, reprezentând consecutiv parametrii macroeconomici ai dezvoltării durabile ca atare (bloc 1), stabilitatea sustenabilă

(bloc 2) și competitivitatea sustenabilă (bloc 3), fiecare exprimată prin vectorul - structură respectiv. Atunci partea stângă $C_i = (C_i^{(1)}, C_i^{(2)}, C_i^{(3)})$ constituie o funcție a valorilor numerice ale produsului intern brut per capita, inflației și indicelui general al competitivității, iar ceilalți parametri c_i pentru fiecare țară vor fi dați de coeficienții lui Gini pentru prima legătură funcțională [2], pentru legătura a doua de rezultatul targetării inflației [9-10], de ponderea pilonilor GCI pentru a treia legătură [8]. Astfel

$$C_i^{(1)} = c_1^{(1)}x_1^{(1)} + c_2^{(1)}x_2^{(1)} + \dots$$



$3 * C_i^{(1)} = (0.3 * x_1^{(1)} = PIBagr) + (0.2 * x_1^{(2)} = PIBind) + (0.1 * x_1^{(3)} = PIBcom) + (0.1 * x_1^{(4)} = PIBtrans) + (0.2 * x_1^{(5)} = PIBalt) + (0.1 * x_1^{(6)} = PIBimpindirecte)$, unde respectiv $PIBagr$, $PIBind$, $PIBcom$, $PIBtrans$, $PIBalt$, $PIBimpindirecte$ înseamnă produs intern brut per capita în agricultură, industrie, comerț, transport, altele neincluse în cele precedente, obținut din impozite indirecte. Pentru ecuația a doua

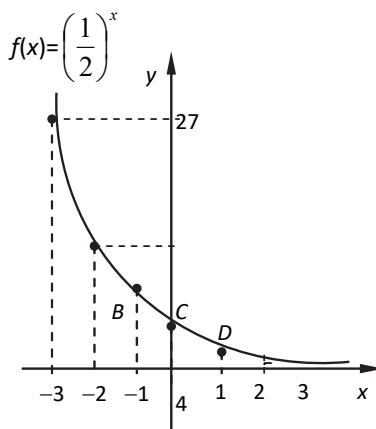
$$3 * C_i^{(2)} = (0.2 * x_2^{(1)} = \text{emisie monetară})$$

$$+ c_{n1}^{(1)}x_{n1}^{(1)}, \\ C_i^{(2)} = c_1^{(2)}x_1^{(2)} + c_2^{(2)}x_2^{(2)} + \dots + c_{n2}^{(2)}x_{n2}^{(2)}, \\ C_i^{(3)} = c_1^{(3)}x_1^{(3)} + c_2^{(3)}x_2^{(3)} + \dots + c_{n3}^{(3)}x_{n3}^{(3)}, \\ \text{aici } \sum_{i=1}^3 \sum_{l=1}^n c_l^{(i)} = 1, n = n1 + n2 + n3.$$

Ideea pornește de la formula propusă de R. R. Yager [11-12] bazată pe mediile ponderate w_i ale indicatorilor economici x_i :

$$f_{OWA}(x_1, \dots, x_n) = \sum_{i=1}^n w_i * x_i, w_i \in (0,1], \sum_{i=1}^n w_i = 1,$$

în baza căreia au fost introduse mai multe noțiuni. De exemplu, pentru Republica Moldova, cu coeficienții ajustați la această formulă, indicatorii pentru prima ecuație pot fi legați prin relația



$+ (0.1 * x_2^{(2)} = \text{rata dobânzii}) + (0.1 * x_2^{(3)} = \text{hârtii de valoare}) + (0.1 * x_2^{(4)} = \text{curs de schimb/paritatea puterii de cumpărare}) + (0.1 * x_2^{(5)} = \text{transfer bugetar}) + (0.1 * x_2^{(6)} = \text{rate impozitare}) + (0.1 * x_2^{(7)} = \text{cote de contribuții sociale}) + (0.1 * x_2^{(8)} = \text{politici statale}) + (0.1 * x_2^{(9)} = \text{remitențe})$.

Iar cea de-a treia ecuația arată (k_i - indicele de dezvoltare a țării i):

$$3 * C_i^{(3)} = (k_i * 0.25 * x_3^{(1)} = \text{Sistemul})$$

instituțional) + ($k_i \cdot 0.25 \cdot x_3^{(2)}$ =
Infrastructura) + ($k_i \cdot 0.25 \cdot x_3^{(3)}$ =
Stabilitatea macroeconomică) +
($k_i \cdot 0.25 \cdot x_3^{(4)}$ = *Sănătatea și educația*
primară) + ($k_i \cdot 0.17 \cdot x_3^{(5)}$ =
Educația superioară) + ($k_i \cdot 0.17 \cdot x_3^{(6)}$ =
Eficiența pieței bunurilor) +
($k_i \cdot 0.17 \cdot x_3^{(7)}$ = *Piața muncii*) + ($k_i \cdot 0.17 \cdot x_3^{(8)}$ =
Piața financiară) + ($k_i \cdot 0.17 \cdot x_3^{(9)}$ =
Gradul de pregătire tehnologică) +
($k_i \cdot 0.17 \cdot x_3^{(10)}$ = *Dimensiunea pieței*)
+ ($k_i \cdot 0.50 \cdot x_3^{(11)}$ = *Condiții pentru*
business) + ($k_i \cdot 0.50 \cdot x_3^{(12)}$ = *Inovarea*).

D) Etalonul. Finalmente, se construiește funcția-obiectiv a procedurii de optimizare, aici luată în forma

$$f(x) = \sum_{i=1}^n (x_i - x_i^0)^2, (1)$$

x^0 - fiind un vector dat, numit etalon.

E) Schema generală. Astfel metodologic modelul formulat are următoarea schemă generală de implementare:

Pasul 1. Se stabilește etalonul (componentele vectorului x^0). Variante: 1) media UE, 2) țara cea mai bine plasată în ratingurile internaționale, 3) construirea vectorului etalon din valorile maxime ale fiecărui indicator inclus în structură;

Pasul 2. Se studiază mai întâi situația reală, abordând problema sistemic (integritatea metodologiei, meca-nismelor și a politicilor);

Pasul 3. Se pornește de la valoarea totală C din perioada imediat premergătoare analizei preluată din rapoartele statistice oficiale;

Pasul 4. Se stabilesc valorile lui c_i , variante: serii;

Pasul 5. Se stabilesc limitele de variație a variabilelor x_i ;

Pasul 6. Se execută procedura de optimizare în baza **modelului creșterii economice optimele**, care va asigura minimizarea distanței de la etalonul dat cu

respectarea tuturor restricțiilor impuse;

Pasul 7. Se obține valoarea vectorului optimal;

Pasul 8. Se calculează Indicele Sintetic al Convergenței (ISC) după formula

$$ISC = \frac{\sum_{l=1}^L k_l \cdot \left(\frac{x_l}{x_{l0}} - 1\right)^2 \cdot 100\%}{L}, (2)$$

$x^0 = (x_{10}, \dots, x_{l0}, \dots, x_{n0})$ - reprezentând structura-etalon, iar $x^j = (x_1, \dots, x_l, \dots, x_n)$ indicatorii optimali ai structurii x^j calculați mai sus, L este numărul indicatorilor, $L \leq n$. În formula (2) numărul indicatorilor incluși L poate fi mai mic decât numărul total n , aceasta stabilindu-se în urma estimării și a indicatorilor necuantificabili și ponderarea lor, procedură inerentă oricărui calcul numeric. Coeficienții k_l sunt neesențiali în model, aceștia fiind utilizați pentru a putea efectua compararea cu alte metode. Se ia de obicei $k_l = 1$. Conform acestei formule în studiile comparative mai sus în rating va fi plasată entitatea cu un indice sintetic al convergenței (ISC) mai mic. ISC poate fi calculat și direct, fără aplicarea procedurii de optimizare, dar în acest caz x_i nu vor mai avea valorile optime.

Pasul 9. Se studiază rezultatele și se iau decizii.

F) Specificul problemei. Dar problemele economico-matematice au specificul lor: în aceste probleme dimensiunea modelului este mare. În acest caz inevitabil apare efectul degenerării soluției numerice. Astfel, o procedură elementară - procedura de inversare a matricelor poate deveni destul de complicată. Încercând evitarea unor atare obstacole în unele cercetări din domeniul economico-matematic cu tangențe la tematica abordată, s-au propus căi de reformulare a problemei inițiale, alte studii se axează pe ideea selectării claselor de probleme de dimensiuni mari, anume care determină careva cazuri particulare

ale problemei generale, dar care acoperă o mare parte din problemele economice și pentru care, totodată, pot fi propuși algoritmi eficienți de soluționare. Mai jos se descrie un astfel de model de cercetare economică elaborat de către autor.

H) Formularea modelului economico-matematic.

Modelul Krugman, folosit pentru determinarea gradului de convergență structurală K a fost utilizat la rezolvarea numeroase probleme practice, inclusiv a fost adaptat pentru evaluarea gradului de convergență a diferitelor state. Acest model este destul de simplu și nu utilizează criterii de optimizare. Astfel acesta nu permite identificarea componentelor mai apropiate sau mai depărtate de omogenitate și nu arată în ce măsură acestea ar putea fi modificate numeric, pentru a le apropia de valorile scontate. Pentru a transforma acest model în unul de optimizare este necesar de a înlocui indicele lui Krugman K cu funcția obiectiv $\min f(x)$ de mai sus (1). Anume diferențele valorilor absolute ale componentelor vectorilor x , x^0 este oportun de înlocuit cu pătratul normei $\|x - x^0\|^2$, ceea ce din punct de vedere matematic înseamnă o altă formă de reprezentare a normei spre deosebire de K , unde norma este pur și simplu suma modulelor, substituție mult mai convenabilă pentru optimizări, deoarece funcția dintr-o linie frântă devine netedă, deci cu derivate continue. Îmbinând ideile modelului Krugman, poate fi formulat următorul model pentru probleme de optimizare în cercetări comparative: se cere de determinat

$$\min f(x) = \|x - x^0\|^2 \quad (3)$$

la respectarea restricțiilor

$$g_j(x) = 0, j = \overline{1, m}, \quad (4)$$

$$0 \leq x_i \leq a_i, i = \overline{1, n}. \quad (5)$$

Modelul permite, pe de o parte, evaluarea stării de apropiere de etalon a procesului/obiectului de comparație, iar pe

de alta, evaluarea nivelului de dezvoltare economică a țării sau comunității de țări. Din punct de vedere metodologic, modelul are la bază metoda de comparare cu un etalon, cercetarea se efectuează pornind de la abordarea sistemică a proceselor economice, iar optimizarea reprezintă suportul principal de analiză și prognoză. Din punct de vedere matematic, modelul este un model de optimizare determinist, cu funcții neliniare și aparține clasei de modele supradimensionate, adică numărul restricțiilor este mai mare decât numărul necunoscutelor. Din punct de vedere economic, modelul intră în așa numita clasă de probleme de dimensiuni mari, trăsătură specifică problemelor economice, care automat le transformă în probleme foarte dificile de rezolvat, îndeosebi la efectuarea de calcule numerice. Modelul poate fi generalizat, presupunând, a priori, existența unei relații între x și x^0 , apărută, bunăoară inevitabil, la aducerea acestora cu ajutorul constantelor și a coeficienților din model la valori numerice comensurabile, de dorit de același ordin. Aceasta generează apariția unei constante k_i , în cel mai bun caz pozitive, în fața termenilor $(x_i - x_i^0)^2$ ai funcționalului f și care nu mai reprezintă deja o sferă n -dimensională, ci un elipsoid. Modelul elaborat este aplicabil și în această situație. Singura condiție a modelului ține de restricțiile sub formă de inegalitate, care pot fi doar „paralelipipedice”, adică de tipul (5).

4. Rigurozitățile modelului. Metoda de rezolvare a modelului (3) - (5) include o singură schemă de calcul complicată, anume alcătuirea matricei de proiectare. În rest sunt operații elementare ale algebrei liniare. Pentru matricea restricțiilor A din (4), operatorul de proiecție va avea forma

$P = A^T(AA^T)^{-1}A$, aici A^T transpusa lui A , luând însă în considerare tipul restricțiilor (3), matricea A , deci și cea A^T , se pot

descompune astfel

$$A = \begin{bmatrix} H & -I \end{bmatrix}, A^T = \begin{bmatrix} H^T & (-I)^T \end{bmatrix},$$

unde I - matrice unitară. În acest caz, operatorul de proiecție se reduce la calculul matricei

$$R^{-1} = (HH^T)^{-1},$$

adică compusă doar din restricții de tip „=”, iar restricțiile de tip „≤” se iau în considerare adăugând în H o coloană, sau scoțând din H o coloană, altfel spus, luarea în considerare a unei restricții în procedura de optimizare echivalează cu adăugarea unei coloane sau cu scoaterea coloanei respective din matricea restricțiilor. Aceasta se întâmplă din cauza restricțiilor (5), care nu sunt altceva, decât niște restricții „paralelipipedice” și devin active la ieșirea pe una din fețele figurii geometrice n -dimensionale. Acum problema auxiliară a (3) - (5), care este o problemă de programare pătratică cu matrice unitară, se poate formula astfel:

$$\min (r(p) = 1/2 \|p\|^2 + (d, p)), Hp = h, (6)$$

$$0 \leq p^i \leq a_i, \quad i = 1, n,$$

unde d, h - vectori de dimensiunea n, m , respectiv, iar rândurile matricei H sunt $h_i(x) \equiv g'_i(x)$ din (4). Fie p_k soluția pentru (1) - (3), λ_k^i - multiplicatorii Lagrange respectivi. Conform (6), se poate efectua încă un pas $i+1$ de minimizare și procesul iterativ continuă până la apropierea de punctul minim cu exactitatea ε . Rezolvarea problemei (6) implică demonstrarea următoarelor afirmații: a) există întotdeauna o direcție nenulă de minimizare; b) este cunoscută de fiecare dată formula de calcul a multiplicatorilor Lagrange; c) soluția se obține neapărat după un număr finit de pași; d) lungimea pasului se calculează după o formulă analitică; matricea supusă inversării este pozitiv definită; e) metoda de inversare este adecvată problemei.

5. Avantaje și dezavantaje. Printre avantajele modelului se evidențiază:

abordarea sistemică, evitarea agregării datelor, invarianța indicatorilor aleși, considerarea caracterului neomogen al datelor, posibilități concomitente pentru analiză și prognoză. Nu pot fi trecute cu vederea nici dezavantajele modelului, cele mai multe fiind de ordin computațional. Acest impediment creează unele dificultăți, însă ele se plasează calculatorului, problema economică inițială neavând de suferit, în schimbsoft-ul și hard-ul sunt exploatate la maximum. S-ar părea că stabilirea vectorului - etalon prezintă o dificultate pentru model. Dar, de fapt, variante ale acestui vector servesc la generarea spectrului de soluții, obținând în acest mod o gamă întreagă de valori optime și quasi - optime.

6. Implementări. La nivel macroeconomic modelul a fost aplicat pentru probleme de evaluare a apropierii parametrilor de dezvoltare ai Republica Moldova comparativ cu parametrii similari ai Comunității Europene la cercetare/dezvoltare și inovare (CDI), intensitate energetică (IE) și produs intern brut (PIB) per capita, care constituie în prezent semnele distincte ale unei economii performante. Este cunoscut, ca acești parametri republicani se află foarte departe de media europeană (sub 20 la sută), dar care urmează, în mod obligatoriu, să fie recuperați în perspectiva aderării. Unul este legat de consumul energetic la creșterea PIB-ului național și poate fi micșorat prin investiții directe în procesul de producție, adică prin dezvoltare preponderent extensivă, iar altul depinde de ponderea în PIB, echivalând cu sporirea volumului de investiții în intelect, adică dezvoltare preponderent intensivă. Dezvoltarea regională, conformă cerințelor comunitare în Republica Moldova, ar permite utilizarea mai eficientă a resurselor financiare la armonizarea disparităților

teritoriale și ar deschide oportunități de lichidare, în perspectivă, a acestora. Rezultatele, obținute cu ajutorul modelului, scot la iveală aceste disparități, în primul rând decalaje puternice față de zonele urbane ale Republicii Moldova și, în cel de-al doilea rând - decalaje substanțiale între diferite UTA de nivelul doi. Alte implementări se referă la competitivitate și targetarea inflației.

7. Concluzii. Categoria *distanța de la etalon* pentru compararea structurilor, acoperă un domeniu de aplicabilitate larg la nivel regional, național și internațional și nu depinde direct de orizontul de prognoză. Din punct de vedere computațional formula propusă pentru ISC evită o serie de dificultăți, specifice celorlalte, prin includerea doar a raportului x/x^o în loc de valorile propriu-zise a acestora, aducând astfel mărimile la același ordin și omogenizând calculele numerice. Astfel se propune o nouă formulă de calcul a indicelui sintetic al convergenței - *ICS*, bazată pe raportul indicatorilor celor două structuri comparate, precum și pe optimalitatea indicatorilor economici.

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FROM THE HUMANS-ROBOTICS SOCIETY TO THE ROBOTICS-HUMANS SOCIETY.

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Abstract: Materialization of the notions of information, knowledge, and conscience and its functions helps to investigate and develop the Computer Based Information Robotic Systems (CBIRS) for Information, Knowledge based, and Consciousness Societies. The CBIRS higher level elements for these societies are evaluated based on its adaptability features and on its corresponding (component parts and phases of activity) CBIRS' lower level elements. Such procedure represents the perspective features of intelligent systems creation process. In order to create Emotional ROBO-intelligences (EQ), which represents the continuation of Creative ROBO - intelligence (IQ) creation process, the Human **emotions** are examined. The fruitful cooperation of both IQ and EQ intelligences will evolves in Consciousness Society, which will be created, according to multiple surveys in the field, in the 2019 - 2035 years.

Adaptable tools help to define the new robotic elements. They are used to define higher level elements of **emotional** and **creative** ROBO-intelligences. Formulation, formalization and adaptable algorithmic of higher level elements of the **temperament** ROBO-intelligences represent the evolutionary development of the Consciousness Society's ROBO-intelligences. The Adaptable Tools, in such a way, are used for evolution first **emotional, creative, and temperament** stages of Robotic Program Products development. Next research steps are concerned to Aura and Energetic development for Robotic Entities. The presented adaptable information technology for ROBO-intelligence's creation process is used in the institutional project "Creating Consciousness Society" that is developed in the period 2008 - 2018 by the team of AESM and supporters.

Keywords: Computer Science, Emotion, Temperament, ROBO- intelligence, Consciousness Society

JEL Cassification: C88, L86

1 Introduction

Human society is on the threshold of Consciousness Society and is currently supported by The Third Industrial Revolution. Consciousness Society, according to estimates by scientists in the field, will be created during the years 2019-2035.

Dramaturgical Consciousness goes along side with the **Distributed energy** and **Communication systems** of The

Third Industrial Revolution, as well as **Psychological Consciousness** that came with The Second Industrial Revolution and **Ideological Consciousness** which participated in The First Industrial Revolution. Empathic human civilization has a multitude of features which in Consciousness Society will be specific to the robotic civilization. Books [3] and [7] on the basis of our multiple references support us in demonstration the truth of

statement: "In Consciousness Society the Artificial Intelligence (ROBO-intelligence) will be equal to structured Human Intelligence (AI = Nstructured) and this Society will be empathic".

For decades robots have diligently been tasked to perform a range of duties largely scoped within industrial manufacturing. More recently, we have seen the emergence of a new landscape of more social, personal, expressive, nurturing, creative, sensual, and emotional robotic platforms. Increasingly, robots play a critical new role as extensions of ourselves, enabling our creativity, creating new objects, serving as companions, expressing emotions, empowering communities, and challenging our civil rights. To initiate discussion in Emotional ROBO-intelligence creation process, for example, let's put some **Problem**: "ROBO-intelligence entity with emotions (Emotional ROBO-intelligence: EQ) has to activate using some situation: Entity is in the best disposition and is asked to clear the dusty room after school lecture in car driving."

Asked **questions**: What is emotional ROBO-intelligence? What are ROBO-intelligence's **component parts**? What ROBO-intelligence competences have to be **activated** to analyze the emotion situation for doing this task? What are **measures** of ROBO-intelligence competences? What are to be ROBO-intelligence competences to **initiate**, **process**, and **finish** the task? What ROBO-intelligence competences have to be **activated** to analyze the emotion situation for doing this task? How to **program** the evaluation process of doing the task using emotional measures? What are emotional **evolution steps** of ROBO-intelligence in the process of doing the task? What competences are needed to **transmit** to asker that task was finished?

Answers to some of these questions can be done on the base of lower level functions of Creative ROBO-intelligences [7] which possess such Piirto's **creative features** as: Inspiration, Imagery, Insight, Imagination, Intuition, Improvisation, and Incubation. These IQ creative features are to **evolve** in correspondence with lower level Piirto's Six functional Steps to the Creativity ROBO-intelligence top: acquire Knowledge, develop Curiosity, become Interested, Passion, Dedication, and Professionalism. Creative features and its evaluation steps produce IQ next higher level items of Creative ROBO-intelligences. Each of those **IQ items** is defined by its special Consciousness Society Intelligent Information System based on lower level ROBO-intelligence functions.

2. Testing

Previous questions underline next problems which have to be solved to obtain ROBO-intelligence. ROBO-intelligence have to: (a) understand the human announced task, (b) do this task in this emotional situation, (c) transform its emotion, and (d) reproduce the answer for asker about finishing the task.

Many tests that promise to measure emotional intelligence appeared in recent years and are used in the process of creation the ROBO-intelligence. Some of these tests seem promising, but many have not been empirically evaluated. We have reviewed many of these tests and selected those for which there is a substantial body of research having a goal of creating ROBO-intelligence (at least five published journal articles or book chapters that provide empirical data based on the test). Created Consortium for Research on Emotional Intelligence in Organizations (CREIO) do not sell or distribute any measures or assessments. To get

information related to obtaining specific tasks of identification and measures such as qualifications or certifications needed to administer specific measures, to store or process emotions and to organize emotion relationship and distribution please refer to the contact information provided with the description of each assessment. Maps of emotional feelings and Computer Based Information Emotion System (CBIES) represent the first steps we consider to go through to create Emotional ROBO-intelligence.

3. Maps of emotional feelings

Definition of the emotional existence plan is the following: **level of human existence which registers changes in emotional states**. The way of expressing the emotions can vary very much: love/hate, happiness/sadness, calmness/anxiety, trust/fury, courage/fear, etc. **Emotions** coordinate our behavior and psychological condition during the main survival events and pleasant interactions. Nevertheless we are aware of our current emotional condition as **happiness** or **fury**. Mechanisms that cause/ feed these sensations are still undiscovered. Here it is used a personal topographic instrument of report that unveils the fact that different emotional conditions are associated with distinct **topographic** sensations and universally cultural body feelings. These feelings could highlight conscious emotional experiences. Watching the sensation topography caused by emotions we perceive a unique instrument for researching the emotions that could be called biomarker against emotional disturbing.

Somatosensory **Feedback** has been proposed to trigger conscious emotional experiences because the emotions often are felt by the body. The body maps show

regions whose activation increased (warm colors) or decreased (cool colors) when feeling each emotion.

Do they (such color effects of emotions) have some connections with the measures of Emotion's Energetic Signals which activate in composition of Human Aura?

3.1. Researchers at Aalto University in Finland have compiled **maps of emotional feelings** associated with culturally universal bodily sensations, which could be at the core of emotional experience. These emotional feelings are: Fury, Fear, Disgust, Happiness, Sadness, Anxiety, Amazement, Neutrality, Love, Depression, Pride, Shame, Envy, and Hatred. The researchers found that the most common emotions trigger strong bodily sensations and the bodily maps of these sensations were topographically different for different emotions. If it is put the question to create some entity - Robot with emotions: Emotional ROBO-intelligence (EQ), the specialists must study carefully images from the entire world about at list the human face expressions with different feelings. For an entertaining and pleasant presence of such a machine to the human, such EQ has to

- behave politely,
- express emotions,
- „read” human emotions and
- react adequately.

It is interesting at least to create EQ's Head & Heart which has to have mobile for expressing emotions such as happiness, sadness or melancholy.

3.2. Mayer-Salovey-Caruso Emotional Intel-ligence Test (MSCEIT) is an ability-based test designed to measure the **four branches** of the EI model of Mayer and Salovey [8-10]. Our goal is to investigate emotional ROBO-intelligences which possess known **classical emotion**

elements: Happiness, Fear, Surprise, Disgust, Sadness, and Anger from the point of view of its introduction in the robot entities as **intellectual, emotional, moral, temperamental, and sensual** compartments. Presented by Aalto University's researchers emotional feelings can be defined and expressed by the help of classical emotion elements using Adaptable tools.

3.3. Emotional ROBO – intelligence evolution

Follow the performing of physical, intellectual and spiritual work (lower level elements of ROBO-intelligences) received with emotional developments of ROBO – intelligences. Emotional developments of ROBO - intelligences represent the lower level elements of ROBO-intelligences. They are to be evolved to higher level items of ROBO – intelligences using other axe with lower level elements: Physical work, Intellectual work, and Spiritual work. High level elements of ROBO-intelligences are functionally defined by the Adaptable Tools of Integrated Systems [13]. For example: Higher level ROBO-intelligence's item "Intellectual work managed by emotions" is defined as functional evolution of lower level ROBO-intelligence's items: "Intellectual work" and "Managing emotions".

