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Foreword

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Being a challenging and a favorable medium for scientific discussions, all the issues of the journal contain articles dealing with current issues from *computer science*, *economics*, *management*, *IT&C*, etc. Furthermore, JISOM encourages the cross-disciplinary research of national and international researchers and welcomes the contributions which give a special "touch and flavor" to the mentioned fields. Each article undergoes a double-blind review from an internationally and nationally recognized pool of reviewers.

JISOM thanks all the authors who contributed to this journal by submitting their work to be published, and also thanks to all reviewers who helped and spared their valuable time in reviewing and evaluating the manuscripts.

Last but not least, JISOM aims at being one of the distinguished journals in the mentioned fields.

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Best Wishes

Virgil Chichernea, Ph.D.

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CONTENTS

Editorial

ACCESSING EUROPEAN FUNDS THROUGH PROJECTS - A MODERN SOLUTION FOR THE ORGANIZATIONAL MANAGEMENT IN IMPLEMENTING SOCIAL RESPONSIBILITY MEASURES

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Abstract: *The article will illustrate the existing connection between the need for sustainable development of any organization and the opportunity to access European funded projects that can provide funding lines for much of the activities through which the organization can actually implement social responsibility measures. The purpose of this research aims at checking by what degree the use of european structural funds through structural development projects is influencing the sustainable development of organizations, especially for social responsibility and environmental protection actions. The authors propose the use of european structural funds as solution for supporting the sustainable development of organizations. The developed econometric model was validated and the results of the research have confirmed the hypothesis of the research. These results were interpreted at the end of the research paper.*

Keywords*: sustainable development, social responsibility, European funded projects, project management*

Introduction

The modern, knowledge-based society, the unprecedented development of information and communication technologies, the internet, the innovation and research - development have led to a strong development and diversification of the business environment, the emergence of new business models, the economic growth of organizations, the increase of their productivity and their competitive advantage, the efficient use of natural resources, etc. However, the strong technological development of the organizations and the increase of their competitiveness have resulted in a negative impact on the environment and local communities resulting in: the pollution of some important life factors (water, air, soil), increased consumption of important natural resources for the quality of life and limited in scope (forests, water, green space), a large quantity of production

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residues that directly affect the environment, living standards and occupational safety for their own human resourses or for those of the community. There is a strong relationship of any organization with the local community in which it operates and which can generate a good or bad consistent effect [1]. This relationship of the organization of any type and size with the environment and the society in which it operates has been in the attention of researchers, scientists, economists and specialists in various fields of activity, of specialized international or regional bodies that have established guidelines, directives or measures binding on the organizations, meant to reduce their negative impact on the community or the environment through concrete actions in the social, cultural, educational and health field, through effective involvement in the life of the local community and the environmental protection. These are the social responsibility measures that organizations have to implement in the community life or in the environment in which they operate, in order to ensure a sustainable development.

The article will illustrate the existing connection between the need for sustainable development of any organization and the opportunity to access European funded projects that can provide funding lines for much of the activities through which the organization can actually implement social responsibility measures. Under these circumstances one can identify the simultaneous and beneficial existance within every modern organization of both classic management [2,3] that has to adapt on the spot to the new requirements and expectations of modern society, together with project management type specific for each of the projects implemented within the company. Through these projects, the organization can implement a series of social responsibility actions simultaneously with organization's competitivity growth and the growth of its sustainable development.

Thus, organizations can access and implement European funded projects which, well-selected, can contribute either to their own technological development, increase their competitiveness, or to the practical implementation of social and environmental responsibility measures. Taking into account that most companies implement these measures mainly through volunteer activities, this means that an external organization funding for a certain well-planned, monitored and project-driven social or environmental responsibility objective will lead to a considerable stimulation thereof, to the success of social responsibility measures implementation by accessing European funded projects and other funding (government, cross-border, etc.). This connection will be analyzed and demonstrated by linear regression statistical models. The purpose of this paper is to essentially stimulate accessing european structural funds by organizations, in order to help them to achieve sustainable growth and competitivity. For this purpose, data regarding approved payments for implemented european structural funds projects [4] and regarding gross medium wage and number of passengers using local public transport, as offered by Romanian National Statistics Institute, were collected, studied and analysed through descriptive methods and then through statistical regression methods.Thus were defined the hypothesis of the research, the

8

correlation models were developed, the correlation was tested and the final results confirm the fact that there is a direct and positive link between the paid amounts for implemented european structural funds projects and de sustainable development indicators mentioned before. This essentially represents a greater possibility to implement the social responsibility actions through financing provided by european structural funds. The novelty of the study consists in scientifically proving the dependence between the above mentioned sustainable development indicators that define the implementation of social responsibility actions and the financing through european structural funds, defining in this process the role and motivation for accessing european funded projects by sustainable growth seeking organizations.

In order to do that, our paper is structured in the following order: in the first chapter we present the "*sustainable development*" concept, in the second chapter we present aspects in relation with "*social responsibility*" of the organizations as a part of sustainable development as well as the european funded projects' role in the development of organizations, and in chapter 3 we present the reseach methodology and results' interpretation. At the end of our paper we presented the conclusions of the research.

1. Sustainable development

The sustainable development issue has been studied by researchers, economists, specialists in the field since 1972, and international bodies such as the World Commission on Environment and Development, known as the Brundtland Commission, have defined the concept of sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [5].

This was followed by a series of actions from other international or regional bodies such as: The United Nations Conference regarding Environment and Development [6] that officially aknowledged the need to include economic development and environment protection within sustainable development objectives; the European Commission [7] in Hanover, and then United Nations Summit for sustainable development from 2002 [8] have set binding conditions for the sustainable development of organizations at international level and believe that sustainable development must make a balance between the economic and social progress, so that the technological development of the organizations do not affect the healthy development of the society and the environment in which they operate, to include poverty elimination and environmental protection actions at global level.

The concept of sustainable development thus binds the economic, competitive development of an organization by its social and environmental responsibility, conditioning its very existence on the global market [9].

The European Commission has defined the concept of social responsibility of the organizations "as a contribution of the enterprises to the sustainable development" [10].

The European Council adopted in June 2001, in Goteborg, the European Strategy for Sustainable Development [11] and in 2006 the Renewed Sustainable Development Strategy for an Enlarged Europe, aiming at alternative solutions for maintaining the quality of life of present and future generations. The Commission gives a new definition of the concept of social responsibility of a organization as "the companies' responsibility for the impact they have on society" [12]. There are also the requirements of the European Commission through the European Strategy on social responsibility of the organizations, which being forced to implement social responsibility measures, can considerably contribute to sustainable development, increased competitiveness and a good management of all the resources they have, while protecting the environment and the community in which they operate.

As a result, Romania has developed its own strategy [1] in 2008 and has determined that it is absolutely necessary to address sustainable development for all organizations in order to ensure economic development while improving the quality of people's lives and social cohesion, environmental and natural resources protection, which are virtually exhaustible.

In 2017, the Department for Sustainable Development [13] was established in Romania. It has the responsibility for coordinating and controlling the implementation of sustainable development objectives by all organizations at the national level. Large companies are required to carry out and publish annually, in accordance with the transparency and free access to information principles, a Report on the implemented social responsibility measures. As these reports are public, as one can search the internet one can discover that, out of the many companies that are registered and operating in Romania, only a small proportion of them have published in recent years such a report (fewer than 200 companies). This does not necessarily mean that only these organizations have implemented social responsibility or environmental protection measures, but only that there are organizations that have not drawn up the report or have drawn up but have not made this report public (on the Internet). That is why we believe that it would be useful to have a sustained campaign to inform about the necessity and the obligativity of drawing up and then publishing a report on social responsibility by all organizations. The publication of this report would be beneficial to the various organizations, to their promotion and image in local communities, in order to provide information on the activities developed for the welfare of the community or for the environmental protection, to improve the working and living conditions, children education, stopping the dropout rate, etc.

2. Social Responsibility and Accessing European-funded Projects

Under the current conditions, the main objective of any organization is to respond as quickly and efficiently as possible to changing business needs, effectively

ensuring the efficient exploitation of the existing resources and investments, along with the requirements of a sustainable development that is absolutely mandatory nowadays and with the implementation of social responsibility codes (CSR), as required by the European Commission through the European Corporate Social Responsibility Strategy [12]. The social responsibility of an organization is practically a contract between the company and the business environment, an investment made by various organizations for the welfare of the community in which they operate. It is defined by the European Commission as a "concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis" [14], the organization thus becoming responsible towards the community and the environment in which it operates. This includes practically the individual whose living, health and safety conditions are the main concern, the environment and the community in which they operate must be protected and transformed by organizations in a transparent way. But in order to be able to implement social responsibility measures, an organization, regardless of its type and size, needs to be developed economically, be competitive on the global market, be able to implement advanced technologies in its own field of activity, modern ecological marketing tools by which the organization and its products be promoted, the use of biodegradable and recycled components in manufacturing processes [15], coupled with professional communication, information through all modern means of communication (including YouTube), that should support the construction and promotion of an appropriate brand [16].

On November 1, 2010, the International Organization for Standardization (ISO) established the Corporate Social Responsibility norms in the ISO 26000 standard, built as a social responsibility guide for all organizations. It presents a series of social responsibility measures that organizations can take to mitigate the negative impact they have on their own human resources, the environment and the local community [17]. The standard classifies the social responsibility measures in 7 major categories [18]: Organizational governance; Human rights; Labour practices; Environment; Fair operating practices; Consumer issues; Community involvement and development.

The sustainable development approach by all organizations is systematically linked to the need for them to implement social responsibility measures, environmental protection measures, to get involved in the community life in order to improve the living conditions, work, education, culture, health and safety in work [19], etc.

During the past 10 years, the Romanian companies as well as others abroad have shown that in every successful organization were working, simultaneously, both day to day or "current" activities, under direct supervision from organization's management, as well as temporary activities organised as "project" based activities, under direct supervision from project managers rather than

organizational management, many of them funded by european structural funds. Those 2 forms of management can coexist in an organization, during implementation period of the projects, providing both management, monitoring and control of the production processes, as well as supplementary activities aimed at providing an efficiency boost for organization, contributing to environment protection or community protection, improvement in living, education, health or security conditions for people. Taking these into consideration, an organization with modern management that works mainly through projects that are temporary and limited in time, have well defined and measurable objectives and precise indicators for evaluating the successful ending of such project [20] will permanently adapt to change demands, will reorganize itself, specialize and diversify its activity in the same time [21], while experiencing increased efficiency. Following increasing importance of implementing european funded projects by different organizations, the Ocupational Code in Romania included new occupations for specialists in this field, such as [22]: project manager (242101), IT project manager (251206), public-private partnership project manager (242112), structural funds accession expert (242213) and so on.

The European Commission defined a *„project"* as: *a series of tasks aimed towards achieving a set of clear and specific objectives, in a predefined timeframe, using a predetermined budget* [23]. These objectives can be defined by organizations in order to temporary supplement their main activity purpose, to serve implementation of social responsibility requirements or even technological development without affecting its own budget for its production processes. European Commission promotes more and more project based actions, through financing and stimulation of project implementation in every field of activity. As a direct response to these, many organizations have accessed various European (or governmental, applied research, etc.) projects to help with the implementation of social responsibility activities in order to cope with the economic competition under conditions of sustainable development such as: improving human resources in high technology (including IC&T technologies), stopping dropout rate, modern training methods, waste recycling measures, alternative energy technologies, forecasting energy consumption [24] and then the use of intelligent metering instruments, measures to prevent risks and occupational diseases, to ensure health and safety at work [25,26], etc. The beneficial effect of European funded project has led, within various organizations, to an extended work on projects and their developing, even resulting in the emergence of a new type of organization - *the project-based organization* [21].

This involves the simultaneous existence within the organization of two forms of management: the "classical management" of the production processes and the "project-based" management, which interact, complement each other to achieve the overall objectives of the organization, while achieving the objectives of the project or projects implemented within the organization.

For the organizations in Romania [1], some areas are mandatory for the implementation of social responsibility measures, as follows:

- respect for human rights - particularly important, covering both the public and the private sector;
- ensuring decent working conditions, equal opportunities, non-discrimination or harassment of any kind, without forced labor or abuse, health and safety at work, decent pay, right to strike, child protection etc .;
- environmental protection, by reducing the negative impact on the environment, through the efficient exploitation of natural resources, which are not unlimited, by endowing and using innovative technologies within the organizations, which reduce the emissions of pollutants, exploitation residues, allow new solutions, production alternatives, collection and handing over for the recycling of waste resulting from its own activity, etc .;
- measures to prevent and combat corruption, which can constitute a major obstacle to sustainable development;
- responsibility for the supply chain, which requires compliance with all quality requirements on the product distribution chain;
- the protection of the local community, which it can influence through activities to support education, reduce dropout rate, help those living in poverty, improve living conditions at home, work, school, hospitals, cultural organizations, etc.

Analyzing along with the specified measures, the typology of European-funded projects, it is clear that they are built with funding lines defined as to support all measures that organizations can take to actively promote social responsibility within communities or the environment [27], but also to support the introduction of the latest and most advanced manufacturing technologies, IC&T technologies, advanced software products, integrated IT systems in all areas: economic, social, cultural, education, health, governance, leisure, etc. The guidelines state that, through all the themes approached for funding in European projects, the use of funds accessed by means of European projects actually leads to the implementation of sustainable development measures.

In the Implementation Final Report [28], through the POSDRU projects implemented within Priority Axis 1 - "Education and professional training in support of economic growth and the development of a knowledge based society" there were approached and financed a certain number of projects aiming "access to education and quality initial professional training" for children in gymnasium and high school, then improving the quality in higher education and doctoral programs, training of teaching staff, improving their digital competences, as well as continuous professional training for the improvement or specialization of the human resources according to the new technologies requirements.

Priority Axis 2 "Correlating lifelong learning to the labor market" is intended for support measures to prevent and combat dropout rate, as well as funding for access

to continuing professional training programs that can improve the organization's relationship with the community in which it operates, with its own human resource, whose competences and practical skills are constantly improved and adapted to the new technological, environmental, legislative, IT or field-specific requirements. Priority Axis 5 concerns the development and implementation of active employment measures for both employers and employees, and Priority Axis 6 "Promoting social inclusion" concerns concrete actions to improve the access of vulnerable groups to the labor market, promoting equal opportunities in the labor market (regardless of gender, ethnicity, people with special needs, etc.). It can be noticed that all the themes approached and funded are practically social responsibility measures that organizations should try to implement within their own communities in which they operate or for their own human resources, which will be more prepared, more adaptable to changes in skills required in different positions, and organizations will be more prepared to introduce new highly specialized technologies, more human resource and environmentally friendly, will be able to increase work productivity and product quality, be more competitive and sustainable at the same time. The same thing can be seen in all other European funding programs. What do all these mean?

In fact, it means that it must be in the interest of any organization to access as many European-funded projects as possible from those that fit their own field of activity and the development strategy they have adopted, so that with the implementation of some social or environmental responsibility measures, it would have the funding to support its own activities, process automatization and / or informatization, ensure work safety, improve the human resource, increase its income. Moreover, the european funded structural development projects have within their structure compulsory rules regarding actions towards sustainable development; as such, they are involved in sustainable development of an organization, of environment or communities. It is therefore noticed that a management that is smart, flexible and adaptable to the new challenges of sustainable and competitive development of organizations will promote, support and stimulate, through any means of communication, the access and implementation of European projects for various areas of interest. European projects have their own "project" management, which monitors, acts and corrects the activities, controls and ensures the quality of the products, with the respect of the allocated terms and resources [29]. The project management administrates the human, financial and communication resources of the projects with maximum efficiency, bears the full responsibility for successfully conclusion of the projects and communicates permanently with the organizational management. The project manager identifies any risk that may arise in running the project, evaluates and removes it as soon as possible [30], to avoid later major expense, it mediates conflicts, manages the changes, motivates the staff involved, is responsible for the successful completion of the project.

Throughout this time, the project manager collaborates and communicates with the organizational manager, finds effective solutions to all issues that have arisen. Thus, instead of voluntary actions or voluntary contracts concluded for the implementation of social responsibility measures, the organization will be able to use funding by means of projects (European, governmental or other), i.e. an external funding to the organization, to implement these measures, all of these being beneficial for the organization, for a part of its own human resource used within these projects and even for the local community or the environment.

4. Research methodology and findings

It is well known that a model of economic process is "a theoretical construct made in order to approximate reality" [31]. The paper will use statistical research and it will construct linear regression models in order to verify the existence of a correlation between the funding obtained through the projects developed in Romania and various sustainable development indicators, as they were established and defined by Romanian National Institute for Statistics in the Romanian Statistical Yearbook. For this, we need to identify which variables are considered and which are the relationships between these relevant variables to form the basis of building a model. Then the series of data that present the evolution of the economic or social phenomenon taken into account are presented. Thus it was taken into account the data on the amounts authorized for payment on the European funded projects from May 2007 to May 2017 [4] and the data on the repayments in RON, by counties and years (Figure 1) was selected and centralized.

Studying the statistical yearbooks and the database of the National Institute of Statistics (INS), the sustainable development indicators, with values per counties and years were taken into account, such as:
  a) the average gross monthly nominal wages per county and year (CTGMLUN)
  b) the local public passenger transport (in thousands of passengers), per county and year (VALPASG).
These variables will be processed by means of the Eviews 7 software product.

a) **MC1** - A linear regression model that verifies whether there is a correlation between the *Average gross monthly nominal wages* (CTGMLUN) and *Total Authorized Payments on European-funded projects between 2007- May 2017* (PLCTG).

Row Labels	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
ALBA	1698583.83	3334144.67	54387716.8	171688493	261594398	290808746	298702742	349558826	241767503	2624207.67	1676165361
ARAD		1535154.51	39102789.5	70598383.3	168908432	221066657	167482530	130514887	252341020	3977831.93	1055527684
ARGES		4407720.32	31426149.2	68737264.2	192937778	312502625	253208022	419259867	354627024	37103.38	1637143553
BACAU		1848657.65	47856732.4	83532371.3	172092666	284453527	223602173	315865727	240164501	559011.43	1369975367
BIHOR		5130824.22	44096097.3	95824459	133706854	202792872	263517919	620740820	489763645	2647788.98	1858221280
BISTRITA-NASAUD		585384	30926835.4	94623956.6	126300460	123042619	136421540	268967894	155628111	1283337.2	937780137
BOTOSANI		398409.49	32937054.2	97431661.8	191371764	174040180	136263759	160361385	140705985	3126785.48	936636984
BRAILA	1547630.94	11542777.7	44474626.7	124830633	141172060	201897820	154170261	196234076	127325374	374264.79	1003569523
BRASOV		17151627.1	52559488.1	126261009	174127780	310728528	374404257	478005478	388368322	7524371.25	1879130860
BUCURESTI	5806936.34	221008075	502456484	2878560060	2771329569	7605189345	8095251443	4590645669	8984565107	44237882.2	3.5699E+10
BUZAU		133180.73	36030907.7	60551926.7	90855005.1	176598831	212887842	220634516	193269804	33396.47	990995409
CALARASI	1988235.34	4771843.03	69645928.6	146558632	151806635	136984530	83021433.9	125547349	76046174.3	6199.94	796376960
CARAS-SEVERIN		1286212.89	1389810.3	27693413.9	45260774.8	69841793.8	91522105.8	125979086	163275740	1174197.5	527423135
CLUJ	2061217.5	28821842.7	135419468	381715005	495346204	802987487	504930644	716452311	538816570	5146294.92	3611697043
CONSTANTA		1757468.07	31779450.9	378658637	236359885	746047070	612151942	636414289	414443205	72040.58	3057683988
COVASNA		413298.04	3706310.42	56130953.2	46894293.9	64899941	109702389	175721101	190049941	2365161.6	649883389
DAMBOVITA		2121079.83	38698804.6	166085616	260754406	390818793	325954448	245558139	274736250	34055380.3	1738782917
DOLJ	2111985.68	31725508.7	127052540	216878234	282468765	479305556	462066503	535884570	555554162	4851509.86	2697897333
GALATI		1874738.12	41866699.6	96069438.8	118995227	235800929	358769094	339618920	147083861	504554.32	1340583461
GIURGIU	1164161.95	4878838.96	18492454.8	77337476.7	145600666	117181667	58432875.4	65694198	92549736.1	328913.97	581660988
GORJ		15784178.9	48538168.2	63000029.8	106813382	112768091	93035648.5	73989112.8	112736931		626665541
HARGHITA		2139507.73	40218434.1	64056140.5	74654848.2	74781504.1	149899448	266457505	177940374	2685567.02	852833328
HUNEDOARA		2219025.1	23162580.1	115901957	167763802	282662923	268667125	487800833	338759024	52002449.6	1738939718
IALOMITA	3849676.08	9990230.64	36210871.2	16062248	19682237.5	23814450.4	45926952.4	50808331.5	108496.4	206453494	
IASI		10229159.6	59472539.9	217964279	392888042	625950063	743577751	694484459	711610189	419014.4	3456595497
ILFOV		347753.66	26542914.5	74841498.2	115924345	279158043	415064147	627514709	344396770	1834283.64	1885624463
MARAMURES	1529429.44	29774337.8	70634642.8	96750822.1	219003366	197550846	365595335	367248742	2559711.97	1350647233	
MEHEDINTI		46570535	82246020.8	89097740.2	90858663.9	53672153.3	103828417	120644818	583273.69	587501622	
MURES		15090375.5	55942534.3	72356962.7	137880544	369246698	264782312	266537824	225726062	7695721.59	1415259034
NEAMT	3694026.98	4876445.99	59674963.3	141621449	182112955	235163825	217518368	199671755	164005479	30857445.2	1239196714
OLT		2966054.55	31758162	74221467	170735685	248313880	145015188	119572778	132726876	2315523.67	927625615
PRAHOVA		959777.82	28762616	93715227.1	158006605	204399264	385509543	470434985	444327976	4014429.93	1790130425
SALAJ		1250669.48	18829537.6	71453473.4	92211901.3	88387008.5	80103311.3	111040272	64353908.1		527630082
SATU MARE		1916262.1	9558254.86	23336999.7	62301014.2	111228800	178073917	190961732	230891052	142834.77	808410867
SIBIU		3986984.91	92895377.5	148092270	207693051	438102791	395673318	415596172	238194587	21300.55	1940255859
SUCEAVA		6185905.04	72108914.8	122458014	144578558	145130488	239628720	402042542	258482993	765945.48	1391382079
TELEORMAN		1429490.39	63250336.7	148276822	157438176	161488022	125244431	154542402	93762983.1	869789.35	906302454
TIMIS	3105104.3	7592482.45	24440716.5	253605247	290729555	541825247	405192866	572518539	362181864	3201072.49	2464392693
TULCEA		12406961.2	105102744	122234891	133429862	89878228.2	193851906	137379880	140425741	33712.36	934743926
VALCEA		5035417.52	23921972.4	69460249	125839221	143487181	197430386	407536750	239946776	1907843.17	1214565796
VASLUI		1607955.78	38276706.9	50763069.1	75370669.8	120514297	95887089.8	132454872	105096648	2710914.16	622682222
VRANCEA			42699692.9	90552284.1	122316531	305164781	141039010	147996080	132958547	199047.41	982925973
Grand Total	23177882.86	446130299	2335798617	7626771495	9328483178	1.7854E+10	1.7933E+10	1.7112E+10	1.9028E+10	229858611	9.1917E+10

Fig 1.Amounts authorized for payment on European funded projects between 2007-May 2017.

Source: Financing contracts reimbursements [4]

It has to be mentioned that the data taken into consideration included as well the data for year 2017 (table no.1), as there were data corresponding to this period on the *Average gross monthly nominal wages* [32]. This sustainable development indicator, defined by the INS in the "Knowledge Society and Economic and Social Development" category, is taken into account in order to show whether payments made on European funded projects directly affect the wages of those communities. We obtained a series of 383 values, out of which 10 were excluded.

Table no. 1. Average gross monthly nominal wages

	An/(RON)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Alba	1243	1506	1545	1692	1683	1746	1818	1976	2193	2434	2849
2	Arad	1271	1521	1639	1689	1755	1831	1925	2052	2304	2508	2909
3	Arges	1346	1713	1858	1966	2021	2123	2267	2449	2683	2858	3207
4	Bacau	1361	1685	1791	1733	1720	1761	1857	2001	2182	2399	2814
5	Bihor	1086	1351	1393	1459	1492	1541	1589	1785	1929	2159	2584
6	Bistrita-Nasaud	1190	1442	1492	1475	1508	1570	1641	1742	2041	2180	2506
7	Botosani	1161	1390	1501	1477	1472	1539	1668	1850	2026	2161	2608
8	Braila	1203	1494	1580	1532	1585	1606	1727	1851	2014	2179	2567
9	Brasov	1320	1639	1788	1777	1898	2013	2045	2207	2457	2779	3190
10	Buzau	1162	1479	1571	1564	1605	1687	1779	1821	2047	2265	2629
11	Calarasi	1114	1408	1509	1449	1530	1608	1703	1862	1982	2241	2688
12	Caras-Severin	1111	1397	1543	1587	1577	1656	1678	1820	1994	2254	2584
13	Cluj	1489	1772	1882	1897	2012	2153	2287	2535	2763	3182	3636
14	Constanta	1428	1736	1894	1821	1932	1956	2047	2167	2403	2586	2938
15	Covasna	1036	1290	1378	1419	1465	1512	1604	1730	1926	2121	2541
16	Dambovita	1331	1573	1664	1723	1717	1813	1939	2041	2168	2397	2776
17	Dolj	1327	1644	1777	1737	1840	1889	2018	2129	2310	2521	2947
18	Galati	1331	1636	1696	1728	1800	1844	1967	2169	2262	2396	2773
19	Giurgiu	1246	1557	1717	1712	1695	1702	1831	1948	2143	2387	2806
20	Gorj	1553	2032	2025	2083	2114	2188	2219	2424	2466	2577	2955
21	Harghita	1081	1322	1458	1382	1431	1455	1543	1713	1895	2092	2489
22	Hunedoara	1262	1546	1656	1641	1632	1766	1794	1917	2101	2206	2618
23	Ialomita	1170	1444	1524	1539	1575	1651	1695	1869	1991	2171	2613
24	Iasi	1333	1680	1781	1806	1841	1880	2048	2265	2473	2666	3215
25	Ilfov	1668	2126	2332	2375	2570	2742	2695	2874	3134	3275	3602
26	Maramures	1101	1359	1407	1389	1417	1570	1590	1765	1893	2158	2604
27	Mehedinti	1372	1695	1757	1795	1774	1771	1874	2036	2123	2236	2617
28	Municipiul Bucuresti	1908	2507	2506	2721	2902	3022	3148	3338	3687	3995	4497
29	Mures	1265	1508	1623	1680	1711	1804	1902	2064	2250	2554	2926
30	Neamt	1190	1394	1462	1488	1520	1537	1650	1752	1887	2182	2585
31	Olt	1279	1608	1713	1660	1670	1809	1900	2149	2245	2425	2834
32	Prahova	1380	1772	1894	1899	1925	2076	2125	2329	2530	2694	3094
33	Salaj	1208	1421	1537	1504	1541	1574	1659	1812	2040	2196	2605
34	Satu Mare	1171	1375	1415	1438	1517	1573	1746	1837	2013	2275	2662
35	Sibiu	1320	1659	1766	1836	1917	1964	2123	2232	2510	2815	3188
36	Suceava	1164	1452	1502	1506	1547	1560	1712	1856	2040	2189	2594
37	Teleorman	1118	1469	1519	1539	1570	1609	1708	1829	1964	2207	2587
38	Timis	1405	1767	1834	1923	2034	2158	2324	2499	2809	3196	3514
39	Tulcea	1245	1491	1599	1710	1752	1738	1897	2019	2185	2348	2775
40	Valcea	1233	1549	1586	1621	1698	1758	1779	1835	1976	2214	2555
41	Vaslui	1091	1398	1486	1446	1416	1526	1597	1780	1877	2211	2588
42	Vrancea	1148	1413	1467	1468	1467	1548	1641	1774	1972	2137	2486

Source: INS database, Wages [32]

17

We note:

y = CTGMLUN; x = PLCTG

We propose an econometric model of simple linear regression such as:

$$y = \beta_0 + \beta_1 x + \varepsilon \tag{1}$$

Replacing these the result is:

CTGMLUN $= \beta_0 + \beta_1 *$ **PLCTG** $+\varepsilon$ where:

- CTGMLUN represents the *Average gross monthly nominal wages* and this is considered the dependent variable;
- PLCTG represents *Total amounts authorized for payment on European funded projects between 2007-May 2017* and this is considered the independent variable (in RON);
- ε – is the random error variable (residue);
- β_0, β_1 are the parameters of the regression model.

The regression line is: $\hat{y}$ = **$b_0 + b_{1*}$ x,** $\tag{2}$

where: b_0 estimates the parameter β_0 , and b_1 estimates the parameter β_1.

Using the least squares method we calculate the parameter values. For the simple linear regression model constructed the following values are obtained:

b_0 = 1901.029435 b_1 = 6.52045169E-07

So, $\hat{y}$ = 1901.029435 + 6.52045169E-07*x

or   CTGMLUN = 1901.029435 + 6.52045169E-07 * PLCTG

Estimations of simple linear regression model parametres MC1 using the least squares method provided by Eviews 7 in table no. 3. Data distribution within data series shows the abnormality of its distribution (Table no.2). The probability from Jarque-Bera probability is 0%, lower than the significance threshold of 5%, so the null hypothesis for normal distribution is rejected, Kurtosis >3, Skewness >0 with an asymetrical distribution oriented to the right side.

Table no. 2. Data regarding data distribution in data series according to variables

	CTGMLUN	PLCTG	RESID
Mean	2032.444	1.52E+08	3.07E-13
Median	1897.000	1.10E+08	-134.6197
Maximum	4497.000	1.24E+09	1731.615
Minimum	1378.000	6199.940	-545.2537
Std. Dev.	497.4381	1.69E+08	437.9541
Skewness	1.273576	1.976019	1.364959
Kurtosis	5.055140	8.829095	4.681463
Jarque-Bera	170.9390	770.8192	159.7648
Probability	0.000000	0.000000	0.000000
Sum	778426.0	5.68E+10	1.17E-10
Sum Sq. Dev.	94523865	1.06E+19	71351016
Observations	383	373	373

Source: Results from processing with Eviews 7

Table no. 3. Estimations of simple linear regression model parametres using the least squares method in MC1 model

Dependent Variable: CTGMLUN ; Method: Least Squares				
Included observations: 373 ; Excluded observations: 10				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1901.029	30.57936	62.16708	0.0000
PLCTG	6.52E-07	1.35E-07	4.845676	0.0000
Adjusted R-squared	0.056988	S.D. dependent var		451.6006
S.E. of regression	438.5440	Akaike info criterion		15.01014
Sum squared resid	71351016	Schwarz criterion		15.03117
Log likelihood	-2797.392	F-statistic		23.48058
Durbin-Watson stat	1.074492	Prob(F-statistic)		0.000002

Source: Results from processing with Eviews 7

Test for the validity of the regression model [33] has to be operated:
- the null hypothesis is determined: H_0: the model is not valid.
- the alternative hypothesis is established: H_1: the model is valid;
- the test F is calculated:

By testing the validity of the regression model, it is found that $F_{calculated} = 23.48058$. So, $F_{calculated} = 23.48058$ (Figure 3). Then we compare $F_{calculated}$ for k = 1 and a significance threshold $\alpha = 5\%$ with: $F_{\alpha; k; n-k-1} = F_{0.05; 1; 371} = 3.86665$; These are calculated using Excel:
$F_{0.05; 1; 371} = \text{FINV}(0.05,1,371) = 3.86665$; It is noted:
$F_{calculated} = 23.48058 > 3.86665 = F_{0.05; 1; 371}$

prob(F-statistic) = 0.000002 <0.05 $\Rightarrow$ So, the null hypothesis H_0 is rejected at a significance threshold of 5% and the alternative is accepted, so the ***MC1 model is valid***.

The estimated value of the determination ratio (R-squared) $R^2 = 0.059523$ shows that in the constructed model the variation of the independent PLCTG variable values explains 5.95% of the variation of the CTGMLUN dependent variable.

In **conclusion**, in the case of the MC1 model, for a significance threshold of 5%, *the model is valid* and the variation of the independent PLCTG variable values explains 5.95% of the variation of the dependent CTGMLUN variable. The line slope $b_1 = 6.52E\text{-}7$ shows that if the value of the independent variable (PLCTG) changes by RON 1,000,000, then the CTGMLUN dependent variable changes in the same way, on an average of RON 1901.089 in the same way. In other words, there is a correlation that shows that the amounts paid for projects accessed by organizations in different counties positively influence the gross wages of local community's members in order to increase them.
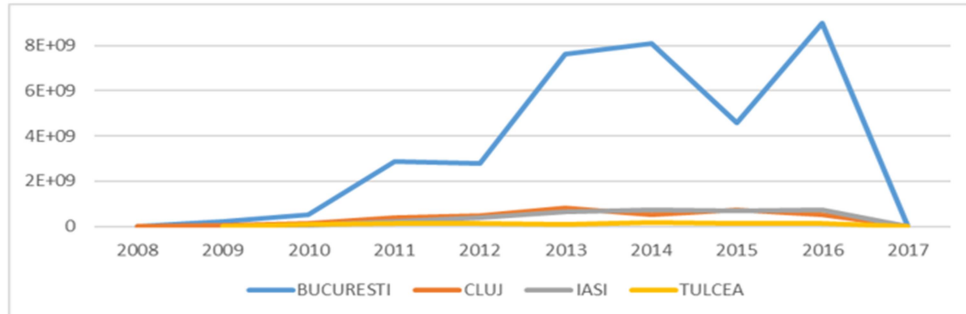
Figure 2. Chart on the evolution of authorized payments for 2008-2017

The graphical representation shows the high level of projects accessing in Bucharest Ilfov area (figure 2), compared to the largest cities of the country (Iasi, Cluj).

b) **MC2** - A linear regression model that verifies whether there is a correlation between *Local Public Passenger Transport* (PASAG) and *Total Authorized Payments on European-funded projects between 2007 and May 2017* (VALPASG).

The total data included as well the specific data for year 2017 (table no. 4), as there was data corresponding to this period on the *Local Public Passenger Transport* [34]. We have taken into account this sustainable development indicator, defined by the INS in the "Transport" category, in order to show whether payments made on European funded projects directly affect the public passenger transport within those communities. We point out that in this model we took into account the amount authorized for the payment of cumulated projects for Bucharest and Ilfov, as the data regarding the passengers were incorporated in those for Bucharest. We obtained a data series with 374 values, out of which 5 were excluded.