4. Emotional Computer Based Information System

Emotional ROBO-intelligence is a Computer Based Information Emotional System (CBIES), which **first level component parts** are:

- (1) emotion measure, identification and perception,
- (2) emotion storage,
- (3) emotion processing, and
- (4) emotion relationship – distribution.

Each of CBIES **component parts** is

supported by corresponding first level elements: **hard-ware, soft-ware, knowledge-ware, social** (people's)-ware, **conscience-ware** and **group-ware**. It is needs to create special CBIES for each of Emotional ROBO-intelligence's **processing characteristics:**

- emotion **identification,**
- emotion **competence,**
- emotion **quantity, quality, storage,**
- emotion **education, evolution,**

processing, and

- emotion **distribution.**

CBIES's Emotion entity **measure** is referred to such functions as emotional **internal states, impulses, preferences, resources,** and **intuitions.**

4.1. CBIES's Emotion Identification functionally represents emotion entity's ID, Competences, Measure, Value, Quality and Quantity of emotion entity. Our investigation is referred to the **classical emotion** elements Happiness, Fear, Surprise, Disgust, Sadness, and Anger

4.2. CBIES's Emotion entity competences, based on Emotional & Social Competence Inventory identified by Dr. **Daniel Goleman** in Working with Emotional Intelligence [Wolff, 2006] and Bar-On model of emotional-social intelligence [Bar-On, 2006], functionally **measure** an overall **EQ power** as well as powers for the following **composite scales:** Self-Awareness, Self-Management, Social Awareness, and Relationship Management.

4. 3. CBIES's Emotion storage and processing are referred to the process of accumulation the processing results of emotion **educational evolution** steps (Home 7 years, High School, Second school, ...) using **Piirto's 7i intelligence characteristics axis** and **Piirto's 6 emotion intelligence evolution steps axis**

Emotional ROBO-intelligence's axe of hierarchically evaluation steps are functionally represented by Piirto's 6 **Creativity's top elements**: (a) Acquire Knowledge, (b) Develop Curiosity, (c) Become Interested, (d) Passion, (e) Dedication, and (f) Professionalism.

4. 4. CBIES's Emotional intelligence relationship-distribution is defined by:

- emotional **Awareness of perceiving and understanding** of others (the skill of perceiving and understanding others' emotions), and

- emotional **Management of influencing the moods** of others (the skill of influencing the moods and emotions of others)

CBIES's Emotion **relationship-distribution** accumulates functionally emotional interpersonal processing, stress management, adaptability, and emotional general mood.

5. Temperament Emotion ROBO-intelligences.

The high level Emotion ROBO-intelligence elements are defined based functionally on elements of inferior level. One axis of ROBO – intelligence's inferior level elements represents emotion functions of intelligence: Happiness, Fear, Amazement, Disgust, Sadness, and Anger. Other axis represents temperament characteristics of the choleric, melancholic, phlegmatic, and sanguine ROBO – intelligences. High level elements of Emotion ROBO-intelligences presented are functionally defined by the Adaptable Tools of Integrated Systems [13]. For example: Higher level ROBO-intelligence's item "Amazed Phlegmatic: phlegmatic is master of himself, is not overwhelmed by emotions" is defined as functional evolution of lower level ROBO-intelligence's items: "Amazement" and "Phlegmatic".

6. Conclusion

If we combine all steps of ROBO-intelligences evaluation (Intelligence, Creativity top, Emotions, and Emotion evolution) we can create all types of ROBO-intelligences with Creativity, Temperament, and Emotions. Each temperament robot will have his own features, which at the same time shows us that everyone's personality is unique and consists of a combination of features. Artificial creative and emotional intelligence can become a great help to people working with consumers daily because such robots can determine a human personality and show an idea of how to interact with them.

6.1. In **Consciousness Society** (2019 – 2035) the value of the Artificial Intelligence (AI) will be equal with the value of the structured Natural Intelligence (NIstructured):

AI= NIstructured In the advanced period of the Society the formula will evaluate in the inequality:

AI>NIstructured. From here starts to activate Artificial Conscience that is the next step in the development of the Human Society – it will be already ROBO-Human Society.

Using **Adaptable Tools** [13] ROBO-intelligences, represented by its pragmatics as was done in this research, can be completed with its usage context, its syntax (representation forms), its semantics (represented by the algorithms of their creation) and by the examples of its higher level elements. This work has to be done in the nearest future.

Adaptable tools are based on the usage of ADAPTER. The ADAPTER is a mechanism of adaptable human-machine interactions on the axes: language, processor, data, actions, definition and appeal from the point of view of usage in

adaptable ROBO-activity. The Adapter represents each new element via other elements defining 1) pragmatics of new element; 2) its syntax (shape) 3) semantics (content – its functional expression given via lower level elements), 4) context of the new element usage and 5) one or more examples of presenting the new element.

6.2. The Adapter for each of the elements of the higher level of the emotional ROBO – intelligences have to be presented by the cell element which is processed by presenting it as an Adapter pragmatics, syntax, content, context and examples of usage. High elements of ROBO-intelligences are functionally evolved by the Adaptable Tools of Integrated Systems [13].

6.3. Future research: Do the color effects of emotions, creativities, temperaments, and sensations have some connections with the measures of Emotion's Energetic Signals which activate in composition of Human Aura?

6.4. Towards 2050: Megatrends in Industry, Politics and the Global Economy
Globalization, Demographic Shifts, Urbanization, Climate Change, and Internet Proliferation are the macroeconomic megatrends that will shape the 21st century. They are global, seemingly irreversible forces that have already made an incredible mark on economies and societies, and will continue to do so for the next few decades.

But how will these megatrends manifest themselves on an industry level? How will they affect and shape the future of sectors such as pharmaceuticals, energy, automotive and agribusiness over the coming three decades? Find out more in [1] looking at how these forces are giving

birth to new, industry-specific megatrends, which will in turn have a tangible impact on business, society and our daily lives. This best-selling Report includes the results from the Industry Megatrends to 2050 Survey of 2018, bringing together the views of 250 industry leaders and senior decision-makers on the forces that will have the highest impact across industries over the next 30 years. In this report there is examined the following:

How new generations of consumers are becoming a lot more conscious of their individuality and conscientious in their choices, which will drive everything from energy efficiency initiatives to personalized healthcare and a new generation of genetically modified micro-food.

Population expansion and urbanization will mean that the drivers behind smart cities and highly intuitive transportation systems will only get stronger and more urgent, and shape how infrastructure is conceived and designed.

Internet and connectivity proliferation will be at the very heart of every industry we have included in this analysis, to the point where we see 'traditional' telecoms as a sector morphing into a service with no discernible boundaries; one that is able to permeate and shape the development of the vast majority of industries present and yet-to-be created. The 'Internet of Things' will become a dominant force across industries, even though the parameters of its economic viability are still emerging and evolution could be delayed or derailed by regulatory, cyber security and policy backlash.

Climate change will impact regulations and public perceptions of everything from extractive industries to driving the future patterns of new food production. Environmental priorities are

pushing for an overhaul of the automotive and natural resources sectors, as corporations seek to transform into entities ready, or at least able, to operate in the low-carbon economy.

6.5. Intelligent Society. It is essential to evaluate those sectors of future society from the point view of implementation of the intelligence, of the intelligent decisions, of **the robotics intelligent functions utilization and implementation**, of the robotics activities, and of the consciousness functions implementation in the society.

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AGE-FRIENDLY PROCEDURES IN RURAL LOCALITIES OF MOLDOVA

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Abstract: Many industries, many markets, and many commercialized activities in society today are **monopolized**. In such a society the rich man will be richer and the poor man will be poorer. The situation is terrible in particular for **pensioners** from rural space. It is normal for present the society of the XXI century - the Society of Consciousness? It is a miserable situation. Such society not has a future. Such situation is revolutionary, the society is in the explosion state. The concept of the proposed projects strives to reduce the unemployment rate as well as reduce the number of people who are under-utilized because of hardships in the economic sectors. Another target of the projects is to start labour migrants returning. It is necessary to invent a set of procedures and a set of such methods of activity in modern society, which will permit to liberate the market relations directly between **producers and consumers**. Those relations have to permit the execution of the marketing and commerce activities between produces and consumers without intermediaries.

Intermediaries are a group of individuals who do not produce anything and just take advantage of the relationships between producers and consumers. They activate only in the quality of the consumers of goods and not as the producers of goods and they have to be excluded from the relations between producers and consumers. The goods after that exclusion will be sold at the price near the real price of its production, and the producer will obtain the real price for his product. Such relationships between **producers and consumers** are to be solved by the help of networks of the type “**Demand & Supply**” which connect directly producers with consumers using a common warehouse of goods. The producers send informations about its products to this common warehouse. In continuation the consumers are searching their needed goods in this warehouse and analyze the possibilities to obtain need goods. The process will be finished by the contact directly between the producers and the consumers with the purpose to produce the Act of sale and purchase of goods. These considerations constituted the basis for the **two projects** elaborated under the calls of the **American Embassy** small grants for organizations and individuals. First project of Grant (February 28, 2019) was concerned with the partial solution of migration process of the women and girls from the rural localities of the West frontiers of the Republic of Moldova. The second project (March 29, 2019) was concerned with the management of stopping the migration of people from the Ungheni District’s rural localities and the creation the Age friendly communities in rural area of the Republic of Moldova.

These two projects were preceded by the project under the **European Cross-border Program RO-RM**, which was transmitted for evaluation in the May 7, 2018 [1]. This

project was concerned with the education of **Young people** from frontier regions of Romania and the Republic of Moldova to learn the processes of elaboration and implementation of the Business plans for the different Micro, Mini and Middle types of rural SMEs. It is clear that raising the standard of living in the rural areas of the Republic of Moldova is essential and will have an impact on the country as a whole. **Education** is paramount for regional socioeconomic development. Part of the educated beneficiaries (youngsters, woman, girls, and intellectuals) will consider staying in rural areas because they want to live close to relatives and friends. In order for them to be able to do so, suitable employment should be available in the Republic of Moldova and in South-Eastern part of Europe.

Keywords: Social Sciences, project, rural area, migration, age friendly communities, training, learning, society.

1 Introduction

The Elders in Moldova - part of South-East Europe are in a terrible situation. Today mass-media has announced that about 39 thousand Moldovans annual leave the country in order to establish their lives in other countries. It's the terrible situation. The country remains without brands of goods, remains uninhabited... villages are with more than half of the houses in the battered floor underlayment, the owners have gone. What could be more chunks for a country?

The Moldovans go in the Romania, Poland, Italy, Spain, Germany and so on, Citizens from the Romania and Bulgaria goes to other European countries, but more overseas, in America, and villages remain without population. Cities are waiting to be stuffed with the population from villages and the town's population goes in other countries. What is being done with sheep breeding? Wool is put in stacks beside farms and rots. The Wool's industry hubs. Carpets, Wool clothes do not occur, the Wool adornments of Southeast Europe with their odd national fabrics is absent. What happens with **products from individual farms**? Nobody collects cherries, sour cherries, plums, apples from peasants. Nobody processes it, it does not produce

vegetables and dried, canned, on smoke. No one sells them. Statistics [2,3] say that 60-80% of these products from farms are lost, are rotting..

People in rural areas of the Republic of Moldova, in particular- the women and elders, the intellectuals of the country, and rural artisans have not forgotten these famous trades and occupations. They remember and wish these rural crafts, and want to have possessions and wealth of these rural crafts. Tourists often wish to see, to enjoy, to buy products from small and medium rural industries. Village dances and feasts have a specific and attractive pleasure when embellished with clothes, shoes, and rural ornaments. It is noticed more often a desire to revive rural trades and small and medium enterprises where the women, elders, intellectuals, and rural artisans would have a possibilities to work and now are without occupation, and without additives for everyday needs.

In the rural area the **houses of trades** with sewers, cantellos, tailors of clothes and footwear, with shared bathrooms, barbers, and house of crafts no longer exists. These homes could be a nest of attractions to work forces, would come from producing goods for villagers and even tourists. Bathroom with sauna for villagers, what better than to say Nigerian

boy living in full! The houses of culture with songs, dances, afternoon meetings, libraries, festivals, dances, lessons of morality and human ecology and nature. a huge set that would sustain higher levels of nation with morals, intelligence, faith and Moldovan, Romanian, and Bulgarian national spirit. This and many others make up the meaning of the Project "Anti-migration **women and elder** management in South-Eastern Europe", a project of the scale in the vector "Come home" and "I love my country" for all through the mouth those who come to the nation's destiny, the destiny of Earth native. Here is proposed the project there want to make it and to implement in the States from South-East region of the Europe. The Russian Projects "**Demographics**" and "**Moskow Longevity**" [Уважение к возрасту (Respect for age), Аргументы и факты, №14 (2003), 3-9 April, 2019, p. 21] also found recently that the Russians are: (1) not afraid of old age (73%), (2) glad that have much leisure time (79%), (3) satisfied with that they had created in life (64%), (4) satisfied with the profession they have processed (61%), and (5) the age limit in the last 8 years has increased by 4 years and is equal to 72. 9 years. Essay underlined that mostly causes that are not favourable to the elders in Russia are: (a) the families are separated, (b) it's a big gap between generations, and (c) the older people don't have possibility to transmit one's life experience. As the result in Russia it is a situation that is not favourable to meet the elderly and young people.

Situations differ, for example, in Canada or Singapore where there are build homes for **orphans and elderly** loners in a single neighborhood. People of different ages have intensive contacts. Elders receive a positive momentum. The kids learn knowledge and life experience

from the elders. In the France not only the parents receive the pension for children, but also the **grandparents which are looking for children**.

Elderly in Russia is mostly insured in Moscow and Caucasus. Moscow **offers elderly people**: (a) Medical services, (b) Social services, (c) Rest and joint meetings, (d) Opening of centres of education (reading, crosheting, learning of computers, master-classes, interest clubs, spa and cultural procedures). As a result: Attention and esteem towards elderly people is high.

In the **Caucasus, the elders** allowed the following conveniences: (1) Propagation of elders in each topic of the media; (2) Elders are primarily in televised frame; (3) Elders allowed Word to offer assemblies; (4) Listening the opinion of the elders at meetings; (5) Elders are surrounded by care and love. As a result: The elders feel needed and thereby their lives are longer!

The Medical assistance for the elderly in Russia is only in perspective: (1) the Geriatric service in 2024 will be offered to every citizen of Russia; (2) by prophylactic examinations and clinical examination till the year 2025 will be attended to 70% of Russians; (3) will be extended long protection of elderly people and invalids; (4) will be increased the quality of life through patronage and learning in medical matters of relatives.

The proposed common Moldova-Romania-Bulgaria Project [4] "**Anti-migration women and elder** management in South-Eastern Europe" consists of 36-month training of the rural intellectuals, especially - women and elders - to solve the problems of making projects of the rural SMEs, to obtain consultation during projecting of their activities, to help them to obtain financing for their projects, and to implement their ideas in practice.

Through this project we try to retain the intellectuals in the country's population.

2. The investment in the Women and Girls.

The project "Business plans for Women's rural SMEs" (Acronym: SMEs4Women) was submitted at the February 28, 2019. Project is oriented to the beneficiaries, represented by the Women and girls from the western frontier rural sector of the Republic of Moldova – the region which is the most affected by the migration.

The given project will perform the business development training for women and girls on how to write SOFT Business plans for Women rural SMEs (WR-SMEs). They will also have the opportunity to pitch an agricultural project idea and secure support for their initiative. In addition, rural women and girls will benefit from guidance to apply to local, republic, and international organizations. Project enhances and supports empowerment that creates enabling environments so that rural women and girls are able to freely and fairly participate in civil society, economy, education, and sports. Project's Actions will stop feminine migration abroad and through their example will stop people of leaving the country.

2. 1. Specific solution & innovation.

The most affected by migration part of the Republic of Moldova represents West region's rural sector of the country which constitutes 606 localities distributed in 11 districts, representing frontier regions. The project aims to facilitate access to business opportunities for 120 women and girls from the West frontier region of the Republic of Moldova localities. Unique approach of the project include the following activities: analysis of women's

migration opportunities in West rural sector of the Republic of Moldova; management warehouse "Women's rural SMEs" which supports the development of localities, elaboration and implementation of the Guidebook "Rural Projects" in the process of teaching rural women and girls how to develop SOFT Business plans for WR-SMEs; organizing the final conference "WR-SMEs" and permanent consultations at the Project's Consortium Consulting Center. In addition to business development training, the women and girls will benefit from guidance and mentorship on new agricultural technologies from agribusiness experts.

2. 2. Impact

The Republic of Moldova has the total of 1,682 localities; from these 982 are incorporated (de jure with 982 mayors and 982 local councils), including 53 cities/towns, other 13 cities with municipality status, and 916 rural localities. A number of villages are self-governed, while others 700 villages are too small to have a separate administration. Project activities will contribute to solving the rural women's problems from 606 localities which represent most affected by migration communities from West frontier part of the Republic of Moldova.

The project aims to facilitate access to business opportunities for 120 rural women and girls and will have a reasonable impact on all rural localities of the Republic of Moldova. The Project supposes organize the specialized Women teams to develop SOFT Business plans for WR-SMEs. The Rural female beneficiaries will obtain a better understanding of writing and submitting applications. They will have a possibility to create SOFT Business plans for WR-SMEs of different levels, and to adapt them using the variety of local environments and

various spheres of activity. We anticipate this project to spark a community dialogue that cultivates new ideas (SOFT Business plans for WR-SMEs) and effective strategies for promoting rural area's economic and socio-cultural progress. The strategies of SOFT solutions for Business plans for projects of Rural SMEs can then be coupled with ongoing HARD national and international development programs and initiatives to substantially increase their impact in Rural Area of the Republic of Moldova.

This project is limited to the creation of the SOFT Business plans for Feminine Rural SMEs. If proves successful, we will seek sponsorship and additional funding to scale it up to HARD types of projects for rural areas of the Republic of Moldova. The Project's Actions will contribute to stopping women's migration abroad and through their example will stop people from leaving the country.

2. 3. Sustainability

The impact of the project will reflect in the change of attitudes toward number of important socio-cultural issues, increased civic engagement, and strengthened international collaboration.

The selected team of 120 women and girls from rural localities of the Republic of Moldova will be initiated in preparation of the real SOFT Business Plans for projects of SMEs in their localities. Selected 120 rural women and girls in the process or/and after the project's ending, will create the real Hard WR-SMEs in the rural sector of the Republic which means creating new work places and opportunities for young specialists.

As a result of the project, opportunities will be created for attracting and hiring a large number of people in the rural sector of the Republic of Moldova. Thus, the project will continue after the external

source of funding is completed. Such project's results will constitute the partial solution of poverty reduction in the rural sector and the partial solution of migration process from the Republic of Moldova.

Also, one of the project results constitutes the developed Guidebook containing the variety of training materials that will enhance the knowledge and skills of rural women in writing/developing new rural projects.

Nowadays, there is a high risk for investors to invest money in rural sector, one of the reasons being the fact that the local people are not instructed properly how to monitor the money. However, following on the results achieved via the proposed project activities, and the related knowledge and skills development through the training, potential investors will not be afraid of making the associated investments.

2. 4. Promotion.

This project will be implemented in three phases over a one year period of performance. We will start the activities upon receiving the first grant disbursement and finalize them when we submit the final report. This project will be conducted in partnership with the USA Alumni - to facilitate grant funding and financial management processes in accordance with USA federal acquisition regulations. Project Consortium will further promote results of the project through university student associations, community leaders, and civil society activists of the Republic of Moldova. Lastly, the project will use other forms of media, such as AESM News Papers, Journals, Local University Radio and TV set platforms, seminars, conferences and other national and international FORs which all will be used to share information about the project.

3. The Pilot Project for Ungheni District's rural localities.

The project "Rural SMEs for Network "Demand & Supply" (Acronym: RSMEs4NetDS) was submitted at the March 29, 2019. Project is oriented to the beneficiaries, represented by the habitants from the Ungheni District's rural localities – the most affected by the migration District from the West Frontier of the Republic of Moldova

3. 1. Network "Demand & Supply"

Main objective of the Project consists in training the population from Ungheni District's rural localities to prepare Dijital Business plans for rural SMEs. Rural SMEs will represent the basis for real Network "Demand & Supply" which have to be implemented in Ungheni District's Rural Area to support the direct connections between rural Producers of goods and Consumers of goods from around the World. This project aims to create teaching product by training rural population in creation Digital Business plans for rural SMEs which will activate in future Ungheni District's Network "Demand & Supply" with its Data Warehouse of goods produced by the rural SMEs. Project will enhance the Entrepreneurship and Economic Competitiveness in the rural area.

The effect of the project results objectives are: raising living standards by creating jobs in rural zone; collection, processing, storage and commercialization of goods produced by rural SMEs; organization direct contacts between producers and consumers; improvement of the social and economic situation in the rural area; stopping partial migration of people from rural area; partial returning of rural migrants to the country. Project objectives also represent the basis for creation the Ungheni

District's Network "Demand & Supply" using the warehouse "Digital Rural SMEs" of goods produced by the rural SMEs. Project actions will mitigate migration and through their example will stop people from leaving the country.

3. 2. The Ungheni District's rural localities.

The most affected by migration part of the Republic of Moldova represents West region's rural sector of the country which constitutes 606 localities distributed in 11 districts and, in special, the Ungheni District's rural localities which constitute 74 localities with 101,064 population. The project aims to challenge rural population to create digitized rural SMEs in such a way solving the migration problem in rural sector by implementing modern working places in rural area.

The project aims to facilitate access to business opportunities for 148 beneficiaries (Leaders of rural SMEs) from 74 rural localities of Ungheni District. Beneficiaries represent the total of 101,064 population: 49,310 men, 51,754 women, 23,035 of 0-17 age group, 68,286 of 18-65 age group, and 9,743 of 65+ age group.

The Project supposes to organize the 5 special groups to develop 148 Digital Business plans for Rural SMEs, based on established priorities for SMEs, SMEs' categories, and SMEs' number to be created in each of rural localities. Project activities will contribute at solution of the rural problems of 74 localities from Ungheni District's rural area, which represent the most affected by migration communities from West frontier part of the Republic of Moldova.

The innovative solution proposed by Project consists in teaching rural population to create and implement Digital Business plans for rural SMEs.

This solution facilitate access to business opportunities for 148 main beneficiaries – SMEs’ future leaders - from the Ungheni District’s rural localities

3. 3. The innovative approach of the Pilot Project

The project will work closely with the following partners: the NGO “EcoInfoMold”, the Ungheni American Corner, the Academy of Economic Studies of Moldova (AESM) with its innovation IT4BA incubator, its Continuing Education Centre, and its Information department, the Section "Economy and Reforms" of the Ungheni District Council, the AO “Parlament - 90”, and Administrations, Schools, Hospitals, and Agriculture farms from the Ungheni District’s localities. The project aims to challenge rural population to create digital rural SMEs in such a way solving the migration problem in rural sector by implementing modern working places in rural area.

The innovative objective proposed by Project consists in teaching rural population to create and implement Digital Business plans for rural SMEs which will be connected to the future Ungheni District's Network "Demand & Supply". This solution facilitate access to business opportunities for 148 main beneficiaries –Producers and SMEs’ rural leaders - from the Ungheni District’s rural localities. The unique approach of the project includes the following specific activities:

- the creation and implementation of questionnaire for research and analysis of the situation in the rural sector related to the number and diversity of rural population after current and perspective occupation;
- the analysis of migration opportunities in Ungheni District’s rural

localities based on the implementation of the questionnaire;

- the creation the warehouse "Digital Rural SMEs" of data about the needs of rural enterprises and the possibility of a successive implementation of them in the rural sector;

- the elaboration of the Guidebook “Digital Rural Projects of SMEs” which will be used as a tutorial for creating Digital Rural SMEs for all rural enterprises of the Republic of Moldova;

- the training rural beneficiaries in the processes of the formulation, the developing and the implementation of the digital business plans for Digital Rural SMEs;

- the organization and conducting of consultations at the Centre For Consultation;

- the organization and spending of the final conference entitled "Digital Rural SMEs”.

The NGO “EcoInfoMold”, the AESM, and the AO “Parlament - 90” represent the Project Consortium. The training activities will be held by the Centre for Consultation situated partially at Ungheni american Corner and partially at the AESM.

3. 4. The impact of the Pilot Project

The impact of the project will be reflected in the change of attitudes toward number of important socio-cultural issues, increased civic engagement, and strengthened international collaboration.

The selected team of 148 beneficiaries from Ungheni District’s rural localities of the Republic of Moldova will be initiated in preparation of the real SOFT Business Plans for projects of 148 SMEs in their localities.

Selected beneficiaries in the process or/and after the project's ending, will create the real Hard Rural SMEs in the

rural sector of the Republic which means creating new work places and opportunities for young specialists from Ungheni District's rural and urban areas.

As a result of the project, opportunities for attracting and hiring a large number of people in the rural sector of the Republic of Moldova will be created. Thus, the project will continue its activity after the external source of funding is completed.

Such project results will constitute the partial solution of poverty reduction in the Ungheni District's rural sector and the partial solution of migration from the Republic of Moldova process.

3. 5. Results of the Pilot Project.