Table no. 4. Local public passenger transport   thousands of passengers

Judet/An	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Alba	8004	7875	20801	21557	7808	5772	5466	5394	5395	5973
Arad	32869	22273	23255	21382	23620	19764	21338	18236	16971	15765
Arges	25832	25534	25735	22752	25465	27286	26648	26759	27443	31654
Bacau	25187	13665	11809	10320	10864	10043	8729	8535	8522	8472
Bihor	67790	58999	58816	58357	55143	52217	53288	47223	48156	47447
Bistrita Nasaud	3127	3545	3513	3768	3886	3977	3884	4313	4308	4170
Botosani	3531	3543	2371	2563	3074	3059	3098	2795	2517	2451
Braila	41568	47070	44451	39458	31599	32268	33152	35653	35191	32878
Brasov	64076	58382	59099	54539	52587	49206	49147	44695	76050	100030
Bucuresti	972671	966267	969585	939750	929203	914907	962076	778731	619066	606779
Buzau	4890	4435	5584	5439	4985	4114	5779	5257	6191	5553
Calarasi	3170	3927	5449	1301	2983	1784	837	594	544	1783
Caras-Severin	9305	6463	6369	6118	6814	5857	5268	5528	5879	5925

20

Cluj	155141	157049	168184	165718	160035	176828	187933	201161	202941	203665
Constanta	78947	72823	64648	58845	56907	55167	54271	55118	54768	52593
Covasna	1306	1443	2005	1326	1420	1311	1617	1521	962	860
Dolj	117848	60464	58368	50837	38386	52231	57902	56660	58922	68213
Dambovita	2573	3573	7321	1502	1722	1394	2030	2394	3200	3740
Galati	63678	53841	48312	45329	39227	38699	39464	39488	49965	56424
Giurgiu	2083	2001	833	896	1289	1780	1240	1233	1238	1250
Gorj	4403	5870	3124	4942	5105	4347	4160	4274	4729	4075
Harghita	233	290	356	404	421	457	446	453	456	488
Hunedoara	6485	4220	3415	3648	2936	2747	2818	1989	2450	1926
Ialomita	3531	3209	3100	3436	4492	2169	2103	2191	1904	1865
Iasi	124734	138648	133281	133221	131733	142973	137952	149814	153774	164573
Ilfov	-	-	-	-	-	-	-	-	-	224
Maramures	31680	29422	20264	17141	18875	21727	25060	28923	28355	28417
Mehedinti	2942	2666	1590	1238	1003	763	576	475	289	207
Mures	33231	33125	33341	36808	37422	38400	40413	42429	49923	48679
Neamt	8080	5238	4625	3444	4426	4580	4516	4397	4042	4599
Olt	2885	2303	2540	3240	4885	5256	1423	1602	4082	4430
Prahova	78858	81419	82792	83019	83702	82241	261050	285441	151356	117992
Salaj	13459	12764	12588	12096	11743	12051	11979	11900	11962	13190
Satu_Mare	7930	7135	5553	7018	7021	7010	7999	7990	7799	7839
Sibiu	42325	49956	51890	37591	40771	37750	37777	40046	40365	39665
Suceava	11598	12210	11090	11482	10240	10900	10617	10039	12630	13760
Teleorman	1725	1231	1378	1439	1344	1484	1377	889	815	772
Timis	91970	106471	141327	101402	75190	77413	73471	71964	160321	163284
Tulcea	5558	5306	5186	4017	2879	4217	3849	3614	3392	3077
Vaslui	4723	7104	6487	5387	5557	5391	5051	5310	6508	7552
Vrancea	3370	3267	2973	3062	3130	2969	2656	2616	2550	2476
Vilcea	4159	4578	3792	3925	4184	4562	3956	3997	4142	3171

Source: INS database, Transport [34]

Notes: y = PASAG; x = VALPASG

Similarly, to MC1 the simple linear regression econometric model MC2 is developed and, replacing these, the result is: **PASAG = β_0 + β_1* VALPASG +ε**
where:

- PASAG represents *Local Public Passenger Transport*, expressed in thousands of people and this is considered the dependent variable;
- VALPASG represents *Total amounts authorized for payment on European-funded projects between 2007 and May 2017* and this is considered the independent variable (expressed in RON);
- ε – is the random error variable (residue);
- β_0, β_1 are the parameters of the regression model.

The regression line is: $\hat{y}$ = b_0 + b_1* x,   where:

b_0 estimates the parameter β_0 , and b_1 estimates the parameter β_1.

The parameter values are calculated using the least squares method. For the simple linear regression model constructed the following values are obtained:

b_0 = 16958.45962 ; b_1 = 0.0001396990996 ; So, $\hat{y}$

=16958.45962+0.0001396990996*x

or   PASAG=16958.45962+0,0001396990996*VALPASG

Estimations of simple linear regression model parametres using the least squares method in MC2 model, Eviews 7 in table no. 6.Data distribution within data series shows the abnormality of its distribution (Table no. 5). The probability from Jarque-Bera probability is 0%, lower than the significance threshold of 5%, so the null hypothesis for normal distribution is rejected, Kurtosis>3, Skewness >0 with an asymetrical distribution oriented to the right side.

Table no. 5. Data regarding data distribution in data series according to variables

	PASAG	VALPASG	RESIDE
Mean	45563.06	2.41E+08	2.58E-11
Median	7018.000	1.12E+08	-18182.62
Maximum	972671.3	8.98E+09	954901.6
Minimum	207.2000	6199.940	-185781.8
Std. Dev.	132745.1	7.97E+08	100665.0
Skewness	6.074809	8.836813	7.027826
Kurtosis	41.39952	86.71781	61.18848
Jarque-Bera	24940.34	114086.0	55095.71
Probability	0.000000	0.000000	0.000000
Sum	16812767	9.00E+10	8.87E-09
Sum Sq. Dev.	6.48E+12	2.37E+20	3.73E+12
Observations	369	374	369

Source: Results from processing with Eviews 7

Table no. 6. Estimations of simple linear regression model parametres using the least squares method in MC2 model

Dependent Variable: PASAG ; Method: Least Squares					
Included observations: 369 ; Excluded observations: 5					

Variable	Coefficient	Std. Error		t-Statistic	Prob.
C	16958.46	5527.562		3.067982	0.0023
VALPASG	0.000140	8.48E-06		16.46769	0.0000
R-squared	0.424931		Mean dependent var		45563.06
Adjusted R-squared	0.423364		S.D. dependent var		132745.1
S.E. of regression	100802.0		Akaike info criterion		25.88511
Sum squared resid	3.73E+12		Schwarz criterion		25.90631
Log likelihood	-4773.803		F-statistic		271.1847
Durbin-Watson stat	0.452079		Prob(F-statistic)		0.000000

Source: Results from processing with Eviews 7

By testing the validity of the regression model, it is found that $F_{calculated} = 271.1847$ So, $F_{calculated} = 271.1847$ (Figure 6). Then we compare $F_{calculated}$ for k = 1 and a significance threshold $\alpha = 5\%$ with: $F_{\alpha; k; n-k-1} = F_{0.05; 1; 367} = 3.866921$
We calculate this using Excel: $F_{0.05; 1; 367} = FINV(0.05,1,367) = 3.866921$; It is noted:

22

$F_{calculated} = 271.1847 > 3.866921 = F_{0.05; 1; 367}$

prob (F-statistic) = 0.000000 <0.05 $\Rightarrow$ So, the null hypothesis H_0 is rejected to a significance threshold of 5% and the alternative is accepted, so ***the MC2 model is valid***.

The estimated value of the determination ratio (R-squared) $R^2 = 0.424931$ shows that in the constructed model the variation of independent VALPASG variable values explains 42.49% of the variation of the PASAG dependent variable.

In **conclusion**, in the case of the MC2 model, for a significance threshold of 5%, *the model is valid*, and the variation of independent VALPASG variable values explains 42.49% of the variation of the PASAG dependent variable. The line slope $b_1 = 0.0001396990996$ shows that if the value of the independent variable (VALPASG) changes by RON 10000, then the PASAG dependent variable changes in the same way, on an average of approximately 17000 passengers/year in the same way. In other words, there is a correlation that shows that the amounts paid for projects accessed by organizations in different counties influence in the same way the local public transport of the local communities.

5. Conclusions

We have shown that any organization, of any type and size, operating on the global market, in the knowledge-based society, besides the economic development of its own business, besides the competitiveness of its efficiency with which it uses all the resources and ensures the quality of the products or services provided, has to implement a range of social and environmental responsibility measures. This means ensuring sustainable development, a development that does not negatively affect the community and the environment in which it operates but, on the contrary, helps to protect the community and the environment, the welfare and the labour security of its own human resources, and all this occurring in a more transparent way. Many organizations implement social responsibility measures through actions and / or voluntary contracts, trying to contribute either to improving living, education, health, work conditions, their own human resources, their families or local communities, or to contribute to the environmental protection, waste collection, recycling, water, soil, air pollution, the introduction of new, innovative technologies in order to obtain new types of energy, new techniques and modern marketing tools, etc.

There is a wide range of actions that fit into the typology of those that can be implemented in order for an organization to "achieve" social responsibility. On the other hand, a multitude of "projects" with European non-reimbursable funding or other types (government funding, cross-border or even research projects) can be accessed and won by various organizations. We have shown that all the funding lines of these types of projects focus on actions that are socially or environmentally responsible. We also state that the introduction of new, innovative and performing

technologies is part of social responsibility measures, as they directly influence the organization's impact on the environment and the community, either by providing better, safer, healthier conditions or by reducing pollutant emissions and residues, either by attracting new highly specialized human resources or by other beneficial effects on the community.

Therefore, an organization whose management will stimulate the access to European-funded projects will provide its own financing for both its own development, resulting in competitiveness on the global market, as well as for the implementation of social responsibility measures. It is not easy; the organizational management will coexist with the managers of the projects currently in implementation, who are responsible for the successful completion of the respective projects. In this case we are talking about the ability of the general manager to communicate, to ensure good conditions for the projects, to collaborate with the project managers in order to ensure their good running and completion.

In order to convince how important it is to access non-reimbursable funds through European projects for organizations of any type, the correlation between the amount of payments made for projects (amounts authorized for payment) during 2007-2017 and the sustainable development indicators for which data by years and counties is available was demonstrated in this research.

Therefore, it was scientifically demonstrated that the amounts received for the projects at county level influenced in a positive way the sustainable development indicators that were taken into consideration: the average gross monthly nominal wages for local communities (in RON); - the local public passenger transport (in thousands of passengers).

As a result, the value increase of these project payments is basically found in the rise of the average gross wages, which is beneficial for all members of the community, but especially for those actually involved in implementing the respective projects. Concerning the public transport, the project payments are seen in the increase of the number of passengers in local public transport, which is especially beneficial for environment, which means either the transport was improved so more passengers use the public transport, or more citizens need to travel more, are more active, as they are involved in the implementation of these projects.

If it was proven how beneficial the European projects are for both the organization and the community or the environment in which it operates, and considering the great difference in accessing these projects in different counties (Bucharest vs. Iasi county, Cluj county, etc.) as can be seen in the chart in figure no. 2, it means that all types of projects, the benefits they bring, as well as the additional training of some specialists in the field (project managers, experts in accessing structural funds, IT project managers, etc.) must be promoted more consistently. The latter must become the specialists to find the idea that corresponds to a real need of a

community, to write the project accepted by an organization, then to coordinate its implementation until it is successfully completed.

The paper has scientifically proven, in this way, a role and motivation for accessing european funded projects and the need to stimulate their use at all levels. Instead of voluntary activities that usually see a limited application, the organization will be able to use european funding through projects in order to achieve these same social measures, that will prove beneficial for organization, for organization's internal existing workforce that will be used in implementing these projects, as well as for the local community or environment. The research can be expanded in order to determine the correlation between the values of these amounts paid for projects with other very important sustainable development indicators, such as: research and development expenditure, education, dropout rate, water treatment plants, environmental protection investments, waste recycling enterprises, health, tourism, etc.

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DATA ANALYSIS ON NON-RESIDENTIAL ELECTRICITY CONSUMPTION BY STATISTICAL AND MATHEMATICAL TECHNIQUES IN VIEW OF DEVISING APPROPRIATE CONSUMPTION STRATEGIES

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Abstract: *The aim of this paper is to analyze, process and interpret, from economic and statistical perspectives, the data regarding the quantity of electric energy, measured at the non-residential consumers' level. Our intention was to track and analyze the electric energy consumption level at hourly intervals for a real consumer in Romania. The measurements were carried out in MWh, and collected in databases, in order to facilitate the application of the calculation methods. The results and their interpretations facilitate the scientific substantiation of new policies in order to optimize the electric energy consumption. The statistical and mathematical methods employed represent viable tools in achieving an adequate data analysis on non-residential electricity consumption in view of devising appropriate consumption strategies. These will be transmitted and proposed to the real consumer as scenarios of its analyzed consumption profile. After having experimented several methods for approximating the data repartition, we have concluded that by adjusting the primary data with the estimated normal repartition one obtains the ideal model in the case of hourly electricity consumption of non-residential consumers offering valuable insights regarding the modelling of their consumption patterns.*

Keywords: *data analysis, grouping intervals, optimizing electricity consumption, intervals of variation.*

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Data Availability Statement

Data available on request from the author: The data that support the findings of this study are available from the corresponding author upon reasonable request.

1. Introduction

Our study is based on data regarding the electric energy consumption of a non-residential consumer in Romania. The data that are part of the present study were collected during January-December 2016. The measurements were performed using specialized smart metering devices situated at the nonresidential consumers' locations and stored in databases dedicated to the analyzed field. The measurements sampling was carried out on an hourly basis over the entire period of the calendar year.

The authors' concerns regarding forecasting energy consumption and using the obtained results in reducing it, can be seen in the previous researches that they have done on residential households. In (Oprea, Pîrjan, Căruțașu, Petroșanu, Bâra, Stănică, & Coculescu, 2018) a mixed neural network approach has been used in order to provide an accurate method for forecasting the residential electricity consumption in smart homes complexes, using data recorded by sensors. The developed method was validated and further compiled, the idea being to incorporate it in the IoT cloud solution that was proposed in (Stănică, Căruțașu, Pîrjan, & Coculescu, 2018). The solution here was to optimize the electricity consumption and costs of households, based on analyzing disparate data collected from sensors and home appliances in smart homes.

In Europe, non-residential buildings represent 25% of the total building stock and are considered to be more heterogenous and more complex than residential buildings (Droutsa, Balaras, Dascalaki, Kontoyiannidis, & Argiriou, 2018). Out of these, the retail and wholesale buildings represent the leading sector, with 28% of non-residential stock floor area. However, according to the same paper, the available data and the studies that track energy performance in non-residential buildings are more limited compared to those for households.

Nevertheless, the existing reviews show that the research community is making efforts in this direction. Miller, Nagy, and Schlueter (2018) have done a review of 100 publications that used unsupervised machine learning techniques in order to analyze the performance of non-residential buildings. Most of the publications being reviewed focused on energy performance. The conclusions show that clustering algorithms (particularly k-means clustering) and visual analytics are commonly used, but other procedures and techniques are worth exploring as well.

In a similar study (Ruparathna, Hewage, & Sadiq, 2016), a number of research articles focusing on increasing energy efficiency in commercial and institutional

buildings were reviewed. The study included only articles published in well-reputed journals. Three main approaches in the literature were identified, concentrating on technical, organizational, and behavioral changes. As an outcome of the comprehensive review, the authors proposed a strategy map for improving buildings energy performance, stating that their findings could set the basis for developing national and organizational strategies in this direction.

Other studies focused on identifying the most performant techniques for modelling and forecasting the energy consumption. Tso and Yau (2007) made a comparison between three different techniques for predicting energy consumption: regression analysis, decision tree, neural networks. In order to choose the best one, the authors suggested the idea of developing a platform that implements different models and therefore can assess their prediction performances.

Another article on electrical consumption forecasting methods, authored by Daut et al. (2017), is focusing on both conventional and artificial intelligence methods, comparing the performance of both of them. The article concluded that a hybrid of the two forecasting techniques could lead to better results.

Covering the same topic, Zhao and Magoules (2012) evaluated different models for energy consumption prediction, including statistical, engineering, and artificial intelligence models, and at the same time, emphasized the difficulty of making such predictions, since there are many factors that can influence them and must be taken into consideration.

Perez-Chacon, Talavera-Llames, Martinez-Alvarez, and Troncoso (2016) analyzed a big time series of data collected from the electricity consumption of two university buildings over a period of three years. For establishing patterns, the authors used the distributed version of k-means clustering algorithm for Apache Spark, for which they also tested its computational performance.

For the residential sector, the prediction of energy consumption is modelled in Fumo and Biswas (2015), which used simple and multiple linear regression analysis on hourly and daily collected data from a household. Also this paper promotes the idea of developing a user-friendly software for modelling and forecasting the energy consumption.

Another research direction aims to identify the factors that influence the electric energy consumption. In Ma et al. (2017) the authors perform a case study on a number of public non-residential buildings in China, by analyzing their energy consumption patterns and the factors influencing it. Similarly, Gutiérrez-Pedrero, Tarancon, del Rio, and Alcantara (2018) also focused on determining the main factors influencing electricity consumption of non-residential sector, their results showing that higher technological progress and higher electricity retail prices lead to a reduction of the consumption intensity.

By analyzing the existing body of knowledge, one can identify a necessity, a clear need for modeling the variation of non-residential electricity consumption covering various time intervals in order to identify specific consumption profiles. Therefore, the main objective of this analysis was to find the variation mode of the electric energy consumption for various time intervals as shown in Sections 2 and 3, in order to identify specific consumption profiles. Our research was aimed at identifying the main statistical sizes for modelling the collected data. For a more accurate analysis, collected data were stored in a table having the fields: month, day-number, hour-number, and energy-consumption-MWh.

The reminder of the paper is structured as follows: Section 1 presents the statistical and mathematical methods and techniques for analyzing data of electric energy consumption, Section 2 contains the processing and results, in Section 3 is presented the data analysis by grouping on intervals of variation, Section 4 contains the computer model for data analysis, followed by the Conclusions Section.

2. Statistical and mathematical methods and techniques for analysing data of electric energy consumption

Since the data in this study are linearly distributed at one-hour intervals over a calendar year, we have tracked their statistical behaviour in the case of grouping on equal intervals of variation. The statistical and mathematical methods and techniques applied in the present study allowed us to develop a specific computer model, in which we identified:

- The amplitude of variation of the general overall consumption (*C*) on an hourly basis during January-December 2016, using the equation (1):

$$A = C_{max} - C_{min}. \tag{1}$$

The number of groups, using Sturges' formula (Sturges, 1926; Scott, 2009)

$$k = [1 + 3.322/lg\ n], \tag{2}$$

where *n*, in this case, has the value of 24, i.e. the number of hours analyzed on a daily basis.

- The size of the grouping interval, denoted by *h*, which represents the ratio between the consumption amplitude and the identified *k* number of groups, was determined, the calculation formula being equation (3)

$$h = A/k. \tag{3}$$

Based on the statistical and economic support for the repartition of the value intervals samples, we used rounded intervals in order to carry out the calculations. Under these conditions, we identified the size of the grouping interval as 91 MWh.

- Starting from the minimum value of the determined sum and the size of the identified grouping interval, we constructed the vectors of the minimum and maximum limits of the grouping intervals. Based on these vectors, the grouping of the data on the electric energy consumption was made, in order to build the statistical indicators specific to the analysis of the value series on intervals of variation. The vectors of the grouping intervals limits (*L*) are input variables in the mathematical-computer model presented in Section 4.

$$L_{min} = [C_{min}, C_{min} + h, \dots, C_{min} + (k-1)*h),$$
$$L_{max} = [C_{min} + h, C_{min} + h, \dots, C_{min} + (k-1)*h].$$

- The center of each analysed interval was identified as the simple arithmetic mean of the interval bounds, according to equation (4):

$$c_i = (c_{imin} + c_{imax})/2. \qquad\qquad (4)$$

- The absolute frequency of each group (n_i) was calculated; this is equal to the number of statistical units having the value of the characteristic greater than or equal to the lower limit of the interval and less than or equal to the upper limit.

Subsequently, based on the absolute frequencies, the ascending and descending cumulative absolute frequencies at each group level were identified. Similarly, ascending and descending cumulative relative frequencies could be determined. The absolute, relative, and cumulative frequencies represent the support that allows the identification of the overall behaviour of the distribution of values in collectivity, especially of the central tendency to normality of the frequency repartition.

Systematization of data on electric energy consumption in 11 equal intervals of variation, as well as the statistical and economic interpretation and construction of histograms (Scott, 1979) and curves of cumulative frequencies, are presented in the results section.

When applying the selection method, the most common situations are those in which the theoretical repartition law is normal *N* (*m*, *σ*) (Purcaru, 1997). For selections from statistical populations with normal repartitions, the probability theory states the following results:

Theorem 1. If $\{X_1, X_2, \dots, X_n\}$ is a selection of volume *n* in a statistical population characterized by a random variable that follows a normal distribution $N(m, \sigma)$, then the selection mean has a normal repartition of mean *m* and standard deviation $\frac{\sigma}{\sqrt{n}}$, i.e.:

$$\bar{X} = \frac{X_1 + X_2 + \cdots + X_n}{n} \in N\left(m, \frac{\sigma}{\sqrt{n}}\right). \tag{5}$$

Theorem 2. If $X_1, X_2, \ldots, X_n$ are normally distributed random independent variables, $X_k \in N(m_k, \sigma_k)$, $k \in \overline{1, n}$, and $\alpha_1, \alpha_2, \ldots, \alpha_n \in \mathbb{R}$, then the random variable

$$Y = \sum_{k=1}^{n} \alpha_k X_k \in N\left(\sum_{k=1}^{n} \alpha_k m_k, \sqrt{\sum_{k=1}^{n} \alpha_k^2 \sigma_k^2}\right). \tag{6}$$

In particular, if $\alpha_1 = \alpha_2 = \cdots = \alpha_n = \frac{1}{n}$, we have:

$$Y = \frac{\sum_{k=1}^{n} X_k 1}{n} \in N\left(\frac{\sum_{k=1}^{n} m_k}{n}, \frac{\sqrt{\sum_{k=1}^{n} \sigma_k^2}}{n}\right). \tag{7}$$

From the estimation theory (Popescu, 1993), we know that the selection mean $\bar{X} = \frac{X_1 + X_2 + \cdots + X_n}{n}$ is a fixed, consistent and efficient estimator for the mean m of the general statistical population, and the dispersion of selection $S^2 = \frac{\sum_{k=1}^{n}(X_k - \bar{X})^2}{n}$ represents a sufficiently consistent estimator for the dispersion σ^2 of the general population (Popovici, 2015). In case of small volume selections, the dispersion σ^2 is evaluated with the corrected dispersion of selection, given by the formula $s^2 = \frac{\sum_{k=1}^{n}(X_k - \bar{X})^2}{n-1}$.

3. Processing and results

For reasons related to the rigor of the statistical analysis, as well as to facilitate the calculation process for limiting the field of error propagation (measurement, calculation, method), we used calculation approximations in certain data processing and analysis. When processing the data, we have used the following hardware configuration: the ASUS Rampage V Extreme motherboard, the central processing unit Intel i7-5960x with 32 GB DDR4 quad channel and the GeForce GTX 1080 TI NVIDIA graphics card. The software configuration that we have used consists in the Windows 10 Educational Version 1803 operating system. Starting from the initial data underlying the present study, and from the mathematical model in section 1, we have calculated in Table 1 statistical and mathematical indicators for data systematization.

Table 1. Statistical and mathematical indicators for data systematization

Intervals of variation of electric energy consumption	Value of class 1	Value of class 2	Number of hours frequency	Percentage	Center of interval	Ascending cumulative absolute frequencies	Descending cumulative absolute frequencies
887.02 – 978.02	887.02	978.02	5	0.21	932.52	5	24
978.02 – 1069.02	978.02	1069.02	2	0.08	1023.52	7	19
1069.02 – 1160.02	1069.02	1160.02	0	0	1114.52	7	17
1160.02 – 1251.02	1160.02	1251.02	1	0.04	1205.52	8	17
1251.02 – 1342.02	1251.02	1342.02	1	0.04	1296.52	9	16
1342.02 – 1433.02	1342.02	1433.02	1	0.04	1387.52	10	15
1433.02 – 1524.02	1433.02	1524.02	1	0.04	1478.52	11	14
1524.02 – 1615.02	1524.02	1615.02	0	0	1569.52	11	13
1615.02 – 1706.02	1615.02	1706.02	2	0.08	1660.52	13	13
1706.02 – 1797.02	1706.02	1797.02	4	0.17	1751.52	17	11
1797.02 – 1888.02	1797.02	1888.02	7	0.29	1842.52	24	7

Table 1 contains the main numerical characteristics that allow the statistical and mathematical systematization of the recorded values for the intervals of variation of electric energy consumption, number of hours frequency, ascending cumulative absolute frequencies, descending cumulative absolute frequencies etc.

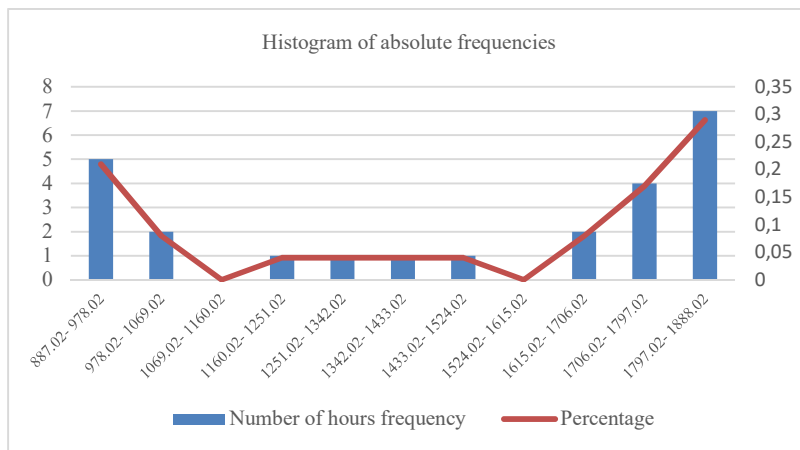The statistical results led to the histograms represented by the Figures 1 and 2.

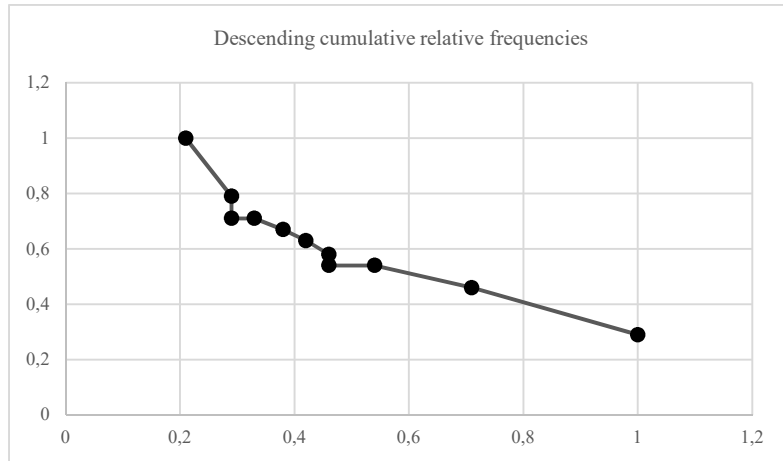Figure 1. Histogram of the absolute frequencies calculated based on data in Table 1

Figure 2. Descending cumulative relative frequencies

Figure 1 highlights the fact that since there are two grouping intervals with null absolute frequency, then it is necessary to remake the systematization.

Based on the experience gained from the analysis of previous studies in the electric energy field, we have reduced the number of grouping intervals to avoid the excessive fragmentation of the processed statistical collectivity. Thus, by using 6 grouping intervals corresponding to an amplitude of $h = 180$, Table 2 resulted.

Table 2. Statistical and mathematical indicators for amplitude $h=180$

Intervals of variation of electric energy consumption	Absolute frequencies (number of hours)	Relative frequencies (percentage)	Ascending cumulative absolute frequencies	Descending cumulative absolute frequencies	Ascending cumulative relative frequencies
887.02 – 1067.02	6	0.25	6	24	0.25
1067.02 – 1247.02	2	0.08	8	18	0.33
1247.02 – 1427.02	2	0.08	10	16	0.42
1427.02 – 1607.02	1	0.04	11	14	0.46
1607.02 – 1787.02	6	0.25	17	13	0.71
1787.02 – 1967.02	7	0.29	24	7	1

By analyzing the results in Table 2, one can observe that the possibilities of the occurrence of null absolute frequencies were eliminated.

Corresponding to the values calculated in Table 2, histograms for absolute frequencies, relative frequencies, and ascending cumulative relative frequencies are shown in Figures 3 and 4.
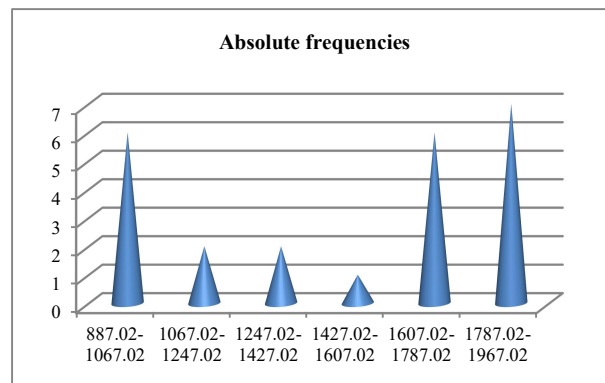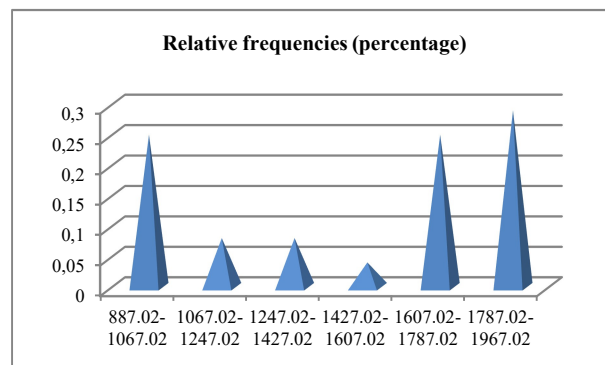
Absolute frequencies

Figure 3. Absolute frequencies (number of hours)

Relative frequencies (percentage)

Figure 4. a – Relative frequencies

Ascending cumulative relative frequencies
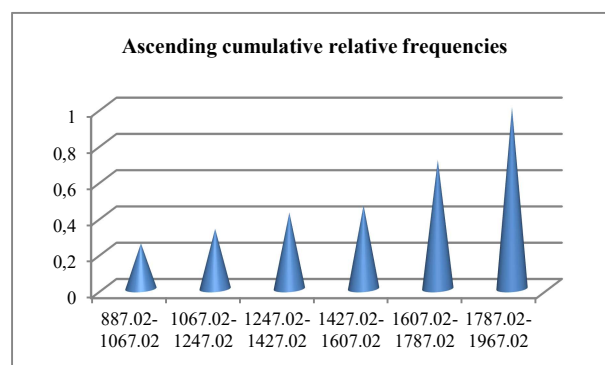
Figure 4. b – Ascending cumulative relative frequencies

The charts of histograms (Feedman & Diaconis, 1981) and cumulative frequencies indicate that the distribution of hourly electric energy consumption within a full 24-hour horizon has a normal tendency. Our research aimed, for the argumentation of the normality hypothesis of theoretical repartition, to apply a concordance test, by which we verified the possibility of concordance between the data provided on the experience and the hypothesis made on the form of the theoretical repartition law.

For the application of the concordance tests, the selection repartition function is determined in advance, based on the observed data, grouped by intervals and expressed using the relative frequencies and the cumulative relative frequencies. Subsequently, the selection repartition function is compared with the hypothetical theoretical repartition of the general population (Poisson, binomial, exponential, normal repartition). The literature mentions several methodologies (Sivilevičius, Vislavičius & Bražiūnas, 2017; Teodorescu, 2015; Ahmad, Ahmed, Vveinhardt & Streimikiene, 2016) for the implementation of these studies: Pearson's χ^2 test, Kolmogorov-Smirnov's test.

In the case of normal repartition, Kolmogorov is one of the most used tests of concordance. According to this test, the selection repartition function of the observed data noted as $F_n^*(x)$ is compared to the hypothetical theoretical repartition of the general population noted as $F_0(x)$:

- if $max|F_0(x) - F_n^*(x)| < \frac{\lambda_\alpha}{\sqrt{n}}$, then there is concordance between $F_n^*(x)$ and $F_0(x)$ and the hypothesis H_0: $F(x) = F_0(x)$ is accepted;

- if $max|F_0(x) - F_n^*(x)| \geq \frac{\lambda_\alpha}{\sqrt{n}}$, then there is no concordance between $F_n^*(x)$ and $F_0(x)$ and the hypothesis H_0 is rejected,

where, to the given significance threshold α it corresponds, by the formula $K(\lambda_\alpha) = 1 - \alpha$, a value of λ_α, such that, for a given *n* volume of the selection, we identify the value λ_α (Popescu, 1993).

Starting from the observations regarding the annual electric energy consumption on an hourly basis, grouped on intervals of variation and expressed by means of the relative frequencies and ascending relative cumulative frequencies, we checked the normality hypothesis of the repartition of the observed values.

The concordance hypothesis was created with the following formula:

$$H_0\text{: } F(x) = F_0(x, m, \sigma^2),$$

where F_0 is the normal repartition function of parameters *m* and σ^2 , which are unknown, but estimated by:

- the selection mean $\bar{X} = \frac{X_1 + X_2 + \cdots + X_n}{n}$,

respectively

- the dispersion of selection $s^2 = \frac{\sum_{k=1}^{n}(X_k - \bar{X})^2}{n-1}$.

We calculated the differences $F_0(x) - F_n^*(x)$ in Table 3 where: X successively takes the values of the right bounds of the intervals of variation.

Table 3. Calculation of the differences $F_0(x) - F_n^*(x)$

Intervals of variation of the electric energy consumption	Interval right limit (x)	Number hours frequency (n_k)	Relative frequencies $\left(\frac{n_k}{n}\right)$	Ascending cumulative relative frequency (F_n^*)	Reduced standardised values $\left(\hat{z} = \frac{x - \bar{x}}{s}\right)$	Laplace values $\Phi(\hat{z})$	Reduced normal repartition function $F_0(x) = \frac{1}{2} + \Phi(\hat{z})$	$F_0(x) - F_n^*(x)$
1	2	3	4	5	6	7	8	9
887.02 – 1067.02	1067.02	6	0.25	0.25	-1.05	-0.35314	0.14686	-0.10314
1067.02 – 1247.02	1247.02	2	0.08	0.33	-0.58	-0.21904	0.28096	-0.04904
1247.02 – 1427.02	1427.02	2	0.08	0.42	-0.12	-0.04776	0.45224	0.03224
1427.02 – 1607.02	1607.02	1	0.04	0.46	0.35	0.13683	0.63683	0.17683
1607.02 – 1787.02	1787.02	6	0.25	0.71	0.82	0.29389	0.79389	0.08389
1787.02 – 1967.02	1967.02	7	0.29	1	1.28	0.39973	0.89973	-0.10027
Total		24						

As can be seen in Table 3, in column 4 we calculated the relative frequencies corresponding to each interval, and in column 5 the cumulative relative frequencies, i.e. the values of the repartition function of the selection $F_n^*(x)$. For calculating the values of the theoretical repartition function $F_0(x)$ in column 8, we calculated the reduced standardised selection values (column 6) and the corresponding values of the Laplace function (column 7).

To test the H_0 concordance hypothesis, in column 9 we calculated the differences $F_0(x) - F_n^*(x)$ from which we obtained $max|F_0(x) - F_n^*(x)| = 0.17683$.

Considering the significance threshold α = 0.005, we correspondingly found $\lambda_\alpha = 1.358$, resulting that $\frac{\lambda_\alpha}{\sqrt{n}} = 0.2772$.

Since $max|F_0(x) - F_n^*(x)| = 0.17683 < 0.2772$, then the repartition normality hypothesis in Table 3 is accepted.

Therefore, we can assume that the evolution of the annual electric energy consumption has a normal repartition, with the parameters $m = 1471.942625$ and $\sigma = 385.7714135$. This allowed us to use the theoretical normal repartition constructed beforehand, in order to evaluate the probability of the electric energy consumption, for any real value of it between the minimum and maximum limits of the possible field of variation.

The adjustment of the observation data based on this repartition has led to the results in Table 4 and the histogram in Figure 5.