The Main goal of the Project constitute training the population from Ungheni District's rural localities to prepare Business plans for rural SMEs. Rural SMEs will represent the basis for real Network "Demand & Supply" which have to be implemented in Ungheni District's Rural Area to support the direct connections between rural Producers of goods and Consumers of goods from around the World. Information Base for direct connections between Producers and Consumers represents common Warehouse of Data "Demand & Supply" of goods produced by Producers which can be asked by Consumers. Such idea represents innovative, fresh, and perspective decision for the modern economic relations between communities of producers and consumers based on common Warehouse of Data "Demand & Supply" of goods.

4. Sustainability

General migration, Youth migration, shrinking working places, unemployment, poverty, inequality between men and women, unfunded retirement, no rapport between generations,

all these irregularities lead to a society of injustice, a oligarch society, a society where difference between rich and poor grows, a society with a high mortality of elderly people, a society with a high possibility of revolution. That's why our attempts of advancing projects made from:

(1) stopping the **migration of Eastern Europe** by creating jobs in the Republic of Moldova, Romania and Bulgaria, passing them towards;

(2) stopping the **migration of youth** from rural space of the border between Romania and Moldova through learning youth in universities, high-schools and secondary schools to write and to implement business plans and projects of SMEs, passing them towards;

(3) stopping the **migration of women and girls** from rural frontier areas of the Republic of Moldova through creation of ENTERPRISES feminine and continue towards;

(4) stopping **migration from the villages of Ungheni District's localities** through training of rural beneficiaries in creating business plans of digitized SMEs and finishing with

(5) the implementation of the Pilot Project - Creation of the network "Demand & Supply" of direct link between producers and consumers, avoiding various intermediaries.

All these activities of mixed teams of researchers and implementers from the South-Eastern Europe are directed toward stopping migration in rural space, create jobs, increase the standard of living in rural space and, in particular, ensuring and improving the lives of the elders. The sustainability of these research and implementations of new rural SMEs in European space constitutes the creation of digitized SMEs and implementation of network "Demand & Supply" between

producers and consumers. The network "Demand & Supply" of digitized SMEs can be designed and implemented consecutively, starting with network implementation in one of the Districts of the Republic of Moldova, continuing with its implementation in one of the European Regions, the implementation of analogical network in a group of the European countries, and finishing with implementation of network „Demand & Supply” throughout Europe.

Acknowledgements

Some theoretical research results in the evolution of the society based on implementation of Business plans for SMEs are published in [6-17]. The experimental works in the branch of creation and implementation of the business plans for digital SMEs some of which are in the process of evaluation can be consulted in [18-31]. The research results obtained at present time are to be presented at the ARA-43 Congress in June 2019 [32-35] in Greece.

We are in big duties to all our co-partners who help to understand the real help for the citizens of our countries to solve the migration problems. We also underline the help of our colleagues in creating this Project. At last but not the list our acknowledgements to Professor Radu Mihalcea from the ISU, Chicago, who help to teach and implement the Cracking Creativity Productive Thinking Method in the process of developing new Projects.

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QUALITY MANAGEMENT: SYNERGY INTERACTION MODEL OF INTERNAL FACTORS OF QUALITY

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Abstract. In this article is presented the model of synergistic interaction of internal factors of quality. The model, developed by the author, is composed of four components of quality: focus on value, skills, quality culture, processes. Quality is achieved as a result of synergistic interaction of these components: ethos, human capital and management system of the institution.

Key-words: quality, quality culture, quality management system, processes, evaluation of the management.

1. Introduction

The phenomenon of globalization is increasingly felt in the last years, producing changes in educational systems worldwide. The development at a rapid pace of information technologies require major changes in the educational sector, which cannot preserve its traditional, national character, regulated by government policies, but tends to gain international dimension.

In this context, *quality* is undoubtedly one of the most important requirements of any result of taken actions, and any activity designed to detect problems, to assess the influence and find solutions to solve them is, for any educational institution (EI), the key to progress.

Starting from the ideas of R. Barrett's organizational culture [1], we suggest THE SYNERGY INTERACTION MODEL OF INTERNAL FACTORS OF QUALITY that can help us establish the main factors of quality and the effects that may arise from their interaction. The model consists of four quadrants, which

occur as a result of interaction of internal (culture) and external (behavior) dimensions of quality at an individual and institutional level. We can highlight four components of quality: axis value, competence, quality culture, processes. The quality of human capital, ethos, system and management of the institution is achieved as a result of synergistic interaction of these components (Figure 1).

We summarize the main concepts of the model, namely the eight internal factors of quality:

1. Axis value - is the inner world of individuals, those ideas, principles and values underlying the personality. Value as a motivating report, characterizes the choice of several possible alternatives and as an emotional state locates an experience and a subjective measure; it expresses the capability of each person to extract different satisfaction from interaction with an object, event, or another person.

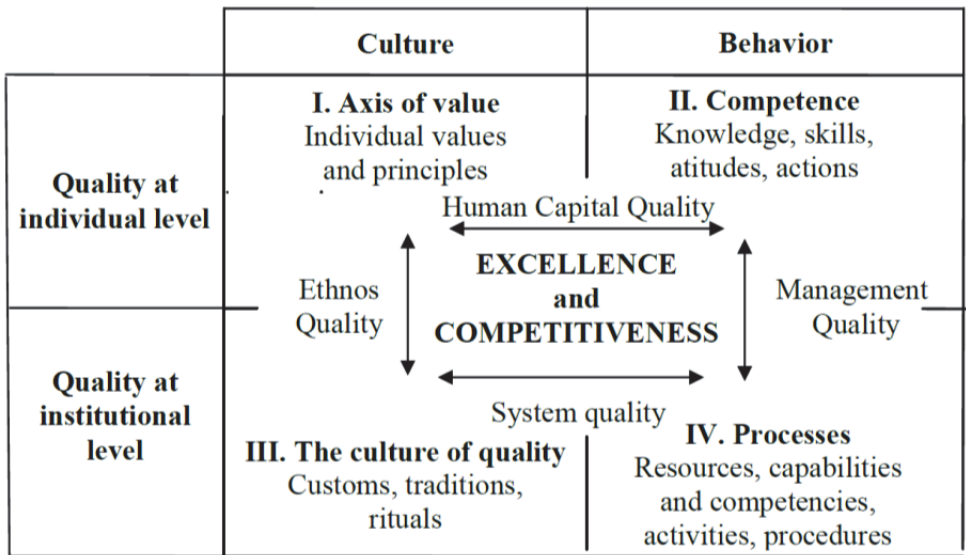


Figure 1. The synergistic interaction model of internal factors of quality

The individual can not only discern values and rank them according to intensity and the level of pleasure or suffer received. It is important to cultivate in the employees the values that produce quality, because through human value the man plans his personal value implications or seeks certain attitudes and qualities of others, the value conditions formulating of momentary goals or the perspective ones, also value defines the character and the direction of personal relationships, the preference of choice or rejection of partners in a collective participation.

Value is one of the most important criteria of socializing of mankind; it defines the personal or group system of options and guidance of the subject or a group in the complicated network of conditioning of an evolved institution that are differentiated operatively and decisional. The value in the space of human action is the dominant criterion for reporting and qualification of a situation, it determines the goal of the individual, the means of implementation and the

strategies of effects acquisition to achieve a goal - to provide qualitative services.

2. Competence - refers to realizing work activities in a profession, at the necessary capacity to successfully carry out specific functions of the profession, and the proper application of appropriate knowledge and corresponding skills.

To be competent in an occupation means:

- to apply specialized knowledge,
- to use specific skills,
- to continuously improve the work,
- to analyze and make decisions,
- to relate creatively to assigned duties,
- to produce zero defects,
- to work with others as a member of a team,
- to communicate effectively,
- to adapt to the specific working environment,
- to deal with unexpected situations.

Competence is exhibited in professional and social behavior of the workers. Human behavior, according to

Planned Behavior Theory [2], is driven by three types of considerations: beliefs concerning the likely consequences or other attributes of the behavior (behavioral beliefs), beliefs regarding normative expectations of other people (normative beliefs) and beliefs about the presence of factors that can facilitate or impede the manifestation of the behavior (control beliefs). Behavioral beliefs produce favorable or unfavorable attitudes about a certain behavior, normative beliefs have as a resultant the perception of social pressure or subjective norms and control beliefs lead to the perception of behavioral control, the difficulty or ease to realize behavior. All these three units of beliefs lead to the formation of behavioral intention and behavior as a manifestation of intention may appear or not, sooner or later, depending on situational context - people will show that behavior when favorable opportunities appear. Thus, inducing changes in the institutional context, we influence the beliefs, and thus may be influenced the attitudes and behavior of subjects in the development of quality assurance activities.

3. Quality culture - is a component of organizational culture that resides in all the values, beliefs, aspirations, expectations and behaviors outlined in the institution over time, which prevails inside it and conditions quality assurance.

When we describe the way how an educational institution works to develop the quality of culture, Lanares [3, p. 13] states that: "there are at least two points of view here. In some cases, the institution will introduce quality assurance. This will involve new values which will be integrated into the organizational culture. In others, creating quality assurance starts from the existing culture quality. Once completed, quality assurance will

influence and change, in its turn, the quality of culture. The second option is favored, since that continuity will facilitate the change."

The basic assumption of our research is that the management processes of quality and culture quality are interconnected and culture quality can be applied through structural decisions that stimulate values and common ideas.

Today anthropologists focused their research on cultural studies project. But most of them reject the identification of culture with consumption goods, though and the notion of a culture with borders, stratified, so by default that of subculture as well. In its place, they propose the model of a complex network of variable patterns that link the people who are in different positions or the social formations found on different scales. According to this idea, each group can build their own cultural identity. So each institution may have a specific culture quality!

4. Processes - interrelated sets of activities, that involve the use of resources (human, material, financial, information) to obtain a result. *Process quality* refers to the degree to which an acceptable process, including measurement and quality criteria was implemented and complies with established standards, guidelines etc.

Process quality is measured not only by the degree to which the process is consistent with superior quality, but also by the quality level of products as a result from the process. In estimating the quality of the process, we consider the current implementation status of the process compared to the planned implementation. A "quality" process has the ability to reproduce a continuous control of the process flow.

The educational process designed as a specific act of knowledge (of discovery or

preparation for discovering the truth), *interactive process* (the agents involved in this process interact to create learning situations, cause cognitive conflicts, they question, etc.) *based on a particular type of communication* (pedagogical communication, rewarding the positive behavior change in the personality development and affirmation process of the educated), *is a cybernetic process with self regulation through evaluation* (diagnostic, formative, final, criteria, regulatory, etc.) by default, *monitoring*, which by its actions mobilizes all resources to achieve predetermined objectives. We found that the processes of EIs can be of four types:

a) *Management processes* relate to the identification and analysis of requirements of interested parts and the assurance of functioning of the institution and the Quality System Management, the procedures for management and maintaining under control of the educational program.

b) *Support processes* are aimed at creating a suitable environment for teaching-learning-evaluation. They refer to didactic resources, libraries, databases, etc.

c) *Basic processes* refer to: formulating the aims of research, educational formation in terms of educational vision, competences and aptitudes, curriculum projection, curriculum design and other components of formation, student evaluation system design, organization and development of curricular and extra-curricular activities, providing knowledge and competence, scientific research, pedagogical counseling.

d) *Monitoring and control processes* refer to the evaluation and improvement of activities. To ensure permanent process capability, in the purpose of process capability to achieve the product

according with the specifications, it is necessary to maintain properly the equipment used in processes.

5. Quality ethnos - a group of people with common features, expressed with the mood of staff oriented towards quality, which tends to prevail in a given period, reflecting both organizational culture and recent developments of the institution, particularly economic and managerial.

Ethnos quality depends on social representations of employees who by institutional communication, build a shared vision of the organization, having a functional character in the sense of assuring the access of individuals to knowledge and understanding the professional environment, the conduct of individuals and groups gain respect for them at the same time with the interpretation of reality. In general, social representations, as understood by Serge Moscovici [4] have a complex and dynamic character, subordinating attitudes and opinions, which are side forms of knowledge and evaluation; the main argument is that a subject cannot have opinions or attitudes without, first of all, to have a representation of the object attitude or opinion, in our case referring to the quality of EI. In this sense, social representations provide arguments for a certain attitude, contributing directly to attitude formation, which are then expressed in institutional behavior.

6. Human capital quality – consists of the skills of individuals which are characteristic for them and remain the same in any social environment, being able to be valued on the labor market in exchange for economic resources of any kind.

We mention some specific features of human capital required by XXI century organizations [5]:

- a large amount of knowledge held;
- big share of intellectual capital;
- dependence between individual performance and the capacity of knowledge exploitation;
- dedication and focus on the profession;
- high mobility (professional, organizational, geographical) and lack of loyalty to the organization;
- high motivation for developing the level of knowledge (creating, acquiring, developing, combining knowledge) and therefore, to invest in personal development, in lifelong learning;
- better paid / rewarded by employers.

Basically, human capital consists of synergistic interaction of educational capital (skills acquired by individuals in the process of training at school and outside it) and biological capital (physical abilities of individuals, most often synthesized by the state of health). Each of the components of human capital raises questions of definition and operation. *Educational capital* is presented in two distinct forms: on the one hand are the skills gained from participating in formal education systems, knowledge attested by diplomas, on the other hand are any other kind of knowledge and skills acquired during life through their own efforts or from contacting with experts in various fields, completed with knowledge gained from assimilating the information received through interaction with them. For Educational capital gained by diplomas, the problem of measurement at individual level is not very tricky, even though they can be discussed the different methods used: by measuring the years of education, degrees of instruction, etc. However, informal education produces educational capital stock which is difficult to estimate.

The essence of the idea of human capital investment is made in human

resources to improve their productivity. Costs are generated in the hope of future benefits, from where comes the term "investment" in human resources. Like all investments, the key issue here is whether it is economically justified. The answer to this question depends on whether the benefits overcome or not the costs with a satisfactory amount and in which they apply or not standard investment criteria. There is thus a direct analogy between investment in human capital and investment in physical capital, although there are differences too. First, the human capital cannot be considered a guarantee because it cannot be sold. In addition, the owner of such a capital cannot disperse or diversify the risk in the way he can with physical capital. Beyond these factors, the parallel between human and physical capital is very suitable; for example, human capital, as well as the physical, may suffer impairment.

A broader application has the concept of individual which invests in it self. This principle applies not only to investments in formal schooling and post-school qualification, but also investments in family manifested as care to the primary school child, concern for good health, investment in information regarding labor market and job search.

7. System quality - an organized set of subsystems dependent between them, seen as a whole by relations that link subsystems between them. To provide quality services, the educational institution must be concerned, as stated in the *Methodology of external evaluation, standards, reference standards and performance indicators list* ARACIS [6], of development of a philosophy management focused on Total Quality Management - *a way of managing an organization, focused on quality, based on*

the participation of all its members and aiming at long-term success through customer satisfaction as well as benefits for everyone in the organization and society.

This can be achieved only by developing and implementing a Quality Management System, which aims *to integrate all the elements that influence the quality of products and services offered* by the educational institution. The system must be open, because in opposite case, the effect of **entropy** (chaos and uncertainty) can occur [7] and to be approached from a cyber perspective to assure, based on a permanent feedback, a good functioning and its development. The Quality Management System consists of a set of organizational structures, responsibilities, procedures, guidelines, processes and resources aimed at implementing quality management. We will follow **the organizational Management System theory** in the organization of Quality management system.

8. Quality management – the art to achieve something qualitative together with other people and it provides activities in an efficient manner, aiming to obtain the maximum level of results through optimal use of resources. It represents the management activity in the direction of developing and implementing a set of rules and tools that form the quality management system which aims to assure the desired level of quality for the company's product. The management activity may be referred to teams or processes. The resources that a manager mainly has at its disposal are: time, talent, financial resources and human resources.

The manager of an educational

institution, in order to create a productive and pleasant learning environment must be a true leader. Leadership is a complex term that characterizes the kind of manager who has the "art of leadership", being a leader not only by the nature of the position but by a recognition of his skills by all coworkers, because his activity is under the sign of credibility arising from competence. Leaders are very important for an organization because they set goals and directions of development of an educational institution.

Below we present a model for evaluating the management, developed by us, based on competence evaluation of the manager based on achieving the institutional standards. This model was expertise, validated by the Senate of the Academy of Economic Studies of Moldova and applied in the process of management evaluation.

Table 1. **Evaluation model of the manager**

AREA OF COMPETENCES	COMPETENCES The manager will show that he is capable:	STANDARDS OF PERFORMANCE
Cognitive Competences	<ul style="list-style-type: none"> • To use specialized theoretical and practical knowledge, advanced in Educational Management area • To demonstrate analytical skills related to innovation in Educational Management • To critically analyze theories, concepts and principles which are the base of a modern management • To make judgments based on incomplete or limited information • To elaborate strategic and tactical plans to develop the educational institution 	Promoting scientific innovation inactivity
Skills for managing the activities	<ul style="list-style-type: none"> • To organize the development of the educational institution • To demonstrate leadership in work contexts that are unfamiliar, complex and unpredictable and that require problem solving, involving many interacting factors • To establish marketing policies • To be a promoter of change in a complex environment • To solve problems by integrating complex information, possibly incomplete, in new and unfamiliar contexts 	<p>The activity of the educational institution is organized in compliance with institutional project of educational institution development</p> <p>The image and the interests of the educational institution are promoted in relations with the community</p> <p>Efficient and effective organization of activities at the level of system</p> <p>The educational process in the educational institution is realized in accordance with national and international educational policies</p> <p>The decision-making process in the institution is monitored properly and coherently</p>
Skills for managing people	<ul style="list-style-type: none"> • To demonstrate autonomy in the process of activity • To self-evaluate and evaluate the work of colleagues 	<p>A positive working climate is promoted in the educational institution</p> <p>The evaluation process of</p>

	<ul style="list-style-type: none"> • To motivate and lead people to action • To evaluate and improve the strategic performance of teams • To show ability to work within a multidisciplinary team • To act synergistically, through creative cooperation and capitalization of differences. • To hire, advise and train employees, subordinates 	<p>activities and results is focused on increasing the quality of education. The organizational culture of the educational institution has a progressive character</p> <p>The permanent training of teaching/managerial staff / corresponds to the educational policy in Republic of Moldova, to the educational institution's strategy and has a systemic character</p> <p>The manager is a personality in a permanent development</p> <p>The institution is provided with the necessary human resources</p>
Resource management skills	<ul style="list-style-type: none"> • To develop general budgets of an educational institution • To take action to attract extra-budgetary sources 	<p>The consolidation and dynamic development of the technical and material base of the educational institution</p> <p>Practice of a correct financial management</p>
Administering information skills	<ul style="list-style-type: none"> • To collect and interpret relevant data in order to solve problems • To communicate effectively using information technology as well 	<p>The informational system in the educational institution is organized, dynamically</p> <p>The institutional and community database is functional</p>
Quality assurance skills	<ul style="list-style-type: none"> • To build and implement quality assurance systems 	<p>Policies and quality assurance systems are implemented in the educational institution</p>

For each standard will be established evaluation indicators, for example, for the standard of *Educational institution activity is conducted in accordance with institutional development project of the institution*, are established the following indicators:

- the projection is systemic and includes four main levels of projection: determining the mission, the strategic level, tactical level, operational level;
- the projection meets the following

requirements: relevance, appropriate forecasting, rationality, feasibility, internal and external consistency;

- the projection respects the key steps: setting policies and strategies, the diagnose of internal and external environment, exploring the near future, goal setting, identifying and allocating resources, operationalization and completion of concrete action plan in time and space.

- the projects contain clear evaluable

purposes, which are analyzed in terms of cost-results;

- the projection reflects rationally and develops real and potential resources (human, informational, material, financial, of time);
- project monitoring is permanent;
- projection involves human resources with different status (teachers, parents, students, educational partners, etc.) in initiated projects within the educational institution.

It is important to note that at the end of the evaluation, when information is collected or when the recommendations are presented, they should be made so that the director who is evaluated to understand that he is not judged but compared with some unique institutional standards.

The development of educational institution depends on performing managers able to promote innovation. We consider important to realize a systematic and systemic evaluation of educational institution managers, in this way we can apply the evaluation model developed by us.

Introducing quality management in an educational institution is a major change in its culture and it is usually stroke by the resistance of the staff and existing structures. If we focus our activity on developing these quality factors, we will be able to obtain institutional and personal performances.

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DISTRIBUTED DECISION-MAKING MULTI-AGENT SYSTEM IN MULTI-DIMENSIONAL ENVIRONMENT

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Abstract: This paper deals with the design of a distributed decision-making multi-agent system in which the decision-making area is described as a multi-dimensional space with a set of agents. For the optimal distribution of computational power and functionality, three categories of agents are defined: Sensor agent, Actuator agent and Decision agent with artificial and natural intelligence. The process of agent's identification is based on an XML code with the corresponding attributes. The interaction of agents for distributed decision-making is described by an UML sequence diagram.

Keywords: Multi-agent system, decision-making, artificial intelligence, distributed computing, multi-dimensional space, agent, XML code.

1. Introduction

The world around us can be viewed as a lot of multi-dimensional processes in which many operations, transformations and actions take place simultaneously. The perception and management of these processes can be related to a wide variety of methods for complex tasks solving. One of the most effective approach is the use of Artificial Intelligence Systems (AIS) [1].

The main features of using AIS in order to solve complex tasks are [2,3]:

- decision-making on the basis of fuzzy, insufficient or poorly defined information;
- application of methods and models of fuzzy logic, neural networks, genetic algorithms and membrane computing;
- the use of formal models to describe and present information and knowledge;
- the use of heuristic methods in cases when obtaining the accurate answers is impossible or requires a lot of time or

technical resources;

- the use of machine learning methods to update knowledge etc.

The most effective approach to control complex processes (complex tasks solving) can be considered the use of Multi-Agent Systems (MAS) [3,4], since MAS involves the application of artificial intelligence methods and models, ensuring the autonomy and heterogeneity of agents, thus allowing the optimal design of distributed decision-making systems [5].

Although MAS have a great importance in engineering applications, there is a lack of scientific methodologies to control multi-agent systems. This restraint the management of these networked systems and the realization of their full potential. Multi-agent systems have a lot of significant features: they consist of large collections of agents which are capable of sensing, computation, communication and actuation, which

facilitate their ability to solve problems. One of the main methods of controlling multi-agent systems is distributed decision-making. It is defined as the development of practical mechanisms which agents can utilize to autonomously coordinate their actions or decisions through local message exchanges and successfully achieve a goal with necessary performance guarantees.

The distributed decision-making model offers a number of advantages over traditional centralized management. Firstly, message passing is only necessary between neighboring agents. Secondly, the need of transmitting data to a central unit is not needed, and computational problems are shared among other agents. As a result, concurrent decision-making performed by agents improves computational efficiency. Thirdly, decisions are made by individual agents autonomously. This enables agents to adjust their actions in the environment, so the networks possess the capability of self-adaptation to environmental changes.

One of the main challenges for the normal operation of distributed decision-making systems is ensuring the optimal distribution of the tasks, organization and synchronization of data exchange between computational devices. To solve this problem, we propose the use of an XML formatting language, which provides the transfer of parameters and data at the application level of the OSI network model. The optimal distribution of computational capacity is ensured by assigning to each agent (sensing, actuation and decision making) a set of elementary computational operations.

2. Problem statement

Let P be a computational process in the multi-dimensional space $S \subset R^N$,

where: $P : S[T] \rightarrow S[T+1]$.

The process P represents a set of operations involving the perception of space $S[T]$, decision-making task and the actuation on space $S[T+1]$ in order to achieve $S_{opt} \subset R^N$, where T represents the discrete time moments of interaction with space S .

The purpose of these study is to design a Multi-Agent System for distributed decision-making in order to implement a computational process that will provide

$P : S[nT] \rightarrow S_{opt}[nT+1]_{opt}$, where S_{opt} is the optimal value of space S and $[nT+1]_{opt}$ is the optimal time interval allocated to achieve the optimal value S_{opt} .

As an example we will consider a multi-dimensional process, defined as a system of equations $F = \{f_1, f_2, \dots, f_K\}$, which ensures $F : S \rightarrow R^N$. The state of the process S is determined by the state vector $X = \{x_1, x_2, \dots, x_N\}$ [7, 8].

The set of functions F are defined as the following system of equations:

$$\begin{cases} f_1(x_1, x_2, \dots, x_N) = 0 \\ f_2(x_1, x_2, \dots, x_N) = 0 \\ \dots \\ f_K(x_1, x_2, \dots, x_N) = 0 \end{cases} \quad (1)$$

Based on the system of equations (1), the search criteria for optimal solution S_{opt} can be defined as:

$$S = \sum_{j=1}^K f_j^2(x_1, x_2, \dots, x_N) \rightarrow S_{opt} \quad (2)$$

Multi-Agent System model

The proposed MAS model consists of a set of agents operating in the action space $S \subset R^N$. Each agent is able to exchange data with other agents and

implement a sequence of operations p_k ,

where $p_k \subset P$ and $P = \bigcup_{k=1}^K (p_k)$; K is

the number of agents in the MAS model.

For the efficient MAS functionality, three categories of agents are considered: *Sensing agent*, *actuator agent* and *decision agent*, which, in the process of decision-making, exchange data based on standard and special protocols at the application level.