Table 4. Adjusted values

| Hour	Hourly annual consumption x	Hourly annual standardised consumption $(x-m)/\sigma$	Normal standardised distribution of the consumption $N(0,1)$
1	981.487	-1.27136332	0.101799713
2	942.031	-1.373641505	0.084776502
3	920.86	-1.428521155	0.076570955
4	899.077	-1.484987236	0.068773603
5	887.02	-1.516241496	0.064729149
6	955.821	-1.337894948	0.090465342
7	1286.612	-0.480415652	0.315465934
8	1418.438	-0.138695152	0.444845524
9	1671.148	0.516381899	0.697206147
10	1741.403	0.698497518	0.757566945
11	1779.658	0.797662461	0.787466803
12	1830.843	0.930344661	0.82390367
13	1859.225	1.003916728	0.842290623
14	1876.665	1.049124847	0.852939669
15	1883.546	1.066961834	0.857005465
16	1863.549	1.015125438	0.844976981
17	1837.069	0.946483752	0.828049047
18	1818.669	0.898787113	0.815616967
19	1764.055	0.757216229	0.775539836
20	1711.728	0.621573726	0.732888899
21	1636.821	0.427399152	0.665455688
22	1475.068	0.008101624	0.503232045
23	1218.669	-0.656538085	0.255738986
24	1067.161	-1.049278435	0.147024994

Distribution of the adjusted values
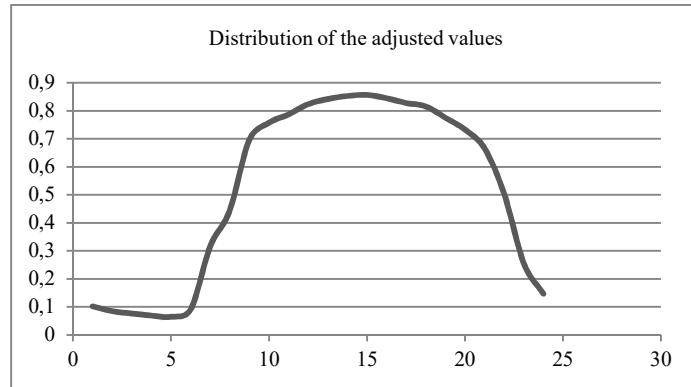
Figure 5. Distribution of the adjusted values

4. Data analysis by grouping on intervals of variation

The results of the analysis and the grouping of data on intervals of variation are presented in Table 5 and were based on the estimation of the parameters (mean and dispersion) of the theoretical normal repartitions that approximate the selection repartitions. Within the intervals of variation $(I_1..I_6)$ obtained by the data analysis in Table 2, we calculated the selection mean and the dispersion for each set of selection data.

Table 5. Intervals of variation of energy consumption I_1 = [887,02-1067,02]

Interval	hour	X selection mean	stdev
I_1 = [887.02 – 1067.02]	1	81.79058333	8.806464
	2	78.50258333	8.862347
	3	76.73833333	7.876533
	4	74.92308333	7.823663
	5	73.91833333	7.611099
	6	79.65175	7.912416
I_2 = [1067.02 – 1247.02]	23	101.5558	17.4152642
	24	88.93008	12.5056917
I_3 = [1247.02 – 1427.02]	7	107.2176667	9.460543232
	8	118.2031667	11.19081416
I_4 = [1427.02 – 1607.02]	22	122.9223	18.3328563
I_5 = [1607.02 – 1787.02]	9	139.2623	15.09059277
	10	145.1169	17.40209719
	11	148.3048	19.02851054

	19	147.0046	23.7693493
	20	142.644	23.10819802
	21	136.4018	21.54638284
	12	152.5703	21.15601997
	13	154.9354	22.50710768
	14	156.3888	24.16318601
$I_6 = [1787.02 – 1967.02]$	15	156.9622	24.87144687
	16	155.2958	25.09644122
	17	153.0891	25.07614269
	18	151.5558	25.21181051

As a result of researching various methods for approximation of data repartition, we identified that the adjustment of primary data by estimated normal repartition provides the ideal model applied to the hourly electric energy consumption for the January-December time series, as it can be seen in Table 6 for the interval of variation $I_1 = [887.02–1067.02]$, Table 7 for intervals $I_2 = [1067.02–1247.02]$, $I_3 = [1247.02–1427.02]$, and $I_4 = [1427.02–1607. 02]$; Table 8 for $I_5 = [1607.02–1787.02]$ and Table 9 for the interval of variation $I_6 = [1787.02–1967.02]$.

The histogram of data grouped over the 6 determined intervals is shown in Figure 6.
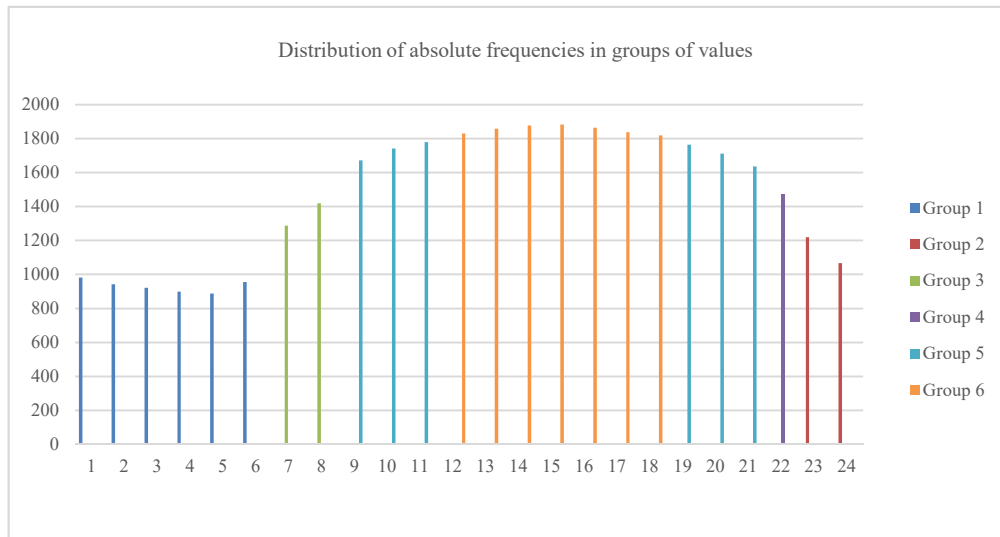
Figure 6. Distribution of absolute frequencies in groups of values

Table 6. Intervals of variation of the electric energy consumption I₁= [887.02-1067.02]

$I_1 = [887.02 - 1067.02]$						
	Hour					
Month	1	2	3	4	5	6
Jan	0.355	0.394	0.437	0.491	0.438	0.412
Feb	0.138	0.155	0.142	0.139	0.122	0.131
March	0.161	0.174	0.187	0.129	0.171	0.159
April	0.184	0.168	0.132	0.135	0.117	0.124
May	0.265	0.274	0.281	0.266	0.264	0.255
June	0.908	0.897	0.885	0.862	0.88	0.849
July	0.968	0.968	0.966	0.962	0.955	0.949
Aug	0.926	0.935	0.934	0.934	0.941	0.948
Sept	0.549	0.542	0.528	0.502	0.518	0.544
Oct	0.428	0.435	0.5	0.6	0.53	0.567
Nov	0.394	0.378	0.431	0.422	0.481	0.595
Dec	0.375	0.313	0.27	0.318	0.337	0.255

Table 7. Intervals of variation of the electric energy consumption I₂, I₃ and I₄.

	$I_2 = [1067.02 - 1247.02]$		$I_3 = [1247.02 - 1427.02]$		$I_4 = [1427.02 - 1607.02]$
	Hour		Hour		Hour
Month	23	24	7	8	22
Jan	0.301	0.304	0.343	0.388	0.347835
Feb	0.136	0.106	0.104	0.112	0.226021
March	0.175	0.122	0.196	0.175	0.2908
April	0.203	0.21	0.146	0.129	0.287687
May	0.259	0.244	0.228	0.214	0.358772
June	0.887	0.874	0.827	0.831	0.18391
July	0.962	0.953	0.953	0.959	0.072961
Aug	0.941	0.909	0.926	0.931	0.115001
Sept	0.643	0.577	0.579	0.478	0.393751
Oct	0.36	0.405	0.606	0.59	0.383884
Nov	0.325	0.341	0.718	0.686	0.392983
Dec	0.47	0.765	0.216	0.316	0.308018

Table 8. Intervals of variation of the electric energy consumption I₅

$I_5 = [1607.02 - 1787.02]$						
	Hour					
Month	9	10	11	19	20	21
Jan	0.343	0.338	0.327	0.327	0.327	0.31

Feb	0.119	0.126	0.126	0.158	0.151	0.14
March	0.222	0.238	0.231	0.214	0.222	0.22
April	0.157	0.174	0.179	0.192	0.185	0.207
May	0.283	0.263	0.267	0.271	0.279	0.301
June	0.856	0.849	0.854	0.873	0.871	0.875
July	0.973	0.977	0.979	0.971	0.971	0.971
Aug	0.94	0.938	0.929	0.944	0.942	0.942
Sept	0.446	0.473	0.521	0.598	0.596	0.604
Oct	0.491	0.445	0.435	0.365	0.392	0.394
Nov	0.526	0.505	0.469	0.432	0.435	0.417
Dec	0.304	0.299	0.307	0.264	0.246	0.238

Table 9. Intervals of variation of the electric energy consumption I_6

$I_6 = [1787.02 - 1967.02]$						
	Hour					
Month	12	13	14	15	16	17	18
Jan	0.301	0.3	0.294	0.3	0.299	0.302	0.309
Feb	0.132	0.142	0.146	0.145	0.15	0.142	0.143
March	0.227	0.225	0.222	0.212	0.213	0.209	0.202
April	0.199	0.206	0.206	0.208	0.212	0.215	0.208
May	0.286	0.289	0.294	0.308	0.309	0.311	0.295
June	0.874	0.874	0.876	0.879	0.882	0.876	0.872
July	0.976	0.976	0.974	0.972	0.971	0.97	0.971
Aug	0.931	0.934	0.935	0.937	0.94	0.942	0.942
Sept	0.558	0.577	0.607	0.618	0.624	0.622	0.612
Oct	0.408	0.383	0.383	0.384	0.364	0.363	0.369
Nov	0.45	0.424	0.415	0.405	0.383	0.389	0.419
Dec	0.274	0.271	0.259	0.25	0.259	0.269	0.275

The normal distribution (Kosareva & Krylovas, 2011) of the hourly electric energy consumption values is confirmed by the graph of the repartition of the adjusted values for Figure 7.
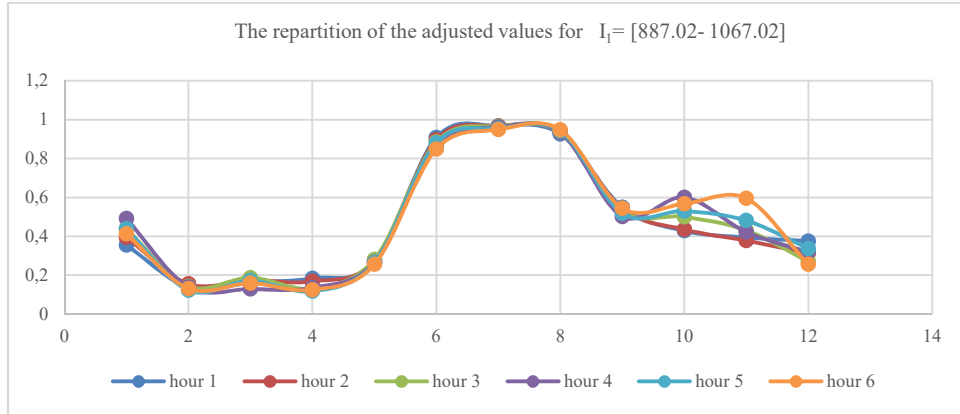
Figure 7. a – the repartition of the adjusted values for I1.
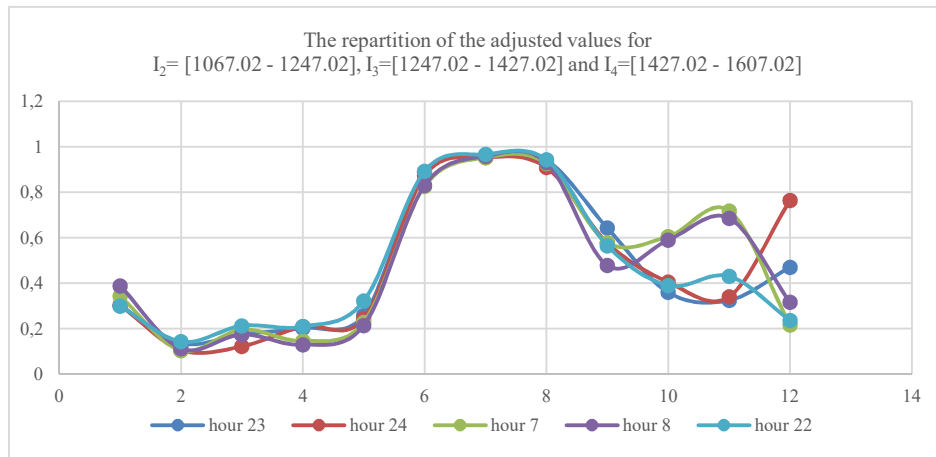
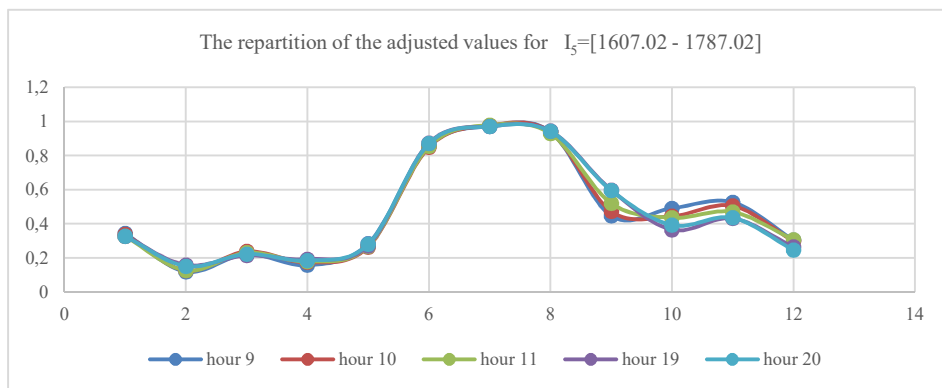Figure 7. b – the repartition of the adjusted values for I_2, I_3, I_4.

Figure 7. c – the repartition of the adjusted values for I_5.
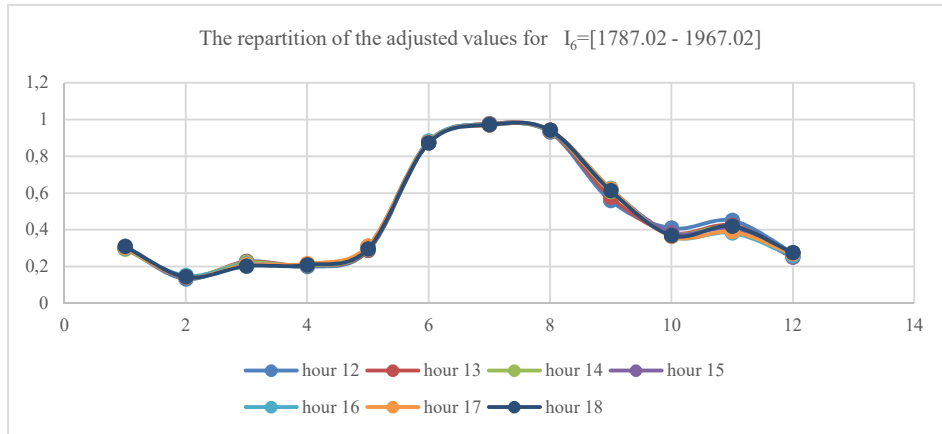
Figure 7. d – the repartition of the adjusted values for I_6.

Figures 7 a-d show that the processing of initial data led to obtaining adjusted values whose distribution corresponds to the normal distribution. This demonstrates the possibility of forecasting the electricity consumption based on the estimated normal distribution.

5. Computer model for analysis

In order to make this study more efficient, we propose the construction of a software system that corresponds to the mathematical support presented in section 1. The functional diagram of the proposed system is presented in Figure 8.

For the modelling and validation module, the analysis and processing techniques are specific to each methodology. The principle of their application is common, and it seeks to specify the form of the theoretical repartition function both in the case when its parameters are known, but also when the parameters are estimated based on the research data.

The decisional situation is characterized by the degree of certainty of the consequences of each formulated alternative. For the choice of decisions, the Electre method was used in situations where there are several possible variants Vi ($i=1,m$) to reach a goal, the evaluation is based on Cj ($j=1,n$) criteria, based on which the possible variants are compared two by two.

Various software for data analysis exist, but the data included in the present study required specific processing, which led to the need to develop our own software application for implementing the mathematical model used in the analysis.

The software application has been developed using a modular approach. Therefore, the "Data collection" module offers the possibility to collect, store, process, and archive data in a database. The "Modelling" module provides functionalities to

model data, obtain decisions based on the modeled data, and achieve forecasts of the electricity consumption for non-residential consumers. The "Statistical indicators" module provides the possibility to compute the statistical indicators, to build and process grouping intervals. The "Mathematics of data" module implements the statistical tests and methods for verifying and validating the statistical repartitions, used for approximating the repartitions of the experimental data. It offers the possibility to use mathematical techniques in order to model data, to test them based on the Kolmogorov test, and to build assignment functions.

Functional diagram
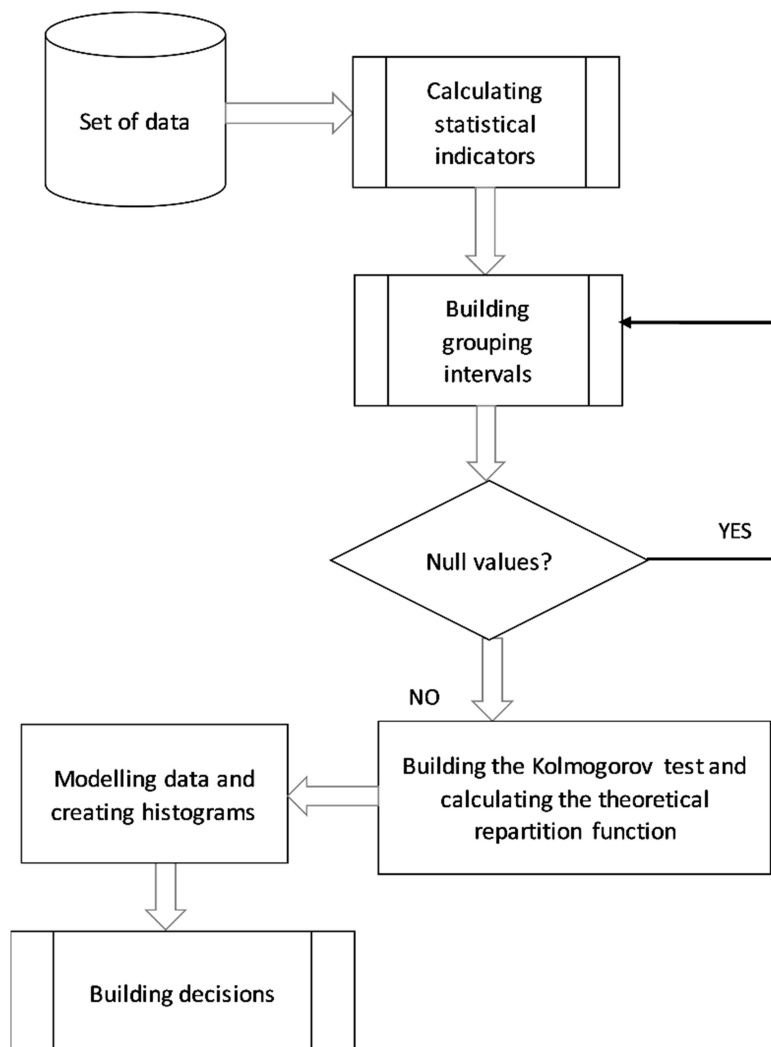
Figure 8. Functional diagram

45

6. Conclusions

Assuming that the analyzed phenomenon keeps its trend of evolution, the estimated normal repartition can be used to forecast the electric energy consumption. The data sampling allowed a detailed analysis that reflects as accurately as possible the actual process studied for the analyzed consumer data. As a result of the research of various methods for approximating the data repartition, we have identified that the adjustment of the primary data with the estimated normal repartition provides the ideal model for hourly electric energy consumption for the January-December time series. Using the normal theoretical repartition obtained, we can assess the likelihood that the electric energy consumption varies continuously in the analyzed intervals. Furthermore, in order to model the data, it is necessary to use a dedicated computer system that contains specific analysis functions, which continuously adapt for new input data as well.

Acknowledgements

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BUSINESS ENGLISH LITERACY AND LEARNING BY RESORT TO CLOUD-BASED TOOLS
MEASURING INTERMEDIATE STUDENTS' LEVEL OF ENGAGEMENT

Mariana COANCĂ[1]

Abstract: *This article aims to develop a comprehensive understanding of Business English literacy and learning through cloud-based tools. It outlines the scholars' approach to literacy and showcases the traditional methods for language teaching integrated in our methodology for business English literacy through visuals and mobile learning. Furthermore, we analyze the use of technology in the classroom to improve our students' phonics, fluency, vocabulary and reading comprehension and whether it enables us to assess the level of student engagement more effectively. We conclude that videos and mobile apps influence our students' attitude about learning in a positive way in the sense that they became motivated and self-confident. We increased their level of engagement by becoming facilitators and transforming the learning environment into a creative and flexible classroom to keep them engaged.*

Keywords: *Business English, literacy, intermediate students, cloud-based tools, engagement*

1. Introduction

Research has shown that literacy skills in a variety of domains increase the students' potential for employability and integration in a multicultural organization. According to The Merriam Webster Dictionary, the term *literacy* is "the quality or state of being literate". The Cambridge Dictionary provides two entries for the term *literacy*: the first one is "the ability to read and write" and the second one is "knowledge of a particular subject, or a particular type of knowledge".

The first expert report of the EU level was published in September 2012. It includes five chapters on the level of functional illiteracy in Europe and recommendations for reducing it. The vision of the expert group is summarized in the following statements:

• All citizens of Europe must have literacy skills that enable them to reach their aspirations at the individual, family, professional and social levels;

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• Improving literacy skills leads to innovation, prosperity and social cohesion, increasing the standard of living of the population, reducing unemployment and active participation in society;

• EU member states need to understand that it is their legal obligation to provide all the support needed to achieve the group's vision.

Since the technological change occurs at an exponential rate, our society has increasing demands on the ability of the person to cope with the challenges of an extremely dynamic and globalised world, thus the concept of literacy encompass three dimensions which are outlined by the Romanian Association for Literacy:

• Basic literacy - the person's ability to read and write, which generates self-confidence and motivation for further development.

• Functional literacy - the person's ability to read, write, understand and apply in practice the information extracted from the text, which allows him/her to function in society, at home, at school and at work.

• Multiple literacy - the person's ability to use reading and writing skills to produce, understand, interpret and critically evaluate multimodal texts (texts that use multiple semiotic systems).

Building on previous research conducted by experts who have worked on various European projects on functional literacy, we use the concept of literacy into foreign language acquisition thereby we define the Business English literacy skills as follows:

• The student's ability to read an economic text;

• The student's ability to understand the respective text;

• The student's ability to make connections with what he or she saw and knew before reading the text;

• The student's ability to formulate a point of view on what he/she has seen and read;

• The student's ability to express his or her point of view in writing or orally;

• The student's ability to apply the information/knowledge obtained in future real life and work contexts;

Since there are different types of literacy which overlap and are evolving in the digital age, researchers coined the term *multiliteracies* (Cazden et al. 1996). Another significant study (Dudeney et al. 2014) identified sixteen distinct literacies that are required today, which fall into the category of filtering literacy (based around information) and the category of remix literacy (the ones associated with digital creation).

The phrase *Cloud computing* is defined in the Merriam Webster Dictionary as "the practice of storing regularly used computer data on multiple servers that can be accessed through the Internet" whereas in the Cambridge Dictionary, it is defined as "the use of services, computer programs, etc. that are on the Internet rather than the ones that you buy and put on your computer".

50

Computer science students use this term frequently and are aware of its influence on the education generally speaking. Obviously, it requires a great deal of effort on the part of the teacher to select the appropriate applications and integrate them in class activities so that they could meet students' needs and expectations. This work should be aligned to the principles of the Bologna process:

- Students must be partners in their own education and not consumers of a pre-packed product;
- University education must be flexible focusing on the needs of every student;
- University education must be relevant to the labor force market and especially connected with it.

Through cloud computing teachers create innovative classrooms formats, such as blended or flipped classroom. Teachers can connect their students to many applications, having easy access to a myriad of resources across multiple platforms.

The cloud models are "Infrastructure-as-a-Service", "Platform-as-a-Service", and "Software-as-a-Service". Each model has its functions as presented in the figure below:

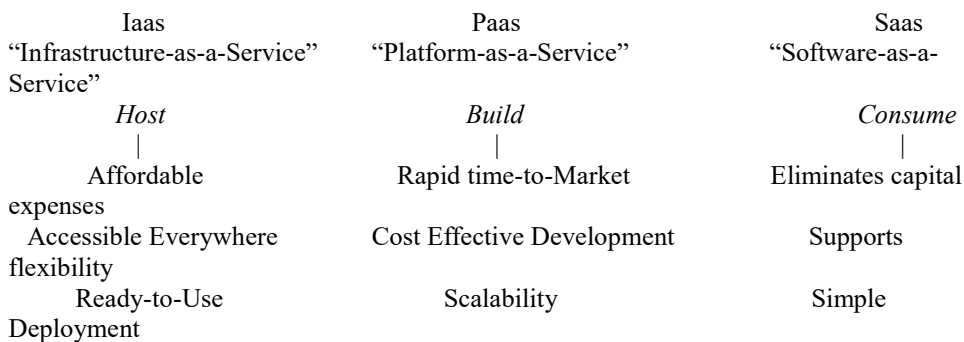| Iaas "Infrastructure-as-a-Service" Service"	Paas "Platform-as-a-Service"	Saas "Software-as-a-Service"
Host	*Build*	*Consume*
Affordable expenses	Rapid time-to-Market	Eliminates capital
Accessible Everywhere flexibility	Cost Effective Development	Supports
Ready-to-Use Deployment	Scalability	Simple

Fig. 1: The three cloud computing service models (source: paranet.com)

The ability to master modern technologies for education is one of the major challenges of this century. Our experience has shown that teachers and young generations can contribute to the progress of the knowledge society and can become effective partners in the teaching-learning process.

Cloud-based tools have been around for a while and their use in the classroom has impacted student's motivation and achievement. It is important to establish which cloud model suits language teachers' and students' needs the best. A recent report shows that the global cloud-based language learning market is driven by the need of technology-enabled tools that facilitate user engagement, motivation, and collaboration. More precisely, the global cloud-based language learning market will reach values of around $8 billion by 2024 (Research and Markets, 2019).

The Digital Age has changed our lifestyle and the way we do our work. Most people enjoy living in a visual world. The ubiquity of mobile devices allows us to

capture still and moving images while the video-sharing platforms and social media networks allow us to upload visual content which harnesses the power of visual communication.

Therefore, we can enhance students' phonemic awareness, phonics, fluency, vocabulary and comprehension by adopting innovative tools for learning and literacy which are presented in the Methodology section.

2. Statement of the problem

So far we have enhanced our students' participatory culture through resources or materials from our practice books, course books elaborated by native speakers and other authentic materials (e.g. economic texts that appear in particular contexts which need to be interpreted critically and creatively). The language of economics has been very dynamic in the past years and the vocabularies of the economic sub-domains have enriched considerable due to the economic and social changes at the global level. Literacy practices for language acquisition have changed in the past years due to technological developments and we are aware that students should be encouraged to introduce their own content into the classroom and become active contributors of their own digital experience. One can argue that there is a plethora of Course books on the market or in libraries nowadays.

Despite this notable presence, some of them focus on the reading comprehension of texts/articles written years ago, so they do not contain terms which describe current economic aspects/situations/trends. For example, a text about the impact of bitcoin on financial markets and why governments are afraid of it would be appropriate in the English class, because some students are interested in current articles/topics which answer their questions. These students are active and show behavioral involvement in learning persevering and facing the challenges. Other students are passive and disengaged as they refuse to answer questions based on texts, are bored, nervous and sometimes they give up easily, especially when they have to translate from Romanian into English a text/sentences using key economic terms explained in class.

Sometimes the material on offer in our practice files cover language that our students already know or it might deal with topics that they are not interested in. Then we have to look for supplementary resources that challenge and engage them in a variety of topics that focus on their academic activities and future job roles. Not long ago two tasks based on the extra material brought in class were to read about Steve Jobs' life, analyze his speech at the graduates' ceremony organized by the University of Stanford, and then write a biography of a person who drove his/her business to international success.

3. Methodology

The students selected for this study are enrolled in the Economic Informatics bachelor program and their level of English is intermediate. Fifty students participated in this study and the investigation spanned a period of one semester.

According to the Common European Framework of Reference for Languages, intermediate students are able to:

- Communicate with a degree of spontaneity and fluency that allow the standard participation in a conversation with a native speaker of the respective language. They can also present clear and detailed descriptions on a large number of topics in their field of interest and express a point of view on a current topic;

- Read reports and articles on concrete or abstract contemporary topics, as well as literature written in contemporary language;

- Write texts, essays, reports in which they transmit information or argue a point in a meaningful way;

The knowledge society requires a more evident connectivity between individuals and communities. Mastering new technologies has become a matter of individual security, personal or collective progress.

From the students' point of view, the use of cloud technologies creates premises for:

- Personalized and cooperative learning (students report individually, interact with their peers and the teacher);

- Continuous learning (the computer integrated in a network brings a permanent flow of information, in accordance with the latest evolutions in the field of knowledge and socio-cultural practice);

- In-depth understanding from several directions;

-   Promoting the interest (if students are really interested, they become more motivated to acquire the information);

- Enhancement of solidarity on a global level, by connecting with people located spatially-culturally at remarkable distances.

Without being an exclusively applied method, an open teaching supported by cloud technologies would support the student's ability to access specific information, filter it and use it in real time, developing his/her ingenuity and creativity in using learning tools. I believe that the main result of learning should not be the ad-literam reproduction of impressive amounts of data, but the proof of understanding and assimilation of information that prepares the student for real life (e.g. to accomplish certain work tasks).

In reference to all the points expressed above, our study aims to answer the following question: Does the use of cloud-based tools for language acquisition enable us to measure the students' level of engagement more effectively?

The most important aspect in the use of economic language is related to the mixture of interpretations and theories about the economic environment. In this

respect, loans from other fields of knowledge and spontaneous or deliberate reform have produced the most significant changes in the economic language.

Our discipline pursues the students' acquisition of knowledge, skills and abilities corresponding to the current stage of language acquisition, in order to ensure for them, new prospects for employment on the domestic and international labor market. We consider the following specific competences:

- Mastery of economic language to ensure efficient written and verbal communication;
- Economic and organizational communication according to international standards;
- Internal communication and external communication (the communication activity carried out at the level of a company);
- Correct use of economic language and fundamental economic principles to improve the clarity of economic messages;
- Implementation of different communication activities and tools.

It is always good practice to adapt to students' approach to tasks and diversify the resources and activities regularly to match their interests and meet their needs more closely. In order to respect the trends in the field of Business English and to adapt to the learning style of our students, we reshaped the ways of learning to make them more attractive and interactive, so that the learner could remain involved and active.

Our strategy for improving Business English literary and learning focused on the following elements:

3.1. Literacy through visual learning

Mobile technologies can be used in the educational process both in day-to-day and, in particular, in distance education. M-learning apps offer flexibility in terms of difficulty and number of exercises to solve. The training is based on several audio, visual and animated sequences. Students are very attached to the smart phone, which is why this practical and creative approach to learning gives them a space to play and motivates them to achieve great results.

Researchers investigated language learning through mobile technology and texting and found that students' vocabulary enriched with the help of mobile phones (Cavus and Ibrahim, 2009). However, the most important element was the selection of an effective mobile app. Our selection was based on user activity, ratings, and its experiential value.

We wanted to bring the "outside of the class activity" in the class, so first we tested the features of Business English free app and decided that it met the needs of our intermediate students mainly due to the 5 game types - challenge, timer, daily, practice and feedback. Students could see the answers after practice games and play feedback games by clicking on their feedback at the end of practice games. Moreover, daily questions were brought to the learner every day. Students could

test their business vocabulary and grammar (questions per level), answer to quiz questions using the settings button to start or to stop (see Fig. 2). A Scoreboard displayed their score thus motivating them to try again and do their best to get a higher score.
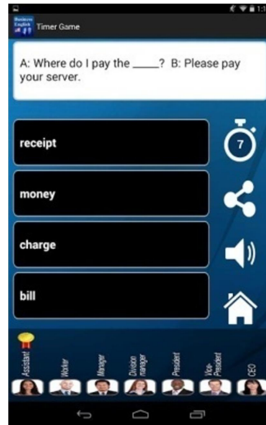

Fig. 2: Business English Free App (source: https://appcrawlr.com/)

The mobile app instruction enhances the creativity and flexibility because students are digits and like to acquire new knowledge through the appealing games. We welcomed questions throughout the class and explained to the students that obtained a low score what went wrong and how to avoid mistakes in the future by reviewing and writing on the board examples to help them understand grammar structures and by providing contexts that mirror the difference between the terms. Additionally, we designed tasks for individual and pair work which focused on synonymy, antonymy, and collocations including the economic terminology used and displayed by the Business English app and encouraged them to make up sentences using derivatives of the economic terms already encountered.

3.2. Movie scenes

Movies have a great impact on our lives. To spark improved participation we decided to integrate movie scenes. To introduce the overall idea of the scene, we divided the class into groups and encouraged them to discuss a short problem in a mini group session thus giving students the possibility to provide input and interact with colleagues. For example, participating in a business meeting requires preparation, openness, clarification, active listening, etc. We explained to the students the stages for organizing a business meeting, the phrases used in each stage and asked them to watch a short instructional video to see how the participants in the meeting interact with one another and express their views.

Watching movie scenes in class helped students to enhance their knowledge, get information and analyse the situations and ideas communicated by other

persons.We explained to the students that watching could be considered effective or productive if they respect the following stages:

- The pre-watching stage when they prepare themselves to watch a scene. Basically they set a purpose for watching the movie scene, anticipate messages and make predictions.
- The during watching stage when students check their understanding, make connections, interpret and summarize.
- The after watching stage when they reflect and analyze, evaluate and create being given the possibility to respond critically and creatively.

In this regard, we selected ten movie scenes used in class throughout the semester, but we describe only two of them, the teaching approach and the student tasks:

- Margin Call (2011)

John Tuld, CEO and Chairman of the Board, has a meeting in which he gives lessons to everyone - from the young executives to seasoned C-suite managers. Tuld proves to be an intimidating and powerful business leader. He doesn't give the impression that he is a warm person, but he is very determined and tells exactly what he expects from the people around him. After watching this scene, we asked students if they met intimidating people and how they would continue the discussion in the movie scene. We also asked open questions to stimulate students' thinking encouraging learners to construct longer answers. As for the writing activity, we instructed them to work in pairs and write a paragraph about IT leaders whose vision led to innovation and high profits (e.g. developing products that improved our life, getting involved in charitable activities, investing in research, etc).

- Gung Ho (1986)

In this scene, Hunt Stevenson is delivering a presentation to a Japanese board of directors. He makes some jokes during the presentation with the purpose to create a relaxing atmosphere. Since the directors had a different cultural approach to business meetings, feedback did not occur after Hunt's presentation. The speaker should have known the meeting etiquette in Japan to craft relevant messages and connect with his audience. Asking divergent questions and nominating students to answer, we managed to elicit more language from them as a form of guided oral practice. To enhance students' awareness of the meeting etiquette in other cultures we brought supplementary reading material followed by reading comprehension activities. Then, we divided the class into groups and asked each group to improve Hunt Stevenson's speech taking into account the words and phrases from the reading material.