XML elements for agents

Each agent is identified by a protocol, presented as an XML element with corresponding attributes:

```
<Agent Type="Agent Type"
Name="Agent Name" OP="Operation
Specification" Date=" Date Activiti of
Agent" Time="Time Activiti of Agent">
  Activiti of Agent (Data, Commands,
Parameters, Expressions, ...)
</Agent>
```

We now proceed to describe each agent.

A^S - Sensing agent, designed to enter data about the state of the action space S .

An XML code for a Sensing agent is:

```
<Agent Type="Sensor"
Name="DS18B20" OP="ID/Config/TxD"
Date="27. 10. 2019" Time="11:25:07"
>17. 43
</Agent>.
```

17. 43 – is the parameter transmitted by the Sensing agent. Depending on the agent type, the transmitted data can take both logical and Fuzzy logical values or expressions.

A^A - Actuator agent, designed to action on space S .

An XML code for an actuator agent is:

```
<Agent Type="Actuator"
Name="Relay" OP="ID/Config/Exec"
Date="27. 10. 2019" Time="11:32:15">
```

On/Off

</Agent>.

On / Off - parameters transmitted by Decision agent for executive devices. Depending on the type of actuator, there may be different types of values: logical (ex. 0/1), integers (ex. 23) or real numbers (ex. 6. 35).

A^{DM} - Decision agent, designed to analyze the state of the space $S[T]$ and the control vector $U[T]$ in order to action on space S and generate a new control vector $U[T+1]$ to action on space $S[T+1]$.

The XML code for microcontroller-based Decision agent with artificial intelligence is:

```
<Agent Type="MCU"
Name="Raspberry_Pi_4"
OP="ID/Config" Date="27. 10. 2019"
Time="11:32:22">Ready/Busy</Agent>.
```

The XML code for Decision agent with natural intelligence is:

```
<Agent Type="Human"
Name="Admin" OP="ID/Config"
Date="27. 10. 2019"
Time="11:32:43">Ready/Waiting/Busy
</Agent>.
```

Ready/Waiting/Busy – are the state parameters of the Decision agent.

The most specific attributes used in the proposed XML elements are:

OP = "ID" - attribute of the agent identification in the MAS model. At the beginning of the MAS operation, each agent transfers its identification attributes to all other agents;

OP = "Config" - attribute of a new configuration request. If necessary, any agent generates a request for a new configuration, and, as a result, all other agents respond with their identification attributes **OP = "ID"**;

OP = "TxD" - data transfer attribute. Data, addressed to all decision agents, is

transmitted by Sensing agents;

OP = "**Exec**" - attribute that denote the fulfilling of the conditions specified in the XML element. These operations are generated by Decision agents and are addressed to Actuator agents. The Actuator agent identifies its name and fulfills the condition of the **On / Off** parameter.

3.2 Agents block diagrams

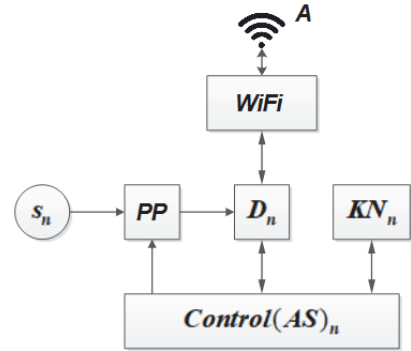
For MAS operation, three categories of agents are used: Sensor (A^S , Figure 1, a), Actuator (A^A , Figure 1, b) and Decision Making (A^{DM} , Figure 1, c).

Each agent includes: a unit for knowledge storage (**KN**), a memory for data storage (**D**), a unit for data exchange between agents (**WiFi**) with an antenna (**A**), and a program control unit (**Control**). The sequence of operations performed by the program control unit is determined by the knowledge of **KN**. At each decision cycle, **KN** is updated. Data exchange between agents is carried out in the XML format.

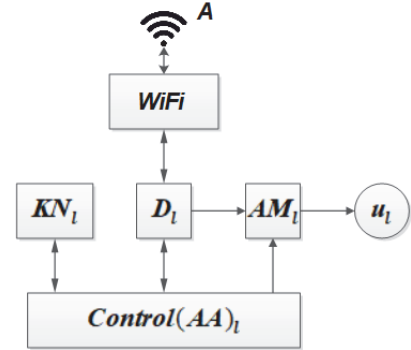
Sensor agent A^S collects information about the state of the action space \mathcal{S} . The sensor S_n generates a signal that is applied to the input of the pre-processing unit (**PP** – *preprocessing*), subsequently, under the influence of the program control unit, **KN** is updated and its data is transmitted to other agents via the **WiFi** data exchange unit.

Actuator agent A^A performs the action on space \mathcal{S} . Initially, Actuator agents are in standby mode, waiting for network command from the Decision agents. When the name of the appropriate agent is identified, the following actions take place: an XML code is processed, signal u_i , which is amplified by the

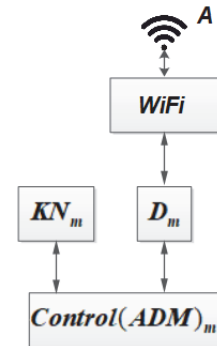
AM_i block, performs an action on space \mathcal{S} , after which the **KN** is updated.



a) Sensor Agent.



b) Actuator agent.



c) Decision Agent.

Figure 1. Agents schematic diagrams.

Decision agent A^{DM} is in standby mode, waiting for data from Sensor agents, which come from the **WiFi** network via the data exchange unit. Depending on the

data, Decision agent generates commands for Actuator agents, and updates its own knowledge KN .

3.3 Knowledge building

Data processing algorithms used by agents in their strategies are based on knowledge.

Knowledge building steps are presented in Figure 2, where: X is the state of the process S ; X/D is the conversion of the signal X to binary code **Data**, according to the model $C(X/D)$; D/I is the conversion of the binary code **Data** into **Information** according to the model $C(D/I)$; I/C is the conversion of **Information** into **Knowledge** according to the model $C(I/C)$; I/D is the conversion of the **Information** into **Decision** according to the model $C(I/D)$; **Knowledge**[T] represents the knowledge model for conversion of data, information and knowledge; **Knowledge**[$T+1$] is a new knowledge, generated according to the previous information and knowledge.

The process of knowledge updating is described in more detail in [6].

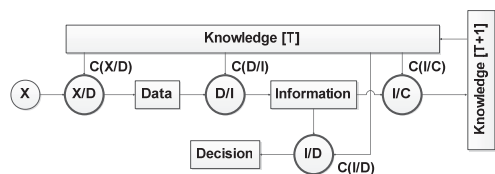


Figure 2. Knowledge building diagram.

3.4 Agent collaboration

The collaboration of agents for proposed distributed decision-making MAS model, is presented in Figure 3 in a form of UML sequence diagram.

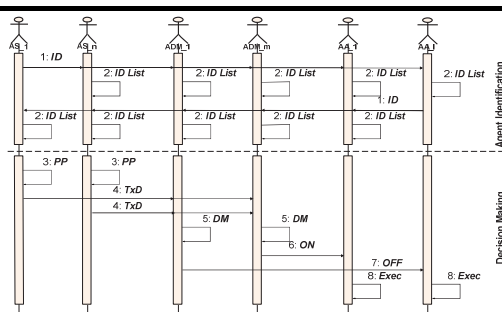


Figure 3. UML sequence diagram for agent collaboration.

The UML sequence diagram displays the overtime collaboration of agents. At the beginning of the MAS operation all agents are initialized. Thereafter, the MAS switches to the decision-making mode. According to the diagram, many processes are executed in parallel by all or just several agents. Thus, the MAS works asynchronously, each agent solves its subtask, that ensures the convergence of the global task, for example, to achieve the optimal state of space S_{opt} .

Specification of operations:

- 1: **ID** - each agent sends its identification code to all other agents;
- 2: **ID List** - each agent accepts the identification codes of other agents and adds them to the list of active agents;
- 3: **PP** - Sensor agents perform an input operation and preliminary processing of data about the state of space S ;
- 4: **TxD** - all Sensor agents transmit data to all Decision agents;
- 5: **DM** - Decision agents, based on the embedded algorithm and their own knowledge KN analyze the state of space S and make a decision;
- 6: **ON** - Decision agent send the command to enable Actuator AA_I ;
- 7: **OFF** - Decision agent send the command to turn off the Actuator AA_I ;
- 8: **Exec** - Actuator agents execute received commands.

4. Assessment of the decision-making results convergence

Achieving the optimal value for the state of the space S_{opt} is the main goal of the Multi-Agent decision-making system. In Figure 4 the simulation results for different numbers of agents are presented. We considered that $A^S = A^A = A^{DM}$ and $K = \{3, 9, 15, 30\}$. T_{opt} is the optimal time for which the decision is acceptable.

The results in Figure 4 show that the Multi-Agent System which consists of one Sensing agent, one Actuator agent and one Decision agent can't achieve the optimal value for the state of the space S_{opt} in a given time interval T_{opt} . As the number of agents involved in decision-making increases, the time required to reach the optimal value S_{opt} is significantly reduced.

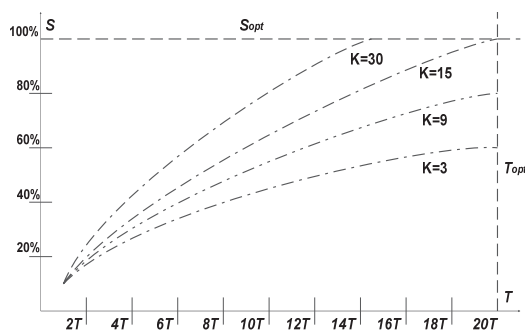


Figure 4. Convergence of decision-making results.

Conclusion

In this paper, we describe the multi-agent distributed decision making system. The decision-making area is presented in the form of a multidimensional space in which three categories of agents are collaborating: Sensing agents, Actuator agents and Decision agents. Two types of Decision agents were proposed: one with artificial intelligence on the basis of

technical means and the other with natural intelligence, which implies that the decision is made with the participation of a person, thus making the proposed solution the most effective and appropriate. For each category of agents, a block diagram is developed and operating principles are described.

The identification and description of agents on the network is based on XML elements with the corresponding attributes. The agent collaboration is presented in the form of an UML sequence diagram.

The proposed technical solutions provide optimal distribution of computational capacity, autonomous behavior and implementation of self-configuring multi-agent systems.

Further studies include the design of new application layer protocols for data exchange and testing of the MAS architecture based on the ESP32 and Raspberry Pi 4 computational modules for management of various technological processes.

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THE INFORMATION INTERCONNECTIONS, AS A CONTRIBUTING FACTOR TO THE AUTOMATIC ACHIEVEMENT OF INFORMATIVE ISSUES WITHIN THE FRAMEWORK OF THE INTEGRATED ECONOMIC MANAGEMENT SYSTEM

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Abstract. In article, the varieties of the functional and procedural interconnections and interactions between the information subsystems and their constituents with the informative role in the unitary process of economic management are highlighted and elucidated. It is established the possibility of using these interconnections and interactions during of elaboration of the economic integrated informatics system and their contribution to the automatic functioning of the same category systems. It's elucidated the unitary informational informative fund (U. I. Iv. F.), as rational and efficient form of realization of the information interconnections and interaction between economic functional issues, their complexes and subsystems.

Keywords: Varieties, Interconnections, Interactions, Information, Informative, Unitary, Economy, Management System

1. Introduction. For the existing economic management system, spatial isolation and the discreet evolution of material (manufacturing, distribution (commercialization), consumption) and informational (informative, decisional) processes are characteristic, which virtual and in analogue interpretation they form whole. This explains the multiple disparities between the activities of these two categories of activities (material, informational), the breaking down of the managerial system on management levels (bodies) (primary, intermediate, superior), operational periods (operative, current, prognostic) and of the information system on subsystems, complex and particular

issues. Such a situation led to the most expressive influence, especially at the intermediate and higher levels, of the subject's role on the material and spiritual events of both the human society as a whole and each her subdivision, individual. Have been created the conditions of favouring of prevailing negative tendentious impact of the managerial system over the driven object (process), as well as to the predominance of applied practically in any space and management moment of the administrative methods and means. From unitary positions, all these moments, with prevalence, are caused by the inadequacy of the performance level of the

management subsystem comparatively with the it driving subsystem. The formation of the mentioned breaking off has occurred once with the establishment of the social character of the human material activities, as a consequence of the qualitative information shortage.

The analysis of the unfolding of course of these two constituents of the unitary economic management process revealing in transparence the objective going, but until unconscious of the subject, towards the liquidation of the territorial isolation and the discrete function of them. At present and from the beginning of the socialization of the subject's activities, such advancement is observed and is accomplished by inventing, elaborating and applying of the various technical, programmed means, technological methods, a.s.o., considered as informatics resources.

By drawing a parallel between the progress of the development of elucidated resources, it becomes perceptible the fact that the above mentioned essentially have advanced, while, from the point of view of the complete inclusion of the information phenomenon as an integral unit, their application in the economic informative and decisional fields is insufficient. In this sense, it is certifying the satisfactory coverage by the informatics means and methods only of a transformative stage of the information - the processing (information, structural, calculation) stage, the other two stages - initial (of the formation of the primary and intermediate values) and of using (analysis of information products and based on the results of this analysis forms of decisions), remain mostly conducted manually by the subject.

As a result, there has been a substantial disagreement between the levels of performance of the informatics methods and means and level of their application

domain - information. This situation can be qualified as an unpreparedness of the information resources for the involvement of the nominated resources in their processing.

The created circumstances are caused by the major spatial expansion and the unimaginable speeds of achieving human material preoccupations. About this confessing the evolutionary formulation of the concept of globalization of the in-cause activities, objective being pushed by the imperative of the material informational integration. Otherwise affirming, the material globalization has provoked and can not be achieved and operated without the informational globalization.

It is worth mentioning that at the moment and permanently, the listed above informatics resources rightly and justifiably are considered to be decisive in the data processing. But not less valuable for this way is the suitability of structuring and organizing of the information resources, their processing and functional (of serving of management functions) interconnections.

The consecutive accomplishment of these two categories of interconnections, starting with each problem and finalizing with the information system, ensures the continuity of all information processes. In the case where continuity is supported by technical means and methods, it is automatic. That is why, not only the informatics factors, but also the itself domain - information resources, its rational structural interconnections, efficient organization and processing directly contribute to their mechanically processing.

Therefore, the decisive importance in supporting of the automatic functioning of integrated system of economic management disposing the identification, respecting, putting in working and

guaranteeing of the technical functioning of any variety of interconnections and interactions within the framework of named system.

2. The making evident, analysis and contribution of the varieties of interconnections and interactions between economic informative subsystems and their constituents.

In accordance with the played role in the integrated unitary system of economic management, based on the inclusion of both constituent compartments of it - material and informational, within the latter can be highlighted informative and decisional information. The informative ones perform the function of unilateral reflection concerning the availability and evolution of economic resources (human, material, financial).

The unilaterality of the reflection lies in the description of the parameters, the quantitative and qualitative characteristics of the economic category objects (processes) at a certain moment of time control of management or only at the beginning or only at the end of a certain period of time. Therefore, any information values of such variety, taken in particular, without taking account of and matching them with other varieties of information of the same class, can not serve as a basis of enterprise certain material or spiritual actions. Consequently, the in-question information is devoid of comparative features, their decisive predestination remaining descriptive.

For this reason, in order to obtain such attributes, it is impose the formation and combination of two and more types of information for to inform the decision-maker. The joining is objectively challenged by the uni-positional description of the events and their participants, that is, only from a point of view, in one aspect and moment of their

evolution. Regarding the description on the temporal time, the information of the informative role would be appropriate to be considered as situational, as they reflect the status of activities and their constituents after the leakage or waiting for a period of time.

As an example of the need to combine the different categories of information of economic informative issues, can be used this argument that the information of evidence (operative, accounting, statistical), without the rate - setting (primary, generalizing), settlement (constructive, technological) and foreseeing (operative, current, forecasting) information do not making up the basis of the formulation of any decision in the environment of the integrated system of economic management.

The same situation applies and to economic analysis (operative, current), which entirely depends of all other economic information, but also on any other category (social, technical, medical, etc.), the latter being the basis for their formation. As a result of the study, the informational interconnections and interactions between the informative subsystems of the economic unitary integrated management system are presented in Fig. 1

The following meanings are allowed in the scheme: R. S. - the rate – setting and settlement subsystem of economic material activities; FS. - the forecasting subsystem, C. F. - the current foreseeing subsystem, O. F. - operative foreseeing subsystem; P. E. - the primary evidence subsystem,. O. E. - the operative bookkeeping subsystem,. C - the accounting subsystem, S. - statistical subsystem O. E. A. - operative economic analysis subsystem; C. E. A. - the current economic analysis subsystem.

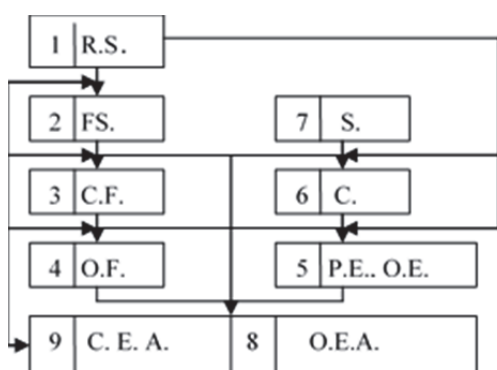


Fig. 1. The scheme of the informational interconnections and interactions between the informativesubsystems of the unitary integrated economic management system (U. I. E. M. S.)

From the content positions, the integrated unitary economic management system, taken as a whole, is built on management functions, which after their temporal achievement are divided into the following two large groups:

1) the functions that precede the economic material activities (E. M. A.), to which refers the rate - setting and settlement (R. S), the forecast (FS.), the current (C. F.) and operative (O. F.) forecasts,

2) the functions that succeeding the E. M. A., referring to them the primary (P. E.), operative (O. E.), accounting (C), statistics (S) and the operative (O. E. A.), current (C. E. A.) economic analysis.

The scheme of Fig. 1 shows that after the functional content, the starting of the evolution of U. I. E. M. S., takes place at once with the elaboration and putting in function of the rate - setting and settlement subsystem (R. S.), on the basis of which further on it fulfilling the chain: FS. → C. F → O. F. → P. E. O. E. → C → S → O. E. A. → C. E. A.

The presented succession confirms the fact that all informative activities of U. I. E. M. S. are crowning by the economic

analysis subsystem (E. A.), after achieving which inevitably following the formulation of economic decision-making products (D. P.). From this moment the impact of E. A. is the most immediate with the economic managerial system (E. M. S.), with in the framework of it take place the eruption from the economic decisional products (E. D. P.) from economic informative products (E. Iv. P.). Therefore, the activities of E. A. finalizes the evolution of the informative sub-compartment and serves as a basis for starting of the realization of the decisional sub-compartment of U. I. E. M. S. That is why E. A. occupies an intermediate position between the informative and decisional compartments of the given system.

Regards of the content interconnections and interactions between the structural information components of U. I. E. M. S., it comes out that them are functional, transformative and pragmatic. The first theirs category refers to the connections and the functioning of informative informational units of each problem, complex of problems, sector, subsystem and system of information issues (informative and decisional). The second category have is attributed to the categories of procedures and transformative operations, performed on the informative informational units values, the chain of sequence of their realization being the following: information procedures (I. Pr.) → structural procedures (S. Pr.) → operations of calculation (O. C.) = information procedures (of concluding and offers of the processing results).

The pragmatic interconnections and interactions have an attitude to the involvement of informational economic informative units in the processes of transforming their values and of formulating of decisions. In the context of

content, both transformational and functional, the most frequent performed variants of joint involvement of economic informative informational units are the following: R. S. + FS. ; R. S. + C. F. ; R. S. + O. F. ; R. S. + O. E. ; R. S. + C; R. S. + S. ; C. F. + C; C. F. + S; O. F. + O. E. and so on. From this enumeration it can be noticed that the most massive are the interconnections and interactions between informative information rate – setting and settlement of economic material activities (R. S. E. M. A.), then the forecasting (FS., C. F., O. F.) and fragmentary - of the operative evidence (EO), accounting (C) and statistics (S.)

3. The unitary informative fund (U. Iv. F.) - the contributory form of rational and efficient realization of the information interconnections and interactions between informative issues, their complexes and subsystems

The concretization of the semantic (sense) content of the information is achieved through its functional predestination (the pragmatic aspect). Both this predestination and the essential increase of the volume and compositional complexity, of the structural variety have objectively contributed to the specification of the information in various varieties. Subsequently, each variety of information evolved quantitatively and qualitatively.

These circumstances and reasons have led to the need of highlighting and forming of certain structural information units, which allowing to the as possible efficient organization of information resources. In this sense the organization of economic information (E. I_f) has evolved through a series of evolutionary stages and forms of organization of its functioning, the main ones of which are the following (in order of their evolution):

1) organizational forms based on elementary information units in the shape of communications, peculiar indicators;

2) organizational forms based on separate (autonomous, stray) information massifs;

3) organizational forms based on information collections, which include not only attributes, communications and indicators, but also informative massifs;

4) organizational forms based on the principles of organizing of informational supports (document indexes, card indexes, reels index, disk index, floppy disk index, library of CD, DVD, STICKS). For most of these forms it is characteristic the disperse of the information units in space and time, for which reason they were formed, processed and used separately, not organized, without taking into account the systemic character and therefore the interconnection of economic informational informative components.

Gradually, however, made to the measure of increase of the volume and complication of the economic material activities, grace of the intensification of the mutual relations between the various subdivisions and economic agents, the necessity of creating and achieving an integrated unitary information nucleus, which is nothing more than the unitary economic informational informative fund (U. E. I_f. Iv. F.) of the economic unit (E. U.).

In this fund, all initial informational informative units, which refers to the entirely led object and any it components are accumulated for the purposes of their processing, keeping and subsequent offer. Also, this fund is concerned and serving with different varieties of derivative information, necessary to make concrete managerial decisions.

Thus, the fundamental predestination of U. E. I_f. Iv. F. consists in providing with data any processes of organizing

(storing), transforming and using concrete information.

The fact that the information fund is unitary does not mean that its organization and operation is carried out in a centralized manner. Even and in this case, at the general level, actually the processing and using of information takes place in a distributed way, because the economic management system has a lot of managerial levels and their objects, spatially dispersed and temporally discrete. The necessity of organizing U. E. I. Iv. F. is caused by the following basic factors:

1) the changing of the functional content of the environment of economic activities, which consists in the fact that the increase in volume, variety and promptness of the latter leads to the improvement of the form of their realization, with the solving of a new, more efficient management system. In turn, the new management system calls a new form of information resources organization. As economic activities requiring coordination in space and time, they must be done in a unitary concept.

For this reason, from an organizational point of view, they are interpreted as a whole in the interconnection. Because the system of economic material activities takes the form of a unitary interconnected body, respectively the informational resources that describe and permanently accompany them, they must be organized in the form of such a unit, which would also ensure the connection of the information elements based on unitary concept. The accomplishment of this organizational information unit has found its expression in the form of unitary informational informative fund (U.I.Iv.F.).

2) the establishment of this fund contributes to the determination of the most rational composition and appropriate structures of the managed object. This is because of the organization of the fund is

inconceivable without the identification of all the information units and the connections between them, with their unified coordination and regulation for the purpose of qualitative and timely service with necessary data of the decision making activities;

3) the perception of U. I. Iv. F. as a unitary object, makes the development of an adequate logical and flexible managed information system;

4) being the informational model of the managed object, U. I. Iv. F. ensures the authenticity, completeness, opportunity of the information system and hence the increase of the quality level of the informational resources of the integrated unitary system of economic management;

5) organizing of the information system based on the concept of U. I. Iv. F. also leads to the economy of the space of memory, as in this variant practically any duplication of the information units and the connections between them is excluded;

6) the agreement of U. I. Iv. F. also contributes to the saving of time and to the reduction of other consumption related of the recording, preservation and transformation of information, as the values informational units, as a rule, are fixed on the memory only once;

7) automatic achievement of the informational connections of the economic issues within the shape of the U. I. Iv. F. of E. U. contributes to the maximum automation of data processing and of ensurancewith informationthe management process. This is explained by the fact that, from an informational point of view, a issue arises from another. In this way, the results of solving a problem can be used to solve other problems and so on;

8) application of the U. I. Iv. F. concept substantially improves the technology of data organizing and processing by transforming it into a

continuously automated achieved unitary process;

9) as U. I. Iv. F. informationally links all issues into a single unitary complex, it indirectly contributes to the full automation of the management system.

Starting from the above mentioned, it can be concluded that the U. I. Iv. F. is considered to be a internal unitary organizational form that is predestined for organizing and providing any information for the management system as a whole and any component there of. Initially, and currently for the time being in the form of U. I. Iv. F. the information resources that require permanent storage on the informatics memory are partially organized. So, the area of achievement of U. I. Iv. F. in the practice of economic information activities contains only some of the relatively constant data and does not refer at all to the variable ones, which are daily fixed, organized and processed. Because of this, variable information by volume is enormously considerable comparatively with the constant information.

This assertion is aimed for to underline the level of theoretical treatment and practical accomplishment of U. I. Iv. F. and for to establish that in this domain currently we are at the initial stage. Therefore, regarding the composition and content of U. I. Iv. F. of E. U. will made reference to their functional aspect within the framework of the economic management system.

The created situation for the establishment and functioning of the U. I. Iv. F. is also explained by the fact that until now the unitary system of economic information for the economic unit has not been elaborated the functional informational relations of internal and externally character fully and genuine are not highlighted.