Visual and Mobile Learning tools for learning business English are designed to enhance the business communication skills, considering diverse communication situations which occur in today's company. We exposed them to real communication situations and encouraged them to participate in these situations as well. The application of the traditional audio-lingual method in tandem with the

modern methods of teaching through visuals and mobile cloud has led to an active and responsible participation by the students due to the fact that they have been exposed to the authentic English language. Thus, the students watched videos about the etiquette of a business meeting and cultural differences arising from a presentation in a meeting, we transmitted the knowledge that they should use (words, expressions, intonation, and gestures) so that they can acquire this knowledge and continue the communication or build other communication situations. Communicative competence is another traditional method that we have used effectively, without insisting on grammar rules and correct pronunciation. Specifically, we encouraged students to communicate fluently, considering not only the accuracy of the language used, but also the ability of the student to handle specific communication situations (which register should be used in communicating with foreign people, colleagues, a human resource specialist and which is the appropriate tone in these communication situations, etc.).

4. Results

Student engagement in language literacy and learning has multiple dimensions: behavioral, emotional, and cognitive (Fredricks at al., 2004). In our case, the first dimension consists of students' involvement in academic, social and extracurricular activities (e.g. participation in courses taught by foreign guest professors). The second dimension, emotional engagement, shows the extent of positive and negative reactions to teachers, colleagues and school (e.g. positive or negative reactions to colleagues from other cultures, to the teacher's methods employed in class, etc.). The third dimension, cognitive engagement, refers to the student's level of participation in language learning. In this regard, students enjoy collaborative work, put in the necessary effort to grasp new economic concepts to enhance their vocabulary and to be purposeful and sensible in their approach to the required tasks.

In order to measure the student level of engagement, we analyzed three types of measurement methods, the psychometric properties of measures (Fredricks et al., 2011). Eventually, we decided to apply two methods:
- "Student self-reports" - measures in which students responded to items, using the Likert scale which contains specified response formats (McLeod, 2019):
  Strongly agree (5), *agree (4)*, *undecided (3)*, *disagree (4)*, *strongly disagree (5)* for statements of agreement;
  Always (5), often (4), sometimes (3), rarely (2), never (1) for statements of frequency;
  Very important (5), important (4), moderately important (3), slightly important (2), unimportant for statements of importance;
  Excellent (5), good (4), fair (3), poor (2), very poor (1) for statements of quality;

Scores were summed across items to form total scores to describe the students.

- "Observational measures" which involved our direct observation of behavior of students during the learning activities. However, it is difficult to employ observational measures systematically and to collect the data accurately if the teacher is not trained or lacks experience.

We created a semester questionnaire (twenty questions) to assess student level of engagement during the leaning process over a period of one academic semester. The sample was composed of 50 third-year students enrolled in the Economic Informatics Program who filled in the questionnaire at the end of the semester. We also observed students in class and registered data about their active learning behavior.

If an instrument produces consistent results then it could be considered highly reliable. However, reliability is not sufficient because a measure can be reliable but not valid. The validity of our instrument showed that the results obtained from using the student self-reports actually measured the student level of engagement in our class in which we combined traditional approaches with modern ones through activities focused on the use of visual and mobile learning.

To measure the behavioral engagement we asked students to report on their attendance, preparation for class, attention, concentration, participation in technology-based activities, effort and persistence. To measure the emotional engagement we included questions about students' emotional reactions to class such as expressing interest and enjoyment, reporting fun, having the support of teachers, and having positive relationships with colleagues. As for the cognitive engagement, we included questions about the use of innovative strategies to learn, remember and understand the class material, the importance of Business English literacy and learning and their future aspirations.

The extent to which students responded one way to one item responded the same way to the other items intended to measure the same thing. The results showed that forty-two students enjoyed technology-based activities, appreciated the teacher's effort to apply modern methods of teaching, mentioned that their level of concentration increased when solving multiple choice questions provided by the mobile app. From their point of view, movie scenes were motivators which made learning more entertaining and enjoyable that is why they felt confident when answering open-ended questions related to the movie scenes. The other eight students refused to fill in the questionnaire arguing that they were absent throughout the academic semester due to work or personal problems.

5. Conclusions

We strongly believe that the importance of technology in education improves the outcomes of both students and teachers and increases the three types of engagement – behavioral, emotional and cognitive. Our study focused on the use of

cloud application to improve students' Business English literacy and learning and how the applications integrated in the classroom benefited students and increased their level of engagement. Through the movie scenes and the mobile app students could obtain the information they needed and to critically relate to it, combining it through adaptability, critical thinking and collaboration with colleagues. There is no golden rule to assess the level of student engagement. However, we tried to assess the level of engagement of fifty intermediate students over the period of one semester. We noticed their level of engagement increased because the teacher understood that the class needed more flexibility and put in the efforts to harness a new classroom structure through cloud technologies aiming to improve their cognitive, intrapersonal, interpersonal, and technical skills. The use of cloud applications, in addition to providing the ubiquity and flexibility of the learning process, increased collaboration, participation and creativity due to the co-creation of content and knowledge.

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DESIGNING AN ONLINE PLATFORM TO FACILITATE THE COMMUNICATION BETWEEN SPORT ORGANIZATIONS

Silvan-Samuel-Cristian COVACI [1*]

Eugen-Gabriel GARAIS [2]

Abstract: *Sport Organizations are now in a situation that need a flow of funding through a modern infrastructure. The world wide web facilities offer the right channel for intersecting funding, ideas and real needs. This article presents a platform design that enables clubs and federations at first, private actors at a later stage, to advertise their projects, connect, and find funding and support across the world.*

Keywords: *social networking service, organizational communication, technology, sport developing, project management, online platform*

1. Introduction

The Internet is nowadays filled with documents and contacts but needs processing power and filters to distribute the needed information to the right persons and organizations. In sport there is a large need of connecting sport organizations to specialized interdisciplinary information. Such information is about funding and business management. There is a real need of designing an online platform witch acts as a network router to distribute information on the needed path between funding management agencies and sport organizations of any size. This article presents the need, the actors and the solution for putting together a platform that acts as a portal with access to big databases that respond to the need of today's sport organizations.

2. The project what drives the project?

The project is based on the will to provide information for the observed needs of European sport federations, among which:

- The lack of specialists due to low funds;

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- The lack of communication with other entities;
- The lack of communication between European Sport Confederations;
- The lack of visibility and publicity;
- The lack of funding both from governments and businesses;
- The inability of clubs and federations to attract Erasmus Funds and EU funds;
- The lack of a clear common development project between clubs and federations;
- The fact that projects lack transparency.

This project aims at increasing cooperation, partnerships, visibility, funding and information sharing by and between sports organizations from all over Europe and the world. It will participate to the development of a real network of sports organizations. It could also, on the long-term, facilitate the organization of a yearly meeting between European Confederations leaders and sponsors to further develop sport in regions where the sport is less practiced today.

3. The project itself: Creating an online platform for connecting other sports organizations

The project consists of creating an online "organizational informational communication" tool in the form of a platform that connects other sports clubs, federations but also public and private actors acting as sponsors across the world. The platform will enable and facilitate the creation of relationships as well as the communication between clubs and federations all over the continent to join EU funding projects, attracts sponsors, share expertise and resources and organize joint activities.

The goals of the platform are:

- Bringing and connecting sport actors across the world together;
- Increasing the visibility and publicity of sport in Europe and in countries where it is less popular;
- Enabling communication and facilitating partnerships between sport organizations, within continents but also trans-continentally;
- Concentrating the information in one place;
- Facilitating the finding of sponsors and funds for other sports organizations;
- Encouraging cooperation between other sports organizations across borders;
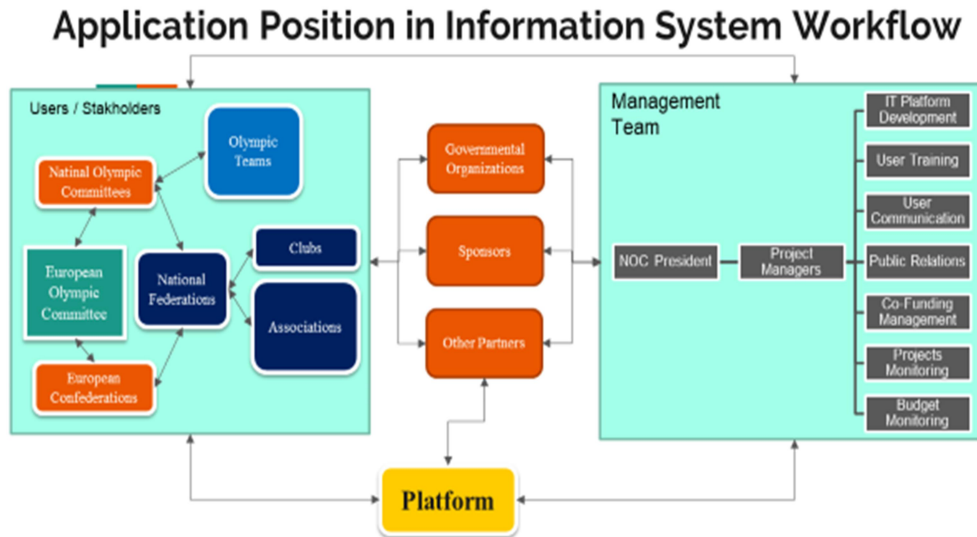- Foster the development of learning and exchange sport programs between European countries.

Fig 1 – Application Position in the System Workflow

3.1. Platform members

The platform works as a kind of social network connecting its different members. Members. Members join the platform to exchange, communicate, find partners and initiate collaboration with other clubs of federations as well as join Erasmus+ projects or even develop new projects together.

There are different kinds of members:

- National Olympic Committees (NOCs), International Confederations, National Federations, sports clubs and associations could have access to the platform and constitute its core members. Each of these actors will be able to create their own profile on the platform and fill it with information such as: contact details, activities and projects, research for funds.

- Sport Ministries and Government bodies can also have access to the platform.

- Funding entities such as private companies have access to the platform based on a membership fee. There they can consult the ongoing projects and research for funding of all the members of the platform.
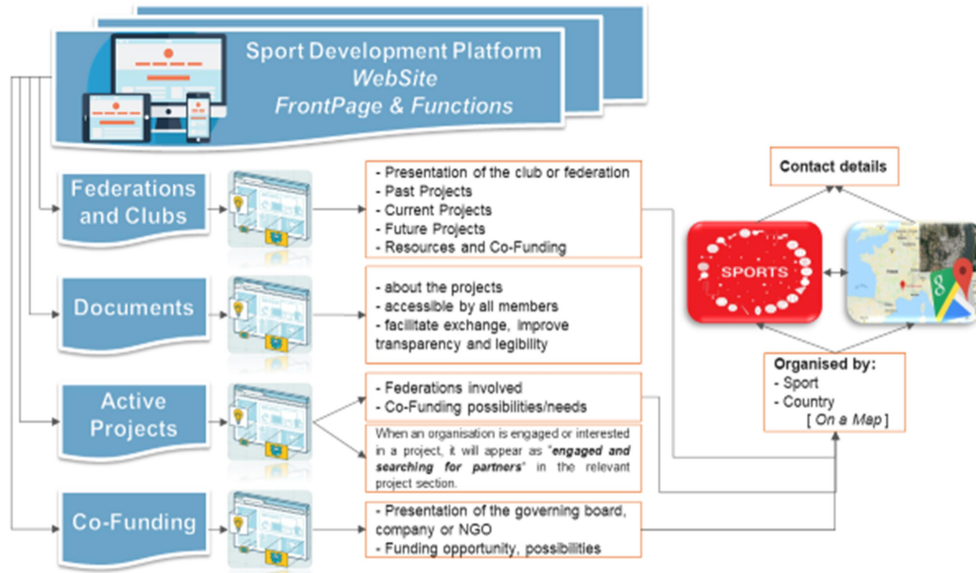
Fig 2 – Platform sections

3.2. Platform structure

The portal has two functional sides depending on the users that will manage it. One side is characterized by the backend which handles the IT administrative part and management of the entire system. The other side handles the front side, which is accessible by the organizations, federations and other final users.

The backend side will manage the administrative part with the following attributes:

- General platform rules such as localization and language
- Visual Theme properties with user specific customizations
- User and roles management
- Modules and plugins management for specific workflow functions
- Views and reports management with
- Communication management
- Platform security rules and modules
- Backup modules that ensures against critical system crashes
- API's that connect the platform to third party applications such as law portals
- Analytics connection module to observe visitor's behavior during its own navigation session
- Social Media Login possibility and other social media connection
- Search Engine Optimization implemented actions to facilitate a widespread visibility and accessibility of the application worldwide

- And other collaborative platform implementations that will have it's own analysis of need and opportunity.

The front side of the platform is divided into four sections: first federations and clubs section (national and international), secondly a documents section, thirdly an active projects section and fourth, a co-funding section. Other modules could be added based on the needs of the users (confederations or clubs, players).

Table 1 – Platform main structure

1. Federations and Clubs	2. Documents	3. Active Projects	4. Co-Funding
Organized by: - Sport - Country - On a Map	The platform will provide a space to upload documents - about the projects of the organization for instance -. They will be accessible by all members. This will facilitate exchange and improve transparency and legibility.	Organized by: - Sport - Country - On a Map	Organized by: - Country - Name - On a Map
Presentation of the club or federation		Federations involved	Presentation of the governing board, company or NGO
Past Projects		Co-Funding possibilities/needs	Funding opportunity, possibilities
Current Projects		When an organization is engaged or interested in a project, it will appear as "engaged and searching for partners" in the relevant project section	
Future Projects			
Resources and Co-Funding			
Contact details			Contact details

This would participate in making the activities and initiatives of other sports federations and organizations more visible and attract the attention of civil society

partners and sponsors. A discussion forum tool or a group tool could also be present enabling members to exchange directly with a group of interested entities on specific topics. Finally, a FAQ section could come add to the platform to facilitate its ease of use.

3.3. Examples of similar types of platforms.

There exists online platforms or social networks that connect actors together and where members share what they are looking for but also what they can offer and then enter in contact to exchange services or start a cooperation. These platforms can be found for common services such as baby-sitting, private lessons (Yoopies.com; Superprof.com, etc.) but also for various projects in a specific locality where they enable inhabitants from the same area to get together to launch a project (Pal'réseau). Apps such as ConnexMe that was used at the EU Sport Forum also to facilitate the interaction between organizations and actors by making documents available but also proposing an "interact" function to reach out to fellow participants.
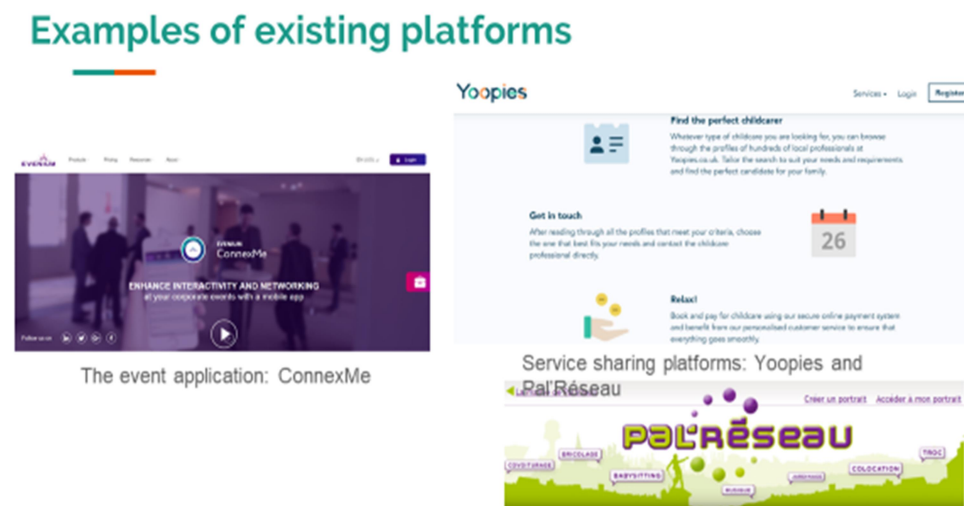

Fig 3 – Existing platforms

4. Who would join the project?

The creation of a Europe-wide communication platform for sport organizations can only work if a variety of actors is interested to be members of the platform and to bring it to life. These include other sports Governing Bodies at national, continental and world level, but also clubs across the world, Ministries, NOCs, and other organizations such as NGOs, private actors, etc. A handful of sport actors have manifested interest in the first steps of the projects already.
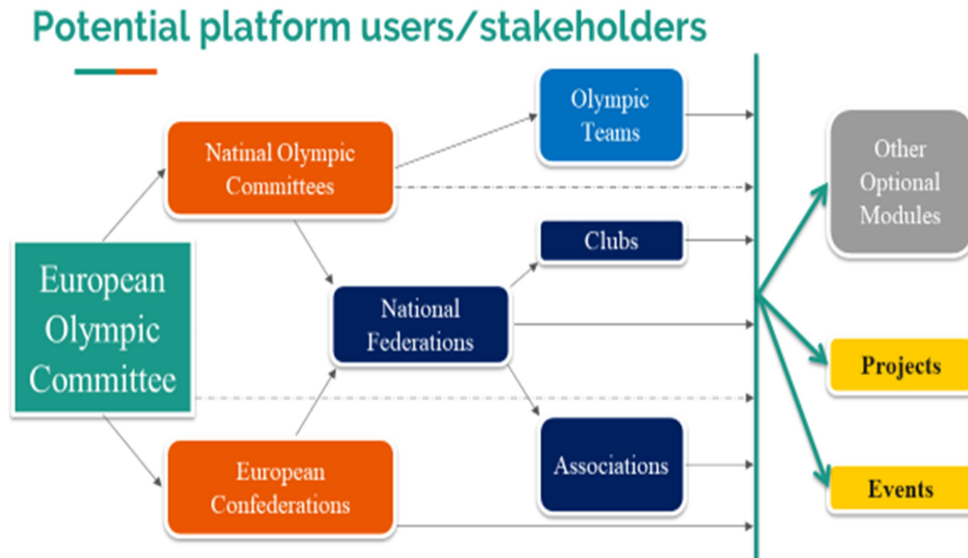
Potential platform users/stakeholders

Fig 4 – Platform users

The project could start as pilot for an Olympic Committee. It could later be developed as a tool for worldwide sport. It will notably provide athletes with opportunities to find contracts outside their country as well as to attract individual sponsorships.

Junior clubs could use the platform to connect with regional clubs and to organize competitions together with a region or a given geographic area. For example, clubs from Romania could organize a regional cup with clubs from Bulgaria, Moldova.

At a later stage, a platform module could be dedicated to athletes that are searching for a new career and are searching for a new team to join. They could upload their information and description on the platform. Scouters could then access the platform as a database they could use to identify young talents. Players could transfer more easily to European clubs and to European or American universities for instance. These organizations represent prospective platform users.

The platform modules could be adapted and transformed according to the member Federations' needs.

The platform could be used by multiple sports Confederations, Olympic Committees and Ministries or Agencies.

Project management companies could collaborate with the project holders – the EOC or specific NOCs for instance, in the form of packages, in order to help them develop. Ex. Low budgets federations would say they do not have the budget to hire a project manager, but they can use the platform to receive all documents and

know-how in order to apply for external funding (this compiled and provided by the project management company).

As on the platform will host many sports entities, it will be a place where sport retailers could advertise their products.

Sponsors could become members of the platform (after paying a fee) and engage (fund) some of the projects that can be found on the platform. This creates a single point of information for private companies as well and gives them more incentive to engage with sports projects.

*EOC – European Olympic Committee

*NOC – National Olympic Committee

*NGO – Non Governmental Organization

4. Conclusion

Collaborative software applications are used in the case presented in the article as for connecting different parties that otherwise are having difficulties in relating in an easy way. The presented platform brings sport federations and sports club together with management companies that can offer state of the art access to optimized investments using funds from the European Union Committee and other financial institution that can easily support sport projects. The platform is designed to be a portal of opportunities for sports clubs of any size and any type of financial and managerial institutions or specialists.

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EU-NATO COOPERATION WITH UKRAINE IN COUNTERING INFORMATION THREATS

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Abstract: *The hybrid war is aimed at obtaining influence over the population, politicians, business and power structures by non-conventional means. Information security holds one of the first places in countering hybrid threats. Ukraine pays enormous attention timely detection, prevention and neutralization of information threats, but it still needs external assistance including the EU and NATO. At the same time, Ukraine a battlefield for new information warfare technologies, and knowledge and experience of Ukraine's resistance is helpful for both organizations. This stimulates a tringle cooperation in the field of information security with a cross-exchange of financial and technical support, new information technologies, administrative methods, knowledge and experience between the EU, NATO and Ukraine.*

Keywords: 5-8 keywords *information threats, strategic communication, hybrid warfare, European and Euro-Atlantic integration of Ukraine, disinformation, propaganda, resilience.*

1. Introduction

Hybrid or non-conventional threats have become especially relevant for the European security after the beginning of Russia's aggression against Ukraine. They are aimed at the societies' minds and consciousness, and thus, the population, which is under the constant informational influence, needs protection against such hybrid challenges and threats, first of all, through strengthening its resilience. Ukraine increased its attention to this problematic after the beginning of the active phase of Russian aggression in 2014.

In countering information threats at the national level, Ukraine has achieved some success, but it can be strengthened through the synergy and enhanced cooperation with the European Union and NATO. These two organizations have been paying attention to this area of activity for a long time, and they now have experience both at the national and regional levels and in the areas of operations and missions.

Strategic communication, including information security, is one of the priority areas of cooperation between NATO and the EU (EU-NATO Enhanced

Cooperation). At the same time, these organizations develop cooperation with Ukraine in this field. Therefore, it is vital to deepen the EU-NATO interaction for their coordinated assistance to Ukraine. Increased stability and ability of the Ukrainian society and the state of Ukraine to effectively counter hybrid threats will make the situation in Europe more stable and secure.

2. Information threats to ukraine, the eu and nato

Ukraine, as well as the EU and NATO, face numerous information threats, which have become more dangerous in the situation of the modern hybrid warfare and development of information technologies, methods and tools. To coordinate activities of different players in countering such threats, it is necessary to have similar bases of their definition, detection, assessment and neutralization. The analysis and comparison of these bases in the EU, NATO and Ukraine allows understanding frames of cooperation between them and mutual assistance.

The European Union has made a clear definition of the information threats. Countering them is included to "strategic communication" sphere, which is interconnected with countering hybrid threats. Thus, the In-depth Analysis "EU strategic communications. With a view to counteracting propaganda" describes strategic communications as "*systematic series of sustained and coherent activities, conducted across strategic, operational and tactical levels, that enables understanding of target audiences and identifies effective conduits to promote and sustain particular types of behavior.*"[3] The European External Affairs Service defines that "*hybrid threats combine conventional and unconventional, military and non-military activities that can be used in a coordinated manner by state or non-state actors to achieve specific political objectives*".[4] The primary dimension for the EU is "strengthening strategic communications to tackle disinformation".[5]

In practical terms, along with other activities, strategic communication is aimed at countering information challenges and threats, in particular – disinformation. In the EU, this countering is primarily directed against the threats from the East, i.e. the Russian Federation, as it is reflected in several EU documents, for example, the EU Global Strategy, the Joint Framework Document on Countering Hybrid Threats, the EU Action Plan on Strategic Communication, the Report of the Directorate-General for External Policies of the European Parliament titled "EU strategic

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[4] https://eeas.europa.eu/topics/economic-relations-connectivity-innovation/46393/europe-protects-countering-hybrid-threats_en
[5] https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2788

communication with a view to counteracting propaganda"[6]. Sources of information threats, as identified in the EU, can exploit vulnerable members of the society by engaging them with radical and extremist ideas through new communication channels. "*Disinformation poisons hearts and minds. We can no longer deny the fact that our institutions and societies are the targets of hostile Kremlin propaganda, which in turn is part of a broader strategy*," said Anna Fotyga (Member of the European Conservatives and Reformists Group, Poland).[7] Therefore, in the information field, the European Union has identified raising public awareness and counteracting propaganda as a critical objective. The East StratCom Task Force was set up, an EU-STRAT special project was launched, which also works in Eastern Europe, and the EU Anti-Terrorism Internet Center operates within Europol to remove illegal information content.

In its turn, NATO takes a more detailed approach to strategic communication, focusing on the military and security component. In the interview to the News Agency "Ukrinform", Director of the NATO Information and Documentation Center in Ukraine Barbora Maronkova explained: "*Strategic communications sound difficult, but it is elementary. It is all about coordinating positions and being able to speak in one voice* ".[8] In the Alliance, the active development of strategic communication began with its operation in Afghanistan and expanded into all NATO activities. Among other, they include dimensions, which concern countering information threats: press and media; information activities of international military cooperation; actions in cyberspace, including social media; involvement of key leaders in information events; information operations; Informing about the situation and documenting the events on a battlefield.[9]

Strategic communications in the Alliance are also based on information activities. However, unlike the EU, NATO focuses on military component and operations. Meanwhile, countering disinformation is always in the Alliance's focus. Therefore, the Declaration of the 2018 Brussels NATO Summits said: "*We face hybrid challenges, including disinformation campaigns and malicious cyber activities.*"[10]

The report of the EU Institute for Security Studies "Strategic communications: East and South"[11] emphasizes that the primary purpose of Russia's information influence on Europe is the conviction of Europeans that there is no threat from Russia, and the EU should focus on threats from the South. To this end, the

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[6] http://www.europarl.europa.eu/RegData/etudes/IDAN/2016/578008/EXPO_IDA(2016)578008_EN.pdf

[7] https://eeas.europa.eu/delegations/ukraine/59610/node/59610_uk

[8] https://www.ukrinform.ua/rubric-polytics/2556092-barbora-maronkova-direktor-centru-informacii-ta-dokumentacii-nato-v-ukraini.html

[9] http://goal-int.org/rol-strategichnix-komunikacij-v-protidii-gibridnij-vijni-proti-Ukraini/

[10] https://www.nato.int/cps/en/natohq/official_texts_156624.htm?selectedLocale=uk

[11] https://www.robert-schuman.eu/en/european-issues/0415-strategic-communications-east-and-south

Russian propaganda machine worked to strengthen the migration crisis in Europe, anti-immigration sentiments, ethnic and religious hostilities. This information impact culminated in January 2016, when the Russian media actively inflated the "Lisa case"[12] and the situation around the violations of public order by illegal migrants at the railway station in the German city of Cologne.[13] It took a long time to overcome the consequences of the flow of disinformation from Russia. At the same time, Russia is trying to discredit the EU in the eyes of the inhabitants of the post-Soviet space, comparing the EU with the Soviet Union, and linking the process of European integration with the loss of independence and sovereignty. Information attacks of the Russian Federation are also carried out in the following areas: "decline" of Christian values in the EU; weakness of European politicians and institutions; instability in European countries; disagreements within the EU and NATO; economic crisis.

The information sphere has become one of the critical areas in NATO enhanced cooperation with the EU, which includes joint counteraction to hybrid threats in the South and the East. "*We have increased our ability to respond to hybrid threats: we reinforce our preparedness for crises, we exchange timely information including on cyber-attacks, we confront disinformation, we build the resilience of our members and partners, and we test our respective procedures through parallel and coordinated exercises,*" the Joint Declaration on EU-NATO Cooperation of July 10, 2018 stated.[14]

Ukraine has also enough coordinated approach to the definition of information threats, fixed in the Doctrine of Information Security of Ukraine.[15] They are: special information operations aimed at undermining defence capabilities of Ukraine; special information operations in other countries conducted by an aggressor state in order to create a negative image of Ukraine in the world; information expansion of an aggressor and its controlled structures; information domination of an aggressor in the temporarily occupied territories; insufficient development of the national information infrastructure, which limits the ability of Ukraine to effectively counteract information aggression; inefficiency of state information policy; appeals for radical action, promoting isolationist and autonomous concepts of regional coexistence in Ukraine. Some aspects of countering information threats are indicated in other documents in the sphere of security and defence: Annual national program of cooperation between Ukraine and NATO, Concept for Development of the Security and Defence Sector of 2016, Strategic Defence Bulletin and other.

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[12] https://www.nato.int/docu/review/2016/Also-in-2016/lisa-case-germany-target-russian-disinformation/UK/index.htm
[13] https://www.gazeta.ru/social/2016/01/11/8016293.shtml
[14] https://www.nato.int/cps/en/natohq/official_texts_156626.htm?selectedLocale=uk
[15] https://zakon.rada.gov.ua/laws/show/47/2017

The information sphere is the main dimension of Russia's hybrid war against Ukraine as Moscow considers information-psychological instruments as a kind of weapons of mass destruction. In Ukraine, Russia is using the following awareness-raising mechanisms: rapid and extensive filling of the combat zone with controlled by Russian media in the case of need; an attempt to monopolize control over the channels of news provision from the combat zone; producing fakes; sending of the Russian cultural celebrities to the area of combat actions; the use of hired foreign journalists, etc. All these mechanisms are supported with adequate financial resources. For example, the budget of "Russia Today" has grown significantly for recent years and is approaching $2 billion, according to unofficial data.[16] A relatively new information tool of the Russian Federation - "Sputnik", distributes information in more than 30 languages in dozens of countries, mainly in Europe, and in some countries, it became a local news-maker.

The primary propaganda efforts of Russia are aimed at discrediting the leadership of Ukraine, the Ukrainian Army, the Ukrainian foreign policy, the restoration of Ukrainian power in the liberated territories, and the ongoing process of reforming the country. The target groups are: citizens of Russia; citizens of Ukraine in the occupied territories; other citizens of Ukraine; the Western countries, the partners of Ukraine in countering aggression; the population of the countries within the orbit of influence of Russia.[17]

If we compare the approaches of three sides, in the EU and NATO, major information threats are considered more generally as disinformation and propaganda, but in Ukraine actual threats are wider and more detailed. They include problematic issues in the sphere of information security of Ukraine, namely the inefficiency of the state information policy and the lack of development of the national information infrastructure of Ukraine. They are mostly challenges, and they should be supplemented by: low level of coordination central governmental bodies in the information area and their work with the media; unformed policy of information support for the consolidation of national identity in Ukraine in terms of work with population of Ukraine, especially in the occupied territories; insufficient financial and technical support of the state bodies and media of Ukraine for prompt and timely response to the relevant acts of information aggression.

In addition to the officially declared information threats, it is necessary to list other actual information threats, in particular:

- Overt and covert use of democratic norms and principles of the freedom of the media for information discreditation of Ukraine and its attempts to shape the international support to counter Russian aggression (*Example: In December 2018*

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[16] https://www.5.ua/polityka/shaleni-tsyfry-iakyi-biudzhet-prokremlivskoho-russia-today-a-iakyi-v-mininformpolityky-184151.html
[17] https://geostrategy.org.ua/ua/analitika/item/1401-hibrydni-zagrozy-i-syspilna-bezpeka

the Russian media, including media abroad, spread disinformation about the alleged preparation of the Ukrainian forces to use the banned chemical weapons, trying to discredit Ukraine[18]);

- Political and lobbying activities in the West, used by Russia for the formation of doubts about the position of the EU in support of Ukraine (*Example: On 26 may 2019 on a YouTube channel, a video on how in 2022 Romania can occupy Chernivtsi region and part of the Odesa region of Ukraine appeared; General Prosecutor Office of Ukraine launched criminal proceedings on a special information operation by Russia[19]*);

- Increased use by the Kremlin of the information channels of the Russian Orthodox Church – the UOC-MP for demoralization and disorientation of the population (*Example: In December 2018, the SSU reported that, during searches in several administrative offices of the Ukrainian Orthodox Church of the Moscow Patriarchate, materials to incite religious hatred were discovered[20]*);

- Use of the Ukrainian television channels and other media to broadcast pro-Russian narratives (*Example: In September 2018 Ukrainian TV channel website 112.ua posted a quote of the representative of the party "Za Zhyttia" (For Life) Serhiy Bogolyubov: "Ukraine does not fulfill the Minsk agreements"[21]*);

- Formation of an isolated socio-cultural and informational reality in the occupied territories of Ukraine, blocking access of the inhabitants of these territories to the Ukrainian information content (*Example: According to the report of the Crimean Human Rights Group based on the results of the monitoring carried out in March-April 2019, signals of the seven Ukrainian radio stations are fully or partially jammed in 20 settlements of the Northern Crimea[22]*);

- Use of the Ukrainian experts by Russia to form a negative information image about the Ukrainian expert environment (*Example: As reported by the publication "Komsomolskaya Pravda", the Ukrainian experts participate in a TV show on Russian television as "whipping boys" for the appropriate fees, including Vyacheslav Kovtun, who is one of the most paid - monthly he receives from 500 to 700 thousand Russian Rubles*)[23];

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[18] http://tass.com/world/1035166

[19] https://www.slovoidilo.ua/2019/06/04/novyna/polityka/hpu-porushyla-spravu-cherez-video-pro-zaxoplennya-rumuniyeyu-bukovyny

[20] https://www.unian.ua/politics/10364304-pid-chas-obshukiv-u-primishchennyah-upc-mp-znayshli-broshuri-z-propagandoyu-foto-video.html

[21] https://112.ua/politika/bogolyubov-donbass-neobhodimo-vozvrashhat-putem-vypolneniya-minskih-soglasheniy-463170.html

[22] https://www.radiosvoboda.org/a/news-v-krymu-ukrainskie-radiostantsyi-glushat-rossijskimi/29935810.html

[23] https://www.crimea.kp.ru/daily/26744.7/3772307/?see-also.number=1414#see-also

- Dissemination of information products to form the lines of division in society *(Example: In February 2019 Russian edition of RT published the news under the title "The European Parliament said about the link between the Church disunity in Ukraine and the Poroshenko's election campaign»[24]*).

A conflict situation like this one waged by Russia against Ukraine has proven to be a challenge not only for Ukraine but also for NATO and the EU. Therefore, effective counteraction to the information threats requires the formation of messages necessary to counter Russian aggression. Ukraine, the EU and NATO need a clear vision and definition of the information threats, as well as close cooperation to counter them, which should be coordinated and avoid unnecessary duplication.

3. Current state of ukraine-eu-nato cooperation in countering information threats

At the current stage, Ukraine's cooperation with the EU and NATO occupy one of the priority places in the Ukrainian foreign and internal policy that is fixed in the corresponding Ukrainian law adopted in 2017. For better coordination of the European and Euro-Atlantic integration, the post of the Deputy Prime Minister on European and Euro-Atlantic Integration was created in the Ukrainian Government at the end of April 2016. The Governmental Office on Coordination of the European and Euro-Atlantic Integration of the Ukrainian Government started its work. The European Union Department of the Ministry of Foreign Affairs of Ukraine was transformed into the EU and NATO Department Posts of Deputy Ministers on European and Euro-Atlantic Integration were established in most Ukrainian ministries. This allows to improve coordination of two integration processes and enhance efficiency of Ukraine's cooperation with the EU and NATO, including on countering information threats.

Almost immediately after the Association Agreement between Ukraine and the EU came into full force on September 1, 2017, in October of the same year, the Cabinet of Ministers of Ukraine approved the 2018-2021 European Integration Communication Strategy and annual action plans for its implementation.[25] One of the priorities was determined "countering disinformation aimed at discrediting Ukraine's relations with the EU and Ukraine's future membership in the EU."

At the 20th Ukraine-EU Summit on July 9, 2018, in Brussels, a joint decision to strengthen the work on countering information threats was reached.[26] The development of such cooperation was specified during the Association Council

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[24] https://russian.rt.com/ussr/article/605957-evroparlament-vybory-ukraina-raskol
[25] https://zakon.rada.gov.ua/laws/show/83-2019-%D1%80
[26] https://www.consilium.europa.eu/media/36086/joint-statement-eu-ua-summit-2018.pdf

meeting on December 17, 2018: «*The Parties agreed on the importance of countering disinformation and interference in the elections, and discussed the possibilities of cooperation in this area*».[27] The EU leading institutions to implement these solutions are the EU Delegation to Ukraine and the EU Advisory Mission in Ukraine. They focus on the dissemination of information about the EU, the development of governmental structures in the field of strategic communications, enhancing their communication with non-governmental organizations and security structures with the population to counter disinformation.

The EU Plan to counter disinformation, adopted in December 2018, identified Russia as the primary source of information threats and provided increasing of the EEAS founding for strategic communications from 1.9 million euro in 2018 to 5 million euro in 2019. Particular attention is paid to the East StratCom Task Force.[28] In March 2019, the EU created a System of rapid identification of disinformation that was crucial for the preparations of the European Parliament elections in May 2019. "*It is critically important to work together to confront those who are trying to manipulate our elections*," wrote the European Security Commissioner Julian King.[29] The System was limited for the EU institutions and member states but previewed cooperation with partners like Ukraine, which is at the forefront of countering Russian propaganda.

Meanwhile, cooperation between Ukraine and the EU in countering disinformation and propaganda began earlier. In 2017 the East StratCom Task Force created an informal working group with the Government of Ukraine. Analysis of the web site of this EU group (www.EUvsDisinfo.eu/) shows that disproof of Russian propaganda are mostly the facts concerning Ukraine. With the aim of supporting Ukraine in this field, in the EU several projects like "EU Mythbusters twitter feed", "Disinformation Review" and "Center for the exchange of the news in Russian language in Prague" were implemented, and journalists from different countries helped each other in investigations of disinformation. To counter disinformation, the EU Delegation developed the Roadmap and created a system of online consultations with representatives of civil society.

The EU Advisory Mission to Ukraine trains law enforcement officers on strategic communications. In 2017 and 2018, the two-day training on strategic communications was held for representatives of the press services of the National Police from all regions of Ukraine. The emphasis was on modern trends in the media, new communication tools, and active development of messages. "*Today,*

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[27] https://www.kmu.gov.ua/storage/app/media/uploaded-files/UKR.pdf
[28] https://www.reuters.com/article/us-eu-internet-fakenews/plan-to-combat-fake-news-proposed-as-eu-elections-approach-idUSKBN1O41LM?feedType=RSS&feedName=worldNews&utm_source=Twitter&utm_medium=Social&utm_campaign=Feed%3A+Reuters%2FworldNews+%28Reuters+World+News%29
[29] https://twitter.com/JKingEU/status/1107562567650689024/photo/1

information can either destroy the organization or consolidate its positive reputation. Therefore, an effective and "proactive" communication is a critical component of the work of the police," the Head of the EUAM Kestutis Lančinskas said during the mentioned training.[30]

Cooperation of NATO with Ukraine focuses on assisting both governmental agencies and civil society organizations. The Strategic Communications Partnership Road Map between Ukraine and NATO was signed in September 2015 and became a framework for various programs and projects, including those within the Comprehensive Assistance Package for Ukraine (CAP), approved at the meeting of the Ukraine-NATO Commission on July 9, 2016, in Warsaw.[31] It provides trainings of personnel of the governmental bodies and helps to inform the society about NATO activities to counteract Russian propaganda.

Being responsible for Ukraine-NATO cooperation on strategic communications, the NATO Information and Documentation Center (NIDC) contributes to the information campaign to support Ukraine's accession to NATO as part of the Concept of improving public awareness of Ukraine's cooperation with NATO for 2017-2020. However, in the East of Ukraine, the local people are more vulnerable to propaganda and have enough negative attitude to the Alliance that requires information campaigns there with a focus on NATO practical actions to help the population affected by the conflict. Ukraine maintains a high-level cooperation with the NATO Strategic Communications Centre of Excellence, based in Riga (Latvia). *"We have powerful institutions that help us a lot, for example, the Strategic Communications Center of Excellence, which is located in Riga, Latvia. This center has become a hub for research and analysis in this area,"* Barbora Maronkova, Director of NIDC, said in his interview for the "Ukrinform" in October 2018.

Considering the nature of hybrid warfare, the information security will continue remaining at the forefront of Ukraine's cooperation with NATO. However, Ukraine has experience in countering Russian propaganda and becomes more a source of knowledge than a consumer that was emphasized at the international round table *"Ukraine-NATO: non-military cooperation as a joint response to hybrid threats"* on February 9, 2017, in Kyiv[32],

Coordination of the EU and NATO assistance to Ukraine in the security sphere will support Ukraine and other partners in their efforts to increase resilience so that they can defend themselves against internal, hybrid and information threats. The Third

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[30] http://www.euam-ukraine.eu/ua/news/euam-provides-strategic-communications-training-for-police-spokespersons-from-all-ukrainian-regions/
[31] https://mfa.gov.ua/mediafiles/sites/nato/files/7_.pdf
[32] http://ucipr.org.ua/index.php?option=com_content&view=article&id=516:ukra-na-nato-sp-lna-nev-yskova-sp-vpracya-u-protid-g-bridn-y-v-yn&catid=16&Itemid=186&lang=ua

progress report on the implementation of the list of joint proposals, which was approved by the EU and NATO on December 5, 2016 and supplemented on December 6, 2017[33], determines information exchanges and discussions on formats for further cooperation in the Western Balkans, the East and the South.

The *European Centre of Excellence for Countering Hybrid Threats* (Helsinki, Finland) promotes closer coordination between the EU and NATO on countering hybrid threats, including the informational component – propaganda and disinformation. Both organizations hold joint meetings, participate in the activities of the Center, attend the meetings of the Steering Committee of the Center, and are involved in exercises and trainings. Under the auspices of the Centre, recommendations were developed to strengthen further EU-NATO security cooperation. Ukraine is developing cooperation with this Centre but has not yet joined its activities.

The NATO Representation to Ukraine now chairs the donor coordination group for the security and defense sector and works closely with the EU Delegation and the EUAM to Ukraine. NATO personnel also work with the EU support group for Ukraine to identify specific projects, including the sphere of strategic communications. Well-coordinated cooperation in the triangle NATO-EU-Ukraine will be an evidence of common approach in this dimension.

4. The Eu-Nato cooperation with Ukraine will focus on information security

Ukraine continue its movement to a full-fledged membership in the EU and NATO that is considered as a challenge by the Russian Federation because Moscow wants to keep Ukraine in its sphere of influence. To reach this goal, Russia will use information warfare to prevent the European and Euro-Atlantic Integration of Ukraine. This requires attention to the trilateral Ukraine-EU-NATO format of cooperation and coordinated actions not to allows realization of Russia's plans. Thus, it is necessary to identify problem areas:

- continuation of Russia's hybrid-type aggression against Ukraine by: granting Russian citizenship to residents of Donbas - both on the occupied territories and areas controlled by the Government; actions on the transformation of the Sea of Azov and the Black Sea into "Russian lakes" using a doubtful motivated navigation restriction; escalation of pressure on Kyiv to push it to unilateral implementation of the Minsk agreements in the Russian interpretation;

- probable "gas attack" in the winter of 2020, taking into account likely termination of the Russian gas transit to the EU through the territory of Ukraine

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[33] https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2018_06/20180608_180608-3rd-Joint-progress-report-EU-NATO-eng.pdf

and the completion of gas pipelines "Nord Stream 2" and "Turkish Stream" (so-called "Problem 2020");

- Russia's use of civil infrastructure on the sea to covertly spread its military presence under the pretext of protecting it from subversive and terrorist threats;

- security of Ukraine in the period after the end of the Intermediate-Range Nuclear Forces Treaty;

- Russia's subversive activities against the EU and NATO from within with the use of various actors of influence to disrupt functioning of organizations and prevent Ukraine's integration to them.

The problems to some extent lie in the dimension of Ukraine's relations with NATO and the EU. The mutual understanding between the sides in both bilateral and multilateral formats will be needed as never before, especially considering continuation of Russia's destructive policy towards them. Shortcomings of strategic communications of the Ukrainian authorities on various issues in the past had severe consequences for Ukraine. The lack of strategic communications with the United States, the Great Britain, Poland, Germany and France in 2014, in the conditions of domestic political turbulence and the beginning of Russian aggression against Ukraine, was one of the reasons that instead of the Budapest format on *Security Assurances* to Ukraine, the Normandy format of negotiations and the Minsk process were initiated. The US, as the initiator of the Budapest Memorandum, appeared absent in those formats and Russia tried to play a role of a mediator like Germany and France, although it was a party to the conflict in reality. The issue of Russian occupation and illegal annexation of Crimea was left out of the negotiating process, and some European politicians interpreted the Russian aggression against Ukraine as an "internal civil conflict".

A similar situation of substitution of concepts occurred in 2009 when Russia resorted to the use of gas as a weapon against Ukraine, and later against the EU countries. Thus, absence of an official reaction at the beginning, diplomatic lethargy and lagging reactive actions of Ukraine in the winter of 2009 against the background of the massive Russian propaganda and lobbying efforts of Gazprom in Europe became the main causes of inadequate conclusions of the European Commission regarding the nature and reasons for the "gas attack" against the EU during two weeks and Ukraine during three weeks. Brussels limited itself to stating: "On the night of January 6-7, all supplies from Russia through Ukraine to the EU were stopped. Gas supplies from Russia to Europe were absent from 7 to 20 January."[34] Russia was not accused in that "gas crisis", as Brussels assigned the responsibility to both sides - Russia and Ukraine.

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[34] Commission Staff Working Document. Accompanying document to the Proposal for a Regulation of the European Parliament and of the Council concerning measures to safeguard the security of gas supply and repealing Directive 2004/67/EC. The January 2009 gas supply disruption to the EU: an assessment. Brussels, p. 4

The gas crisis of 2009 was accompanied by the large-scale information-psychological campaign and PR-support of the actions of Gazprom by the authoritative international PR-agencies (Gavin Anderson, GPlus Europe, and Ketchum). It was paid off. Russian propaganda stamps like "Ukraine interrupted transit to Europe", "Ukraine is an unreliable transit chain", "Northern and southern flows are ways out of transit problems" were fixed in the European public consciousness. The propaganda thesis - about "theft" of gas by Ukraine was and remains especially widespread. Even former European Commissioner for Energy Gunter Etinger in August 2014 used rhetoric about the possibility of "stealing has" by Ukraine, predicting a possible gas crisis in the winter of 2015, although his forecast was not justified. Today, in the context of "Problem 2020" there are signs that the scenario of "General pressure of strong parties on a weak one" may repeat, although the EU's attitude to Russia would have to be transformed in the light of the events for the last five years.

Countering Russian aggression, especially its information component, increases the importance of coordinated NATO-EU-Ukraine actions. To do this, Ukraine requires the involvement of all actors and the creation of a full-fledged and long-term mechanism for the training of relevant specialists, research and implementation of their results. The EU and NATO help Ukraine to perform these tasks. However, at the strategic security level, the Alliance is more involved that points the need to strengthen work with the EU. At the tactical level, the Alliance is more focused on the military-security component, and the European Union works deeply in the sectors of public security through EUAM and the EU Delegation. Despite this separation of dimensions, precise coordination of the actions of both organizations is essential, and Ukraine itself must ensure that there is no duplication of their efforts. Therefore, the adoption of normative legal acts on information security, based on the Information Security Doctrine of Ukraine, and the formation of administrative and organizational mechanisms in Ukraine become priorities, without which the relevant assistance of the EU and NATO will be ineffective. The Alliance is ready to assist in these tasks, as defined in the NATO-Ukraine *Strategic Communications Partnership Road Map*.

It is necessary to move to practical steps aimed at preventing information threats. Ukraine should initiate projects on information security in the framework of the EU PESCO cooperation mechanism and join the NATO StratCom Centre of Excellence. As it was proposed by the Centre for Global Studies "Strategy XXI" (Ukraine) within the project on monitoring and enhancing security situation in the Black Sea region, supported by the Black Sea Trust Fund[35], the EU, NATO and Ukraine can cooperate on dissemination of up-to-date information on violations of

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[35] https://geostrategy.org.ua/images/Policy-brief-BSS-2_ENG.pdf

the international law by Russia in the Black Sea, the Sea of Azov and the Kerch Strait in the international information space.

In conditions of the hybrid war, Ukraine, the EU and NATO should work together to protect their information borders and build the future information space through: raising public awareness of the dangers of aggression; prevention of information flows, which go beyond the usual human awareness; consideration of the speed of information dissemination through social networks; development of cooperation between information volunteers; correspondence of information messages to real actions.

The information sphere should become a field not only for NATO and the EU assistance to Ukraine but also for adoption and using of practical knowledge and experience that Ukraine has gained in countering Russian propaganda to guarantee common information security. One of the areas of cooperation between Ukraine, the EU and NATO should be raising awareness of the population of neighboring member countries of both organizations to improve their public opinion about Ukraine and effectively counteract Russian propaganda, which is actively spread by the Kremlin. It is essential to continue active cooperation with the EU StratCom East Task Force, effectively use of public diplomacy tools, involvement of NGOs, experts and cultural figures. Strengthening cooperation with European think tanks to counter Russian propaganda will help to increase mutual awareness of the societies of Ukraine, the EU and NATO member states, strengthen security, increase trust, and defend common values.

The European Union can get an added value by including Ukraine to its system of rapid identification of disinformation, which will allow Brussels to respond more effectively to information threats, because most of them come from Russia, and Ukraine is the main target of its attacks. Information products produced by StratCom East Task Force should be translated into all languages of the EU countries for better distribution. Their translation into the languages of the partner countries, including Ukrainian, contributes to their dissemination in Ukraine. In parallel, the EU should continue supporting independent Ukrainian media through technical assistance, trainings and exercises. Ukraine can use NATO experience in returning territories which are temporarily controlled by illegal armed groups to government control and guaranteeing the social security of the local population and internally displaced persons.

Ukraine is developing cooperation with the EU and NATO on information security, but it is necessary to draft a clear road map for triangle cooperation to counter the current information threats, based on the EU-NATO Enhanced Security Cooperation and bilateral formats with Ukraine. This will allow better coordination of all efforts and avoiding unnecessary duplication to increase their effectiveness.

5. Conclusions

The development and accessibility of the media, social networks and personal communications have made it easier for an aggressor to use information tools to influence societies. Creation of a protective shield for a society of a victim state has become more difficult. The aggressor is not considered as an open enemy, but it disguises its actions as "taking care" of specific groups of people and "special" regions. Instead, the leadership of a victim state and its patriots are portrayed as a "war party" in the aggressor's media. In the Ukrainian case, using mass media and disinformation in the international arena, the aggressor creates an image of Ukraine as a state, in which "civil conflict" takes place, but the aggressor acts as a "peacemaker". All this hinders the active and effective resistance of the state institutions to the aggression.

In the context of Russia's hybrid war against Ukraine, when society became the object of attacks, effective counteraction can be achieved only through close cooperation with the public, especially civil society organizations, increasing confidence in its actions and informing about the situation in and around the country. A shield that should protect the Ukrainian people from hybrid threats from Russia requires Ukraine to strengthen internal unity, associated, in particular, with a vast truthful public awareness of sensitive topics, including historical ones, which aggressor uses or can use to achieve its goals. Therefore, non-governmental organizations, experts and academics, independent media should be involved in the process.

After the start of Russian aggression against Ukraine, the entire population of the country was involved in protection activities in all spheres, including the information one. However, over time, this involvement began to decrease because citizens gradually returned to everyday life. At this stage, the priority task is to create a functioning system of information security in the state, which can be assisted by the EU and NATO.

With the support of the EU and NATO, Ukraine is working out the mechanisms to counter information threats, by using their experience, knowledge and technical assistance. These two organizations are not standstill. They interact with each other on the principles of mutual complementarities. Threats to Ukraine, the EU and NATO are similar, and their source of origin is the Russian Federation. Therefore, Ukraine must deepen cooperation with each organization separately and in the context of their mutual cooperation.

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USING TECHNOLOGIES IN THE PROCESS OF TAKING DECISIONS IN BUSINESS

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Abstract: *In the midst of today's rapid change, timely and appropriate data needs to be collected and analyzed regularly instead of arbitrarily or haphazardly for business decisions and for business analysis and strategy. Despite the importance of systematic intelligence activities, both in academia and the business world, they are still trying to find a footing. When businesses aim to be more data-driven, efforts will increase in data sharing and collaboration. Visualization of data will be even more critical for groups and divisions to work together. The paper includes in the first part a short overview about the main business intelligence techniques. In the second part we present a customer relationships management software (hubspot) as an instrument for taking decissions in business.*

Key words: *CRM, business intelligence, database, digital economy, software*

An overview of business intelligence used techniques

Business Intelligence (BI) is the process of using existing technologies, programs, and application to collect, combine, and analyze data and then the presentation of this information. This helps top management of a company, including executives and managers, to make well-informed and important business decisions. "Business Intelligence systems are data-driven Decision Support Systems (DSS)" [1]. Simply put, Business Intelligence in the process of transforming raw abstract data into information in a usable form for the end users [3]. The implementing of BI in a business can give them a competitive advantage. This is reasonable to expect because it provides users with operational information, in an effect time efficient manner; this could be through queries to form reports. These applications provide historical, present, and future observations of a company's business dealings. Initially BI applications and tools were used IT individuals like data analysts. With the introduction of Self-Service Business Intelligence (SSBI) users can get access to information without needing prior IT experience or involvement. The result is freedom and flexibility in how the information can be utilized. With the need for any business to now be able to survive in the global market, having a well-integrated BI system can mean the rise or demise of a company. We see that the

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amount of data a company can collect as of present can is over whelming and would be near to impossible for a human to mining through it all for useful information, then factoring in the margin of human error. This would also require a business to keep up with the latest technologies and applications of business intelligence. Business intelligence data is usually stored in a data warehouse or in smaller data marts containing the details of a client.

In connection with the progressive importance of business intelligence, Gartner predicted that because of failure to adapt to the environment and implement the necessary business intelligence software or strategies, 35 percent of the world top 5,000 businesses would not be able to make informed decisions with regards to huge changes and developments in their industry and markets [3]. Also, that 40 percent of the company budget would be used in connection with business intelligence. This is because the purpose of business intelligence is to better the company by making the way they access data and how that data is utilized to the company's benefit and profit. The data acquired can give the business insight into the nature of their operations. This then allows for the business to create and make strategic decisions that lead to better management of resources, increase in revenue, the growth of the company, which result is a sustainable profit.

Listed below are a few additional advantages of business intelligence:

- Substantially increase in revenues
- Competitive advantage over market rivals
- Identification of business problems that need attention
- Display of market trends
- Quicker and more accurate decisions made, and
- Improved internal harmony of company.

There are numerous tools of data analysis and business intelligence that target different aspects. Some include Ad hoc analytics, Online analytical processing (OLAP), Mobile BI, Real time BI, Operational BI, Software-as-a-service BI (SaaS BI), Open source BI (OSBI), Collaborative BI, and Location intelligence (LI) [5]. Below a few of these are elaborated:

- **Data visualization tools**: Data visualization has to do with presenting information in a visual to highlight the significance. The most common data visualization tools are the graphs and charts in Microsoft Excel. There are more complex tools for example info-graphics, sparklines (embedded line graph showing a trend), and detailed fever charts (graph showing change of a variable over time). Data visualization tools play an important role in the simplification data and analytics and making data-driven insights available to employees in ever section an organization. It also improves analytics because it is easier to interpret visual that numerical output. User have the option of a variety of data visualization tools on how

88

to present any type of date. The have been advance in some tool automatically interpret data and present them in the appropriate visual.

- **Real Time BI**: This allows for up-to-date data by putting transactions into a real-time data warehouse and BI system. It supports quick decision making, for example like up-to-date inventory values for online shopping. Real-time does not have to be implemented at every part of the business process. Real-time are also highly expensive. Weekly, monthly, and yearly reports are used by most business to meet their goals, for example for year to year comparison.

- **Collaborative BI**: The process of joining business intelligence software with tools like Web 20 tech, to improve decisions. Collaborative BI can be extended to enterprise-wide reporting and evaluation, making the process of collaboration simpler and allowing more effective decision-making between team members who may have worked independently to reach conclusions. Examples of these are SAP, Lotus Notes, and Microsoft SharePoint.

- **Key Performance Indicators (KPIs)**: Metrics used to track factor that success is dependent on. The focus is on business processes that top management deem as most important in accomplishing the objectives of the corporation. Different companies have different KPIs that they prioritize, some focus on the number of new customer for example. Without KPIs, it would be impossible for the managers of an organization to evaluate this in a meaningful manner and then make organizational adjustments to resolve performance issues. Usually, BI applications integrate advanced forms of analysis, such as data mining, predictive analysis, text mining, statistical analysis, and big data analysis. It could also be difficult to keep employees focused on company projects and responsibilities that are essential to organizational performance without designating KPIs to demonstrate the importance and value of such activities. KPIs that measure business results, such as quarterly profit and revenue growth, are referred to as lagging indicators as they track things that have already happened.

- BI dashboard development tools and quality scorecards showing visualized business measurement information. A Power BI dashboard is a single page that uses visualizations to tell a story, also called a canvas. Because it is limited to one page, there is only the most important elements of that story in a well-designed dashboard.

Decisions are the main force of business intelligence. The success of a decision made by the management of a company can affect the business future in the positive or negative. There are two types of decision a company can make: strategic and operational. Strategic decisions must identify the target markets, the key skills required, involvement in the value chain, competitiveness, and financing. Few examples of strategic decisions can be: should we enter a certain market, how

should we model our new product, what partners we should choose and which distribution channels. Operational decisions are determinations made by companies on a regular basis, a choice or estimation of an outcome that relies on a variety of prevailing circumstances (inputs) and ultimately has a notable impact on an organization's behavior. This has led to the development of a field of business called Decision management, also known as Enterprise Decision Management (EDM) or Business Decision Management (BDM). This encompasses all aspects of designing, constructing and managing automated decision-making systems used by an organization to manage its interactions with customers, employees and suppliers [8]. Intelligent decision support systems have the huge potential to transform the human decision-making by integrating research into artificial intelligence, IT, and process engineering. Communication and collaboration between distributed systems can provide a human decision-maker with just-in-time data, real-time storage, collaborative environments, and globally up-to-date information [10]. Computerization has changed the way companies approach their decision-making because it involves automating more decisions, managing response times and unattended computerization-required activity, and allowing "information-based decisions" – decisions based on historical behavioral data analysis, previous decisions, and their outcomes.

To tackle the challenge of making informed decisions there was a need for decision making software. Decision-making software (DM software) is computer application technology that helps individuals and organizations make choices and make decisions, usually by rating, prioritizing or choosing from a variety of options. DM tools can help those making decisions at different stages of the decision-making process and include the problem exploration and formulation, the identification of decision alternatives and the solution constraints. Also it includes the structure of preferences and tradeoff the judgements.[9]

HubSpot – an instrument of business intelligence

Hubspot is a CRM (Customer relationship management) software that manages a company's interactions and relationships with both current and potential customers. When launching Hubspot, the first thing to get acquainted with is the dashboard. Whether the user press the Hubspot logo or go all the way to Reports and Dashboards, he will be able to access the dashboards.
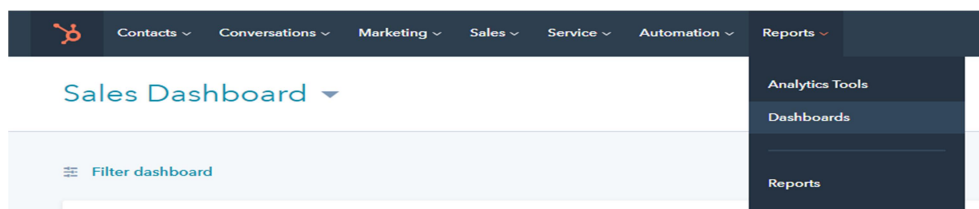
This is the first place where it can be seen what is the status regarding the business, the sales, the marketing and so on. The user can move the different tabs around and customize them according to the liking by just dragging them for an easier use.
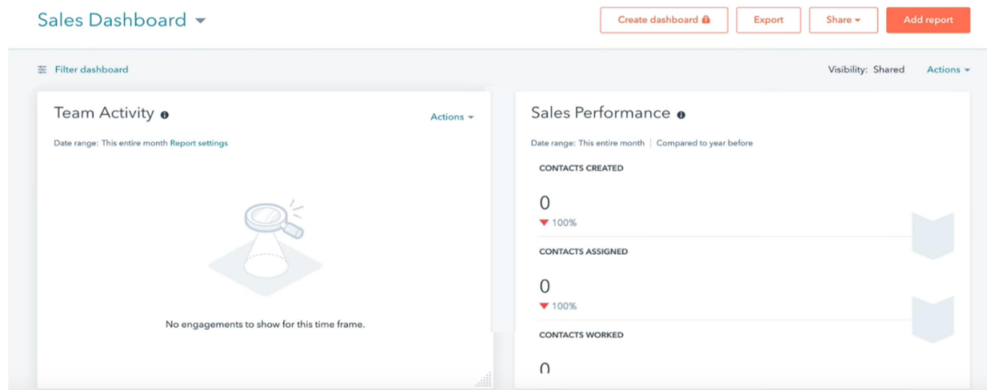
The Team activity window is a report the will always show the 20 most recent activities that the sales team is doing. Use it to see specific tasks, emails, meetings, and calls that the team is completing.

The Sales performance window will show the reports of the sales progress. It shows contacts that have been assigned and worked by users in the CRM, and the number of deals that have been created and closed won. Use this report to get a good understanding of how the sales pipeline is progressing in the selected time range.
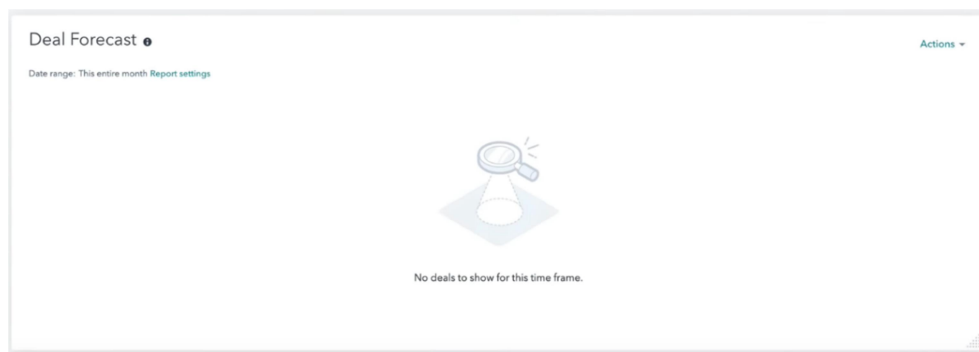

The Deal forecast tab represents a standard report on the sales dashboard, which shows the amount of revenue for deals in each stage of the deal pipeline. The forecasted revenue is calculated by multiplying the deal amount by deal stage probability.
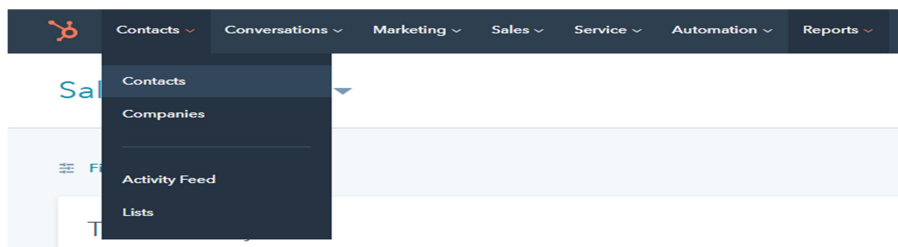
The Deals Closed versus Goal window shows revenue from closed deals, compared to the user team's quota or a custom goal. Use this report to track the team's progress over time and to help set better sales goals.

The Productivity window is a report that shows the total number of calls, emails, notes, tasks, and meetings that the team has conducted in the selected time frame. Use this report to get a better understanding of how productive the team is with their sales activities.
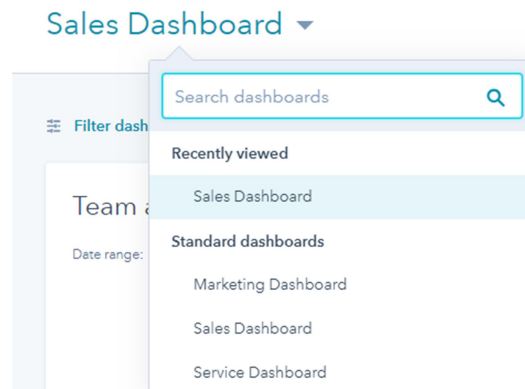
The user can search and customize different dashboards. Look out for this logo ( ) and hover on it to get information and detailed explanation at what it is looking at.
On the top left of the screen there are different drop down menus. The First one is Contacts that presents the people who work for the company.

To create a new contact the user must press the "Create contact" button on the top right hand corner of the screen and fill out a menu. The "Companies" option represents the business, the people who get the invoices. Once the user goes to companies, it will appeared a list of the companies.

Similarly to Contacts, all the user need to do to add/create a company is go to "Create Company". When clicking on a certain company, the software will take to their profile.

This is the place from application where the user will spend most of the time – it can be create notes, tasks for and write emails to the companies.

Here it can also been seen which contacts are related to that company, as well as what deals the user has with them. If there are some customers requiring help with a problem related to this, the user can also find it here.
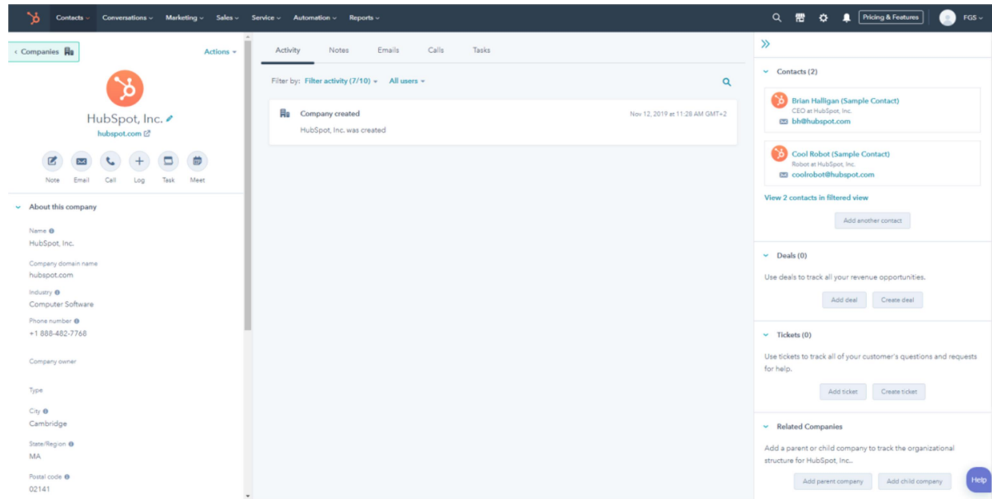
Contacts (2)

Brian Halligan (Sample Contact)
CEO at HubSpot, Inc.
✉ **bh@hubspot.com**

Cool Robot (Sample Contact)
Robot at HubSpot, Inc.
✉ **coolrobot@hubspot.com**

View 2 contacts in filtered view

[Add another contact]

Deals (0)

Use deals to track all your revenue opportunities.

[Add deal]   [Create deal]

Tickets (0)

Use tickets to track all of your customer's questions and requests for help.

[Add ticket]   [Create ticket]

Related Companies

Add a parent or child company to track the organizational structure for HubSpot, Inc..

[Add parent company]   [Add child company]   **Help**

Under the conversations tab there is the Inbox, which contains all the conversations with other users and employees will be. It can also been created some Chat-flows, snippets and Templates, but this option is for a more advanced user of the software.
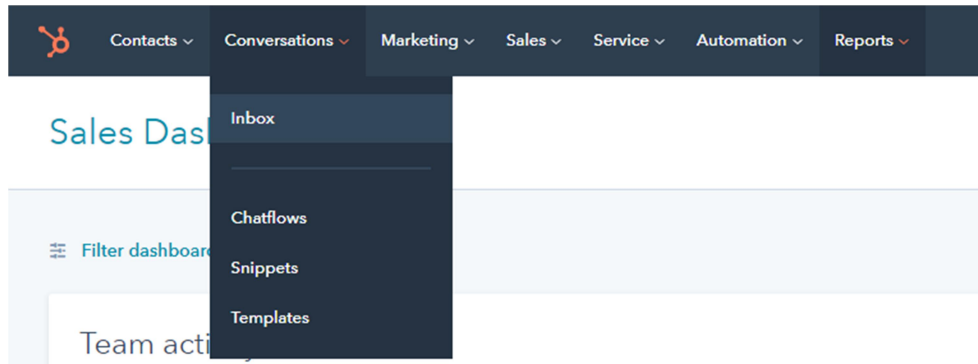
Also the user can compose and assign emails as well as link the personal email to the account. The software also gives the possibility to see the email addresses of people that contact the user, allows contacting them outside the software.

The inbox option of Hubspot is very similar to any other email platform therefore it is fairly easy to navigate.

Under the marketing tab there is the Ads tab. This is the place from application where the user can create ads and track their data, for example: visitors, clicks, conversions, impressions and others.
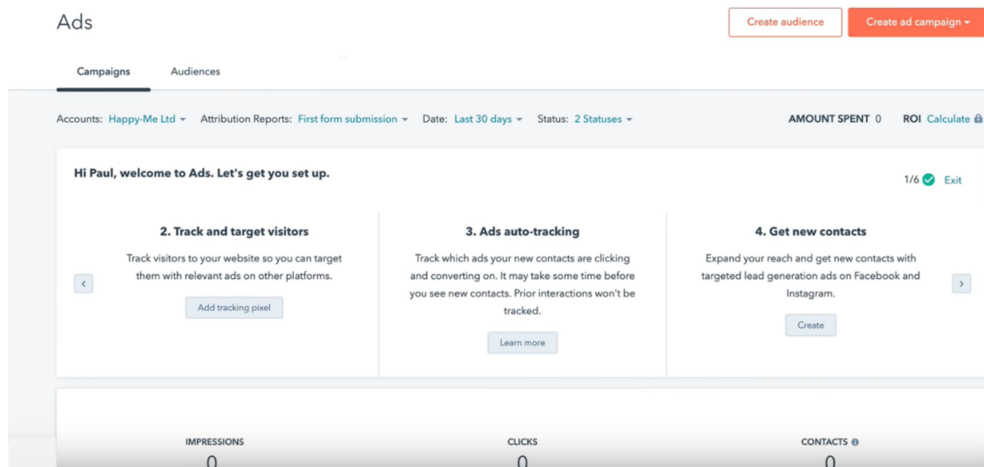
The next tab, and probably the most important one, is the Sales tab. This is basically what CRMs are here for – making deals, improving the management and the profits of a company.

The first sub-tab is the Deals one. There, user will find a timeline of the deals that currently have in place, regardless if it has just started the work on them or have already completed them.
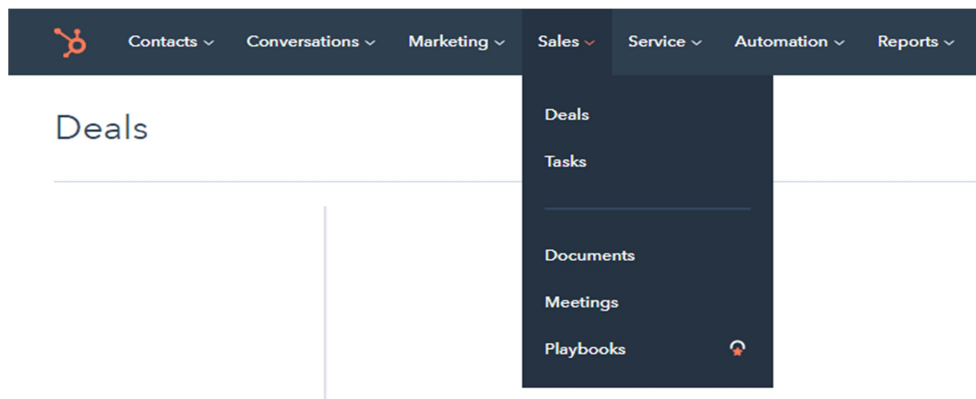
The timeline is well documented and very self-explanatory – from "Appointment scheduled", which is the first ever time of talking to and have contact with somebody to "Closed won" or "Closed lost", depending on whether the deal was successful or not.
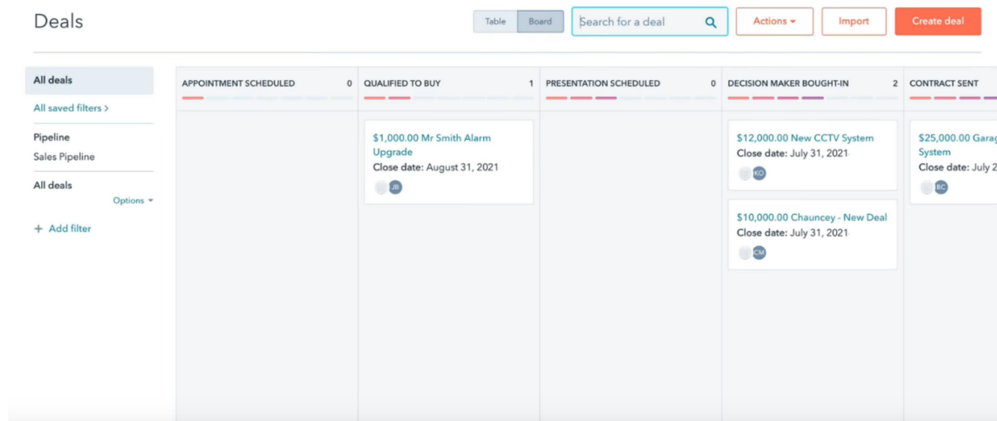
The user can drag the tabs from column to column whenever that specific deal has progress. If it is wanted to create a deal, go on the top right hand corner and select "Create deal". A menu window will pop-up and allows creating any sort of deal. After creating the certain deal it can be customized as well.