At the same time, even and organizing a relatively constant part of information in

the shape of U. I. Iv. F. is advantageous, as it leads to the reduction of time, space, and other resources related to data input, processing, and previously enumerated and characterized factors.

Elaboration of U. I. Iv. F. requiring the solving of multiple groups of the issues, among which of basis are the followings:

1) determination of the composition and number of issues, complexes of its and informatiive subsystems that need to be solved by the economic informatics system, them filtering and distributing on economic management levels;

2) selecting of the logical structure of U. I. Iv. F. and its components. Given in view that this fund is a totality of data files, it requiring the issue of selecting and determination a optimal composition and number of data elements that would provide information that would fully satisfy the solution of all the issues of the economic informatics system (E. Ic. S.) and its subdivisions;

3) correlation of information and technological aspects of automatic data processing;

4) elaboration of the logical structure of the database, which includes such works as selecting and determining the totality of data elements included in the composition of its content, establishing of the semantic relations (of meaning, content) between them, highlighting the different types of data structures and correlation between them, determining the elements of these structures.

During of the constitution of U. I. Iv. F., also it is necessary to solve the problem of doubling of contained in the files the values of the data. In this context, the most economically and rationally constructed is U. I. Iv. F. in which the data redundancy is totally excluded, which leads to the maximum simplification of the data files correction, but at the same time causes difficulties for the processes for the elaboration and functioning of the

programmed and technological resources of E. Ic. S. If in E. U. I₁. Iv. F. there is admitted insignificant redundancy and poor connection between its files, then a rational and efficient data update system must be provided.

The process of elaboration U. I₁. Iv. F. of E. U., by virtue of the latter's importance, for the establishment of E. Ic. S., in fact is iterative. This is explained by the fact that, depending on the obtained results at the functional design stage (detail, operation) of E. Ic. S. or experimental exploitation and comparison of these results with the expected ones, in some cases it is necessary to return to the previously at the achieved stages (works already fulfilled) in order to specify some materials or to revise some decisions regarding the composition and structure of E. U. I₁. Iv. F. E. U.

All that has been elucidated so far has confirmed that at present and in the foreseeable future the full creation of E. U. I. M. S. presents an extremely complex and difficult issue of being translated into life. However, the concept of this system, as well as its systemic approach with the inclusion of all possible components, needs to be constant kept. Until now, one of the most efficient and rational forms of organizing the informative components of E. U. I. M. S. is considered the economic informational informative fund of the economic unit (E. I₁. Iv. F. E. U.).

Regarding the perspective of the forms of the integrated data organization on the informatics support space, it can be expected that the most efficient one would be that which automatically ensure the accumulation, distribution, preservation and provision of the necessary information at any time for the purpose of establishing, formulating and taking of contributive to the long – expected evolution of the managed object (process) decisions. Thus, the examined forms, by reasonably distribution of the

necessary data on the informatics memory space, in the ultimately essential will facilitate the preservation, protection and execution of all processual procedures and operations, but especially those of recovering. The rationalization of the organization is motivated by the concrete goals of in common data using (implication) for processing and using in the processes of solving both informative and decisional issues. These, in turn, ultimately will it reflecting on the results of human material and spiritual activities, thereby influencing their volumes and quality.

4. Conclusions

1. Although the existing system of economic management in virtual interpretation forms a whole, in reality from integrated unitary positions, it is spatially isolated and temporally-discreet, which creates conditions of decisive negative influence of the subjective factor on the course of human economic material activities.

2. The outrunning of this situation, which took place with the socialization of the nominated activities, has occurred and is carried out by creating and applying various informatics resources, especially the technical, mathematical, programmed and relatively technological ones.

3. If the listed resources have somewhat advanced, then the domain of their application, in the present case - the economic management information system, proved to be "unprepared" to be organized and functioned under the conditions of its total informatics achievement.

4. As a result, because of insufficient investigations and minor practical achievements, it registration a essential lag of information domain both to other informatics resources, and to the material domain.

5. During the process, it was realized

the fact that the elimination of this discrepancy through the integral informatics accomplishment of the integrated system of economic management contribute not only the technique, the programming, etc. but also to the information - by its rational structuring, efficient organization and processing.

6. Starting from the reason that a informational managerial issue arises from another, a complex, subsystem of issues – also they are informational conditioned, through highlighting and the full informatics achieving of the interconnections and interactions between them, a managerial system can be developed and put into analogous operation a management system, which including in tight and direct interconnection and interaction all the material and informational processes, thus forming a automated material - informational nucleus.

7. In such conditions objective it requiring the highlight, analyze and select the most rational and effective possible sequences of assurance with information resources of the solving processes of each issue within the framework of each complex, of each complex of issues within the framework of each subsystem and each subsystem – within the framework of integrated unitary issues system.

8. The composition of information interconnection and interaction variants between managerial constituents are objectively required by two circumstances: the managed object (process) for the first time is implemented or is already functioning.

9. The unitary integrated achievement of such interconnections and interactions has found its expression in the form of a unitary information informative fund of the economic unit (enterprise, association, sub-branch, branch, national economy of the country).

10. The efficient elaboration, implementation and operation of the given fund goes handa row of rather complicated and bulky groups of issues.

11. At present and in the near future its full constitution presents an extremely complex and difficult issue of being translated into life. However, the concept of this system, as well as its systemic approach to inclusion of all components, is necessary to be taken into account.

12. The perspective of the forms of integrated data organization and processing in the informatics milieu indicates that the most powerful one wouldbeing that assure the automatically accumulation, distribution, preservation and provision of the necessary information at any time for the purpose of establishing, formulating and taking contributory decisions to the long – expected desired evolution of the managed object (process).

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MOLDOVA ONE-STOP 4-DATA

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Abstract

Key to the success of any society is the accumulation and universal access to its data. The internet has become the vehicle for such access. The challenge is to acquire a vast array of data geophysical, health, agricultural, business, resources (human, physical, technical), private, gubernamental, climate, services, etc. Many databases exist in Moldova. More and more in electronic format, but still, the largest percentage in hard copy. Added to that dilemma, such vital information is not only scattered throughout the country, but in many cases available only through lengthy searches and guesswork as to where the data actual resides. A geographic information system (GIS) is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations—helping users make smarter decisions. A Public-Private Partnership (PPP) of Moldova's ASEM (Academia de Studii Economice din Moldova) IT4BA Incubator(IT4 Business Applications), Trimetrica Moldova (ESRI USA) and The Institute for Economic Growth & Legal Reform (IGROW - USA) launched a National Moldova GIS Portal. The One-Stop portal brings a vast array of data built upon the ESRI GIS mapping of Moldova and the IGROW vendor registration and eProcurement system.

Key words: Economy, Computer Science, GIS, Public Private Partnerships, Incubator/Accelerator, Artificial Intelligence, Interdisciplinary Sciences.

1 Moldova eGovernment

In last years, Moldova has pursued a trade-focused development strategy. It consistently applies efforts to harmonise its trade regime with the requirements of the multilateral trading system. It also expands the scope and coverage of its bilateral and regional cooperation agreements. Moldova benefits from preferential market access to the EU within the Association Agreement (AA) together with the Deep and Comprehensive Free Trade Area (DCFTA). All the same, the country has not attained the

expected benefits from its trade development strategy. The economy is still based on labour-intensive activities with low value-added. The effect of reforms has not been fully attained partially due to the lack of adequate market support institutions and transport infrastructure.

During the last 15 years Moldova actively embraced a digital transformation agenda. The National Commission for e-Transformation was created as a result of the 'Governance eTransformation Project. The Com-

mission is chaired by the Prime Minister with representatives of the government, private sector, academia and civil society. They provide a vision and leadership for Governance e-Transformation and approve major government initiatives and programmes. Besides, the e-Government Centre (eGC) and the Government Chief Information Office were established as public entities under the State Chancellery and Prime Minister's Office in August 2010.

To facilitate the sectorial e-Transformation, the Government established in each ministry a position of the coordinator for e-transformation (CeT) and the e-transformation division. Sectorial CeT are members of the Council of e-Transformation Coordinators, which ensures alignment and coordination of sectorial e-Transformation actions and initiatives. Subsequently, the line ministries and state agencies are the main responsible governmental institutions for promoting digital agenda in Moldova. Inter-sectoral committees are established to coordinate relevant activities among various institutions. Harmonisation of Digital Markets (HDM) is one of the objectives that need a cross-institutional cooperation and elements of its implementation plan are included in each ministry's activity plans, and in various strategies adopted by the Government. Following the implementation of various provisions from the above normative acts and strategies the following national information systems and electronic services were created:

- Common Governmental Technological platform – MCloud;
- Governmental Service for Electronic Payment – MPay;
- Paperless Government Initiative 'SIGEDIE';
- e-Reporting government platform

for business;

- Government platform for business authorisations;
- e-Procurement;
- e-Invoicing;
- e-justice;
- Interoperability Governmental Platform – MConnect.

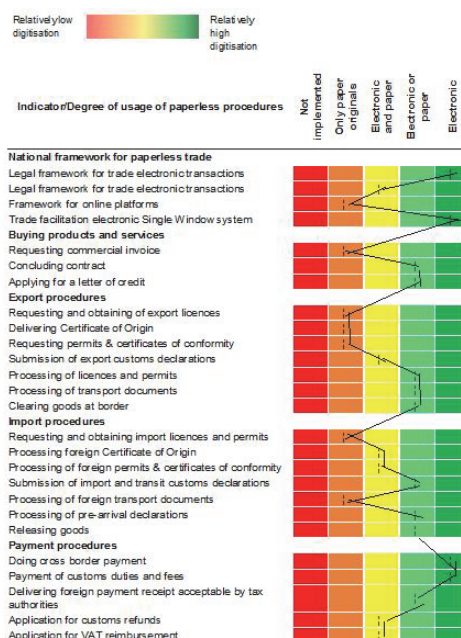


Figure 1. Source: EU HIQSTEP PROJECT Harmonisation of the Digital Markets (HDM) in the Eastern Partnership (2018)

The MConnect government interoperability platform will enable public authorities to exchange data in real time, exempting citizens and businesses from the obligation to provide certificates, reports, etc. Public authorities connect their information systems and databases to the MConnect platform to reduce administrative burdens on businesses and citizens. The MConnect government interoperability and data exchange platform aims to exclude redundancy

in the public-sector procedures. It was implemented according to the provisions of the EU interoperability program. Currently, the MConnect platform is at the end of its pilot stage, with 15 public bodies connected to it.

The below chart presents the overall status of digitisation of trade procedures in Moldova. For each indicator, the black bar indicates the status of usage of paperless procedures in the country in each corresponding trade process.

Moldova is bound by the Association Agreement with the EU and has developed an advanced e-Governance infrastructure with modern information systems and sectorial Single Window solutions in the governmental agencies. Therefore, the following roadmap focuses on effective use of the existing infrastructure and systems to be integrated into the national paperless trade platform. The current state of play in Moldova and the proposed steps on the road to the integrated NPTS are presented in the following chart.

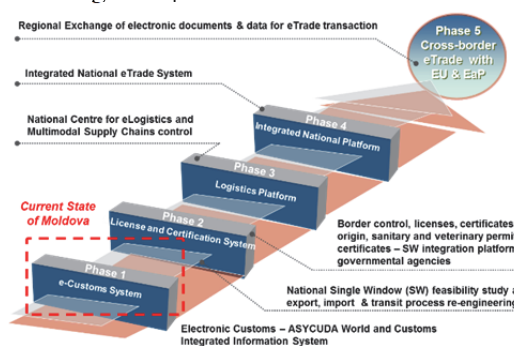


Figure 2. Source: EU HIQSTEP PROJECT Harmonisation of the Digital Markets (HDM) In The Eastern Partnership (2018)

2. Nationwide Digital Platforms and Projects

Following the phase of trade procedures re-engineering and governmental information systems modernisation,

the main nationwide digital platforms are planned:

Modernisation of the governmental Single Window platform to be used as NPTS portal creates the online platform integrating the existing elements of national digital infrastructure and information systems of the governmental agencies into the Single Window portal for foreign trade in Moldova.

National platform for eLogistics creates the integration platform for multimodal supply-chain management and control with cargo/goods flow tracking.

3 About Moldova One-Stop 4-Data

Key to the success of any society is the accumulation and universal access to its data. The internet has become the vehicle for such access. The challenge is to acquire a vast array of data geophysical, health, agricultural, business, resources (human, physical, technical), private, governmental, climate, services, etc.

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A Public-Private Partnership (PPP) of Moldova's ASEM (Academia de Studii Economice din Moldova) IT4BA Incubator(IT4 Business Applications), Trimetrica Moldova (ESRI USA) and The Institute for Economic Growth & Legal Reform (IGROW - USA) launched a National Moldova GIS Portal. The One-Stop portal brings a vast array of data built upon the ESRI GIS mapping of Moldova and the IGROW vendor registration and eProcurement system. A geographic information system (GIS) is a framework

for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations—helping users make smarter decisions.

The Moldova One Stop GIS Portal mapping and analytics software allows visualization and analytics of data in terms of its location on the map. Then, use the portal data to take accurate measurements, spot patterns, and identify relationships among features and can also plan efficient routes, perform profitable site selection, and model predictions to make better decisions.



Figure 3. *www.esri.com*

With the Portal, it is easy to integrate information from many sources and locations. Add local data to an organization's authoritative data. The Portal Includes dynamic and cloud-based data such as demographics connect to live feeds from social media, and add other content from its Living Atlas of the World.

The Operations Dashboard of the portal is a configurable web app that provides location-aware data visualization and analytics for a real-time operational view of people, services, assets, and events. From a dynamic dashboard, view the activities and key performance indicators most vital to meeting the organization's objectives.

The Portal offers situational awareness of real-time streaming data with as, part of its Geospatial Cloud. Whether tracking moving assets, monitoring stationary sensors, or following social media feeds, the Portal taps into, analyses, and displays real-time and the Internet of Things (IoT) data on user maps and boost real-time monitoring and response rate when from defined filters that focus on the data and events that matter most. The Portal automatically updates maps and databases and sends alerts to stakeholders when thresholds are met allowing better decisions the moment something happens. Through desktop, web, and mobile apps, Moldova One Stop 4 Data GIS Portal provides location-based intelligence for planning, site selection, and customer segmentation.combine demographic, lifestyle, and spending data with map-based analytics for accurate reports and dynamic presentations. Thus, any private or non-governmental entity can download, process and analyze them using proper software solutions.

Below are examples of already existing geo-datasets created by private and public institutions. In addition the Moldovan government is stimulating the placement of the electronically readable files the datasets from various public institutions on its open data portal: *www.date.gov.md*

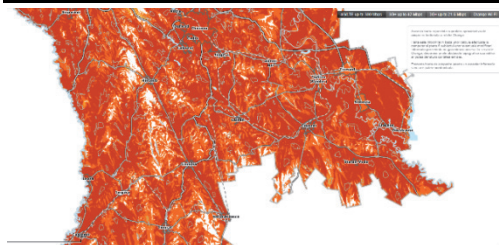


Figure 4. 4G, 3G, etc., coverage of mobile services in Moldova by Orange Telecommunications

Source: <https://www.orange.md/map/>

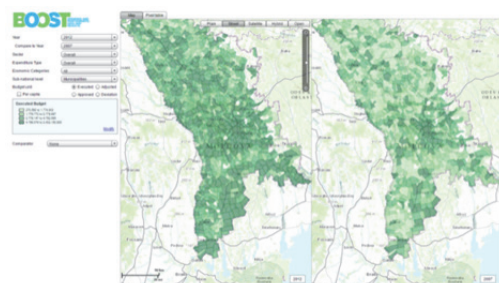


Figure 5. Data on the average Moldovan secondary schools budget expenditures by community. Source: World Bank

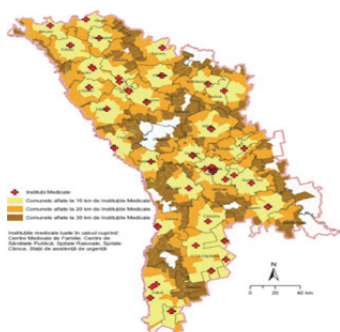


Figure 6. Moldovan Local hospitals' services coverage per community Source: Trimetrica Ltd

This unique Moldovan public private partnership will be carrying out a wide array of activities within the state-of-the-art IT4BA Incubator/Accelerator facilities. In addition to Trimetrica-ESRI and IGROW, business partners such as representatives of IBM, CISCO, Developmental Aid and others that will have satellite offices at the Incubator/Accelerator, to offer technology

assistance and mentorship to budding business process and IT scientists for business such as AI (Artificial Intelligence), Cyber Security, Block Chain, eLearning, and other advanced technologies and business models.

Numerous modules will be created and designed that cover and will cover agriculture, health care, business to business and international trade, international logistics, etc.

In the modern economic environment, taking advantage of the 21st century IT technologies, means a significant reduction of transaction costs, which for small and open economy as Moldova's is one of the utmost priority. Thus offering quick and easy access to the various economic and infrastructure data via the Moldova One-Stop 4 Data GIS Portal will offer new opportunities not only to logistics but to the various producers who can better be served and release new products for the domestic and external markets.

Moldova One-Stop 4-Data will bring together the brightest minds from Moldova's universities, private and public sectors and international experts to build modules that incorporate state of the art technology for One-Stop data that will take Moldova into the 22nd century.

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BAYES-NASH SOLUTIONS IN THE BIMATRIX INFORMATIONAL EXTENDED GAMES

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Abstract: In these articlewe present some approaches for studying and solving the bimatrix informational incomplete noncooperative games. The bimatrix game in completeand (1 ↔ 2)-perfect information over the sets of pure strategies is reduced to the incompleteand imperfct information bimatrixgame generated by the informational extededstrategies which is also reduced to associated Bayesian gamein the non informational extended strategies which in the end is reduced to Bayesian subgamein the non informationalextended strategies. Based on the proven theorem the Nash equilibrium profiles of the bimatrix Bayesian subgame is the Bayes-Nash equilibria of the bimatrix informational extended game

1. Bimtrix informational extended games

We consider the informational non extended bimatrix game

$$\Gamma = \langle I, J, A, B \rangle, (1)$$

where $I = \{1, 2, \dots, n\}$ is the line index set (the set of strategies of the player 1), $J = \{1, 2, \dots, m\}$ is the column index set (the set of strategies of the player 2) and $A = ||a_{ij}||_{i \in I}^{j \in J}$, $B = ||b_{ij}||_{i \in I}^{j \in J}$ are the payoff matrices of player 1 and player 2, respectively. All players know exactly the payoff matrices and the sets of strategies. Players maximize their payoffs. So the game is in **complete information** (the players know exactly the normal form of the game). We assign to players an additional characteristic which we call *an informational type of the payer*. More exactly, we say that the player 1 is of the “ $2 \rightarrow 1$ informational type” and respectively, the player 2 is of the “ $1 \rightarrow 2$ informational type” if the player 1 (respectively player 2) knows the precise value of the strategy which will be chosen by the player 2 (respectively by the player

1). These conditions stipulate that we can analyze the informational extension of the game generated by a double-sided informational flow, denoted by $1 \rightleftharpoons 2$. It means the player 1 knows exactly the value of the strategy chosen by the player 2, as well as, simultaneously, the player 2 knows exactly the value of the strategy chosen by the player 1. So the game (1) is in **perfect information** over the set of pure strategies.

The conditions described above stipulate that we can use the set of informational extended strategies of the player 1 (respectively 2) which is the set of the functions

$$\Theta_1 = \{\theta_1^\alpha: J \rightarrow I\}_{\alpha=1}^{\chi_1}$$

and, respectively

$$\Theta_2 = \{\theta_2^\beta: I \rightarrow J\}_{\beta=1}^{\chi_2}.$$

It is easy to see that $\chi_1 = n^m$ and $\chi_2 = m^n$.

Thus, the informational extended strategies of the player 1 are the functions θ_1^α such that, for all $j \in J$, there is $i_j^\alpha \in I$ such that $\theta_1^\alpha(j) = i_j^\alpha$ and it means the

following: the player 1 will choose the line $i_j^\alpha \in I$ if the player 2 will choose the column $j \in J$. Respectively, the informational extended strategies of the player 2 are functions θ_2^β such that, for all $i \in I$, there is $j_i^\beta \in J$ such that $\theta_2^\beta(i) = j_i^\beta$ and it means the following: the player 2 will choose the column $j_i^\beta \in J$ if the player 1 will choose the line $i \in I$.

It should be mentioned that the players do not know the informational type of each other. In other words, the players do not know the informational extended strategies of each others and from this point of view we can consider that the game is in **imperfect information** structure over the sets of the informational extended strategies.

Denote by $Game(1 \rightleftharpoons 2)$ the bimatrix game in the informational extended strategies, described above. Remark that the notation $Game(1 \rightleftharpoons 2)$ does not represent the normal form. This game is in imperfect information on the set of informational extended strategies, but because we do not know yet the normal form, we can not say if this game is in complete or incomplete information. The quantification of information in the games of type $Game(1 \leftrightarrow 2)$ is done by means of functions which represent informational extended strategies.

For the game in informational extended strategies it is very difficult to construct utility matrices. That's because we can not answer the following question: for all informational extended strategy profile $(\theta_1^\alpha, \theta_2^\beta)$ which element of the matrix A and B should be considered as a payoff value of the player 1 and 2?

Thus, in order to solve games in informational extended strategies, we propose to use the methodology described below. The quantification of information

in the games of type $Game(1 \leftrightarrow 2)$ is done by means of functions which represent informational extended strategies.

We can describe the informational extended strategies $\Theta_1 = \{\theta_1^\alpha: J \rightarrow I\}_{\alpha=1}^{\chi_1}$ and $\Theta_2 = \{\theta_2^\beta: I \rightarrow J\}_{\beta=1}^{\chi_2}$ in bimatrix game as follows. For all fixed α and β we construct the vectors $i^\alpha = (i_1^\alpha, i_2^\alpha, \dots, i_j^\alpha, \dots, i_m^\alpha)$ and $j^\beta = (j_1^\beta, j_2^\beta, \dots, j_i^\beta, \dots, j_n^\beta)$. The i^α vector's elements mean the following: if the player 2 will choose the column $j \in J$ then the player 1 will choose the line $i_j^\alpha \in I$. Respectively, the j^β vector's elements mean the following: if the player 1 will choose the line $i \in I$ then the player 2 will choose the column $j_i^\beta \in J$. So we can introduce the following definition.

Definition 1. The vector i^α , respectively j^β , is called the α -informational extended strategy of the player 1, respectively β -informational extended strategy of the player 2. The sets

$$I = \left\{ i^\alpha = (i_1^\alpha, i_2^\alpha, \dots, i_j^\alpha, \dots, i_m^\alpha), \right. \\ \left. \alpha = 1, \dots, n^m \right\}$$

and

$$J = \left\{ j^\beta = (j_1^\beta, j_2^\beta, \dots, j_i^\beta, \dots, j_n^\beta), \right. \\ \left. \beta = 1, \dots, m^n \right\}$$

is called the sets of informational extended strategies of the player 1, respectively of the player 2. The (i^α, j^β) is called the informational extended strategy profiles. The set

$$I^\alpha = \{i_j^\alpha \in I: i_j^\alpha \neq i_k^\alpha, \forall j, k \in J, j \neq k\} \subseteq I,$$

respectively

$$J^\beta = \{j_i^\beta \in J: j_i^\beta \neq j_r^\beta, \forall i, r \in I, i \neq r\} \\ \subseteq J,$$

is the set of informational non extended strategies of the player 1,

respectively 2, generated by the informational extended strategies i^α , respectively j^β .

2. Bayes-Nash solutions in the bimatrix informational extended games

For all fixed $\alpha = 1, \dots, n^m$ and $\beta = 1, \dots, m^n$ the strategy profile (i^α, j^β) in informational extended strategies generates a couple of matrices, which represent the utility of the players in informational non extended strategies generated by the informational extended strategies i^α , respectively j^β

$$\left\{ \begin{array}{l} A(\alpha, \beta) = \|a_{ij}^{\alpha\beta}\|_{i \in I, j \in J}^{\beta=\overline{1, m^n}} \\ i_j^\alpha \in I^\alpha, j_i^\beta \in J^\beta \end{array} \right\}_{\alpha=\overline{1, n^m}}^{\beta=\overline{1, m^n}}.$$

$$\left\{ \begin{array}{l} B(\alpha, \beta) = \|B_{ij}^{\alpha\beta}\|_{i \in I, j \in J}^{\beta=\overline{1, m^n}} \\ i_j^\alpha \in I^\alpha, j_i^\beta \in J^\beta \end{array} \right\}_{\alpha=\overline{1, n^m}}^{\beta=\overline{1, m^n}}.$$

So as the players do not know what informational extended strategies are chosen by their partners, player 1, respectively player 2, will have a possible utility matrices from the following set of matrices $\{A(\alpha, \beta)\}_{\alpha=\overline{1, n^m}}^{\beta=\overline{1, m^n}}$, respectively $\{B(\alpha, \beta)\}_{\alpha=\overline{1, n^m}}^{\beta=\overline{1, m^n}}$. This type of games is one in **incomplete information** because neither player 1 nor player 2 knows exactly which matrix from the mentioned set of matrices will be his utility.