Under sales it can be also find the Tasks tab. Here it can be seen all the created tasks, including those that are for the day, week or those that are overdue.
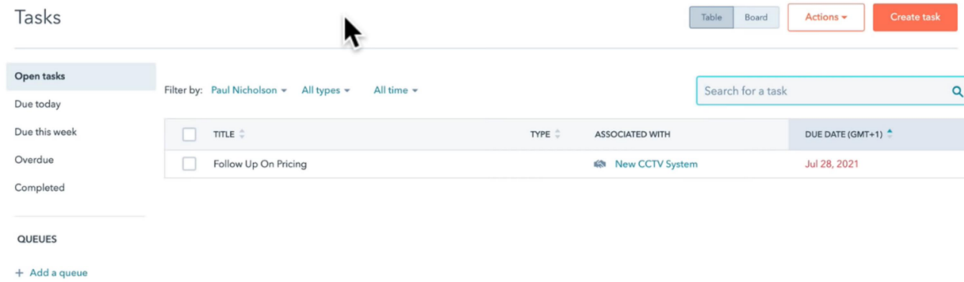
Right beneath it is the Meetings tab. This tab allows linking it with the user personal online calendar to facilitate the planning.

Next up is the Service and Tickets tab. This is where the customers create tickets if they have problems. The tickets can then assign those to members of the team so they can help the customers out.

An important facility of the Hubspot CRM is the search menu. From this menu the user can quickly search for anything on the program – contacts, companies, deals and others. This is very helpful for big companies with multiple employees and dozens of deals.

The settings menu allows customization the preferences and privacy settings depending on how the decision maker wants to use the program. It's also the place where the manager can edit all the info related to the company.

97
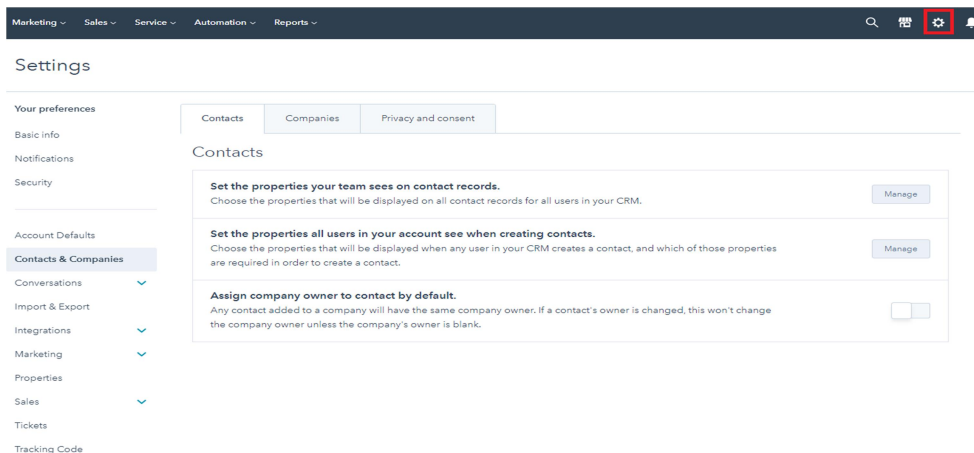
The notifications tab allows the user to see new messages, deals, tasks, issues and others about the work. A simple click on the notification icon will open the respective menu. The notification preferences can be edited, either through the previous notification tab or through the settings option in the notifications menu.

The options of purchasing a plan will give some additional options and tools within the software. This is features is mostly recommended for advanced and experienced users of the platform.

Conclusion

Business intelligence continues to evolve depending on business needs and technology, so it should been identify current trends every year to keep users up to date on innovations. Realize that artificial intelligence and machine learning will continue to grow, and companies will be able to integrate artificial intelligence expertise into a wider business intelligence strategy. Business intelligence software results are, in our opinion, essential for effective measuring using performance indicators across all levels of management. The ability to have and analyze both past and present information is crucial to a company's success. Company should be looking into investing in their business intelligence if they want to have a chance to survive in the ever-changing global economic system.

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THE NEW DATA PROTECTION REGULATION CLAIMS UNDER GDPR

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Abstract: *After 2 years since The General Data Protection Regulation entered in force, we finally face the day when it starts to apply. May 25, 2018 was the "Z" day regarding Data Protection Laws and Practices.*
The necessity of this regulation is obvious and addresses both the data processed within European Union and the data transfers outside the European Economic Area. GDPR extends the scope of EU data protection law to all foreign companies processing data of EU residents.[1] The regulation highlights the following key requirements: scope, single set of rules, responsibility and accountability, lawful basis for processing, consent, data protection officer, pseudonymization and anonymization, data breaches and sanctions.
The main purpose of the GDPR is protect this important asset called personal data. First fines within this new legal background were imposed and it is important for all of the data controllers to ensure their compliance towards the GDPR.

Key words: *The General Data Protection Regulation; scope; data protection officer, lawful basis for processing, consent, data breaches and sanctions.*

Introduction

Starting with 2012, the European Commission initiated the process of the new legislation regarding data protection. By the end of 2015 the European Parliament, Council and Commission established the novelty for the data protection area, which had the same legal frame in the European Union as a result. This is why they accepted the Regulation to the detriment of the Directive as a final legal basis. The new law, under the Regulation final form was adopted in April 2016 by the Council and the Parliament.

On May 4th, 2016, the European Union Regulation Official Newspaper 679/2016 of the European Parliament and Council of April 27th, 2016 published an article „on the protection of individuals with regard to the processing of personal data and on the free movement of these data and the repealing of Directive 95/46 / EC" (General Data Protection Regulation).[2]

The regulation is a mandatory European Union legislative act that must be applied entirely by each and every single member state of the EU. As the EU states on its

own homepage„unlike a regulation, the directive is a legislative act setting an objective that all the members of the EU must meet, but each of them has the right to decide on how to meet the established objective. The distinctions between the mode of application and the effects of the two types of European legislative acts also shows us why the regulation option is more effective".

The protection of personal data has the following technical cause: the development of information systems. The development of computer systems raises the following issues: memory, communication and intelligence. Computer systems have memory, computer systems allow for easy communication of stored information and information processing in a sufficiently short time for the use of processing results to be effective.

"The Charter of Fundamental Rights of the European Union" only concerns the rights of individuals. So is the art. 8 of the Charter, which provides: "Everyone has the right to the protection of personal data concerning him or her. Such data must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis laid down by the law. Everyone has the right of access to data which has been collected concerning him or her, and the right to have it rectified. Compliance with these rules shall be subject to control by an independent authority" [3]

The right to data protection derives from the right to respect for privacy. The concept of private life is associated with human beings. Individuals are therefore the main beneficiaries of data protection. [4] Furthermore, according to the Working Party 29 Opinion, only human beings are protected by European data protection law. The jurisprudence of the ECHR on Article 8 of the ECHCR shows that the complete separation of private and professional life can be difficult.[5]

The GDPR Regulation is structured on 11 chapters that grouped 99 articles and 173 recitals, as follows [6]:

1. „General provisions" (Art. 1 – 4)

2. „Principles" (Art. 5 – 11)

3. „Data subject rights" (Art. 12 – 23)

4. „Processor/Controller" (Art. 24 – 43)

5. „Personal data transfer to third countries/international organizations" (Art. 44 – 50)

6. „Supervisory Authorities from the Member States" (Art. 51 – 59)

7. „Cooperation" (Art. 60 – 76)

8. „Penalties" (Art. 77 – 84)

9. „Specific data processing situations" (Art. 85 – 91)

10. „Delegated acts and implementing acts" (Art. 92 – 93)

11. „Final provisions" (Art. 94 – 99) [7]

1. Regulation (EU) 2016/679 - Scope

Regulation (EU) 2016/679 is directly applicable in all EU Member States, protects the rights of all individuals within the EU and extends the scope also to data controllers working outside the EU in the extent to which their goods and / or services are addressed to persons located within the EU.[8]

Personal data is important in the identification of individuals (Article 4 (1) of the Regulation). [9] Social interaction between people is done through exchange of information; in the absence of information exchange, the functioning of society is unthinkable.

We could say that some of this information allows us to identify the people who interact, but closer to the truth if we observe that most of the information conveyed allows us to identify the person who is talking to them. We can say that society abounds with personal data.

The information allows the holder to act effectively. That is why information is power. Information extracted from personal data is important because it allows profiling. Consequently, they enable active agents to achieve attention management through personalized interactions.

The legal meaning of personal data does not clarify when a person is deemed to be identified. Identifying clearly involves elements that describe a person in a way that he can distinguish himself from all other persons and can be recognized as a natural person. Someone's birth name can be an example of a description element. In exceptional cases, other identifying elements may have a similar effect to the name. As an example, in the case of public figures, it is enough to specify their position, for example, the President of the European Commission.

2. How it works?

 The new data protection legislation is a regulation so it will automatically apply to all concerned entities without the need for national legislation, since it is a regulation and not a directive. It replaces Romanian law no. 677/2001 on Data Protection.

 It is necessary to implement technical and organizational security measures through which data protection principles can be effectively implemented. It is also necessary to minimize processed data and to ensure safeguards in the processing in order to comply of the Regulation and to respect the data subjectsrights [10].

The protection granted by the GDPR concerns individuals, regardless of their nationality or residence, in respect of the processing their personal data. Therefore, the GDPR confers on individuals more rights, which they can exercise freely with respect to the data processing entities, such as: the right to information, the right of access their personal data, rectification and erasure, the right to restrict the processing, „the right to reuse personal data a.k.a portability", the right to object against using such data.

3. Principles of GDPR

The principles governing the general data protection regulations are:

- Lawfulness, fairness and transparency (linked to fundamental human rights).

- Purpose-limitations (personal data of the subjects needs to respect the well-defined criteria, legitimate purposes, and subsequent processing must not deviate from these purposes); [11]

- Minimizing the collected data

- Appropriate, limited and relevant (this principle makes it clear that any personal data collection needs to be the most relevant to what is the purpose in which they are processed);

- Verifying the accuracy of data and updating it;

- Storage-related limitations (data must be kept as long as needed for the underlying storage. Longer storage periods are exceptions associated with public archiving, research or statistical activities);

- Integrity and confidentiality - data security (security processing Ex ISO 27001 certifications);

4. Lawfulness of processing

Article 6 provides the scenarios in which data controllers are allowed to process individual's personal data:

(a) the data subject has given a valid consent regarding the granular purpose of processing their personal data;

(b) the data is vital for the signing of a contract;

(c) the controller has a legal obligation while processing that personal data;

(d) there is a vital interest of the personal data subject or another natural person. Ex when calling for an ambulance;

(e) there is a public interest for processing the personal data;

(f) there is legitimate interests when processing such data" [12]

There is no time limit specified in GDPR, for how long the consent will be valid. The consent timeframe will be contextual and the initial consent scope will depend as expectations of the person concerned. If processing operations change or evolve considerably, the initial consent is no longer valid. In this case, a new consent must be obtained.

Article 6 (f) is provided as the last option among the six grounds that allow the personal data to be processed lawfully. It requires a comparative test: what is necessary as legitimate interest of the operator (or third parties) must be balanced against the interest or fundamental rights of the data subject.

Article 6 from the General Data Protection Regulation is considered to be one of the most important because it is drafting the scenario when any individual can process personal data. It is clear that if anyone can link their processings to any of the cases listed above, there is la lawful processing of such data.

4. Who is evaluating?

In Romania, the National Supervisory Authority called ANSPDCP [13] will carry out checkings and apply sanctions on behalf of the EU.

5. Special features for a valid Consent

As for the consent, the former Working Party 29 (EDPB now) has given a general understanding of how this consent should be obtained from the natural person. Consent should, inter alia, be given unequivocally, informed and free of charge.

Article 4 (11) The GDPR defines a valid consent as "any freely given, specific, informed and unambiguous indication of the data subject's wishes by which he or she, by a statement or by a clear affirmative action, signifies agreement to the processing of personal data relating to him or her" [14]

Consent must be given through an action (unequivocal declaration or action). This means that the simple reference currently available on many sites that says "by continuing to use this site you agree to processing your data" is no longer enough.

Thus, consent must be given by an unequivocal action which is a free expression, specific, informed and clear expression of the person's agreement. Such actions may be written statements, including in electronic form, including ticking a box when the person visits a site.

For the manifestation to be specific, informed and clear, the operator to process the data must provide clear, simple and transparent information respecting the main purpose of that processing, the basis of the processing, the time for which the data is processed, and its right to take back their consent.

The subject of the data must also be informed of the data controller identity and data protection officer, the data recipient and any interests and intentions to transfer them to third countries. Be careful: If you need multiple purposes, consent must be given for each of them!

There is also a very important clause in the official guideline regarding the imbalance of powers. In practice this case can be translated as a typical situation where a aanager is going to ask his employees to consent on installing CCTV cameras in their office. This is clearly an imbalance of powers because in most of the cases those employees are going to be literally forced to accept anything their direct manager is going to ask for. Ideally when we talk about personal data processed as an employment form, we should not use the consent as a valid way of using personal data.

Working Party 29 also stated that there are also other cases beside the employment context, such as public authorities and any other situation when the data subject is not able to express a real choice without feeling pressured, intimidated or significant negative consequences. In these cases consent is not going to be given free so it is not going to be valid.

There is another important factor when any processing is going to be based under the consent form and that is the granularity of the consent. The meaning of this lies in the core of this Regulation. Any data subject must be informed about how his/hers personal data is going to be used. So, specifically for the consent, the data controller must be able to demonstrate that he has obtained a different consent for each and every final purpose of that processing. For example, if there is a consent form where it is clearly stated that the subject is accepting to receive marketing informations by email, the controller should only use that database to send the requested information to the people. But, in case that data controller wants to transfer these data to thers, he/she should have to obtain a different consent for this new purpose of the processing. Shortly, the data subjects have to be clearly informed about whatever is going to happen with their data.

The controller should also be able to demonstrate that the consent can be withdrawn at any moment without any negative consequences. Moreover, the consent must be withdrawn as easy as it was adressed and should always be free. As an example, we cannot ask someone to call (costly phone call) in order to withdraw their consent. It should be as easy as checking a box, filling a form or sending an email.

When asking for consent, controllers should not use pages of technical language because it is not going to be a valid form of informative measures regarding the usage of personal data. The language used should be accessible, easy to understand and clear.

Maybe the most important aspect of the constent is the way the data controller is going to be able to demonstrate it. In other words we cannot ask someones consent verbally when using the personal data because we are not going to be able to prove so. Any written statement as acceptable under GDPR as a valid consent.

There are cases when special legal requirements are asking for the usage of personal data. For instance, for security reasons, every tourist that is going to rent a room in the hotel will have to fill a form regarding his/hers personal data. In such cases, the law is specifically stating which data should be collected and what is going to happen with it. In most of the cases, these papers are being sent to the police station.

Conditions of a valid consent
a.   It must be free
Thus, according to the Regulation, the consent will not be freely expressed if:
- the data subject does not really have the freedom of choice or is unable to refuse or withdraw his consent without being harmed;
- there is an obvious imbalance between the data subject and the operator, especially if the operator is a public authority. For example, this requirement will question the validity of employees' consent for data processing by employers. In Romania, in general, employers process data based on consent. As such, they will have to consider if, after May 25, 2018, they can still rely on the consent of the employees one of the theme of data processing;
- the granting of consent does not allow it to be given on different data processing operations, although this is appropriate in the particular case

b.   It has to be specific
A very broad consent, given for general / indeterminate purposes, is not valid. To be considered valid, operators must clearly identify the purposes of the processing, and the consent must cover all processing activities carried out for the same purpose. In addition, if data processing is for multiple purposes, consent should be given for each purpose separately (granular)

In case the data processing is done for scientific research purposes, it is not mandatory to fully identify the purpose of the processing that is the object of the research, being sufficient that the data subjects can only consent for certain research areas identified by the operator. However, the requirement regarding the granularity of the consent should be respected, that is to allow the data subject to give his consent only for certain fields of research or parts of the research projects (to the extent permitted by the intended purpose).

106

c. It must be informed

The regulation provides that any processing of personal data should be carried out in a transparent manner by informing the data subjects about the existence of data processing and the conditions under which the data are processed.

Thus, the information and communications regarding data processing must be easily accessible and easy to understand, using a simple and clear language. Information notes with very technical terms do not comply with the requirements of the regulation and will attract invalid consent.

Thus, when drafting the information notes displayed on web pages / online platforms, operators must take into account the language of each jurisdiction in which the data subjects are located, in order to avoid any possible discussions regarding the validity of the consent.

d. It must be unequivocal

The regulation makes some clarifications regarding the meaning of unequivocal consent. Thus, in order to be considered unequivocal, it must take the form of a statement or an action that clearly shows the intention of the data subject to give his consent.

What are the actions that clearly show the intention of the person to give his consent?

Below are some examples provided by the Regulation:

a) ticking some boxes when the person visits a web page,

b) choosing the settings for the information society services; or

c) any other statement or action that clearly indicates in a given context the acceptance of the proposed processing by the data subject.

In the general hypothesis provided in letter. c) the following examples could be included

- providing the e-mail address in the context of creating an account on an online platform, in a box where it is indicated that the provision is optional, and under the box a short message such as "e-mail address will be used for to send commercial communications with our products and / or services:

- the processing of body size data by a tailor, if the data subject requested the creation of a clothing item and thus provides the body dimensions; it could be considered that there is the consent of the data subject and if this allows the tailor to take the bodily dimensions necessary to create the clothing object.

It is important to note that the Regulation expressly provides that the absence of a response or action cannot be considered valid consent. Also, the boxes previously

checked in the web pages or the software applications will not be able to be invoked as viable mechanisms of expressing the consent.

Finally, the Regulation provides that, if the statement of the data subject relates to several aspects, the request for consent must be presented in a form that clearly differentiates it from the other aspects.

7. Personal data /sensitive data

Special categories of personal data are strictly delimited by law: race, ethnicity, political orientation, religion, philosophical or similar beliefs, sindical status, health data, sex life data and so on. In addition, sesitive data is considered:

 • Personal data that is going to immediately identify any natural person such as National Identification Number (CNP)

• personal data relating to criminal offenses or contraventions

8. Rights of the data subjects

- Right of access (art. 15) it is possible to ask the operator in writing, under his/her signature and date, to communicate if he / she is processing the data, for what purpose, what data, who he / she reveals, where they were collected, automatic machining mechanisms use.

- Right to rectification (art. 16) it may be required by the operator in writing, under signature and date, to rectify or update the data, or to block the data processing, erase, anonymous data if it has illegally processed or communicated to third parties to whom your data has been disclosed, any requested operation (rectification, update, deletion, etc.)

- Right to be forgotten (art. 17) - individuals will have the right to require an operator to delete records of data related to them, provided there are no legitimate reasons for such data to be retained; Individuals may request that their data be "deleted" when there is a problem related "to the lawfulness of the processing" or the withdrawal of the consent.

- The right to be notified in case of data security breaches (art 19): companies will be obliged to immediately notify individuals of significant breaches of data security.

- The right to data portability and transfers the data to another provider (art 20) - customers will be entitled to request an electronic copy of their data undergoing processing and transmission of data required directly to another operator.

- The right to restriction (art 18): it may be required to require the operator, in writing, under his/her signature and date, not to process the data for direct marketing purposes or to disclose it to third parties for that purpose.

- "Automated decision-making, including profiling" (art 22): this right refers to the option that a natural person is not going to be subject to individual automated decisions: the operator may be required to withdraw, cancel, re-evaluate a decision he has taken solely by using the automatic means by which he assesses his professional competence, credibility or behavior under certain conditions.

Example: An important example of making automated decisions is the assessment of solvency. To take any decision on the future creditworthiness of a client, some data is collected from the client and combined with data on the person concerned from other sources such as credit information systems. The data is automatically listed into an evaluation algorithm, which calculates a total value representing the solvency of the client potential.

The data subject has also the following rights:

 - „The right to be informed" (free of charge): by the operator, when the data is collected or at the earliest at the earliest, before disclosing to third parties: who is the operator, for what purpose does your data work, to whom could reveal in trhe case you have to provide him with all the required data and what the consequences of a refusal are, what rights you have and how you can exercise them.

- „The right be inforbed about the personal data processing registry" (free of charge): it can be checked whether an operator has notified ANSPDCP that it processes personal data, including online, by accessing www.dataprotection.ro.

 - „The right to contest to the courts" (free of charge): the operator who has failed to comply with the rights or has caused damage by illegally processing the data may be sued.

9. Why it is the Regulation so important?

The regulation is important in terms of how it governs liability and because of very severe sanctions.

Its primary objective is to protect and empower all EU citizens in data privacy issues and to transform the manner in which organizations approach data privacy. It does not apply only to EU organizations but all organizations that are processing personal data of the subjects residing in European Union.

Along with this increased territorial scope, meaning an extra-territorial applicability, the new regulations bring:

- new conditions for consent, that „must be clear and distinguishable from other matters and provided in an intelligible form, using clear and plain language".

- modifications on data subject rights as breach notification, right to access, right to data, data portability, privacy by design and data protection officers.

10. Sanctions

For disclosure of data protection obligations:

- 10 (ten) million or „up to" 2% of global turnover; For violations of the basic principles of data processing (proportionality, legitimacy, consent, etc.), the rights of data subjects (access, the right to be forgotten, etc.), international transfers of data or non-responsive with a data protection authority measure:

 - 20 (twenty) million or „up to" 4% of global turnover.

11. Famous fines

Based on a report published by the European Data Protection Board on their website [15] we can take a look at how the National Supervisory Authorities enforced the New Data Protection Regulation within the EU.

a) By far, the most important fine under the GDPR was imposed in the UK for British Airways, aprox. 230 million euros. Following an extensive investigation, the Office of the Information Commissioner (ICO) announced its intention to sanction the British airline British Airways with a fine of 183.39 million pounds (230 million euros) for violating the General Protection Regulation Data (GDPR). After a cyber attack, hackers stole data from about 500,000 customers, according to information available on the ICO website. The airline declared itself "surprised and disappointed" by the fine. ICO said this is the largest sanction it has ever given and the first to be made public under new European personal data rules (GDPR).

The incident was made public on September 6, 2018, and airline representatives initially claimed that about 380 thousands transactions were affected. British Airways said the information included names, e-mail addresses, and other info such as credit card information, such as credit card numbers, expiration dates, and the three-digit CVV code found on the back of credit cards, although the airline has stated that it did not store CVV numbers.

b) Marriott International, Inc. (110,390,200 euros) - UK

In second place it is the fine also applied by ICO to Marriott International, Inc. in the amount of 110,390,200 euros (£ 99 million) for infringement of the same art. 32. The fine is not yet final according to the ICO release dated July 9, 2019. In the

Marriott case, a security breach led to the exposure of 339 million customer sign-ups.

The Marriott security breach came after Starwood hotel systems were compromised in 2014. Marriott acquired Starwood in 2016, but customer information exposure was only discovered in 2018.The ICO investigation found that Marriott did not make every effort to secure the systems, after buying Starwood. Marriott has cooperated with the authorities since the occurrence of these events.

c) Google inc. (50,000,000 euros) - France

The third fine of 50,000,000 euros was applied in France by the French Data Protection Authority a.k.a CNIL to Google Inc. for the violation of the article 13, article 14, article 6, article 4, article 5, from the General Data Protection Regulation according to the CNIL communiqué of January 21, 2019. Google has been accused of lack of transparency, inadequate information provision and not obtaining any legal consent for the marketing purpose..

The investigation started in June 2018 on the complaints of the data subjects and lasted about 7 months. It is rellevant to note that the complaints arose immediately after the new regulation 679/2016 came into effect. Verifying compliance with data protection legislation was accomplished by analyzing a user's browsing model and documents that the user can access when setting up a GOOGLE account while configuring a mobile device that uses Android.

CNIL noted that the way the information presented to users is structured is not complying with the GDPR. Essential information, such as data processing purposes, data storage periods, or categories of personal data used to personalize your ads, are over-served in multiple documents, with buttons and links you need to click to access additional information.

d)The Hague Hospital (460,000 euros) - Netherlands

In the Netherlands, the Dutch Supervisory Authority sanctioned The Hague Hospital with a fine of 460,000 euros for violation of art. 32 GDPR, according to the press release dated July 16, 2019. The Haga Hospital was fined for failing to comply with safety and security measures regarding access to patient records.

The national authority started the investigation due to information that several staff members were able to access the medical file of a hospital patient, a public person, although they were not involved in his treatment. The authority applied a fine of 460,000 euros for lack of sufficient security guarantees regarding access to sensitive data, respectively medical data.

In addition to the fine of 460,000 euros, the authority applied to the hospital and complementary (corrective) measures of alignment with the GDPR norms. Thus, the authority forced The Hague Hospital to, by October 2, 2019, improve patient data security. If the hospital does not comply until then, the authority will enforce the damages-comminers: 100,000 euros to be paid every 2 weeks, up to a maximum of 300,000 euros.

e) FRANCE - Sergic, PORTUGAL - Barreiro Montijo Hospital Center (400,000 euros)

- In France, CNIL applied a fine of 400,000 euros to Sergic for violating Articles 5 and 32 GDPR. Sergic was accused of lack of data security measures and failure to observe the storage time.

- The same amount was fined a public hospital by the Portuguese Data Protection Authority (CNPD) for violating Articles 5 and 32 GDPR. Centro Hospitalar Barreiro Montijo was accused of unauthorized access to sensitive data and the lack of internal procedures to ensure data protection.

f) Unicredit Bank Romania (130,000 euros) [16]

The National Supervisory Authority has finalized an investigation at Unicredit Bank and found that it violated the provisions of the GDPR under the aspect of natural persons personal data.

The sanction was applied to Unicredit Bank S.A. „as not being able to secure the usage of personal data both at the time of establishing the means of processing and in the processing itself, intended to effectively implement the principles of data protection, such as minimizing data, and integrate the necessary guarantees in the processing, in order to respect the GDPR requirements.

The sanction was applied as a result of a notification of the National Supervisory Authoritu, indicating that the data regarding the CNP and the address of the persons who made payments to Unicredit Bank S.A., through online transactions, were disclosed to the beneficiary of the transaction, through the account statement / details forms.

The case involving big names such as Google, Facebook (under the old directive), British Airways or Marriott International provides clues about the current state of data security, assuming that the company's financial strength allows it to implement the most effective measures.

However, the reality shows that there are difficulties in interpreting the rules and problems can arise in the most varied fields. The presentation below gives an overview of the affected industries (company names are presented based on data availability):

Financial-Banking: Romania (Unicredit Bank SA), Hungary (bank, debt collector), Bulgaria (banks), Czech Republic (brokerage agency), Spain (debt collector)

Medical: Netherlands (The Hague Hospital), Portugal (Barreiro Montijo Hospital Center), Cyprus (hospital), Bulgaria (medical center)

Authorities: Norway (Bergen Municipality), Malta (Lands Authority), Hungary (City Hall), Belgium (Mayor), Germany (Police Officer)

Hotels: United Kingdom (Marriott International, Inc); Romania (World Trade Center Bucharest SA)

Telecommunications: Spain (Vodafone Espagna), Bulgaria (telecommunications service provider)

Technology, software: France (Google inc.), Denmark (IDdesign A / S)

Political parties: Italy (Italian political party 5 Star Movement), Hungary (political party)

Sport: Spain (Professional Football League - LaLiga), Poland (Sports Association)

Media: Germany (N26), Cyprus (newspaper)

Aviation companies: United Kingdom (British Airways)

Real estate: France (Sergic)

Energy: Spain (Endesa)

Without claiming to be exhaustive the list above indicates sensitive areas and confirms that data protection becomes an issue that should be concerning to any company or private person, in the exercise of a function or not.

Conclusion

According to GDPR, both data operators and their authorized processors will be held responsible for the personal data they process. However, they have different obligations, so it is crucial to draw a clear delimitation. In short, the operator determines the purpose of that processing, while the person empowered as a processor is the one who carries out the actual processing.
The most important consequence of the status of operator or person empowered by the operator as processor is legal responsibility for compliance in accordance with data protection legislation. Therefore, only those who can be held accountable under applicable law can assume these functions
The legislative adoption of EU General Data Protection Regulation, proves that the EU authorities recognize the new realities on the individual rights and liberties and tries to solve possible conflicts in current legislation. The text of the Regulation,

even though not explicitly put it, brings together in the effort to protect personal data of the citizens.

We stronly consider that each and every single time when a data controller has any problems regarding the uderstanding of the new Regulation they should consider the Working Party 29 Guidelines and the EDPB papers established especially to solve the dorctrinary inconsequences.

In our opinion, each data controller should firstly understand the data flows used in his activity, and then to map the risks to which he is exposed, to map these data. From our point of view, this process is specific to each data controller, as the degree of use of personal data differs from one data controller to another. Also, each field of activity has its own specific. In order to comply with a minimum legal requirement, the data controller should train his employees so that they can get a minimal compliance by respecting the data subjects rights. We strongly believe that the data controllers compliance is representing just the tip of the iceberg. The most important aspect of it should be the awareness of the new legislation and corporations should invest time and knoledge in skilled data protection officers in order to comply with the novelty of this updated legal field.

Also, in order to comply with the Regulation, data controllers have to prove that they have obtained a valid consent from the data subjects. Therefore, apart from meeting the conditions addressed by the Working Group 29 in the Guidance on the Validity of Consent, it must always be granted by an action and not by an inaction, especially when talking about completing the online forms.

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ASPECTS REGARDING THE ADOPTION OF E-COMMERCE IN ROMANIA

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Abstract: *The abundance of devices connected to the Internet has made electronic commerce much more versatile and complex. With the help of low investments, any company can enter the global market and compete with the big companies in the field. This has led to a change in the way business is conducted worldwide. Understanding the evolution of current markets and user behavior is a challenge for companies that are active in the sale of products and services. Therefore, in this article, we will analyze the data available for global markets and the differences between them and the local market in Romania. Thus, we will see the distribution of users on the largest market segments according to different key metrics such as usage, reach, revenue, penetration rate, ARPU, gender, users by age, sales channel and user income.*

Keywords: *Electronic commerce, Technology adoption, Segment analysis, Consumer behavior, E-commerce usage, Users attitude, Online shopping*

1. Introduction

The multitude of devices currently on the market, such as computers, laptops, ultrabooks, smartphones, tablets or TVs connected to the Internet, allow users to access online retail offers and made online purchases to become not only more versatile but also more complex [1]. E-commerce has the major advantage of eliminating the need for huge investments and infrastructure spending to develop a global presence, which has led to a revolution in the way business is conducted worldwide. For developing countries, it has the potential to offer solutions to many of the important problems, such as the provision of distance healthcare or education [2].

The development of e-commerce offers a number of opportunities for producers and retailers, but it also comes with countless challenges for organizations, which requires a thorough review of both marketing strategies and consumer behavior information [3]. The implementation and use of electronic commerce allow on the one hand the access by the sellers of narrow market segments that are widely distributed, and on the other hand, the buyers can access the global markets, thus having access to a greater number of products, from to a variety of sellers, at lower

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costs. E-commerce brings advantages not only for large companies but also for small and medium-sized enterprises, which can compete with larger businesses, offering independence in time, as location, or facilitating communication [4]. Adopting e-commerce in business is an innovative move for any organization with significant effects in reducing costs, increasing quality and performance [5].

E-commerce is expected to continue its double-digit growth over the next five years, remaining the fastest growing form of commerce. Just as cars, airplanes, and electronics defined the twentieth century, so will e-commerce define business and society in the 21st century. The rapid move to an economy and an e-commerce company is driven by established companies such as Tesco, Ford, IBM, Carrefours and General Electric, but also by online companies such as Google, Amazon, Apple, Facebook, Yahoo, Twitter, or YouTube. Thus, students in the fields of business and information technology are recommended to establish a solid foundation in e-commerce in order to be efficient and successful managers in the next decade [6].

Regarding the international e-commerce market, according to [7], the revenues in 2019 are worth EUR 1,594,574 million. It is estimated that revenues will have an annual growth rate of about 10.4%, reaching a market volume of EUR 2,368,216 million, by 2023. The largest market segment is fashion, which has a market volume of 528,999 million. EUR in 2019. User penetration is 52.3% in 2019, and according to estimates, it is expected to reach up to 61.1% in 2023. The local e-commerce market in Romania, according to [8], amounts to EUR 2,465 million in 2019. It is estimated that revenues will have an annual growth rate of 10.0%, reaching a market volume of EUR 3.611 million, by 2023. The largest market segment in Romania is electronics & media, with a volume market share of EUR 747 million in 2019. The user penetration at the local level is 53.7% in 2019 and is expected to reach 58.6% by 2023.

For both e-commerce application developers and human-computer interaction researchers, adoption factors, as well as the moderating effects of demographic data, are important topics. Although there are research efforts to explain the adoption of e-commerce systems, one of the main questions to be answered is related to normative and affective factors [9]. Thus, in this article, we try to review the main features and to analyze the e-commerce market both globally and locally. Therefore, we will analyze the behavior of consumers shopping online and how they are distributed according to different metrics. The market's largest segments will be analyzed by key metrics for usage, reach, revenue, penetration rate, ARPU, gender, users by age, sales channel and user income.

2. Literature review

Research in the field of e-commerce has grown enormously in recent years and has become extremely popular in both industry and academia. Thus, research trends in e-commerce are extensively represented in [10], where over 1000 articles were

analyzed on the topic of e-commerce between 1987 and 2017. Although this research is not exhaustive, it offers a broad perspective on research trends in e-commerce based on an extensive survey of IS magazines. In addition to evolution, e-commerce research is classified into three categories: business models, service relationships and technology. A model that explains how the strategic value of e-commerce is perceived and how it influences managers' attitudes to adopt e-commerce has been proposed in [4]. The obtained results reveal a significant relationship between the perceived strategic value of e-commerce and the factors that influence the adoption of e-commerce in SMEs. Specifically, top managers who perceived e-commerce as adding strategic value to the company had a positive attitude towards its adoption.

The dynamics of innovation adoption were studied in [5] and took into account both local and interactive effects of early adoption in relation to the late adoption of e-commerce. The results of the analysis show that the essential effects of early adoption are concentrated on the nature of innovations, and those of subsequent adoption are focused on the problems of implementing innovations. Unfortunately, there are countries that fail to fully enjoy the benefits of e-commerce. Therefore, it was found that there is a major difference between the rates of adoption, implementation, and use of e-commerce in developed and developing countries, the latter remaining significantly behind. The research carried out in [2] aims to understand the main reasons, respectively the barriers that these countries face and which impede the development and adoption of e-commerce. It also sheds light on the research of critical success factors and the measures that should be taken to stimulate e-commerce, respectively the potential impact for developing countries.