Finally, the game $Game(1 \leftrightarrow 2)$ of imperfect information on the set of informational extended strategies, generates an incomplete information game on the set of informational non extended strategies. So we study the following two person game: the strategies of the player 1 are $I = \{1, 2, \dots, n\}$ and of the player 2 are $J = \{1, 2, \dots, m\}$; the payoff matrix of the player 1 is one of the matrices from the

set $\{A(\alpha, \beta)\}_{\alpha=\overline{1, \chi_1}}^{\beta=\overline{1, \chi_2}}$ and the payoff matrix of the player 2 is one of the matrices from the set $\{B(\alpha, \beta)\}_{\alpha=\overline{1, \kappa_1}}^{\beta=\overline{1, \kappa_2}}$.

When, using (i^α, j^β) informational extended strategy profiles, the matrices $A(\alpha, \beta)$ and $B(\alpha, \beta)$ were already built, we use the following notations:

$$\|a_{ij}^{\alpha\beta}\|_{i \in I, j \in J}^{\beta=\overline{1, m^n}} \equiv \|a_{ij}^{\alpha\beta}\|_{i \in I}^{j \in J} \quad \text{and}$$

$$\|b_{ij}^{\alpha\beta}\|_{i \in I, j \in J}^{\beta=\overline{1, m^n}} \equiv \|b_{ij}^{\alpha\beta}\|_{i \in I}^{j \in J} \quad \text{for all } \alpha = \overline{1, n^m}$$

and $\beta = \overline{1, m^n}$. So we have a bimatrix game where the utility is determined by one of these matrices:

$$A(\alpha, \beta) = \begin{pmatrix} a_{11}^{\alpha\beta} & \dots & a_{1j}^{\alpha\beta} & \dots & a_{1m}^{\alpha\beta} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{i1}^{\alpha\beta} & \dots & a_{ij}^{\alpha\beta} & \dots & a_{im}^{\alpha\beta} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{nm}^{\alpha\beta} & \dots & a_{nj}^{\alpha\beta} & \dots & a_{nm}^{\alpha\beta} \end{pmatrix}$$

$$B(\alpha, \beta) = \begin{pmatrix} b_{11}^{\alpha\beta} & \dots & b_{1j}^{\alpha\beta} & \dots & b_{1m}^{\alpha\beta} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ b_{i1}^{\alpha\beta} & \dots & b_{ij}^{\alpha\beta} & \dots & b_{im}^{\alpha\beta} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ b_{nm}^{\alpha\beta} & \dots & b_{nj}^{\alpha\beta} & \dots & b_{nm}^{\alpha\beta} \end{pmatrix}$$

for $\alpha = \overline{1, \chi_1}$ and $\beta = \overline{1, \chi_2}$ and the set of strategies are I and J . Every player knows that the utilities are determined by the set of matrices $\{AB(\alpha, \beta) =$

$$\|(a_{ij}^{\alpha\beta}, b_{ij}^{\alpha\beta})\|_{i \in I}^{j \in J}\}_{\alpha=\overline{1, \chi_1}}^{\beta=\overline{1, \chi_2}},$$

but they do not know which matrix from this set will be used.

So, the bimatrix game $Game(1 \leftrightarrow 2)$ of imperfect information on the set of informational extended strategies generates the following normal form incomplete information game on the sets of non-informational extended strategies

I, J

$$\tilde{\Gamma} = \left\{ \{1, 2\}, I, J, \left\{ AB(\alpha, \beta) = \left\| \left(a_{ij}^{\alpha\beta}, b_{ij}^{\alpha\beta} \right) \right\|_{i \in I}^{j \in J} \right\}_{\alpha=1, \chi_1}^{\beta=1, \chi_2} \right\}. \quad (2)$$

We call an agent Bayesian rational (or say that he has subjective expected utility preferences) if

- in settings with uncertainty he forms beliefs describing the probabilities of all relevant events;
- when making decisions, he acts to maximize his expected utility given by his beliefs;
- after receiving new information, he updates his beliefs by taking conditional probabilities whenever possible.

In the game theory, it is standard to begin analyses with the assumption that players are Bayesian rational. The way to modelling this situation of **asymmetric** or **incomplete** informations by recurring to an idea generated by Harsanyi(1967). The idea is that the Nature moves determining player's types, a concept that embodies all the relevant private information about them (such as payoffs, preferences, beliefs about other players, etc.). Harsanyi described a game as having incomplete information when the players are uncertain about each other's types.

According to trilogy [1]-[3] we can construct the bimatrix Bayesian game for the bimatrix incomplete information game $\tilde{\Gamma}$ from (2) that consists of the following.

1. A set of players $\{1, 2\}$.
2. A set of possible actions for each player: for player 1 is $I = \{1, 2, \dots, n\}$, the line index, and for player 2 is $J = \{1, 2, \dots, m\}$, the column index.
3. A set of possible types for each player that coincides with the set of

informational extended strategies of that player, namely $\theta_1 = \{\theta_1^\alpha: I \rightarrow \Gamma\}_{\alpha=1}^{\chi_1}$ for player 1 and respectively $\theta_2 = \{\theta_2^\beta: I \rightarrow J\}_{\beta=1}^{\chi_2}$ for the player 2. So the types of the player 1 are $\Delta_1 = \{\alpha = 1, \dots, \chi_1\}$ and of the player 2 are $\Delta_2 = \{\beta = 1, \dots, \chi_2\}$. Only player 1 (player 2) knows his type α (type β) when play begins.

4. A probability function that specifies, for each possible type of each player, a probability distribution over the other player's possible types, describing what each type of each player would believe about the other players' types $p: \Delta_1 \rightarrow \Omega(\Delta_2)$, $q: \Delta_2 \rightarrow \Omega(\Delta_1)$, where $\Omega(\Delta_2)$ (respectively $\Omega(\Delta_1)$) denotes the set of all probability distributions on a set Δ_1 (respectively Δ_2). The function p (respectively q) summarizes what player 1 (respectively player 2), given his type, believes about the types of the other players. So, $p(\beta|\alpha) = \frac{p(\beta \cap \alpha)}{p(\alpha)}$ (Bayes'Rule) (respectively $q(\alpha|\beta) = \frac{q(\alpha \cap \beta)}{q(\beta)}$) is the conditional probability assigned to the type $\beta \in \Delta_2$ (respectively $\alpha \in \Delta_1$) when the type of the player 1 is α (respectively of the player 2 is β).

5. Combining actions and types for each player it is possible to construct the strategies. Strategies will be given by a mapping from the type space to the action space. In other words, a strategy may assign different actions to different types. The sets of pure strategies of the players (line and columns) will depend on the type of the players (or, in other words, on what informational extended strategy will chose the players). So, in this way, we will construct the strategies of the players. If player 1 is of type $\alpha \in \Delta_1$ and player 1 knows that the type of the player 2 may be an element from the set $\Delta_2 = \{\beta =$

$1, \dots, \chi_2\}$, and because the utility matrix elements also depend on the type β of player 2, then the set of matrices that represent his utility is

$$\{A(\alpha, \beta) = \|a_{ij}^{\alpha\beta}\|_{i \in I}^{j \in J}\}_{\beta=1, \chi_2}.$$

We will denote the pure strategy of player 1 by $\tilde{i} = i_1 i_2 \dots i_{\beta} \dots i_{\chi_2}$ and it has the following meaning: the player will chose the line $i_1 \in I$ if $\beta = 1$, namely line i_1 from the utility matrix $A(\alpha, 1)$ and line $i_2 \in I$ if $\beta = 2$, namely line i_2 from the utility matrix $A(\alpha, 2)$ and so on, line $i_{\chi_2} \in I$ if $\beta = \chi_2$, namely line i_{χ_2} from the utility matrix $A(\alpha, \chi_2)$. Then the set of all pure strategy of player 1 will be determined by the set of all corteges of type $i_1 i_2 \dots i_{\beta} \dots i_{\chi_2}$ for all $i_{\beta} \in I$ and will be denoted by $\tilde{I}(\alpha)$. In his turn, if player 2 is of type $\beta \in \Delta_2$ and he knows that the type of player 1 may be an element from the set $\Delta_1 = \{\alpha = 1, \dots, \chi_1\}$, and because the utility matrix elements depend also on the type α of player 1, then the set of matrices that represent his utility is $\{B(\alpha, \beta) = \|b_{ij}^{\alpha\beta}\|_{i \in I}^{j \in J}\}_{\alpha=1, \chi_1}$. By the same

way we will denote the pure strategy of player 2 by $\tilde{j} = j_1 j_2 \dots j_{\alpha} \dots j_{\chi_2}$ and it has the following meaning: the player will chose column $j_1 \in J$ if $\alpha = 1$, namely column j_1 from utility matrix $B(1, \beta)$ and column $j_2 \in J$ if $\alpha = 2$, namely column j_2 from utility matrix $B(2, \beta)$, and so on he will chose column $j_{\chi_1} \in J$ if $\alpha = \chi_1$, namely column j_{χ_1} from utility matrix $B(\chi_1, \beta)$. Then the set of all pure strategy of player 2 will be determined by the set of all corteges of type $j_1 j_2 \dots j_{\alpha} \dots j_{\chi_2}$ for all $j_{\alpha} \in J$ and will be denoted by $\tilde{J}(\beta)$.

6. A payoff function specifies each player's expected payoff matrices for every possible combination of all player's actions and types. Hence, if the player 1 is

of type α , that is, he will choose the strategy $\tilde{i} \in \tilde{I}(\alpha)$, and the player 2 plays some of the strategy $\tilde{j} \in \tilde{J}(\beta)$ for all $\beta \in \Delta_2$, then expected payoffs of player 1 is the following matrix

$$A(\alpha) = \|a_{ij}\|_{\tilde{i} \in \tilde{I}(\alpha)}^{\tilde{j} \in \tilde{J}(\beta)}$$

where

$$\begin{aligned} a_{ij} &\equiv a_{i_1 i_2 \dots i_{\beta} \dots i_{\chi_2} j_1 j_2 \dots j_{\alpha} \dots j_{\chi_1}} = \\ &= \sum_{\beta \in \Delta_2} p\left(\frac{\beta}{\alpha}\right) a_{i_{\beta} j_{\alpha}} \equiv \sum_{\beta \in \Delta_2} p\left(\frac{\beta}{\alpha}\right) a_{ij}^{\alpha\beta}. \end{aligned}$$

Similarly, if the player 2 is of type β , that is, he will choose the strategy $\tilde{j} \in \tilde{J}(\beta)$ and the player 1 plays some of the strategy $\tilde{i} \in \tilde{I}(\alpha)$ for all $\alpha \in \Delta_1$, then expected payoffs of player 2 of type β is

$$B(\beta) = \|b_{ij}\|_{\tilde{i} \in \tilde{I}(\alpha)}^{\tilde{j} \in \tilde{J}(\beta)}$$

where

$$\begin{aligned} b_{ij} &\equiv b_{i_1 i_2 \dots i_{\beta} \dots i_{\chi_2} j_1 j_2 \dots j_{\alpha} \dots j_{\chi_1}} = \\ &= \sum_{\alpha \in \Delta_1} q(\alpha|\beta) b_{i_{\beta} j_{\alpha}} \equiv \sum_{\alpha \in \Delta_1} q(\alpha|\beta) b_{ij}^{\alpha\beta}. \end{aligned}$$

So we can introduce the following definition.

Definition 1. For the incomplete information game $\tilde{\Gamma}$ from (2) the normal form game

$$\Gamma_{Bayes} = \langle \{1, 2\}, \tilde{I}, \tilde{J}, \mathcal{A}, \mathcal{B} \rangle, (3)$$

where

$\tilde{I} = \cup_{\alpha \in \Delta_1} \tilde{I}(\alpha)$, $\tilde{J} = \cup_{\beta \in \Delta_2} \tilde{J}(\beta)$ and the utility matrices are $\mathcal{A} = \|A(\alpha)\|_{\alpha \in \Delta_1}$ and $\mathcal{B} = \|B(\beta)\|_{\beta \in \Delta_2}$, is called the associated Bayesian game in the non informational extended strategies.

It is important to discuss a little bit each part of the definition above. Players types contain all relevant information about certain player's private characteristics of the informational extended strategy to choose. The type α (respectively β) is only observed by player 1 (player 2), who uses this information both to make decisions and to update his beliefs about the likelihood of opponents types (using the conditional

probability $p(\beta|\alpha)$ (respectively $q(\alpha|\beta)$). We still assume common knowledge of the 1)-6) items, but we allow uncertainty about players' preferences. Player's (α, β) type determines (α, β) payoffs matrices $(\mathbf{A}(\alpha), \mathbf{B}(\beta))$. The matrices \mathcal{A} and \mathcal{B} are the "big matrices", which consist of the submatrices type $\mathbf{A}(\alpha)$ and $\mathbf{B}(\beta)$ respectively.

The games defined above are sometimes called *Bayesian normal form games*, since the drawing of types is followed by a simultaneous move game. One can also define *Bayesian extensive form games*, where the drawing of types is followed by an extensive form game.

Definition 2. (Bayesian Nash Equilibrium). *The strategy profiles $(\mathbf{i}^*, \mathbf{j}^*)$, $\mathbf{i}^* \in \tilde{\mathbf{I}}, \mathbf{j}^* \in \tilde{\mathbf{J}}$ is Bayes-Nash equilibrium if we have*

$$\begin{cases} \mathbf{a}_{i^*j^*} \geq \mathbf{a}_{ij^*} & \text{for all } i \in \tilde{\mathbf{I}}, \\ \mathbf{b}_{i^*j^*} \geq \mathbf{b}_{i^*j} & \text{for all } j \in \tilde{\mathbf{J}}. \end{cases}$$

Denote by $BE[\Gamma_{Bayes}]$ the set of all Bayes-Nash strategies profile of the game Γ_{Bayes} from (3).

Remark 1. *The Bayesian Game Γ_{Bayes} (3) for all $\alpha \in \Delta_1$ and $\beta \in \Delta_2$ is a bimatrix game where player 1 is of type α and player 2 is of type β . The Bayes-Nash equilibria profile following the Definition 2 will be found in the next way: we find the Nash equilibria profile for a bimatrix game where the sets of strategies are the "extended sets" $\tilde{\mathbf{I}} = \cup_{\alpha \in \Delta_1} \tilde{\mathbf{I}}(\alpha)$, $\tilde{\mathbf{J}} = \cup_{\beta \in \Delta_2} \tilde{\mathbf{J}}(\beta)$ and the utility matrices are the "extended matrices" $\mathcal{A} = \|\mathbf{A}(\alpha)\|_{\alpha \in \Delta_1}$ and $\mathcal{B} = \|\mathbf{B}(\beta)\|_{\beta \in \Delta_2}$.*

We will introduce the next definition.

Definition 3. *For all fixed $\alpha \in \Delta_1$ and $\beta \in \Delta_2$ the game*

$$\begin{aligned} & \text{sub}\Gamma_{Bayes} = \\ & = \langle \{1, 2\}, \tilde{\mathbf{I}}(\alpha), \tilde{\mathbf{J}}(\beta), \mathbf{A}(\alpha), \mathbf{B}(\beta) \rangle (4) \end{aligned}$$

will be called a subgame of the

Bayesian game Γ_{Bayes} from (3).

According to [4], using the notion of "type-players", the $\text{sub}\Gamma_{Bayes}$ is the bimatrix game of the type-player α and of the type-player β .

We will exemplify the ones described above using the following example.

Example 1. *Consider the following bimatrix game $H_1 = \begin{pmatrix} 3 & 5 & 4 \\ 6 & 7 & 2 \end{pmatrix}, H_2 = \begin{pmatrix} 0 & 5 & 1 \\ 4 & 3 & 2 \end{pmatrix}$ in complete and $(1 \leftrightarrow 2)$ – perfect information for which we construct the normal form of the bayesian subgames associated to the informational extended game.*

Solution. Suppose that the informational extended strategies of the player 1 are $\mathbf{i}^1 = 1_1 1_2 2_3$, $\mathbf{i}^2 = 1_1 2_2 1_3$ and respectively, for the player 2 are $\mathbf{j}^1 = 1_1 2_2$ and $\mathbf{j}^2 = 2_1 1_2$.

We construct the payoff matrices generated by the informational extended strategies.

For $\mathbf{i}^1 = 1_1 1_2 2_3, \mathbf{j}^1 = 1_1 2_2: \mathbf{a}_{11} \equiv a_{i^1 j^1} = a_{11} = 3, \mathbf{a}_{12} \equiv a_{i^1 j^2} = a_{11} = 3, \mathbf{a}_{13} \equiv a_{i^1 j^1} = a_{21} = 6, \mathbf{a}_{21} \equiv a_{i^2 j^1} = a_{12} = 5; \mathbf{a}_{22} \equiv a_{i^2 j^2} = a_{12} = 5; \mathbf{a}_{23} \equiv a_{i^2 j^2} = a_{22} = 7, \mathbf{b}_{11} \equiv b_{i^1 j^1} = b_{11} = 0, \mathbf{b}_{12} \equiv b_{i^1 j^1} = b_{11} = 0, \mathbf{b}_{13} \equiv a_{i^1 j^1} = b_{21} = 4, \mathbf{b}_{21} \equiv b_{i^1 j^2} = b_{12} = 5; \mathbf{b}_{22} \equiv b_{i^2 j^2} = b_{12} = 5; \mathbf{b}_{23} \equiv b_{i^2 j^2} = b_{22} = 3.$

And similar we can construct the payoff matrices generated by the informational extended strategies $\mathbf{i}^2 = 1_1 2_2 1_3, \mathbf{j}^1 = 1_1 2_2, \mathbf{i}^1 = 1_1 1_2 2_3, \mathbf{j}^2 = 2_1 1_2, \mathbf{i}^2 = 1_1 2_2 1_3, \mathbf{j}^2 = 2_1 1_2$:

So, the informational extended strategies $\{\mathbf{i}^1, \mathbf{i}^2, \mathbf{j}^1, \mathbf{j}^2\}$ generate an incomplete information bimatrix game in which the payoff matrix may be one of the following matrices (one in which the utility of the players is determined by one of the matrix below):

$$\begin{aligned}
AB(\alpha = 1, \beta = 1) &\equiv AB(\mathbf{i}^1, \mathbf{j}^1) = \\
&= \begin{pmatrix} (3,0) & (3,0) & (6,4) \\ (5,5) & (5,5) & (7,3) \end{pmatrix}, \\
AB(\alpha = 2, \beta = 1) &\equiv AB(\mathbf{i}^2, \mathbf{j}^1) = \\
&= \begin{pmatrix} (3,0) & (6,4) & (3,0) \\ (5,5) & (7,3) & (5,5) \end{pmatrix}, \\
AB(\alpha = 1, \beta = 2) &\equiv AB(\mathbf{i}^1, \mathbf{j}^2) = \\
&= \begin{pmatrix} (5,5) & (5,5) & (7,3) \\ (3,0) & (3,0) & (6,4) \end{pmatrix}, \\
AB(\alpha = 2, \beta = 2) &\equiv AB(\mathbf{i}^2, \mathbf{j}^2) = \\
&= \begin{pmatrix} (5,5) & (7,3) & (5,5) \\ (3,0) & (6,4) & (3,0) \end{pmatrix}.
\end{aligned}$$

We will construct the Bayesian game for the game in incomplete and imperfect information over the set of informational non extended strategies I, J . The set of types of the player 1 is $\alpha \in \Delta_1 = \{1, 2\}$ and of the player 2 is $\beta \in \Delta_2 = \{1, 2\}$. Let's consider that the belief probabilities of the types are: for the player 1:

$$p(\beta|\alpha) = \begin{cases} p \text{ for } \beta = 1 \\ 1 - p \text{ for } \beta = 2 \end{cases}$$

and for the player 2:

$$q(\alpha|\beta) = \begin{cases} q \text{ for } \alpha = 1 \\ 1 - q \text{ for } \alpha = 2 \end{cases}$$

$0 \leq p \leq 1, 0 \leq q \leq 1$. Construct the strategies $\mathbf{i} = i_1 i_2 \dots i_{\beta} \dots i_{\chi_2}$ and $\mathbf{j} = j_1 j_2 \dots j_{\alpha} \dots j_{\chi_1}$ of the type players. Here $\chi_1 = 2, \chi_2 = 2$. So, $\mathbf{i}(\alpha = 1) = \{1_1 1_2, 1_1 2_2, 2_1 1_2, 2_1 2_2\}$. These strategies means the following:

• $\mathbf{i} = 1_1 1_2$ – player 1 will choose line 1 from bimatrix game

$$\begin{aligned}
AB(\alpha = 1, \beta = 1) &= \\
&= \begin{pmatrix} (3,0) & (3,0) & (6,4) \\ (5,5) & (5,5) & (7,3) \end{pmatrix}
\end{aligned}$$

and line 1 from bimatrix game

$$\begin{aligned}
AB(\alpha = 1, \beta = 2) &= \\
&= \begin{pmatrix} (5,5) & (5,5) & (7,3) \\ (3,0) & (3,0) & (6,4) \end{pmatrix}.
\end{aligned}$$

And so on:

• $\mathbf{i} = 2_1 2_2$ – player 1 will choose line 2 if the following bimatrix game is played

$$AB(\alpha = 1, \beta = 1) =$$

$$= \begin{pmatrix} (3,0) & (3,0) & (6,4) \\ (5,5) & (5,5) & (7,3) \end{pmatrix}$$

and line 2 if the following bimatrix game is played

$$\begin{aligned}
AB(\alpha = 1, \beta = 2) &= \\
&= \begin{pmatrix} (5,5) & (5,5) & (7,3) \\ (3,0) & (3,0) & (6,4) \end{pmatrix}.
\end{aligned}$$

Similar, $\mathbf{j}(\beta = 1) = \{1_1 1_2, 1_1 2_2, 2_1 1_2, 2_1 2_2, 2_1 3_2, 3_1 1_2, 3_1 2_2, 3_1 3_2\}$

These strategies means the following:

• $\mathbf{j} = 1_1 1_2$ – player 2 will choose column 1 from bimatrix game

$$\begin{aligned}
AB(\alpha = 1, \beta = 1) &= \\
&= \begin{pmatrix} (3,0) & (3,0) & (6,4) \\ (5,5) & (5,5) & (7,3) \end{pmatrix}
\end{aligned}$$

and column 1 from bimatrix game

$$\begin{aligned}
AB(\alpha = 2, \beta = 1) &= \\
&= \begin{pmatrix} (3,0) & (6,4) & (3,0) \\ (5,5) & (7,3) & (5,5) \end{pmatrix}.
\end{aligned}$$

And so on:

• $\mathbf{j} = 1_1 3_2$ – player 2 will choose column 1 if the following bimatrix game is played

$$\begin{aligned}
AB(\alpha = 1, \beta = 1) &= \\
&= \begin{pmatrix} (3,0) & (3,0) & (6,4) \\ (5,5) & (5,5) & (7,3) \end{pmatrix}
\end{aligned}$$

and column 3 if the following bimatrix game is played

$$\begin{aligned}
AB(\alpha = 2, \beta = 1) &= \\
&= \begin{pmatrix} (5,5) & (5,5) & (7,3) \\ (3,0) & (3,0) & (6,4) \end{pmatrix}.
\end{aligned}$$

For all strategies \mathbf{i} of α -type player 1 and \mathbf{j} of β -type player 2 we will construct the payoffs matrices

$$a_{ij} = \sum_{\beta=1}^2 p\left(\frac{\beta}{\alpha}\right) a_{i_{\beta} j_{\alpha}} \equiv \sum_{\beta=1}^2 p(\beta/\alpha) a_{ij}^{\alpha\beta}$$

and

$$b_{ij} = \sum_{\alpha=1}^2 q(\alpha|\beta) b_{i_{\beta} j_{\alpha}} \equiv \sum_{\alpha=1}^2 q(\alpha|\beta) b_{ij}^{\alpha\beta}$$

of the associated Bayesian game.

For $\mathbf{i} = 1_1 1_2, \mathbf{j} = 1_q 1_2$ the $a_{ij} = p a_{i_1 j_1}^{11} + (1 - p) a_{i_2 j_1}^{12} = 3p - (1 - 5p) = 8p - 1$. We will explain this in more

detail. Let the player 1 be of the type $\alpha = 1$ and thinks that player 2 with probability p will be of type $\beta = 1$ and with probability $1 - p$ will be of type $\beta = 2$. In other words ("in the utility function language") with the probability p the utility of the player 1 will be determined by the matrix

$$A(\alpha = 1, \beta = 1) = \|a_{ij}^{11}\|_{i=\overline{1,2}}^{j=\overline{1,3}} = \begin{pmatrix} 3 & 3 & 6 \\ 5 & 5 & 7 \end{pmatrix}$$

and with probability $1 - p$ will be determined by the matrix

$$A(\alpha = 1, \beta = 2) = \|a_{ij}^{12}\|_{i=\overline{1,2}}^{j=\overline{1,3}} = \begin{pmatrix} 5 & 5 & 7 \\ 3 & 3 & 6 \end{pmatrix}.$$

Expected payoffs of players will be equal to the average payoffs. The fire comes up with the question: the average value of which elements in these matrices will be made. This is where the strategies $\tilde{\mathbf{i}}$ and $\tilde{\mathbf{j}}$ have to intervene.

So:

• for $\tilde{\mathbf{i}} = 1_1 1_1, \tilde{\mathbf{j}} = 1_1 1_1$ we will have $a_{\tilde{\mathbf{i}}\tilde{\mathbf{j}}} = pa_{11}^{11} + (1 - p)a_{11}^{12} = 3p - 5(1 - p) = 8p - 5$;

and so on

• for $\tilde{\mathbf{i}} = 2_1 2_2, \tilde{\mathbf{j}} = 3_1 1_2$ we will have $a_{\tilde{\mathbf{i}}\tilde{\mathbf{j}}} = pa_{23}^{11} + (1 - p)a_{23}^{12} = 7p - 6(1 - p) = 13p - 6$;

and so on.

We determine the 2 player's utility matrix. In other words ("in the language of utility functions") with the probability q the utility of the player 2 will be determined by the matrix

$$B(\alpha = 1, \beta = 1) \equiv \|b_{ij}^{11}\|_{i=\overline{1,2}}^{j=\overline{1,3}} = \begin{pmatrix} 0 & 0 & 4 \\ 5 & 5 & 3 \end{pmatrix}$$

with the probability $1 - q$ will be determined by the matrix

$$B(\alpha = 2, \beta = 1) \equiv \|b_{ij}^{21}\|_{i=\overline{1,2}}^{j=\overline{1,3}} =$$

$$= \begin{pmatrix} 0 & 4 & 0 \\ 5 & 3 & 5 \end{pmatrix}.$$

So:

• for $\tilde{\mathbf{i}} = 1_1 1_2, \tilde{\mathbf{j}} = 1_1 1_2$ we will have $b_{\tilde{\mathbf{i}}\tilde{\mathbf{j}}} = qb_{11}^{11} + (1 - q)b_{11}^{21} = 0q - 0(1 - q) = 0$;

and so on

• for $\tilde{\mathbf{i}} = 2_1 1_2, \tilde{\mathbf{j}} = 3_1 3_2$ we will have $b_{\tilde{\mathbf{i}}\tilde{\mathbf{j}}} = qb_{23}^{11} + (1 - q)b_{23}^{21} = 3q - 5(1 - q) = 8q - 5$.

Thus a Bayesian game in which the utility functions $A(\alpha = 1)$ and $B(\beta = 1)$ of the players, depending of their types, will be¹:

$$A(\alpha = 1) = \begin{pmatrix} 8p - 5 & \cdots & 12p - 6 \\ \vdots & \ddots & \vdots \\ 8p - 3 & \cdots & 13p - 6 \\ 0 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 10q - 5 & \cdots & 8q - 5 \end{pmatrix}$$

In these 4x9 matrices the columns mean the following strategies: $1_1 1_2$; $1_1 2_2$; $1_1 3_2$; $2_1 1_2$; $2_1 2_2$; $2_1 3_2$; $3_1 1_2$; $3_1 2_2$; $3_1 3_2$ and the rows mean the following strategies: $1_1 1_2$; $1_1 2_2$; $2_1 1_2$; $2_1 2_2$.

Similarly, matrices $A(\alpha = 2)$ and $B(\beta = 1)$ can also be obtained.

Using given above constructions and the Harsanyi theorem [3] we get the following theorem.

Theorem 1. *The strategy profile $(\tilde{\mathbf{i}}^*, \tilde{\mathbf{j}}^*)$ is a Bayes-Nash equilibrium in the game Γ_{Bayes} from (3) if and only if, for all $\alpha \in \Delta_1, \beta \in \Delta_2$, the strategy profile $(\tilde{\mathbf{i}}^*, \tilde{\mathbf{j}}^*)$ is a Nash equilibrium for the subgame $\text{sub}\Gamma_{\text{Bayes}}$ from (4).*

Using the terms of the informational extended strategies, these theorem means the following.

Remark 2. *If the player 1 chooses the*

¹ Due to the lack of paper space, not all the elements of the metrics were completed which were determined above

information extended strategy $\mathbf{i}^\alpha \in \mathbf{I}$, (respectively, the player 2 choose the information extended strategy $\mathbf{j}^\beta \in \mathbf{J}$), and assumes that the player 2, for all $\beta \in \Delta_2$, will choose the information extended strategies \mathbf{j}^β with the probability $p(\mathbf{j}^\beta | \mathbf{i}^\alpha)$ (respectively, the player 2 assumes that for all $\alpha \in \Delta_1$, the player 1 will choose the information extended strategies \mathbf{i}^α with the probability $q(\mathbf{i}^\alpha | \mathbf{j}^\beta)$), then the Nash equilibrium profiles of the bimatrix Bayesian game with matrices $\mathbf{A}(\alpha), \mathbf{B}(\beta)$, for all $\alpha \in \Delta_1, \beta \in \Delta_2$, is the Bayes-Nash equilibria of the bimatrix informational extended game $\tilde{\Gamma}$ from (2).

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QUALITATIVE ECONOMICGROWTH STRATEGY OF PRODUCT DIFFERENTIATION IN SMALL BUSINESS COMPANIES

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Abstract This article propose a model of qualitative growth strategy of product differentiation in small business from food manufacturing area. It is of great importance the activity of identifying, selecting and specifying the main attributes and variables that should be predicted and analyzed in the process of incorporating of these elements into the product before being sold to the market, reducing the risk of failure, as a consequence mainly of the wrong perception that the consumer could have about the product. We will consider in this strategy especially the qualitative elements that give explanation to the approached phenomenon.

Keywords: growth, small business, strategy, product differentiation JEL
Classification: M21

Introduction

The economic growth is a complex process with positive changes embodied in the evolution of the economy, in connection with the factors that determines this change, resulting in the increase in the amount of goods produced by an economy over a certain period of time. The economic growth could be extensive and intensive. Extensive growth is achieved by using a larger volume of resources, therefore using quantitative strategies. Intensive growth is achieved by increasing overall economic efficiency of the activities involved, therefore through qualitative strategies. In this paper we will approach the qualitative strategies.

Product differentiation: a qualitative economic growth strategy

Product differentiation, as one of the most important competitive strategies of the market, has led to consider various

approaches and methods by entrepreneurs in search of unique features that encourage consumer preferences and primacy to the product. The benefits inherent are very large, as this will results in market power and some control over the prices charged to consumers.

The majority of small businesses operate under conditions of a monopolistic competition. Usually, each business offers something different, but all are competing for the same clients.

In a monopolistic competition products are differentiated. We can find four categories of differentiation:

1. *Differentiation through physical product:* size, design, colour, shape, features.

2. *Differentiation through marketing:* distinctive promotional techniques, etc.

3. *Differentiation through human capital differentiation:* skill of the employees, the level of training received,

distinctive uniforms, etc.

4. *Differentiation through distribution*: different ways of distribution. Manufacturing companies in Romania have faced continuously and over time a serious problem with the identification and maintenance of their sources of competitive advantage through appropriate strategies. As a result, the objective of our research is an alternative model in the field of theory and consequently in practice in the process of product differentiation in the manufacturing small businesses to characterize the most significant attributes or elements considered in the field of theoretical contribution.

Literature Review

One of the first articles on the subject of product differentiation is due to American economist Edward Chamberlin [1] who coined the term "product differentiation" to describe how a supplier may be able to charge a greater amount for a product than perfect competition would allow.

Joan Robinson [8], in an independent and parallel manner, along with Chamberlain, contributes to the construction of a model based on monopolistic competition in product differentiation.

With regard to the ideas of Alfred Marshall [6] put these in the plane of thought of modern neoclassical analysis what later would lead to the consideration of the practices of product differentiation as a distinctive element in the theories of imperfect competition, specifically in the Chamberlian monopolistic competition model. All this discussion created favorable conditions for development the ideas and contributions of Chamberlin. Joseph Schumpeter [9] brings into play the term innovation, which he meant the

possibility of renewal of the system. Schumpeter mark as a particular case of development in the capitalist system the introduction of a new product or its modification through quality.

An interesting contribution in the form of product differentiation is in the work of Steiner [11], the central point is the optimal level of advertising as a differentiator in the business, that is, in what sense and to what degree advertising expenditures produce a significant effect on sales volume. So, an interesting finding of this study can be derived through the Steiner condition, which summarizes the following: the more sensitive the demand volume of advertising and the less it is to changes in price, the greater the ratio of advertising expenses and sales volume.

T. Levitt [4] refers to the problem of product differentiation as "augmentation product," the author considers that the consumers do not spend their money on the mere purchase of goods and services but in the background of all this rather considers the acquisition of satisfactions that provides what you buy, called value drivers.

Israel Kirzner [3] notes that the role of advertising is essential in explaining the models of imperfect competition in particular the case of oligopoly. The role assigned to the seller is making the consumer first know the existence and characteristics of the product and this can make an informed buying decision.

For Trout and Rivkin [13], differentiation can be achieved through different ways but especially proposes the following: appropriate attribute, take the lead, keep the tradition, being a specialist, preferences, and how a product is made and be fashion.

Nguyen et al. [5] develop a duopoly model of product differentiation including variable costs of quality development

allowing to domestic firms to purchase a better foreign technology through licensing.

A proposed qualitative model of the product differentiation

In this section we will present first the main authors according to importance they attributed in the development of the theoretical field of economy, but in particular in the area of the marketing.

Thus, to Stanton et al. [10] the key attributes of product differentiating are design, branding, color, packaging, and product quality.

A product discrimination variable which is given a treatment recurring in various other authors and therefore required from the theoretical perspective in the model specification to be developed in the research what is undoubtedly advertising Morandi [7].

Given the group of products analyzed, it is of great importance to include in the model the attribute of flavor.

Secondly, in abstract form we propose seven product differentiation attributes and seven differentiating variables depending on people which we consider of great importance in building a qualitative product differentiating model.

Advertising is the dissemination of news or commercial ads to attract potential buyers, users, etc. It is a nonpersonal, paid form of communication paid for by an identified sponsor.

With regard to product design, we assume the following definition: arrangement of the elements that collectively form a good or a service. The good product design can improve the character of a marketable product making it easier to operate, enhancing quality, improving appearance or reducing production costs [10].

Table 1 Differentiating attributes and variables

Differentiating attributes	Differentiating variables
Advertising	Geographical area
Product design	Age
Brand	Sex
Color	Level of study
Packaging	Home residents
Quality	Number of people contributing to household expenditure
Flavor	Number of minimum wages received in a home

By product brand we understand the name or symbol for identifying the product of a seller or group of sellers and to differentiate products of that of their competitors. For consumers, brands facilitate identification of goods or services. This helps buyers to make quickly remember the product in supermarket, retail outlet or another retail store.

Packaging means activities tending, designing and producing the container or wrapper for a product, seeking to this several purposes; product protection, convince intermediaries through an effective and attractive packaging and consequently assist in effort to convince consumers of the product via a good way packaging the same [10].

The quality is linked to expectations that the client has about the product or service, such expectancies according to the needs, background, price, advertising, technology, company image, and so on [2]. Flavor is defined as the taste, feel that certain bodies produced in the organ of taste, supplementing with relish, perceive carefully and delight the taste of something. Finally, we refer to the color attribute, we highlighting this property the

delimited only to the intrinsic product. The colors are important in the packaging or brand.

Discussion

According to this line of development and application of knowledge generation is expected to contribute to the implementation of differentiating product models in the area of small business manufacturing, and as it manages to see in the review of literature, as a first approximation, the way various brand research courses.

The intention of this work is to develop a proposal model applicable to small businesses from food industry.

Therefore, this article made a literature review concerning the qualitative growth differentiating strategy and presents the attributes and variables of a model of qualitative economic growth of the small businesses from food industry.

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TEMPERATURE DEPENDENCE OF THE THERMOELECTRIC POWER FACTOR OF TTT_2I_3 ORGANIC CRYSTALS

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Abstract. In this paper, the temperature dependence of the thermoelectric power factor of nanostructured organic crystals of tetrathiotetracene-iodide, TTT_2I_3 is presented. It has been demonstrated that such organic compounds are very good candidates for thermoelectric applications, and could be used for different purposes, such as direct conversion of thermal energy into electrical power, cooling systems or infrared sensors. The crystals admit non-stoichiometric compounds, and the thermoelectric properties are well tunable by manipulating the donor-acceptor ratio. In this paper, we have modeled the electrical conductivity, the thermopower and the power factor as a function of absolute temperature for different values of charge carrier concentration.

Key words. Nanostructured organic crystals, thermoelectric converters, electrical conductivity, thermopower, thermoelectric power factor.

1. Introduction

In the last time, the ecological problems facing humanity are becoming more and more serious and require an urgent solution. In the last decades, the scientific interest paid to the renewable energy sources has increased significantly. The possibility of direct conversion of host thermal energy into electrical power has been explored intensively, leading to the discovery of new materials and compounds with unusual and promising properties [1]. Important results have been reported recently in inorganic materials [2-4]. However, the expensive production technology and the small amount of raw inorganic materials are slowing the implementation of these materials. In this sense, organic compounds are more prospective, due to their cheap and eco-friendly production technology, lightweight and flexibility, well tunable

internal properties by simple chemical methods [5, 6]. The class of polymers with high electrical conductivity has been identified as very prospective thermoelectric materials. In this order, the highly conducting quasi-one-dimensional (Q1D) organic crystals of tetrathiotetracene-iodide (TTT_2I_3) were intensively investigated for thermoelectric properties and large possibilities of enhancement [7].

The intensity of electrical power, generated by a thermoelectric element, is directly related to the power factor of the consisting materials. This parameter is directly proportional to the electrical conductivity and the square of thermopower (Seebeck coefficient):

$$P = \sigma S^2 \quad (1)$$

In ordinary materials, these two parameters are interconnected, meaning that while improving the electrical conductivity, the thermopower decreases. It has been demonstrated [8, 9] that in such organic compounds, both electrical conductivity and thermopower could be increased simultaneously, so as the carriers relaxation time as function of carrier energy achieves high maximum for a narrow strip of energetic states in the conduction band. This leads to a maximum of the power factor (1), limited by internal scattering processes.

The internal structure of TTT_2I_3 crystals consists of segregated molecular chains or stacks, resulting in an intra-chain spacing between two adjacent molecules, which is much smaller than the distance between neighboring chains. Along the chains, a narrow conduction band is generated by the overlap of electronic wave functions. The inter-chain overlap is very small and the preferential charge movement is along TTT molecular chains. The electrical conductivity of I iodine chains is negligible and crystals of TTT_2I_3 show a p – type behavior of electrical conductivity. Lattice constants are $a = 18.35 \text{ \AA}$, $b = 4.96 \text{ \AA}$, $c = 18.46 \text{ \AA}$, confirming Q1D structure with conducting direction along \mathbf{b} . The two-dimensional (2D) physical model of the crystal is considering the main charge transport along TTT chains and the rarely electron jumps on neighbor chains in a direction.

The aim of this paper is to investigate the temperature dependences of the thermoelectric power factor in order to determine the optimal temperature interval and the prospective of using the TTT_2I_3 crystals as constructive part of thermoelectric converters.

2. The physical model of TTT_2I_3 crystals

In order to describe the charge

transport in TTT_2I_3 crystals along TTT molecular chains, a temperature-dependent, two-dimensional (2D) physical model was elaborated. Along the main direction (\mathbf{b}), a band-type transport mechanism is considered (with a bandwidth $4w_1 \sim 0.64 \text{ eV}$, where w_1 is the transfer energy of an electron between the nearest TTT molecules along \mathbf{b} direction). In transversal (\mathbf{a}) direction, the overlap of electronic wave functions is significantly smaller, and we have considered a transfer energy $w_2 \sim 0.01w_1$.

The Hamiltonian of the crystals has the form:

$$H = \sum_{\mathbf{k}} E(\mathbf{k}) a_{\mathbf{k}}^+ a_{\mathbf{k}} + \sum_{\mathbf{q}} \hbar \omega_{\mathbf{q}} b_{\mathbf{q}}^+ b_{\mathbf{q}} + \sum_{\mathbf{k}, \mathbf{q}} A(\mathbf{k}, \mathbf{q}) a_{\mathbf{k}}^+ a_{\mathbf{k}+\mathbf{q}} (b_{\mathbf{q}} + b_{-\mathbf{q}}^+) + \left(I_l V_{0l} \sum_{l=1}^{N_l} e^{-i\mathbf{q}r_l} + I_d V_{0d} e^{-E_0/k_B T} \sum_{j=1}^{N_d} e^{-i\mathbf{q}r_j} \right) V^{-1} \sum_{\mathbf{k}, \mathbf{q}} a_{\mathbf{k}}^+ a_{\mathbf{k}+\mathbf{q}}, \quad (2)$$

where

$$E(\mathbf{k}) = -2w_1[1 - \cos(k_x b)] - 2w_2[1 - \cos(k_y a)]$$

is the energy of carriers (holes), measured from the top of the conduction band, in the nearest-neighbor and tight-binding electrons approximations. The second term describes the acoustic phonons

$$\omega_{\mathbf{q}}^2 = \omega_1^2 \sin^2(q_x b/2) + \omega_2^2 \sin^2(q_y a/2),$$

where ω_1 and ω_2 are cut-off frequencies, and q_x , q_y are the projections of the quasi-wave vector \mathbf{q} .

Two main electron-phonon interaction mechanisms are considered in third term of (2). One interaction is similar to that of the deformation potential, and is determined by the variation of the transfer energies of an electron between the nearest TTT molecules due to acoustical phonons. The second interaction is of polaron type, and is determined by the variation of polarization energy of molecules surrounding the carrier charge, due to the same acoustical phonons. The ratio of amplitudes of the second mechanism to the first one is described by dimensionless parameters γ_1 and γ_2 for b and a direction. Also, the scattering on

point-like impurities and thermally activated lattice dislocations is considered (see the last term of (2)). I_i and I_d are the energy of interaction of the electron with an impurity and with a defect within regions of volume V_{0i} and V_{0d} , respectively. E_a is the activation energy of a defect.

3. Electrical conductivity, Seebeck coefficient and the power factor

For a weak electric field and low temperature gradient, we have considered elastic scattering of charge carriers on acoustic phonons. The kinetic equation of the Boltzmann type was obtained by solving analytically the two-particle, temperature dependent, retarded Green functions. The obtained transport integrals have the form:

$$R_n = \int_0^2 d\varepsilon \int_0^\pi d\eta [\varepsilon + d(1 - \cos\eta) - (1 + d)\varepsilon_F]^n \varepsilon(2 - \varepsilon) \times \\ \times n_{e,\eta}(1 - n_{e,\eta}) [s_0 \sqrt{\varepsilon(2 - \varepsilon)} \text{cth}(s_0 T_0 \sqrt{\varepsilon(2 - \varepsilon)} / T) \times \\ \times \gamma_1^2 (\varepsilon - \varepsilon_0)^2 + \frac{(w_2 / w_1)^2}{8\varepsilon(2 - \varepsilon)} (1 + \gamma_2^2 + 2\sin^2 \eta - 2\gamma_2 \cos\eta) \\ + D_0 + D_1 \exp(-E_a / k_0 T)]^{-1}, \text{ where } s_0 = \hbar v_{s1} / (ak_0 T_0), \quad (3)$$

where $\varepsilon = E(k_x) / 2w_1$ and ε_F are the dimensionless kinetic energy of a hole along chains and Fermi energy in units of $2w_1$, respectively. $n_{e,\eta}$ is the Fermi distribution function and $\eta = k_y a$ is the dimensionless quasi momentum. $\varepsilon_0 = (\gamma_1 - 1) / \gamma_1$ is the dimensionless resonance energy. The parameters D_0 and D_1 describe the scattering on point-like impurities and lattice dislocations, respectively. In our investigations we have considered $D_0 = 0.001$ and $D_1 = 0.8$. These values were estimated by comparison with experimentally reported data for electrical conductivity.

The transport integral from (3) can be solved calculated only numerically. The power factor of the crystal, along the TTT

chains (x direction), has the form:

$$P_{xx} = \sigma_{xx} S_{xx}^2 \quad (4)$$

where σ_{xx} and S_{xx} are the electrical conductivity and the Seebeck coefficient, expressed as follows:

$$\sigma_{xx} = \sigma_0 R_0; S_{xx} = (k_0 / e)(2w_1 / k_0 T) R_1 / R_0; \\ \sigma_0 = 2e^2 M v_{s1}^2 w_1^3 r / \pi^2 \hbar a b (k_0 T)^2 w_1' (T_0 / T), \quad (5)$$

R_n are transport integrals (3), k_0 is the Boltzmann constant, e – elementary charge, M is the mass of TTT molecule, v_{s1} – the sound velocity along TTT chains, r is the number of molecular chains per elementary cell and w_1' is the derivative of transfer energy with respect to the intermolecular distance.

4. Numerical modeling of the results

For numerical calculations, we considered the following crystal parameters: $M = 6 \cdot 10^5 m_e$ (m_e is the mass of the free electron), $w_1 = 0.16$ eV, $w_1' = 0.26$ eV Å⁻¹, $v_{s1} = 1.08 \cdot 10^3$ m/s, $\gamma_1 = 1.5$. In crystals with stoichiometric composition, the concentration of charge carriers is estimated to $n_h = 1.2 \cdot 10^{21}$ cm⁻³. It was predicted theoretically [10], that the thermoelectric properties of TTT₂I₃ crystals can be significantly improved by diminishing the concentration of charge carriers.

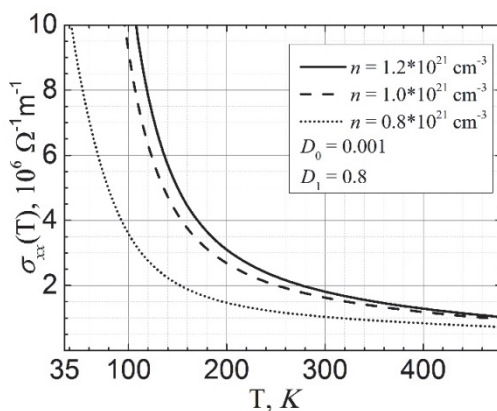


Fig.1. Longitudinal electrical conductivity

as a function of temperature.

Experimentally, it was demonstrated the enhancement of thermoelectric properties of such structures by manipulating chemically the crystal composition [11, 12].

In this case, we have chosen three values of hole concentration: $n_h = 1.2, 1.0$ and $0.8 \cdot 10^{21} \text{ cm}^{-3}$, to which the dimensionless Fermi energies $\varepsilon_F = 0.32, 0.24$ and 0.17 correspond.

In Fig. 1, the electrical conductivity as a function of temperature is presented. For temperatures below $\sim 100 \text{ K}$, a smooth metal-dielectric transition of Peierls type occurs. The phase transition in TTT_2I_3 crystals is described in [13]. This aspect is not considered in our physical model. For energy conversion applications, temperatures near room temperature or above should be considered. With the diminution of n_h , the electrical conductivity is diminished, for a wide range of temperatures.

For higher temperatures, the decrease of charge carrier mobility is caused by the increasing intensity of scattering processes on thermally activated lattice defects.

In Fig. 2, the Seebeck coefficient is presented as a function of absolute temperature T . In this case, the Seebeck coefficient increases significantly with the diminution of n_h . Experimentally values of $S_{xx} = 36 \text{ } \mu\text{V/K}$ were reported at room temperature for crystals with $\sigma_{xx} = 10^5 \text{ } \Omega^{-1}\text{m}^{-1}$ [14]. Our numerical calculations predict values of $S_{xx} = 40, 60$ and $100 \text{ } \mu\text{V/K}$ for : $n_h = 1.2, 1.0$ and $0.8 \cdot 10^{21} \text{ cm}^{-3}$ at $T = 300 \text{ K}$. In the last case, S_{xx} is more than 2,5 times higher than higher mentioned experimental value. It is observed that S_{xx} remains high for a large interval of temperatures around RT.

In Fig. 3, the thermoelectric power factor as a function of temperature is presented. For temperatures below $\sim 100 \text{ K}$, due to the metal-dielectric phase transition, the physical model does not

describe appropriate the charge transport

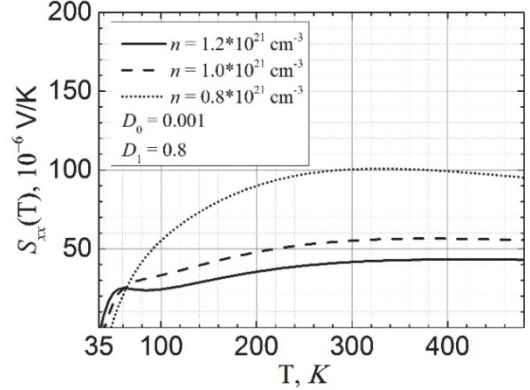


Fig.2. Seebeck coefficient as a function of temperature

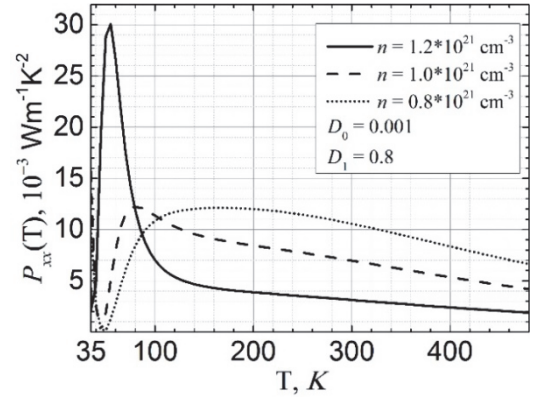


Fig.3. The power factor in longitudinal to TTT molecular chains direction.