The acceptance of e-commerce by users is determined by the attitude towards the system and personal innovation in the field of information technology, and personal innovation has a moderating effect on the acceptance of e-commerce [3]. The social norms, perceived pleasure and the way they, together with the users' gender, influence the intention to adopt an e-commerce system were tested in [9]. The results of the study revealed that the influence of social norms is greater in the female group, and the influence of pleasure is stronger in the male group. In the context of choosing consumer sales channels [1], they stressed the need to understand the benefits that individuals get from each retail channel in order to determine efficient, customer-centric multi-channel sales strategies. The findings show that retailers can improve the consumer shopping experience by offering alternative channels that contribute differently to online customer browsing.

3. Data analysis and results

The data extracted and aggregated in the tables of this research come from [8] and include the sale of goods through digital channels to a private user (B2C). Therefore, both purchases made from desktop computers and those purchased

118

through mobile devices are included. This paper does not include data from the electronic commerce market which refers, in particular, to digitally distributed services, digital media downloads or flows, digital purchase or resale of used goods, respectively B2B or C2C markets. The figures presented refer to the gross annual income and do not take into account the transport costs.

The Internet penetration rate [11] is defined as the percentage of the population that has ever used the Internet to browse for a product online, and Internet shopping adoption rate as the percentage of the population that has ever purchased anything directly online. More exactly, the penetration rate [8] is the measure of use, or reach, and indicates the share of individuals in a country, region, or group that uses e-commerce. The average revenue per user (ARPU) [12] is a key metric that is commonly used by regulators and industry observers to track and compare market performance. Table 1 shows the data for these indicators split on the five continents. Regarding the number of users, most are in Asia, with a value of 1,893.6 million users, and the fewest in Australia, with a value of 21.4. Europe and America have a close number of users, with values of 558.2 and 584.1 million. In terms of penetration rate, Europe is at the top, with a penetration rate of 66.1, followed by America with 60.8, and the lowest value is Africa 26.5. Regarding ARPU, Australia is by far the highest value, namely 846.06. Below is America with a value of 507.84, followed by Europe with a value of 463.55. Africa is at a great distance from the rest of the continents with a value of only 35.72.

Table 1. E-commerce key metric for usage, reach and revenue

	Africa	Asia	Australia	Europe	Americas
Users in millions	288.6	1,893.6	21.4	558.2	584.1
Penetration Rate (%)	26.5	44.2	55.5	66.1	60.8
ARPU in €	35.72	363.51	846.06	463.55	507.84

The revenues on the largest segments of the market, segmented by continent, are shown in Table 2. Thus, we can see that in the field of fashion, which holds the supremacy, the highest incomes are made in Asia, being worth 249,903 million €. The values for America and Europe in the field of fashion are very close, of 75,194, respectively 74,969. And Africa is in the last place, with a value of 2,605. In the field of electronics & media, Asia again ranks first with a value of 151,468, followed by America and Europe with fairly close values, namely 68,401 and 63,787, respectively. The least developed segment is the food & personal care, and the lowest value is 962 recorded in Africa and the largest one is 58,474 in Asia.

Table 2. Revenues in the market's largest segments

Revenue in million €	Africa	Asia	Australia	Europe	Americas
Fashion	2,605	249,903	5,998	74,969	75,194
Electronics & Media	3,202	151,468	3,703	63,787	68,401
Food & Personal Care	962	58,474	2,446	31,383	29,475
Furniture & Appliances	1,884	105,256	2,412	36,358	51,441
Toys, Hobby & DIY	1,657	123,242	3,551	52,273	72,134

Regarding the distribution of users by age ranges, we can see in Fig. 1 that there are significant differences between Asia and Europe. For the other continents, the data are not available, but we have included the data that are available for Romania. We can see that the age range 18-24 has a share of 23.3% in Asia and only 13.0% in Europe. This discrepancy is also maintained over the 25-34 year range where we have 34.3% in Asia and in Eurpoa 23.7%. In the range of 35-44, the values are relatively close. Differences are found in the range of 45-54, with a value of 14.0% for Asia and 22.9% for Europe. In the 55-64 range, the discrepancy is accentuated quite a lot, and the value of 4.4% for Asia is 3.9 times lower than the value of 17.0% for Europe. Therefore we can conclude that in Asia young people are very active and present on the Internet in the e-commerce market, and in Europe the old ones. As an overview, we can see in Fig. 1, that there are no major differences between the age segments between the inhabitants of Romania and those of Europe.
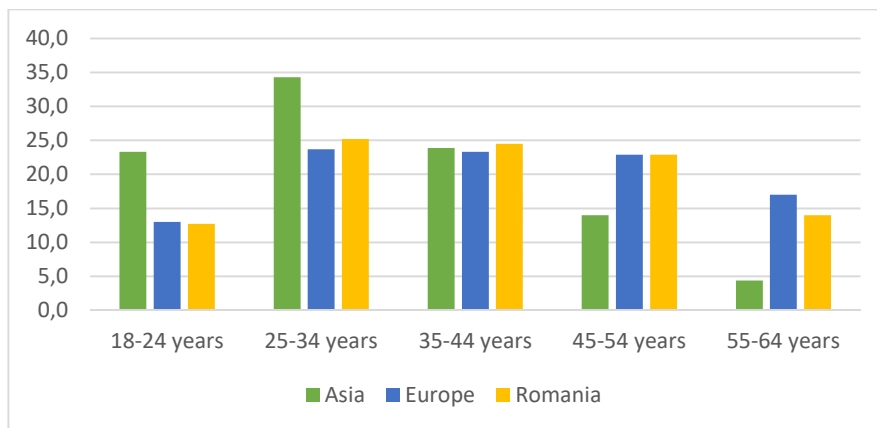
Figure 1. Distribution of users by age

In the following, we will take an overview of the e-commerce market in Romania. The data collected and presented in the following are extracted from [8] and

represent the latest available values, namely for 2017. In terms of the Romanian e-commerce market, it reached a value of 2,017 revenues in million €. In Table 3 we can see key metrics like revenue, number of users, penetration rate and ARPU on the main product segments.

Table 3. Market share of the main ecommerce segments

Category	Revenue in million €	Users in millions	Penetration Rate (%)	ARPU in €
Apparel	**315**	**5.3**	**27.1**	58.99
Bags & Accessories	64	2.8	14.3	22.64
Books, Movies, Music & Games	154	3.0	15.5	50.77
Consumer Electronics	**497**	**4.8**	**24.4**	**103.69**
DIY, Garden & Pets	35	2.7	13.9	12.92
Food & Beverages	30	1.6	8.2	18.92
Footwear	44	2.9	14.7	15.07
Furniture & Homeware	194	1.9	9.5	**103.20**
Hobby & Stationery	**246**	2.2	11.4	**109.49**
Household Appliances	133	3.5	17.6	38.48
Personal Care	131	**3.9**	**19.7**	33.80
Sports & Outdoor	72	2.1	10.9	33.57
Toys & Baby	102	2.9	14.5	35.54

In Romania, the highest revenues are brought by the electronics segment, which has a value of € 497 million, representing 24.64% of the total sales. In the second place is the apparel segment with a value of € 315 million, representing 15.62%, and the third is the hobby & stationery with € 246 million, representing 12.20%. The last places in terms of sales value are footwear, DIY, garden & pets, and food & beverages. Regarding the degree of penetration, the consumer and consumer electronics segments are again in the first place with 27.1%, respectively 24.4%, and in the third-place, it appears surprisingly personal that with 10.9%. The segments with the lowest penetration are sports & outdoor, furniture & homeware and food & beverages. Regarding the number of users in these segments, we can say that the values are strongly correlated with the penetration rate values. Thus, the ranking is kept similar for the two metrics. For the ARPU metric, the highest values are found for the hobby & stationery, consumer electronics, and furniture &

homeware categories, with fairly close values. On the opposite side of the ranking are again the segments food & beverages, footwear and DIY, garden & pets.

Analyzing the data in Table 4 we can see that in only four of the thirteen segments the percentage of men is higher than that of women. Thus, men are the majority in the consumer electronics (63%), sports & outdoor (57%), household appliances (53%) and DIY, garden & pets (50.50%) segments. In terms of women, the most popular category is bags & accessories (72%), followed by personal care (71.70%), apparel (59.80%) and toys & baby (59.30%). It seems that women's appetite for shopping is also reflected in online shopping, categorically outpacing men in nine of the thirteen categories analyzed.

Table 4. Distribution of user preferences for the main market segments

Category	Gender (%)		Users by age (%)				
	female	male	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years
Apparel	59.8	40.2	**14.5**	24.9	23.9	22.6	14.1
Bags & Accessories	**72.0**	28.0	**17.9**	26.6	24.1	19.9	11.5
Books, Movies, Music & Games	51.2	48.8	13.7	23.5	24.0	23.8	15.1
Consumer Electronics	37.0	**63.0**	12.7	25.1	24.4	22.9	14.9
DIY. Garden & Pets	49.5	50.5	7.6	21.9	24.0	**27.6**	**18.9**
Food & Beverages	51.0	49.0	13.4	**29.0**	24.5	20.4	12.7
Footwear	55.5	44.5	14.5	25.2	25.2	22.1	13.1
Furniture & Homeware	56.4	43.6	9.6	28.9	24.6	23.1	13.9
Hobby & Stationery	56.4	43.6	12.5	24.3	25.7	23.4	14.0
Household Appliances	47.0	53.0	8.7	24.9	24.1	**25.2**	**17.1**
Personal Care	**71.7**	28.3	13.0	25.7	24.8	21.2	15.3
Sports & Outdoor	43.0	**57.0**	12.6	26.2	**26.9**	23.0	11.4
Toys & Baby	59.3	40.7	7.8	**32.8**	**31.6**	16.4	11.4

Regarding the age segments, we can see that the vast majority of users who buy online are in the ranges 25-34 (25.20%), 35-44 (24.50%) and 45-54 (22.90%). Regarding the distribution of users by age ranges and interest categories, we can see that the highest percentage, of 32.80%, is at the intersection of the range of 25-34 years with the toys & baby category. The next value of 31.60% is represented by the 35-44 range, which also has a preference for the toys & baby category. In the

following, we will detail the preferences of different age categories for the main market segments. Thus, the age group 18-24 is particularly interested in bags & accessories (17.90%), apparel (14.50%) and footwear (14.50%). Users between the ages of 25-34 are primarily interested in toys & baby (32.80%), food & beverages (29%) and furniture & homeware (28.90%). Those in the 35-44 range have preferences for toys & baby (31.60%), sports & outdoor (26.90%) and hobby & stationery (25.70%). As we age, we see that preferences for different categories are beginning to change significantly. Thus, for the age category 45-54 we see that the main preferences are represented by DIY, garden & pets (27.60%), household appliances (25.20%) and books, movies, music & games (23.80%). The preferences of the oldest users, namely those in the 55-64 range are somewhat similar to those of the previous age category. Thus, they mainly fall into the categories DIY, garden & pets (18.90%), household appliances (17.10%), respectively personal care (15.30%).

Regarding the distribution channels, we can see that online sales have the greatest advantage in the fields of consumer electronics and apparel, both with a value of 13%. Of all the categories for which we have data available, the category of food & beverages is the one with the lowest percentage of online sales, namely 0%.

Table 5. Distribution channels and preferences for the main market segments

Category	Sales Channels (%)		Users by income (%)		
	Online	Offline	low income	medium income	high income
Apparel	13	87	**28.6**	34.7	36.7
Bags & Accessories	7	93	26.0	**35.9**	38.0
Books, Movies, Music & Games	na	na	26.7	34.8	38.5
Consumer Electronics	13	87	25.3	34.3	40.4
DIY. Garden & Pets	na	na	25.0	34.1	40.9
Food & Beverages	0	100	26.7	32.7	40.6
Footwear	4	96	**27.1**	33.4	39.5
Furniture & Homeware	8	92	26.0	33.1	40.9
Hobby & Stationery	na	na	25.4	34.4	40.1
Household Appliances	7	93	25.7	33.4	**41.0**
Personal Care	4	96	26.7	**35.4**	37.9
Sports & Outdoor	na	na	21.5	30.4	**48.0**
Toys & Baby	na	na	23.8	**35.4**	40.8

Regarding the distribution of users according to income by main product categories, we can see that there are no major differences. Thus, users with the lowest incomes are mainly oriented to apparel and footwear. Those with average incomes have in the top of preferences the categories bags & accessories, personal care, and toys & baby. In contrast, high-income users prefer to spend money especially on sports & outdoor, home appliances, furniture & homeware, and DIY, garden & pets. An interesting observation that we can make by analyzing the data in Table 5 is that the sports & outdoor category is on the one hand in the top of the preferences of the users with high incomes, and on the other last place among the users with low incomes. The same is the case for the device, which is at the top of the preferences for users with low incomes and lastly for those with high incomes.

4. Conclusion

E-commerce has become a complex and dynamic domain due to the fact that any company can enter the market with a relatively small budget and compete with the big names in the field. The devices connected to the Internet are in continuous growth, consequently leading to the constant increase of the figures in e-commerce. Understanding the behavior of users, patterns and preferences for online shopping are essential for companies and businesses existing on the market today. Therefore, in this article, we have provided an overview of the e-commerce market globally, but especially locally for Romania. Analyzing the available data we could see the distribution of users on the most important market segments and used key metrics such as usage, reach, revenue, penetration rate, ARPU, gender, users by age, sales channel and user income.

Regarding the Romanian market, the highest revenues are brought by the electronics segment, which has a value of € 497 million and represents 24.64% of the total sales. From the current study, it appears that women's appetite for shopping is also reflected in online purchases, they categorically surpassing men in nine of the thirteen categories analyzed. The most popular segments among women are also the least popular among men. Thus, on the one hand, women's preferences are directed to areas such as bags & accessories, personal care, apparel, and toys & baby. And on the other hand, men's preferences are oriented towards the consumer electronics, sports & outdoor, household appliances and DIY, garden & pet segments.

According to the study it turned out that the interests of young people are especially for the field of fashion, especially to the segments of bags & accessories, apparel, and footwear. The interests of the elderly are aimed at recreational activities and leisure, especially to the segments of DIY, garden & pets, household appliances, and books, movies, music & games. In terms of distribution channels, we can see that online sales have the greatest advantage in the fields of consumer electronics and apparel. Another interesting observation from the current study is

that the sports & outdoor category is at the top of the preferences of the users with high incomes and last among the users of low incomes. The same is true of the device, which is at the top of the list of preferences for low-income users and lastly for high-income users.

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ON SOME APPLICATIONS AND SIMULATIONS OF COUNTING PROCESSES

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Abstract: *In this paper we discuss a special case of stochastic processes, namely counting processes. In particular, we describe a discrete-time counting process (Binomial) and a continuous-time one (Poisson). We present the main theoretical characteristics and properties, algorithms for computer simulations of such processes and some interesting applications.*

Keywords: *Binomial counting processes, Poisson counting processes, stochastic processes, computer simulations, MATLAB.*

1. Introduction

Stochastic processes are random variables that change and evolve in time. As such, they play an important role in probability theory and related fields, providing good models for many real-life phenomena. Among them, *counting processes* deal with the number of occurrences of some events in time. As the name says, they count events, such as job arrivals (in a queuing system), message transmissions, customers served, completed tasks, holding times, times of various events occurrence, etc. They have many applications in renewal processes, survival analysis, seismology, software reliability and many other fields (see [1, 3, 4]).

In this paper, we discuss Binomial and Poisson counting processes, presenting their main characteristics, some applications and simulations.

1.1 Random Variables

We start with a brief review of basic notions from Probability Theory. Let $\mathcal{S}$ denote the sample space (the set of all possible outcomes) of some experiment and P a probability function (see e.g. [2, 8]).

Definition 1.1. *A **random variable** is a function $X : \mathcal{S} \longrightarrow \mathbb{R}$ for which $P(X \leq x)$ exists, for all $x \in \mathbb{R}$. If $X(\mathcal{S}) \subseteq \mathbb{R}$ is a countable subset of $\mathbb{R}$, then X is called a **discrete random variable**, otherwise, it is a **continuous random variable**.*

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A discrete random variable X is described by its **probability distribution function (pdf)** or **probability mass function (pmf)**, an array that contains all the values taken by it, x_i, and the corresponding probabilities $p_i = P(X = x_i)$,

$$X \begin{pmatrix} x_i \\ p_i \end{pmatrix}_{i \in I} \tag{1.1}$$

If X is a continuous random variable, we give its **probability density function (pdf)**, i.e. the function $f: \mathbb{R} \rightarrow \mathbb{R}, f(x) = F'(x)$.

We recall some discrete probability laws, which will be used later on.

Bernoulli distribution *Bern(p)*, with parameter $p \in (0,1)$. This is one of the simplest discrete distributions, with pdf

$$X \begin{pmatrix} 0 & 1 \\ 1-p & p \end{pmatrix}. \tag{1.2}$$

This distribution best models a Bernoulli trial, i.e. the occurrence of "success/failure" in a trial.

Binomial distribution $B(n,p)$, with parameters $n \in \mathbb{N}$, $p \in (0,1)$. In a series of n Bernoulli trials with success probability p in each trial ($q = 1-p$), we let X denote the number of successes that occur. Then X has a Binomial distribution, with pdf

$$X \begin{pmatrix} k \\ C_n^k p^k q^{n-k} \end{pmatrix}_{k=\overline{0,n}}. \tag{1.3}$$

It is easy to notice that a Binomial $B(n,p)$ variable is the sum of n independent *Bern(p)* variables and that $Bern(p) = B(1,p)$.

Geometric distribution $Geo(p)$, with parameter $p \in (0,1)$. In an infinite sequence of Bernoulli trials with success probability p in each trial ($q = 1-p$), let X denote the number of failures that occur before the first success. Then X has a Geometric distribution, with pdf

$$X \begin{pmatrix} k \\ pq^k \end{pmatrix}_{k=0,1,\dots}. \tag{1.4}$$

Shifted Geometric distribution $SGeo(p)$, with parameter $p \in (0,1)$. In the context described above, this is the number of trials needed to get the first success (as opposed to failures in the previous pdf). If X has a $Geo(p)$ distribution, then X + 1 has a Shifted Geometric distribution, hence, the name.

Poisson distribution $Poiss(\lambda)$, with parameter $\lambda > 0$, with pdf

$$X \begin{pmatrix} k \\ \dfrac{\lambda^k}{k!} e^{-\lambda} \end{pmatrix}_{k=0,1,\dots}. \tag{1.5}$$

A Poisson variable X denotes the number of "rare" events (discrete occurrences of infrequently observed events) that occur in a given interval of time. The parameter

λ represents the average number of such rare events per time unit. The Poisson distribution is used to model number of occurrences of discrete events in an interval of time, such as arrival of jobs (tasks, messages, signals, phone calls, etc.), accidents, earthquakes, that happen in given area, errors found in software, etc.

In what follows, we recall some important continuous distributions. Note that we only mention the expression of the pdf on the region where it is non-zero (so it is understood that it is equal to 0, elsewhere).

Uniform distribution $Unif(a, b)$, with parameters $a < b \in \mathbb{R}$, has pdf

$$f(x) = \frac{1}{b-a}, \quad x \in (a, b). \tag{1.6}$$

It is used when a variable can take any value randomly from an interval, so all values from an interval are equally probable to be taken by that random variable.

Exponential distribution $Exp(\lambda)$ with parameter $\lambda > 0$, has pdf

$$f(x) = \lambda e^{-\lambda x}, \quad x > 0. \tag{1.7}$$

An Exponential variable models time: interarrival time (time between arrival of jobs), halftime, failure time, time between rare events, etc. The parameter λ represents the frequency of rare events, measured in time [-1].

It is worth mentioning that in a sequence of rare events, where the number of rare events occurring in an interval of time of length t has a $Poiss(\lambda t)$ distribution, the time between rare events is modeled by an $Exp(\lambda)$ distribution.

1.2 Stochastic processes and Markov chains

Many random variables are not static, they change and develop in time.

Definition 1.3. *A **stochastic process** is a random variable that depends on time. It is denoted by $X(t, e)$ or $X_t(e)$, where $t \in \mathcal{T}$ is time and $e \in \mathcal{S}$ is an outcome. The values of $X(t, e)$ are called **states**.*

*If $t \in \mathcal{T}$ is fixed, then X_t is a random variable, while if we fix $e \in \mathcal{S}$, X_e is a function of time, called a **realization** or **sample path** of the process $X(t, e)$.*

Definition 1.4. *A **stochastic process** is called **discrete-state** if $X_t(e)$ is a discrete random variable for all $t \in \mathcal{T}$ and **continuous-state** if $X_t(e)$ is a continuous random variable, for all $t \in \mathcal{T}$.*

*Similarly, a stochastic process is **discrete-time** if the set $\mathcal{T}$ is discrete and **continuous-time** if the set of times $\mathcal{T}$ is an interval (bounded or unbounded) in $\mathbb{R}$.*

In what follows, we omit writing e as an argument of a stochastic process (as it is usually done when writing random variables).

Definition 1.5. *A stochastic process X_t is **Markov** if for any times $t_1 < t_2 < \cdots < t_n < t$ and any sets $A_1, A_2, \dots, A_n, A$,*

$$P\big(X_t \in A \mid X_{t_1} \in A_1, \dots, X_{t_n} \in A_n\big) = P\big(X_t \in A \mid X_{t_n} \in A_n\big). \tag{1.8}$$

Definition 1.6. *A **Markov chain** is a discrete-state, discrete-time, Markov stochastic process.*

To simplify the notations, we do the following: A Markov chain is a discrete-time process, so we can see it as a sequence of random variable $\{X_0, X_1, \dots\}$, where X_k describes the situation at time $t = k$. Since it is also a discrete-state process, we can denote the states by $1, 2, \dots n$ (they may start at other value and n may not be finite). Then the random variable X_k has the pdf

$$X_k \begin{pmatrix} 1 & 2 & \dots & n \\ P_k(1) & P_k(2) & \dots & P_k(n) \end{pmatrix}, \tag{1.9}$$

where $P_k(1) = P(X_k = 1), \dots, P_k(n) = P(X_k = n)$. Then the Markov property (1.8) can be written as follows:

$$P(X_{t+1} = j \mid X_t = i, X_{t-1} = l, \dots) = P(X_{t+1} = j \mid X_t = i), \text{ for all } t \in \mathcal{T}.$$

(1.10)

All this information is summarized in a matrix.

Definition 1.7.

– *The probabilities*

$$p_{ij}(t) = P(X_{t+1} = j \mid X_t = i),\ p_{ij}^{(h)}(t) = P(X_{t+h} = j \mid X_t = i) \tag{1.11}$$

*are called the **transition and h-step transition probability**, respectively.*

– *The matrices*

$$P(t) = \left[p_{ij}(t)\right]_{i,j=\overline{1,n}},\ \ P^{(h)}(t) = \left[p_{ij}^{(h)}(t)\right]_{i,j=\overline{1,n}} \tag{1.12}$$

*are called the **transition and h-step transition probability matrix**, respectively, at time t.*

Definition 1.8. *A Markov chain is said to be **homogeneous (stationary)** if all transition probabilities are independent of time.*

Proposition 1.9. *Let $\{X_0, X_1, \dots\}$ be a Markov chain. Then the following hold:*

$$P^{(h)} = P^h,\ \text{ for all } h = 1, 2, \dots$$
$$P_i = P_0 \cdot P^i,\ \text{ for all } i = 0, 1, \dots$$

(1.13)

Definition 1.10. *Let X be a Markov chain. The vector $\pi = [\pi_1, \dots, \pi_n]$, where $\pi_k = \lim_{h \to \infty} P_h(k), k = 1, \dots, n$, (if it exists) is called a **steady-state distribution** of X.*

Proposition 1.11. *The steady-state distribution of a homogeneous Markov chain X, $\pi = [\pi_1, \dots, \pi_n]$, if it exists, is unique and is the solution of the $(n+1) \times n$ linear system*

$$\begin{cases} \pi P = \pi \\ \sum_{k=1}^{n} \pi_k = 1. \end{cases} \tag{1.14}$$

Definition 1.12. *A Markov chain is called **regular** if there exists $h \geq 0$, such that*

$$p_{ij}^{(h)} > 0,$$

for all $i, j = 1, \dots, n$.

Proposition 2.13. *Any regular Markov chain has a steady-state distribution.*
For more considerations on stochastic processes and Markov chains, see e.g. [2,5].

1. Counting Processes

A special case of stochastic processes are the ones where one needs to count the occurrences of some types of events over time. These are described by *counting processes*.

Definition 2.1. *A counting process $X(t), t \geq 0$, is a stochastic process that represents the number of items counted by time t.*

Counting processes deal with the number of occurrences of something over time, such as customers arriving at a supermarket, deleted errors, transmitted messages, number of job arrivals to a queue, holding times (in renewal processes), etc. In general, we refer to the occurrence of each event that is being counted as an "arrival". Since their sample paths (values) are always non-decreasing, non-negative integers, all counting processes are discrete-state stochastic processes. They can be discrete-time or continuous-time. Next, we will consider the most widely used examples, Binomial (discrete-time) and Poisson (continuous-time) counting processes.

2.1. Binomial counting process

Consider a sequence of Bernoulli trials with probability of success p and count the number of "successes".

Definition 2.2. *A **Binomial counting process** $X(n)$, is the number of successes in n Bernoulli trials, $n = 0,1, ...$*

Remark 2.3.

1. Obviously, a Binomial process $X(n)$ is a discrete state, discrete-time stochastic process.

2. The pdf of $X(n)$ is $B(n,p)$ at any time *n*. Recall that $E\big(X(n)\big) = np$.

3. The number of trials between two consecutive successes, *Y*, is the number of trials needed to get the next (first) success, so it has a $SGeo(p)$ pdf. Recall that $E(Y) = \frac{1}{p}$, $V(Y) = \frac{q}{p^2}$.

It is important to make the distinction between real time and the "time" variable *n* ("time" as in a stochastic process). Variable *n* is not measured in time units, it measures the number of trials. Let us assume that Bernoulli trials occur at equal time intervals, say every Δ seconds (or other time measurement units). That means that *n* trials occur during time $t = n\Delta$. The value of the process at time *t* has Binomial pdf with parameters $n = \frac{t}{\Delta}$ and *p*. Then the expected number of successes *during t seconds* is

$$E(X(n)) = E\left(X\left(\frac{t}{\Delta}\right)\right) = np = \frac{t}{\Delta}p,$$

so the expected number of successes *per second* is

$$\lambda = \frac{p}{\Delta}.$$

Definition 2.4. *The quantity $\lambda = \frac{p}{\Delta}$ is called the **arrival rate**, i.e. the average number of successes per unit of time. The quantity Δ is called a **frame**, i.e. the time interval of each Bernoulli trial. The **interarrival time** is the time between successes.*

We can now rephrase: p is the probability of arrival (success) during one frame (trial), $n = \frac{t}{\Delta}$ is the number of frames during time t, $X(\frac{t}{\Delta})$ is the number of arrivals by time t.

The concepts of arrival rate and interarrival time describe arrival of jobs in discrete-time queuing systems. In such models it is assumed that no more than 1 arrival can occur during each $\Delta-$second frame (otherwise, a smaller Δ should be considered), thus, each frame is a Bernoulli trial.

The interarrival time, Y, measured in number of frames, has a $SGeo(p)$ pdf (as mentioned earlier). Since each frame takes Δ seconds, the interarrival time is $T = \Delta Y$, a rescaled $SGeo(p)$ variable, whose expected value and variance are given by

$$E(T) = \Delta E(Y) = \frac{1}{\lambda}, \ \ V(T) = \Delta^2 V(Y) = \frac{q}{\lambda^2}. \tag{2.1}$$

Markov property of Binomial counting processes
Obviously, the number of successes in n trials depends only on the number of successes in $n-1$ trials (not previous values $n-2, n-3, ...$), so a Binomial process has the Markov property. Thus, it is a Markov chain. Let us find the transition probability matrix. At each trial (i.e. during each frame), the number of successes $X(n)$ either increases by 1 (in case of success), or stays the same (in case of failure). Then,

$$p_{ij} = \begin{cases} p, & j = i+1 \\ q = 1-p, & j = i \\ 0, & \text{otherwise} \end{cases} . \tag{2.2}$$

Obviously, transition probabilities are constant over time. Hence, $X(n)$ is a stationary Markov chain with transition probability matrix given by

$$P = \begin{bmatrix} 1-p & p & 0 & ... & 0 & ... \\ 0 & 1-p & p & ... & 0 & ... \\ 0 & 0 & 1-p & ... & 0 & ... \\ \vdots & \vdots & \vdots & & \vdots & \end{bmatrix}. \tag{2.3}$$

Notice that it is an *irregular Markov* chain. Since $X(n)$ is non-decreasing, e.g. $p_{i,i-1}^{(h)} = 0$, for all $h \geq 0$ (once we have a number of success, that number can

never decrease). Hence, a Binomial counting process does not have a steady-state distribution.

Simulation of a Binomial counting process
A Binomial counting process is a sequence of Bernoulli trials. We simulate those (see e.g. [7]) and count the number of successes.

2.2 Poisson counting process

Next, we want to obtain a continuous-time counting process, where the time t runs continuously through an interval and, thus, $X(t)$ changes at infinitely many moments. This can be obtained as a limit of some discrete-time process whose frame size (time between trials) Δ approaches 0 (thus allowing more frames during any fixed period of time). We will let

$$\Delta \to 0, \ \text{as } n \to \infty$$

while keeping the arrival rate λ = const.
So, let us take the limiting case of a Binomial counting process as $\Delta \to 0$. Let us consider a Binomial counting process with arrival rate of λ / time unit. $X(t)$ denotes the number of arrivals by time t.

The number of frames during time t, $n = \frac{t}{\Delta} \to \infty$, as $\Delta \to 0$.

The probability of an arrival during a frame, $p = \lambda\Delta \to 0$, as $\Delta \to 0$.

Thus, the two parameters of the Binomial pdf approach, one ∞, the other 0, yet λ remains constant.
$X(t)$ has a $B(n, p)$ distribution with pdf $P(X = k) = C_n^k p^k (1 - p)^{n-k}$, $k = \overline{0, n}$.
Let us see what this becomes:

$$P(X = k) = \frac{n(n - 1) \dots (n - k + 1)}{k!} p^k (1 - p)^{n-k}$$

$$= \frac{n(n - 1) \dots (n - k + 1)}{k!} \left(\frac{\lambda t}{n}\right)^k \left(1 - \frac{\lambda t}{n}\right)^{n-k}$$

$$= \frac{(\lambda t)^k}{k!} \frac{n(n - 1) \dots (n - k + 1)}{n^k} \left(1 - \frac{\lambda t}{n}\right)^{-k} \left(1 - \frac{\lambda t}{n}\right)^n$$

$$\to \frac{(\lambda t)^k}{k!} \cdot 1 \cdot 1 \cdot e^{-\lambda t}, \ \text{as } n \to \infty.$$

So, the limiting pdf is

$$X \left(\begin{array}{c} k \\ \dfrac{(\lambda t)^k}{k!} e^{-\lambda t} \end{array} \right)_{k=0,1,\dots} .$$

which means $X(t)$ has a $Poiss(\lambda t)$ distribution. This is a **Poisson counting process**.

Let us analyze what happens to the other characteristics. Recall that the interarrival time $T = \Delta Y$, where Y has $SGeo(p)$ pdf. For its cdf, we have

$$F_T(t) = P(T \le t) = P(\Delta Y \le n\Delta)$$

$$= P(Y \le n) = F_Y(n)$$

$$= 1 - (1 - p)^n = 1 - \left(1 - \frac{\lambda t}{n}\right)^n$$

$$\to 1 - e^{-\lambda t}, \text{ as } n \to \infty.$$

Then its pdf is

$$f_T(t) = F_T'(t) = \lambda e^{-\lambda t}, t > 0,$$

so T has an $Exp(\lambda)$ pdf.

Simulation of a Poisson counting process

A Poisson counting process can be simulated by a special method, using the fact that each interarrival time (and the first arrival time) has an $Exp(\lambda)$ pdf, which can be easily generated using the Inverse Transform Method by $-\frac{1}{\lambda} U$, where U has a $Unif(0,1)$ pdf (see [6]).

3 Applications

Example 3.1. *Messages arrive at a communication center at the rate of 6 messages per minute. Assume arrivals of messages are modeled by a Binomial counting process.*
1. *What frame size should be used to guarantee that the probability of a message arriving during each frame is 0.1?*
We have $\lambda = 6/\text{min.}$ and $p = 0.1$. Thus,

$$\lambda = \frac{p}{\Delta} = \frac{1}{60} \text{ min.} = 1 \text{ sec.}$$

2. Using the chosen frame size, find the probability of no messages arriving during the next 1 minute;

So $\Delta = 1$ sec. In $t = 1$ minute $= 60$ seconds, there are $n = \frac{t}{\Delta} = 60$ frames. The number of messages arriving during 60 frames, $X(60)$, has a Binomial distribution with parameters $n = 60$ and $p = 0.1$. So the desired probability is

$$P(X(60) = 0) = pdf_{X(60)}(0) = 0.0018.$$

3. Using the chosen frame size, find the probability of more than 350 messages arriving during the next hour;

Similarly, in $t = 1$ hour$=3600$ seconds, there are $n = \frac{t}{\Delta} = 3600$ frames. Thus, the number of messages arriving during one hour, $X(3600)$, has a binomial

distribution with parameters $n = 3600$ and $p = 0.1$. Then, the probability of more than 350 messages arriving during the next hour is

$$P(X(3600) > 350) = 1 - P(X(3600) \leq 350) = 1 - cdf_{X(3600)}(350) = 0.6993.$$

4. Find the average interarrival time and its standard deviation.
By (2.1) we have

$$E(T) = \frac{1}{\lambda} = \frac{1}{6} \text{ minutes} = 10 \text{ seconds},$$

$$Std(T) = \sqrt{V(T)} = \sqrt{\frac{1-p}{\lambda^2}} = \sqrt{0.0250} \text{ minutes} \approx 9.5 \text{ seconds}.$$

5. Find the probability that the next message does not arrive during the next 20 seconds.
Recall that the interarrival time $T = \Delta Y$, where Y has $SGeo(p)$ distribution and, hence Y - 1 has a $Geo(p)$ pdf. The next message does not arrive during the next 20 seconds, if $T > 20$. So,

$$P(T > 20) = P(\Delta Y > 20) = P(Y > 20)$$

$$= 1 - P(Y \leq 20) = 1 - P(Y - 1 \leq 19)$$

$$= 1 - cdf_{Y-1}(19) = 0.1216.$$

Note that this is also the probability of 0 arrivals during n $= \frac{t}{\Delta} = 20$ frames. The number of messages arriving during the next 20 seconds, $X(20)$, has a Binomial distribution with parameters n $= 20$ and $p = 0.1$. Thus, the probability that no messages arrive during the next 20 seconds is

$$P(X(20) = 0) = pdf_{X(20)}(0) = 0.1216.$$

6. The following MATLAB code gives a simulation and illustration for the number of messages arriving in one minute:

```
% Simulation of Binomial counting process with Del  frame
size.
clear all
 N = input('size of sample path = ');
 p = input('prob. of success (arrival) = ');
 Del = input('frame size (in seconds) = ');
 X = zeros(1, N);
 X(1) = (rand < p); % X denotes the nr. of successes
 for t = 2 : N
   X(t) = X(t - 1) + (rand < p); % count the nr. of
 successes
 end
clf
 % illustration
 axis([0 N 0 max(X)]); % allot the box for the simulated
```

```
segment
 hold on
 title('Binomial process of arrivals');
 xlabel('time'); ylabel('nr. of arrivals');
 for t = 1 : N
   plot(t, X(t), '*', 'MarkerSize', 8)% plot each point with
 a '*'
   pause(Del)
end
```

The program returns a sequence of the number of arrivals (messages) each second. The illustration is shown in Figure 1.

```
size of sample path = 60
prob. of success (arrival) = 0.1
frame size (in seconds) = 1
X=
001111222222222222222222223333334444444444445555566667888888
```


Figure 1. Binomial counting process

Example 3.2. *Let us revisit the previous example and model the arrival of messages using a Poisson counting process, keeping the same arrival rate of 6 messages per minute.*

1. Find the probability of no messages arriving during the next 1 minute;

We have $t = 1$ minute and $\lambda = 6$ / minute. The number of messages arriving during 1 minute, $X(1)$, has a Poisson distribution with parameter $\lambda t = 6$. So the desired probability is

$$P(X(1) = 0) = pdf_{X(1)}(0) = 0.0025.$$

2. Find the probability of more than 350 messages arriving during the next hour;
Similarly, in 1 hour = 60 minutes, the number of arriving messages, $X(1)$, has a Poisson distribution with parameter $\lambda t = 360$. Then the probability of more than 350 messages arriving during the next hour is

$$P(X(60) > 350) = 1 - P(X(60)) \leq 350) = 1 - cdf_{X(60)}(350) = 0.6894.$$

3. What is the average interarrival time and its standard deviation?
The interarrival time, T, now has an $Exp(\lambda) = Exp(6)$ distribution, so

$$E(T) = \frac{1}{\lambda} = \frac{1}{6} \text{ minutes} = 10 \text{ seconds,}$$

$$Std(T) = \sqrt{V(T)} = \sqrt{\frac{1}{\lambda^2}} = \frac{1}{6} \text{ minutes} = 10 \text{ seconds.}$$

Notice that the average interarrival time has not changed. This is to be expected, since jobs (messages) arrive at the same rate, λ, regardless of whether their arrivals are modeled by a Binomial or a Poisson process.
However, the standard deviation is slightly increased. That is because a Binomial process has a restriction on the number of arrivals during each frame, thus reducing variability.