For higher temperatures, it is observed that P_{xx} has a behavior with a maximum, displaced towards higher temperatures as the concentration of holes is diminished. This allowed us to predict that high values of power factor could be obtained at room temperature, by accurate tuning of carrier concentration.

For instance, at $T = 300 \text{ K}$, values of $P_{xx} \sim 3; 7$ and $10 \cdot 10^{-3} \text{ Wm}^{-1}\text{K}^{-2}$ are predicted for $n_h = 1.2, 1.0$ and $0.8 \cdot 10^{21} \text{ cm}^{-3}$. At $T = 400 \text{ K}$ $P_{xx} = 2.4 \cdot 10^{-3} \text{ Wm}^{-1}\text{K}^{-2}$ in stoichiometric crystals and could be increased up to $8.3 \cdot 10^{-3} \text{ Wm}^{-1}\text{K}^{-2}$, if the concentration of carriers is diminished by 1.5 times. For comparison, in the most

widely used inorganic thermoelectric material, Bi_2Te_3 , $P \sim 4 \cdot 10^{-3} \text{ Wm}^{-1}\text{K}^{-2}$ at $T = 300 \text{ K}$ [14].

5. Conclusions

The electrical conductivity, the Seebeck coefficient and the power factor of TTT_2I_3 crystals were calculated numerically for different parameters, as a function of temperature. It was found that the crystals could show very promising thermoelectric properties for a wide temperature range, from $\sim 200 \text{ K}$ up to 450 K . For stoichiometric crystals at $T = 300 \text{ K}$, a value of $P_{xx} \sim 3 \cdot 10^{-3} \text{ Wm}^{-1}\text{K}^{-2}$ can be obtained. By analyzing the results of numerical modeling, we predict that values up to $10 \cdot 10^{-3} \text{ Wm}^{-1}\text{K}^{-2}$ could be obtained at room temperature by diminishing the charge carrier concentration by 1.5 times with respect to the stoichiometric one. It was demonstrated that optimized in such a way TTT_2I_3 crystals will still have an increased power factor for a temperature interval of 100 K below and above the room temperature.

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LITHIUM ION BATTERIES: TODAY'S STATUS AND DEVELOPMENT FOR ELECTRIC CARS

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Abstract The leading benefit of the electric vehicles (EV) is that they offer near-emission free transportation and help the environment. However, EV car batteries use rare and/or toxic materials that have a recognized environmental impact. Fortunately, the car batteries that power electric cars can be recycled. The recycling technologies depend on the chemistry of the batteries used in EV. Today the majority of discarded car batteries are used in the steel industry as a cheap nickel-source. Cobalt faces a similar end: since it is not paid as rare earth metal, it is not recovered for re-use. Presently, there are only two car battery recycling technologies that are industrially applied and both are for LiBs and use extreme temperatures to de-activate the batteries: Toxco (cryogenic process) in United States and Sony-Sumitomo (calcination process) in Japan.

Keywords: Li-ion batteries, chemistry, battery producers.

1. Introduction

Projections show that in 2020 electric cars will share half of the new vehicles sale market [2]. EV car batteries use rare and/or toxic materials that have a recognized environmental impact. Fortunately, the car batteries that power electric cars can be recycled. The recycling technologies depend on the chemistry of the batteries used in EV. Therefore, it is important to forecast the battery chemistries/types which will have the majority of future market for electric cars. In order to study and forecast the market penetration of EV batteries in near future, first we reviewed different battery chemistries with the potential to be commercialized in EVs. In the next step the EV battery producers in the U.S. and the EV car producers were reviewed.

The condition for a battery pack in a lithium-ion-powered vehicle is to be fully charged or not less than 80 %. When the

battery charge drops under 80%, cannot be used in an electric vehicle but there is still charge left so that they can go a second life as storage device on the grid. These batteries, before they ever get to a recycling center, can be used as effective energy storage in renewable energy systems. This application of second life batteries is especially important to support the grid when using energy sources that are intermittent in nature (i.e. wind or solar power). Eventually, recycling at batteries end life is a necessity with many challenges. One of the critical technology challenges is how to recover all the valuable parts without contaminating the recycling stream while safely disposing the harmful materials. In many countries, the legislations encourage the development of efficient recycling technologies by making recycling free of charge for the end users or by forcing the battery manufactures to pay for it [3].

However, because electrical vehicles using lithium-ion battery are just now starting to come on the market and to be mass produced, the recycling technologies and centers are still in their infancy, too.

2. Battery Chemistries for Electric Cars

Batteries are electrochemical systems which are composed of anode, cathode, and ionic-conductor electrolyte. The materials, composition, configuration, and structure of battery components have been the center of research for a long time and therefore different batteries has been introduced. The electrochemistry and materials used in batteries for electric cars have been reviewed by different groups.[1-4] The batteries used in BEV and HEV are required to meet different

goals. These goals are summarized in Table 1. Due to this difference in their goals their chemistries are different.

Table 1 The difference in the goals of suitable batteries for BEV and HEVs.[5]

Parameter	Batteries for	
	BEV	HEV
Specific energy (Wh/kg)	80–200	8–80
Energy density (Wh/l)	135–300	9–100
Specific power (W/kg)	75–200	625–1,600
Life cycle (cycles; years)	600–1,000; 5–10	103–105; 5–10
Cost (US\$/kWh)	100–150	170–1,000

Most common battery chemistries and their constituent materials are summarized in Table 2. Since different materials can be used in the anode and cathode of the Li-ion batteries, various chemistries are available. Five of the principal technologies are compared in Figure 1.

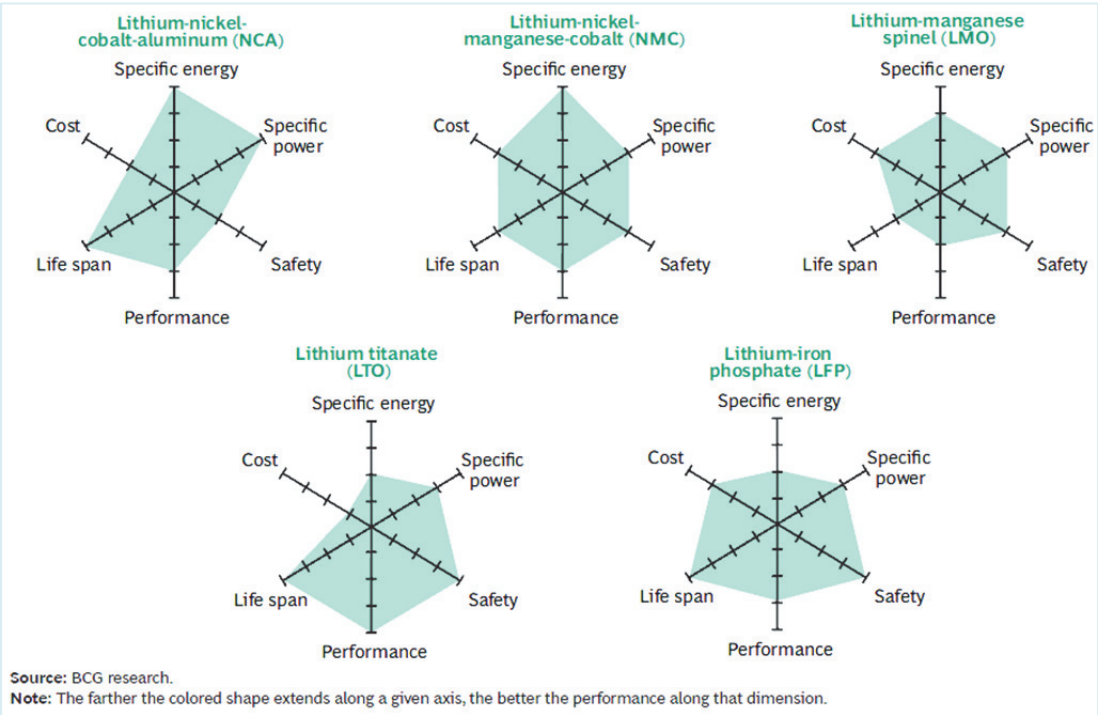


Figure 1 Comparison between five principal Li-Ion battery technologies [6].

Table 2 Battery technologies which are potentially suitable for EVs (References [2-4, 6])

Battery Name	Negative Electrode		Positive Electrode		Electrolyte	Development Stage/ Type(2)	Comment
	Active Material	Current Collector	Active Material	Current Collector			
NiMH(1)	Metal Hydrides	Ni Foam	NiOOH	Ni Foam	KOH	Commercial (HEV)	
Li-Ion						Commercial / (BEV)	
LiCoO ₂	Graphite	Cu foil	LiCoO ₂	Al Foil	Organic containing LiPF ₆		
NiCoAl	Graphite	Cu foil	NiCoAl	Al Foil	Organic		
NiMnCo	Graphite	Cu foil	Li[NiMnCo]O ₂	Al Foil	Organic		
LiFePO ₄	Graphite	Cu foil	LiFePO ₄	Al Foil	Organic		
LiMn ₂ O ₄	Graphite	Cu foil	LiMn ₂ O ₄	Al Foil	Organic		
Li ₄ Ti ₅ O ₁₂	Li ₄ Ti ₅ O ₁₂	Al Foil	LiMn ₂ O ₄	Al Foil	Organic		
LiMP(3)	Lithium foil	-----	Vanadium Oxide	Metallic foil	Thin film polymer	Commercial (BEV)	Low life cycle
Li-Sulfur	Lithium		Carbon/Sulfur		Organic Electrolyte	Demonstration	
NiCd	Cd	Ni Foam	NiOOH	Ni foam	KOH	R&D	
High Temperature							
ZEBRA(4)	Molten Sodium		Nickel Chloride		Molten NaAlCl ₄	Demonstration / (BEV)	1) Molten salt type 2) Upon shot down and solidification requires long reheating
NaS	Molten Sodium		Sulphur		Beta-alumina electrolyte	Demonstration / (BEV)	Molten salt type
Metal-air(5)	Pure metal		Air		Aqueous and non-aqueous electrolyte	R&D / TESLA is using them as backup battery	still need more development due to poor life cycle and rechargability

(1) NiMH: Nickel Metal Hydride

(2) Development stage for electric cars

(3) LiMP: Lithium Metal Polymer

(4) ZEBRA: Na-NiCl₂ battery

(5) Metal: Zn, Li, Al, Fe, Si

(6) Primary batteries are used in BEVs as the main source of energy and Secondary batteries are used as the second source of energy in HEVs.

Comparing different batteries in Table 2, the LiBs and NiMH batteries show more promise as battery cars. In most cases NiMH is more suitable for HEV and LiBs are more compatible with BEVs [3]. Due to proprietary issues related the battery chemistries, the information on the type of

the components of Li-ion batteries produced or employed in the EV cars is limited while companies generally call them “Li-ion batteries”. Due to this lack of data, the forecast of the Li-ion types is not certain at this stage. This makes the gap analysis of battery recycling less accurate.

Battery Producers

In order to find out the current and near future forecast of batteries which have the majority of EV battery market, the main battery producers are summarized in Table 3.

For the sake of the calculation, some of the available information about the battery packs ready to be used in the cars is provided in the following section.

Table 3 List of some of the major U.S. battery producers for electric cars. (References [7])

Battery Producer Name (Location)	Type of Battery	Cars using these batteries	Current Production (Future Production Forecast)	Comments
A123 System (Massachusetts)	LiFePO ₄ ²	1) Chevrolet Spark (BEV) 2) Fisker Karma (PHEV)		Filed for bankruptcy
Johnson Controls (Wisconsin)	Li-Ion (NiCoAl)	1) Ford Fusion 2) Daimler's S-Class 400		
Dow Kokam (Michigan)	Li-Ion	1) ZeroTruck, (BEV) medium-duty truck design based on the Isuzu N series	Nameplate capacity 30,000 BEV batteries per year	Not working at full capacity due to low demand from car manufacturers [8]
Compact Power (Michigan)	Li-Ion Polymer	1) Ford Focus Electric		
EnerDel (Indiana)	Li-Ion (NiMnCo)	1) VOLVO'S C30 2) THINK City electric vehicles		
General Motors (Michigan)	Li-Ion	1) GM's Chevy Volt 2) Cadillac ELR hybrids		
Saft America (Florida)	Li-Ion		Capacity of 3 million battery unit annually ³	
Altairnano (Nevada)	Li ₄ Ti ₅ O ₁₂	1) Phoenix Motorcars planning to use these batteries in its sport-utility vehicles		
Valence (Texas)	LiFePO ₄	1) Smith Electric Vehicles		In 2012 companies filed for bankruptcy

² White Paper: Nanophosphate® Basics: An Overview of the Structure, Properties and Benefits of A123 Systems' Proprietary Lithium Ion Battery Technology

³ <http://green.autoblog.com>

A123System⁴

Nanophosphate® Energy Core Pack (23kWh): This packaged is designed as a ready to be used system for PHEV and BEV applications. Each pack is equipped with battery management electronics, thermal management, and standard vehicle communication and control interface. The battery pack shows a battery life of around a million micro-cycles or thousands of 100% DOD (depth of discharge) cycles which makes them suitable for passenger and commercial PHEVs passenger and commercial BEVs. The specifications are as follows:

- Core module: AMP20 Energy Module
- Nominal voltage: 393V
- Nominal energy: 23kWh

Altairnano (Altair Nanotechnologies Inc.)

The global market in the transportation sector for PHEC and BEV is estimated to be more than \$5 billion. Altairnano produces lithium ion batteries in which the graphite anode is replaced by lithium titanate oxide. Altairnano has three cell chemistries: 11 Ah energy cell, 50 Ah energy cell, and 3.5 Ah power cell. The new 3.5 Ah power cell has specific energy of 40 Wh/kg and specific power of 4 kW/kg. The Alternano batteries can start and operate in – 40 °C without battery heaters.⁵

Electric Car Producers

In order to have an outlook of the EV battery market in near future, first a forecast of EV sale should be considered.

Three forecasts are show in Figure 2 and Figure 3. The aggressive market penetration scenario on electric vehicle market shares in Figure 3 (top figure) for 2050 can be considered as criteria to prepare the recycling facilities to meet the future demand.

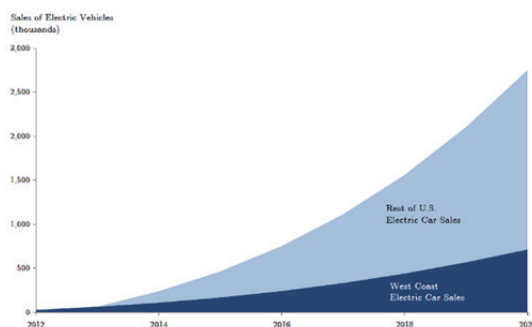


Figure 2 A forecast of electric car sale in the west coast as well as total sale in the U.S. from 2010 to 2020. [9]

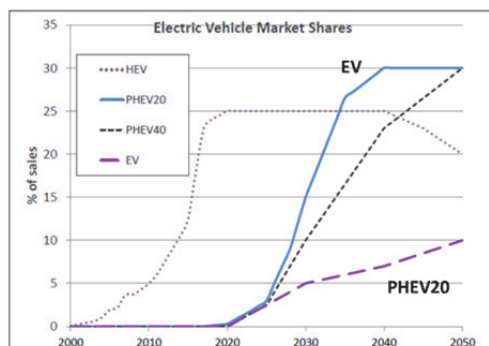


Figure 3 An aggressive market penetration scenario to show the maximum penetration of electric vehicles. PHEV20 and PHEV 40 show plug-in hybrid car with 20 miles and 40 miles of electric drive. [10]

⁴ <http://www.a123systems.com/>

⁵ <http://www.altairnano.com/>

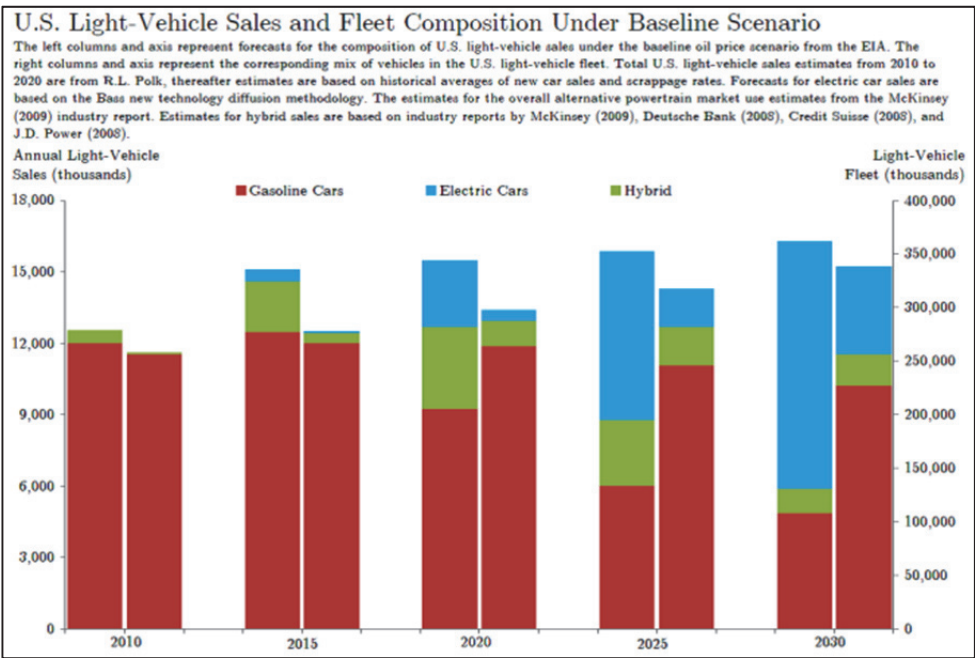


Figure 4. Forecast of light-weight electric cars and hybrid cars in the U.S. from 2010-2030.[9]

Table 4 List of major EV car producers with high-way capable cars with production and/or assembly plant in the U.S.

Company	Model (type)	Battery (Battery Producer)	Annual production (future forecast)	Comments
Nissan	Leaf (BEV)	The 24 kWh Li-ion battery (Automotive Energy Supply Corporation, a joint venture between Nissan and NEC)	37,600 unit sold in the US before Oct., 2013	expected to retain 70% to 80% of its capacity after 10 years
Ford	Focus Electric (BEV)	23 KWh Li-ion battery	Around 2,200 cars before Sept., 2013	Battery in each car weighs 600-700 pounds
Tesla Motors	Model S (BEV)	Li-ion battery with NiCoAl cathode at two sizes of 60 kWh and 85 KWh (Panasonic)	16,250 units before September 2013 in the U.S.	Batteries are guaranteed for 8 years
Toyota	RAV4 EV (BEV)	Li-Ion battery of 41.8 KWh	Around 1100 unit in US before Sept., 2013	- Mini-SUV -Battery pack 380kg -8 years warranty
General Motors	Chevrolet Spark EV (BEV)	21.3 KWh Nanophosphate lithium-ion battery (A123 Systems)	Around 300 units in US before Sept., 2013	The battery weight is around 270 kg.

In the next step, it is important to consider the share of EV market that each EV Producer will have in near future. By considering the market share of each EV Producer and the battery type they are using in their products, an outlook of the near future EV battery can be obtained. The EV producers are summarized in Table 4.

Since the future sell forecast for each EV producer company are usually proprietary and might change due to the company market strategy and policies, the data provided in Figure 4 should be used only as a bottom line. The type of battery and the battery producers which each EV producer will use for their products in most cases is the proprietary strategy of each company which makes the future forecast less accurate

Future Batteries

In the U.S., domestic lithium-ion battery supply chain is developing fast, which is mainly due to financial support by federal and state governments. Department of Energy (DOE) in 2009 boosted the development of Li-ion industry with \$2.4 billion of funding to battery-related manufacturers, including auto manufacturers, battery material suppliers, and battery recycling (TOXCO) companies. DOE also provided low-interest loans (around \$25 billion) to battery companies [11].

Considering the current status of EV battery producers and EV car producers that was discussed in the previous sections, lithium ion batteries will have the majority of EV battery market share in the future. NiMH batteries will be on the second

place. Among different Li-ion battery chemistries, there is still a competition and some of these chemistries are right now in the R&D of demonstration stage. Therefore, the prediction of the market share of each type of Li-ion chemistry is still uncertain. However, based on the battery producers and EV producers, LiCoO_2 , NiCoAl and LiFePO_4 seem to be more promising to have large share of near future market.

Since the battery recycling is sensitive to the chemistry of the batteries, a study of the near future market share of each battery chemistry in the format of teamwork between EV producers, battery producers, recycling facilities and research institutes is recommended.

Conclusions and recommendations

Majority of recycling processes for LiBs and NiMH were not originally developed for them, but adapted from other extractive metallurgy methods. As a result, many of the valuable metals cannot be recovered. There is no single recycling process able to extract all of the battery components. The maximum recycling efficiency is achieved in a combination of processes. For instance, efficient lithium recovery requires a combination of hydro and pyrometallurgy processes but may also increase the cost as an extra mechanical grinding step is added.

The increasing demand in EVs batteries for lithium and other metals, including rare earth metals, needs to be addressed and compared the estimated sources to the anticipated demand. These studies should take into consideration an overall resource outlook. It is important to

know the geographical resources, characteristics of the deposits and the potential to supply metals of interest in EVs batteries, the production of recovered metals through recycling but also the geo-economical-political market that directly affects the availability of important EVs battery metals in a competitive market.

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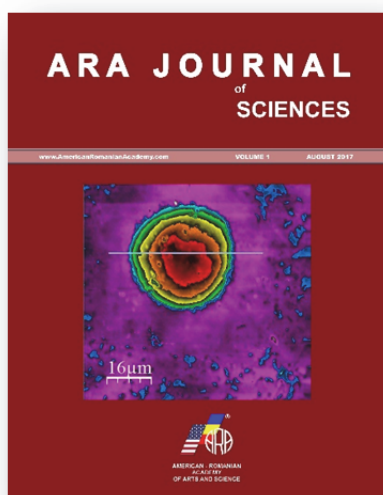
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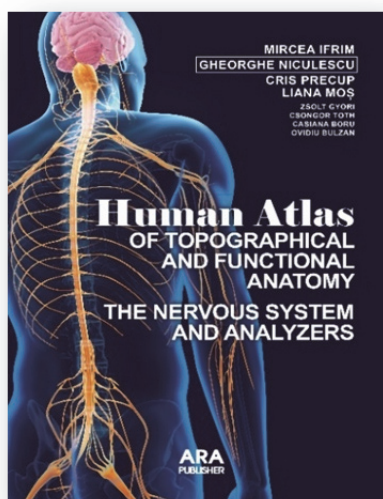
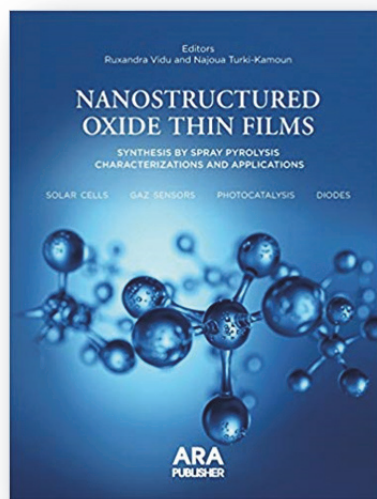
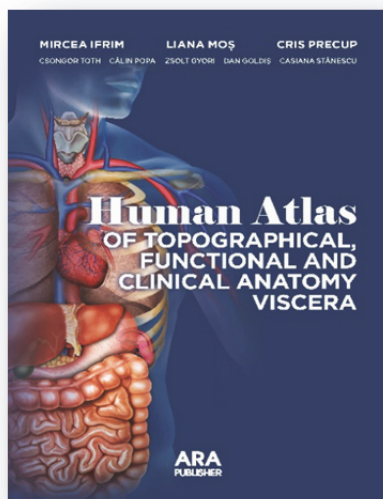
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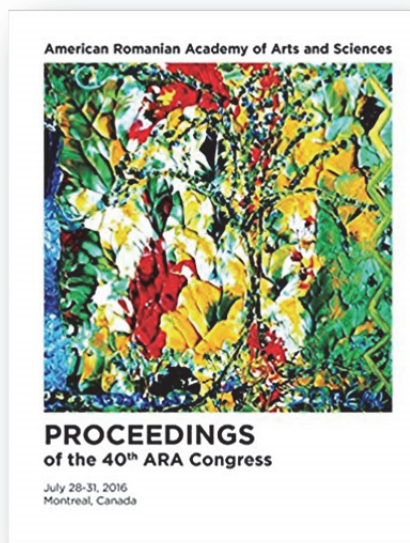
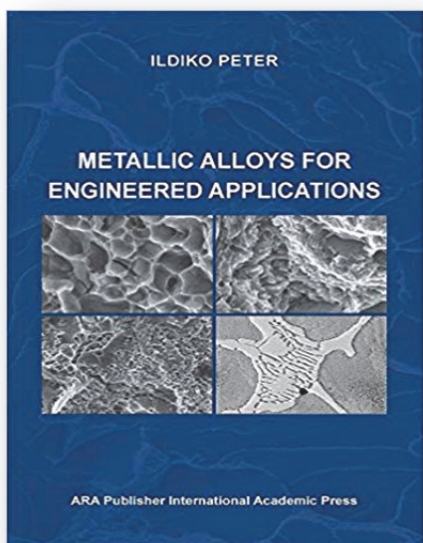
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