4. Find the probability that the next message does not arrive during the next 20 seconds.
Either we work with seconds (so $\lambda = \frac{1}{10}$ /second) and compute the probability $P(T > 20)$, where T has an $Exp(1/10)$ distribution) or in minutes ($\lambda = 6$ / minute, 20 seconds = 1/3 minutes) and compute the probability $P(T > 1/3)$, where T has an $Exp(6)$ distribution. Either way, we have

$$P(T > 20) = 1 - P(T \leq 20) = 1 - cdf_T(20) = 0.1353.$$

Again, this is the same as 0 arrivals in 1/3 minutes, where the number of arriving messages, $X(1/3)$, has a Poisson distribution with parameter $\lambda t = 2$.

$$P\left(X\left(\frac{1}{3}\right) = 0\right) = pdf_{X\left(\frac{1}{3}\right)}(0) = 0.1353.$$

5. The following MATLAB code gives a simulation and illustration for the arrival times and the number of messages arriving in one minute:

```
% Simulation a of a Poisson process on the time interval [0,
Tmax].
clear all
lambda = input('frequency lambda = '); % given arrival rate
Tmax = input('time frame (in minutes) Tmax = '); % given time
period
arr_times = -1/lambda * log(rand); % array containing arrival
times
last_arrival  =  arr_times;  %  each  interarriv.  time  is
Exp(lambda)
while last_arrival <= Tmax
```

136

```
    last_arrival = last_arrival - 1/lambda * log(rand);
    arr_times = [arr_times, last_arrival];
 end;
arr_times = arr_times(1:end - 1) % nr. of arrivals during
time Tmax
                        % last last_arr should not be
                        included
% illustration
step = 0.01; % small step size, to simulate continuity
t = 0 : step : Tmax; % time variable
Nsteps = length(t);
X = zeros(1, Nsteps); % Poisson process X(t)
for s = 1 : Nsteps;
  X(s) = sum(arr_times <= t(s));
 end; % X(s) is the number of arrivals by the time s
axis([0 max(t) 0 max(X)]); hold on
title('Poisson process of arrivals');
xlabel('time'); ylabel('number of arrivals');
plot(t, X, 'r')
```

The program returns the arriving times and a sequence for the number of messages arriving every 0.01 of a minute (or every 0.6 of a second). The illustration is shown in Figure 2.

```
frequency lambda = 6
time frame Tmax = 1
arr_times =
         0.0912 0.3310 0.4608 0.4671 0.5677 0.6763 0.9201
X =
         00000000001111111111111111111111112222222222222444
         4444444555555555556666666666666666666666677777777
```


Figure 2. Poisson counting process

137

Note. All computations of pdf's and cdf's were done in MATLAB.

4 Conclusions

This paper presents the main properties of counting processes. We present theoretical considerations, computational formulas and discuss properties of Binomial and Poisson counting processes. We also describe how each counting process can be simulated on the computer. As applications, we model a problem (message arrivals) by both a Binomial and a Poisson counting process, computing and discussing several quantities relating to the problem. We also illustrate the arrivals of messages in both cases using computer simulations.

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THE COLLABORATIVE PLATFORMS USED IN E-SOCIETY – A CASE STUDY ON THE TOURISM INDUSTRY

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Abstract: *The collaborative technologies and the collaborative economics are terms that are in a closed relationship. It can be appreciated that collaborative technologies are the way of developing the collaborative economy. The tourism and travel industry has a strong impact on the global economy. It is one of the most important economic sectors, concentrating almost 10% of the global workforce, given the large number of suppliers and actors involved. The economy of P2P hosting services platforms carries the imprint of global socio-economic realities. In the paper is made an assembly image on the collaborative platforms existing in the tourism industry, focusing on the P2P hosting services platforms.*

Keywords: *collaborative platforms, social media, tourism, digital, e-society, P2P*

1. Introduction

The popularity and the add value brought by the collaborative economy are difficult to dispute, due to the fact that the gross revenues obtained at the European Union level from the use of platforms and collaborative providers reached the threshold of 28 billion Euro in 2015. Compared to 2014, this represents an increase of 200%. Moreover, studies carried out by the European Commission show that more than half of the citizens of the European Union know the collaborative economy and its means, one of six respondents of the study already having the quality of user of the collaborative platforms.[1]

The term of "collaborative economics" used for the first time in 2008 by Professor Lawrence Lessig of Harvard University, and in 2011 it had listed by Time magazine as one of the ideas that will change the world. This section aims to place the phenomenon of the collaborative economy in the context of the global economy after which the characteristics of this economic system will be analyzed and, as the next; some of the definitions offered over this term are analyzed over time. Shortly after the appearance of the term "collaborative economy" two of the most known examples of companies established on the principles of collaborative economy is launched respectively in 2008 Airbnb and Uber in 2009.

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Taking into account both the value of the global collaborative economy, which exploded from $ 15 billion in 2014, to an estimated $ 225 billion for 2025, and the impressive value of collaborative platforms (Airbnb platform is evaluated in 2019 at a totaling $ 29 billion, and the Uber platform at $ 72 billion, their cumulative value may be associated with the economy of a country ranked 38th in the global ranking), it can be appreciated that the estimation of Time magazine from 2011 did not was far from reality.

Thus, the term "collaborative economy" has increasingly found its place in the vocabulary of economists, investors and everyday reality, is considered the engine of the post-capitalist economy, or the product of the fourth Industrial Revolutionor as the end of the traditional consumer era[4].

The collaborative economics is considered to be an economic and social system based on the concept of shared use of physical and human resources (Lamberton and Rose, 2012). Heinrichs (2013) suggests that the role of the collaborative economy, its concept and the sharing of resources is to promote communication and support links within the society, creating a sustainable framework for the development of the economy. Moreover, the collaborative economy prioritizes the accessibility of services over the property, based on using the information technology to provide people with resources, helping to optimize them - where resources are in excess and transformed them into goods and services for the benefit of consumers (Fang, 2016). Similarly, Belk (2007) considers that the act of sharing, of working in an economic sense is the act and process of distributing a product, a good, owned by an individual, for use by other people, in their benefit. Most often, this act can take many forms, materializing in different contexts, with different results.

Several authors consider the social implications and dimensions of the collaborative economy. Thus, Molz (2013) points out that the morality of the collaborative economy is not given by the distribution of profits, but by highlighting features such as cooperation, generosity, mutual aid, which marks a clear change from the market economy (Molz, 2013). Moreover, these characteristics of the collaborative economy explored in the psychological plane, finding their behavioral equivalents in this plan. A significant number of authors consider that the basis of the collaborative economy is an attitude of people based on more responsibility towards consumption (Barbu, et al, 2018). In agreement with these statements are Sheth, et al, (2011) and Albinson et al (2012). The first author proposed the concept of conscious consumption, which based on conscious actions regarding the consequences of consumption on the environment, the natural environment or the available resources. Thus, he believes that those involved in the collaborative economy have a higher level of awareness about consumption, being

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[4] https://www.weforum.org/agenda/2018/01/the-dark-side-of-the-sharing-economy/

more concerned about the repercussions that their actions have, they avoid wasting resources or destroying the environment in which they live. Albisson et al (2012) consider that in the collaborative economy people are motivated and have a state of gratitude if, in their turn, they can have a positive effect, in the society, being a result of their actions. Last, but not least, the act of sharing implies trust, a fact for which the collaborative economy gains much appreciation - those involved are collaborators and facilitate the creation of connections based on mutual agreement (Barbu et al, 2018). The social dimension complemented by the fact that the collaborative economy stimulates the association between individuals with common interests, with a lower consumption of resources (time, money, etc.) than usual (Botsman and Rogers, 2010).

The activities that characterize the collaborative economy are the following: the production, creation, distribution, trade and consumption of goods and services by individuals and organizations, in a common framework (Belk, 2014).

2. The main features and the position of the collaborative platforms in digital economy

The collective consumption, most often associated with the collaborative economy, takes place in organized systems or networks, where users take part in activities such as renting, lending, trading, exchanging products, services, solutions, transport or money (Mohlman, 2015).

It is clear that there is no consensus on the definition of the collaborative economy. In general, this refers to the forms of organization by which companies and individuals interact, changing, in the form of providing a service or collecting a fee, a surplus of resources.

In the followingare shown the main features of the collaborative economy, derived from the specialized literature:

 - *The prevalence of accessibility and reliability of the service* of the proposed good or resources, to the detriment of the ownership or provision of services intended for a single user. Emphasis is placed on how much the service / good can respond to the consumer's demands, bringing value to the buyer, the supplier / seller, as well as the environment in which they operate;

- *Using the digital technology (information platforms) and the internet connection* for the services provided or received, and respectively, for the sale of goods, as well as the social dimension, enhanced by behaviors that encourage greater care with regard to consumption, by the resources available and by the environment;

- *The intersection of groups of individuals with each other or their intersection with organizations that need their capabilities*, the association of people with

capacities, complementary skills and needs is favored in the collaborative economy, considered as a means to reunite the passions with the money interests.

- Harnessing untapped capacity – the owners of the resources get to offer for exploitation the unqualified part of it, in exchange for a fee or another service. In the case of goods of greater value or with significant untapped capacity, their use made by having the common denominator time, thus benefiting from both parts. For example, in the case of ridesharing platforms, for users, the cost of the purchased service is lower than the cost associated with owning the respective car, but over time, the aggregate value of the revenue obtained by the service provider may exceed the cost mentioned above.

The growth rate of the global collaborative economy, according to a study by the consulting firm PwC, estimated to increase 20 times in the period 2016 - 2025, reaching a total value of 570 billion Euros, in five key sectors:
• Collaborative finance;
• Individual to individual accommodation
• Individual to individual transportation services;
• Services for the household on request;
• Professional services on request.
The platforms intended for p2p accommodation are among the categories that expected to increase significantly between 2016 and 2025. The popularity of such platforms (AirBnb gathers 100 million users and lists on the stock exchange) and the sustained growth rate of the global tourism and travel industry indicates the influence and popularity of individual-to-individual collaborative platforms in the global tourism industry.

Smith & McKeen (2011) emphasize that, in the business environment, the quality of collaborative technologies to provide employees with access to real-time information from anywhere generates numerous benefits at their level such as: efficient teams, cost reduction, access to information and access to communication with individuals located internationally.

In terms of team efficiency, this is given by encouraging interaction between employees, at the workplace and by increasing overall performance (Turel & Zhang, 2008). Moreover, Smith & McKeen (2011) point out that, at the level of some companies, the use of social media platforms by employees encourages the act of getting to know others, learning about new cultures. Thus, it is possible to successfully connect employees of the same company, located at great distances. As a result, the act of getting to know others encourages the creation of personal connections within groups, leading to an increased level of trust, thus facilitating the exchange of ideas and initiatives, and implicitly, in achieving a climate conducive to performance.

The reduction of costs at the level of organizations through the use of collaborative technologies can be achieved through concrete actions, carried out at specific levels (Smith et al, 2011), such as:
• Increase and improve communication
• Reducing misunderstandings
• Increased degree of coordination between teams
• Promoting links between suppliers and customers, which can speed up some processes of the job.

Table 1 presents the classification of collaborative technologies according to time and space. As can be seen, most types of collaborative technologies are found at the intersection between those that allow communication in different time and space coordinates.

**Table 1 Types of collaborative technologies depending on the configuration of
time / space[5] (ZIGURS și MUNKVOLD)**

Time / place	In the same time	In the different time
In the same place	Conference systems, electronic meetings Systems for supporting team / group work	• E-mail • Electronic document management systems • Electronic systems for calendar and management of daily tasks / events • Task flow management systems (work) • Electronic bulletin systems • Suite of software products for collaboration
In a different place	Audio conference Video conferencing Instant messaging / Chat room	• E-mail • Electronic document management systems • Electronic systems for calendar and management of daily tasks / events • Task flow management systems (work) • Electronic bulletin systems • Suite of software products for collaboration • Integrated systems for teams • Systems for working on the web • E-learning systems

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[5] Ilze Zigurs, B.E. Munkvold, *COLLABORATION TECHNOLOGIES, TASKS, AND CONTEXTS,* page 146, 2006

Time / place	In the same time	In the different time
	E-learning systems Integrated systems for teams	

The classification of collaborative technologies according to their functionalities gives greater attention to the capabilities made available to users by the types of collaborative technologies, as detailed in the table below (table 2).

Table 2 Types of collaborative technologies depending on the role they play [6]
(ZIGURS și MUNKVOLD)

The type of function offered	Exemple de tehnologii colaborative
Communication technology	• E-mail • Instant messaging / Chat room • Video and audio conferences
Technologies to disseminate information	• Document management systems • Electronic bulletin systems
Process support technologies	• Support systems for groups / teamwork • Systems for meetings, virtual meetings
Technologies with a coordinating role	• Electronic systems for calendar and management of daily tasks / events • Task flow management systems
Technologies that integrates several functions	• Suite of systems that integrate several products for collaboration • Systems for working on the web • E-learning systems • Integrated systems for teamwork.

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[6] Ilze Zigurs, B.E. Munkvold, *COLLABORATION TECHNOLOGIES, TASKS, AND CONTEXTS,* page 148

In today's business environment, in today's economy, there is a tendency to integrate and interconnect capacities technologies to a much greater degree, in order to obtain a competitive advantage and to face the challenges brought by such a competitive environment. , as shown by the opinion issued by the World Economic Forum at the beginning of 2019 (Nikolaus L.).

Thus, looking at the most popular collaborative technologies used in 2019 and the functions proposed by them, it is impossible not to notice that in their entirety, they are represented by platforms that integrate many of the functionalities mentioned above, which blurs the borders. between the terms collaborative technology and collaborative platform. The functionalities of the collaborative platforms are generally the following (Fearn, McCaskill and Turner):

   • *They are accessible from a variety of devices, including mobile devices*
   • *Provides the opportunity to run a constant, considerable and varied flow of information (photos, videos, text files, attachments, etc.) between users*
   • *Supports communication between users.*

The five best platforms that use collaborative technologies (Fearn, McCaskill and Turner) are described below:

1) **Slack** – a collaborative platform with millions of users worldwide, allowing file transfer between users, sharing direct messages, organizing common conversations across different categories and is compatible with other platforms such as Google Drive or Box.
2) **Asana** – a platform that has the role of tracking and managing the tasks performed by the employees, creating lists of tasks, deadlines. It also facilitates the organization of projects in various categories, benefiting from search functions and updating the status of a project.
3) **Podio** – It is also a platform that integrates the use of other platforms such as Google Drive, DropBox, Evernote and also allows the use of mobile telephones. It has the role to organize the tasks delegated to the team and to communicate at the same time.
4) **Ryver** – this is a similar platform to Slack, but it has several integrated communication facilities. Therefore, it offers the opportunity to delegate and monitor tasks as well as to communicate about them.
5) **Trello** – a platform available in web and mobile format that facilitates the delegation, monitoring of tasks to the team, also benefiting from the possibility of giving feedback for each task.
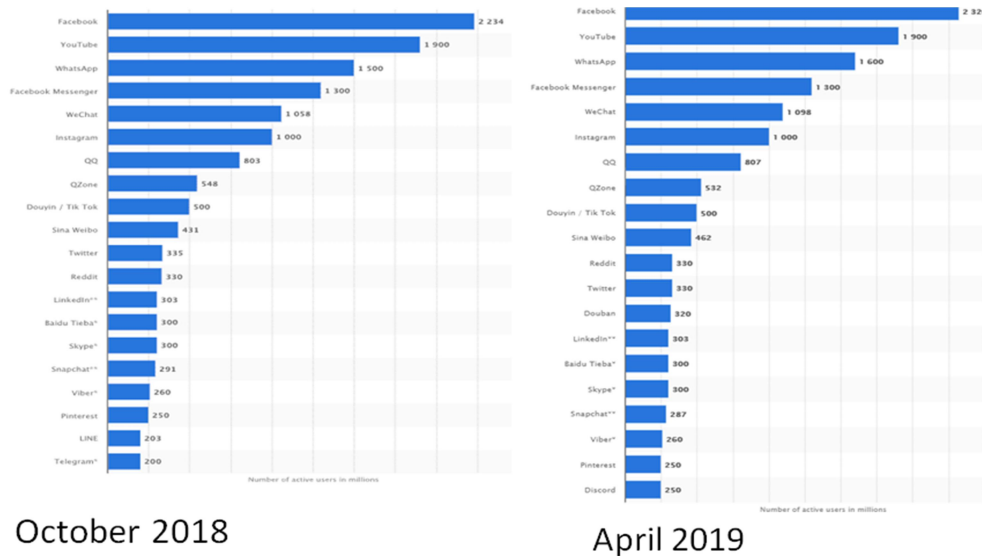
Figure 1. Social media platforms

In the graphs above (figures 1) are presented the most popular social media platforms, according to the number of active users, in two moments: October 2018 and April 2019. Thus, it can be observed that in October 2018 Facebook was approaching about 2.3 billions of active users, and the platforms Youtube and Whatsapp completed the second and third places, with 1.9 billion active users, respectively 1.5 billion. In April 2019, the situation of social media platforms was as follows: Facebook exceeded the threshold of 2.3 billion active users, Youtube remained at the same value, and WhatsApp exceeded the threshold of 1.6 billion users.

The year 2019 brought a lot of news of the future in the field of social media, after the management of the social network Facebook announced in January that they will integrate the online messaging services of the network, with the other two well known platforms, Whatsapp and Instagram. Although the movement aims to be one that will help users, in order to provide premium messaging services, it will bring together, on a single platform, no less than 2.6 billion users.

The collaborative platforms existing at the moment are the following:
- Social networking sites– Facebook, Google Plus, CafeMom, Gather, Fitsugar
- Micro-blogging sites– Twitter, Tumblr, Posterous
- Publishing tools– WordPress, Blogger, Squarespace
- Collaboration tools– Wikipedia, WikiTravel, WikiBooks
- Rating/Review sites– Amazon ratings, Angie's List
- Photo sharing sites– Flikr, Instagram, Pinterest
- Video sharing sites– YouTube, Vimeo, Viddler
- Personal broadcasting tools– Blog Talk radio, Ustream, Livestream

- Virtual worlds– Second Life, World of Warcraft, Farmville
- Location based services– Check-ins, Facebook Places, Foursquare, Yelp
- Widgets– Profile badges, Like buttons
- Social bookmarking and news aggregation– Digg, Delicious
- Group buying– Groupon, Living Social, Crowdsavings

3. Using collaborative platforms in tourism

For the period 2013 - 2025 the growth rate of the accommodation services offered by using the online environment and, in particular, the collaborative platforms such as P2P is estimated to increase by 31%.

It is also worth mentioning that measuring the value of the accommodation sector carried out through P2P platforms is difficult to achieve, this being given by the small number of data in the field. An independent study, conducted by MasterCard in 2017, estimated that the total value of transactions carried out in the P2P platform hosting services industry was $ 75 billion. However, the common point of the studies carried out is represented by the upward trend estimated for the future period regarding the use of P2P platforms.

P2P platforms act as intermediaries between service providers and beneficiaries and they charge a commission for using the platform of both parties or one of them, representing the most common category of P2P accommodation services.

The service provider charges a sum for the services offered, which the tourist can pay either directly (homestay.com) or through a platform (Airbnb.com).

The most used collaborative platforms in the tourism industry are:
- The Airbnb platform charges a 3% commission from the service providers and a fee of between 6 and 12% from the tourists, who have the obligation to pay on the spot, both amounts to the platform. Then, the owners of the accommodation spaces collect the corresponding amounts from the platform, after the arrival of the tourists
- The Homestay.com platform charges a commission of 15% at the time of booking and this amount is used to guarantee the reservation. Payment for the purchased services can be made by bank transfer, cash or PayPal directly by tourists to the accommodation provider.
- The Homeaway platform charges tourists between 5 and 12%, and the service provider can choose to pay for each reservation (8%) or an annual subscription ranging from 349 to 499 USD. Payment can be made directly or through the HomeAway system.
- Booking platform - charges a commission between 12 and 17% only to the providers. Tourists do not pay commissions. At check-in, they pay the providers the fee for the accommodation services. In case the provider applies a cancellation policy, credit card amounts can be withheld.

147

In addition to the P2P platforms for accommodation services, there are two models encountered in this regard:

• Mutual exchange of housing - in this model the houses are temporarily exchanged between users, this exchange is facilitated through a platform, there is no fee for renting the house. The platform charges a fee to both users, which can be for each transaction or a fixed fee. The largest online home exchange platform is HomeExchange and has a fee of $ 150 for a 12-month period.

• Free accommodation - represents a model of accommodation without the obligation to pay for any of the parties. Visits do not imply a fee or without a direct interest. Well-known platforms such as CouchSurfing or WarmShowers do not have a fee for use, however, their cumulative accommodation capacity is 500,000 beds.

A summary of the characteristics of the main digital platforms used for hosting services are presented in table 3.

Table 3. Digital platforms used in tourism

Platform / category	Year of establishment	Number of ads	Geographic area	Number of tourists
P2P platform hosting				
Booking.com	1996	5 millions	226 countries	n/a
Airbnb	2008	4,85 millions	191 countries	200 millions of tourists
HomeAway	2005	2 millions	190 countries	n/a
TripAdvisor Rental	2009	830.000	200 countries	n/a
Tujia	2011	300.000	China	n/a
9flats.com	2011	250.000	140 countries	n/a
Homestay.com	2013	50.000	160 countries	750.000
OYO Rooms	2013	8.500	India	40 millions
Onefinestay	2009	2.500	SUA, Europe, Australia	n/a
Xiaozhu	2012	250.000	China	n/a
Mutual exchange of housing				
GuestToGuest	2011	280.000	197 countries	n/a

Platform / category	Year of establishment	Number of ads	Geographic area	Number of tourists
LoveHomeSwap	2009	100.000	140 countries	n/a
HomeExchange	1992	67.000	150 countries	135.000 of housing exchanges
Free accommodation services				
Couchsurfing	2004	400.000 of hosts	200.000 towns	4 millions of guests annually
Trustroots	2014	6.000 of hosts	n/a	n/a
WarmShowers	1993	61.000 hosts	161 countries	n/a
BeWelcome	2007	35.000 members	n/a	n/a

5. The global trends of accommodation services run through P2P platforms

Further will be presented the main trends in the development of the tourism accommodation sector, as well as the main features of service providers and buyers.

Usually, the growth rate in mature markets slows down, after a period of 5 years of growth. Initially, the platforms for accommodation services were the most popular in the mature markets, where they were favored by the high degree of digitalization and the popularity of travel, but starting with 2017, the demand and supply stabilized. In the mature markets, the research revealed an awareness level of 80% of the platforms for accommodation, which influenced the demand in a negative sense. The regulatory acts as well as the negative image projected in the press contributed to this trend. The mature destinations such as Berlin or Santa Monica, California in 2017 suffered a decrease of 49%, respectively, 37% in terms of platform accommodation services, after imposing legislation and fines.

The emerging markets are potential for these types of platforms. For example, the Airbnb platform noted that in 2017 it brought an increase of 1,160%, compared to 2014, in the number of tourists in low and middle income countries. Indonesia, the Philippines and India are the countries from which the growth came. The number of Airbnb guests in China was 3,290,000, compared to 2016, these figures

increased by 268%. The Homestay.com platform confirms the trend - the pace of revenue growth is sustained in countries such as Cuba, Japan, Iran, Brazil, Argentina, South Africa, India, Mexico, Singapore, China.   Market consolidation and the emergence of super-platforms have led to the emergence of a network effect (that of interconnection) given by the use of digital platforms. This can lead to market integration and concentration in several super-platforms. Similar to the trend underlined for social media platforms, the integration and operation of several adjacent services through multiple platforms, using a common technological architecture, leads to network effects, including Big Data.

The emerging markets continue the trend of consolidation through the emergence of platforms similar to those known, but also their quick purchase by the big players.. În plus, pe lângă serviciile de cazare, platformele își adaugă în portofoliu noi și noi facilități, de multe ori, rezultate prin fuziuni, achiziții, parteneriate (de exemplu platformele GuestToGuest și HomeExchange).

 New entrants to the platform face a low level of support. Although there are modules to accommodate the platform, most of the time, its use by individuals with limited digital skills may prove difficult. In the case of Airbnb, the assistance offered to the hosts is mostly in the online environment, through communities or special question sections. The possibility of constant and appropriate training for each category of individual is limited.

The existing data suggests that the United States and Europe are the largest markets in terms of number of hosting providers. Thus, analyzing the ads on the TripAdvisor Rentals platform in 2017, it is obvious that most of the ads are located in Europe (58% of the total), followed by the USA (28% of the total).

Most hosts on the Airbnb platform are women (55% of the total), respectively one million accommodation providers. The trend is also confirmed on the Homestay.com platform, where women have a 64% share of the total providers on the platform. In Africa and Asia, however, the trend is reversed, with female providers being 47% and 37% respectively. Regarding the predominant age group, the Airbnb platform emphasizes that those around the age of 60 have the highest rate of presence on the platform (13% of all US providers).

The announcements published on the P2P platforms have evolved considerably. If in the initial phase of these platforms the service providers had usually published only one ad, now the ads have evolved, with the category of super-ads. These belong to individuals or companies that manage several properties at the same time, which are available for short-term rental throughout the year. Such practices can be encountered in the case of people who do not have the time or expertise to manage the rental of properties on the platform. Last but not least, the percentage of people who offer their basic home for rent is noted. In the initial phase of platform development, most of the present offers were aimed at the presence of the host in the respective dwelling. Although this particularity may vary depending on

the geographical area, out of the total number of ads, only 30% refer to the rental of basic housing. This decreasing trend can be explained by the regulation of the sector, strict rules being imposed regarding the short-term rental of primary housing.

Regarding the age of the guests, the most present generation of the consumers of accommodation services on the platforms is the one born between 1981 and 1996 (the Millenials generation). For Airbnb, 60% of all guests are between 18 and 35 years old. For Airbnb in China, 83% of bookers are from the Millenials generation. In the case of the Homestay.com platform, again, the age group 18 - 25 years old dominates, being present in a proportion of 52%. The data varies from platform to platform and from region to region, being clear that more data is needed to determine if the preponderance of the Millenial generation is the fact that this type of accommodation is simply more attractive to them or because there is a significantly higher degree of literacy and digital skills than in other age groups.

Regarding the duration of the trip and the composition of the tourist groups, the market analysis in the United States of America and Europe found that the users of the P2P hosting platforms spend more nights of accommodation than those who opt for the usual modes of accommodation. On the other hand, research for the Norwegian market has found a contradictory trend. In addition, according to studies conducted for the United States market, guests of P2P platforms have an above average level of education and income. However, the main criterion according to which the available properties are searched is the price - a trend signaled by the analysis of the US and Finland market. Other important decision-making factors are the number of beds available, the desire to prepare meals on their own, the distance to the city, the host's response time. Moreover, the desire to have an authentic experience and the presence of the kitchens are things that considerably influence the choices of the guests.

The spending patterns of the guests in this sub-sector are different, depending on the tourist destination and many other variables for which the data identification is not yet sufficient. On average, Airbnb guests in Australia spend 1.6 times more per day than other regular guests. On the other hand, Airbnb guests in Norway spend 40% less than those who prefer hotel accommodation.

Business travel is an important growing segment for P2P platforms. In 2017, approximately 15% of the bookings made on the Airbnb platform were made for business purposes, and the company estimates that by 2020 this share will be 30%.

4. Conclusion

Collaborative economics designates an economic system in which the actions of sharing and sharing the resources owned by people are emphasized to generate added value. Collaborative technologies complement this description, designating

precisely the information medium (IT platforms, social media platforms) through which, in the information age, in the collaborative economy, demand and supply meet.

The value chain of tourism can be extremely diverse, involving local farmers, rural workers, craftsmen, artisans. Although hosting services represent the largest sub-sector of tourism, advances in technology, accessibility of the online environment and popularization of social networks, have led to the establishment of the new socio-economic paradigm of the collaborative economy in a significant way in tourism.

Hosting in private homes has always existed so the appearance of the characteristic platforms of the individual to individual economy (P2P platforms) has led to the emergence of new business models in the tourism industry, focused on providing accommodation services, these adding an additional level of complexity but also of controversy.

The economy of P2P hosting services platforms carries the imprint of global socio-economic realities. Already past the initial phase of development in mature markets, P2P hosting platforms pay attention to emerging economies, the business tourism segment, as well as the Milleanials generation. With seemingly higher incomes and level of education, P2P users tend to spend more than other types of tourists, being generally influenced by the desire to enjoy authentic tourism experiences and accommodation facilities.

Among the determining factors of the development of the collaborative economy, the intensive use of the collaborative technologies and social media platforms in tourism are: the number of tourists increases annually, the low-cost airlines are accessible to several classes, the online travel agencies are gaining popularity, the advanced mobile technology and digital banking services facilitate bookings and payments, digital technologies have reduced the costs associated with search and planning, traditional providers of accommodation services are beginning to be present within P2P platforms, with the evolution of this subsector, it is becoming increasingly difficult differentiation of P2P hosting services platforms and online travel agencies.

Given the less and less differences in the platforms used in this subsector of tourism, the hosts present on the P2P platforms should be separated according to the type of accommodation offered, and not the platform used to enter a market.

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INNOVATION AND ICT DEVELOPMENT: AN ANALYSIS FOR THE EU-28 MEMBER STATES

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Abstract: *This paper proposes a new analysis over the relation between the ICT performance and the innovation level for the 28 EU Member States. Two indicators were used:*
(1) the ICT Development Index (IDI), a composite index that has been computed yearly, since 2009, by the International Telecommunication Union and published in the "Measuring the Information Society Report" (MISR), and
(2) the Summary Innovation Index (SII), a 10-dimensions composite indicator for innovation, computed yearly under the auspices of the European Commission and published in the European Innovation Scoreboard.
Several testes were verified: some analyzes between innovation and ICT development for the EU-28 Member States yielded to the conclusion that the two indicators follow a linear regression model with high confidence. This result is not accidental – over the past 7 years, IDI and SII have been strongly correlated, as related tests showed.

Keywords: *ICT, ICT Development Index (IDI), innovation performance, Summary Innovation Index (SII)*

1. Introduction

In today's modern world, ICT plays a fundamental role, being one of the key drivers for improving the economic and educational prospects of a country. ICT is essential for attaining the UN Sustainable Developments Goals (SDGs), "boosting economic growth, enhancing communications, improving energy efficiency, safeguarding the planet and improving people's lives" (MISR 2018, p.6).

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According to International Telecommunication Union statistics, more than half of the world's population in now online, connected to the Internet (MISR 2018, p.2), but the other half ("Connecting the Other Half" – initiative of the Broadband Commission for Sustainable Development in 2018) is unable to benefit from the social and economic resources of the digital world, and the knowledge gap increases by lack or limited connection to ICTs. The impact of ICT for economies and people depend not only on the infrastructure and access, but also on the efficiency in using ICTs and the level of the digital skills possessed.

There is a relation between ICT and digital divide. On one hand, ICT can contribute to an inclusive information society, by providing affordable broadband access for all, which reduces the digital divide. On the other hand, people of any gender, any age, any level of education must have the necessary digital skills in order to use, and to benefit from ICTs. Otherwise, even with the latest ICT technologies available and accessible, the digital divide will increase, as less and less people will be able to use the new devices.

There is another relation between ICT and innovation, as ICT is fostering innovation, and innovations are contributing to ICTs developments. The Connect 2030 Agenda [17] and the "Strategic plan for the Union for 2020-2023" [18] set Innovation as one of the 5 main goals for 2023, strengthening the fact that ICT plays a crucial role in the digital transformation of society, and the innovation in ICT is a key driver in this process. The Internet of Things (IoT), and the new emerging technologies, such as AI, Big Data Analytics, Blockchain, or cloud computing are transforming industries, services, and even our lives, "laying the foundations for smart societies" (MISR 2018, p.88).

There are many other connections between ICT and economic growth, sustainable development or quality of life. The more we understand these correlations the more we'll be able to action on the drivers for economic growth and welfare. Our study is intended to contribute to this understanding, by analyzing the links between the innovation performance and the ICT development level for the 28 EU Member States.

2. National indicators for ICT development and Innovation performance

2.1. The ICT Development Index (IDI)

The *ICT Development Index (IDI)* is a composite index that has been reported annually, since 2009, by the International Telecommunication Union (ITU) in its "Measuring the Information Society Report" (MISR). The index is intended to measure the progress of each country towards the information society, respectively it is as a tool able to describe the current state of development of the ICT sector.

Table 1: The structure of the ICT Development Index (IDI)

ICT Development Index (IDI)		
ICT access		*40%*
1. Fixed-telephone subscriptions per 100 inhabitants	20%	
2. Mobile-cellular telephone subscriptions per 100 inhabitants	20%	
3. International Internet bandwidth (bit/s) per internet user	20%	
4. Percentage of households with a computer	20%	
5. Percentage of households with Internet access 100	20%	
ICT use		*40%*
6. Percentage of individuals using the Internet	33%	
7. Fixed-broadband subscriptions per 100 inhabitants	33%	
8. Active mobile-broadband subscriptions per 100 inhabitants	33%	
ICT skills		*20%*
9. Mean years of schooling	33%	
10. Secondary gross enrolment ratio	33%	
11. Tertiary gross enrolment	33%	

Source: Made by the authors using the information on MISR 2017.

IDI framework includes 3 dimensions which represent the combination of factors needed for each country in the process of transforming into / becoming an information or knowledge-based society: the availability of ICT structure and access, the level of ICT usage, and the capability to use ICTs effectively. Thus, IDI has 3 sub-indexes and 11 indicators. The "ICT access" sub-index includes 5 infrastructure and access indicators, the "ICT use" sub-index comprises 3 intensity and usage indicators, and the "ICT skills" sub-index includes 3 proxy indicators showing relevant skills for ICTs. Each IDI sub-index is calculated as a simple average of its indicators. The IDI is calculated as weighted average of its sub-indexes (40% Access, 40% Use, 20% Skills – see Table 1).

Figure 1 shows the IDI values for the 28 EU member states in 2017. Four groups of countries could be identified: *low performers* (below 90% of the EU-28 average; e.g. Romania), *moderate performers* (below the EU-28 average, but more than 90% of this value; e.g. Bulgaria, Poland, Hungary, Italy, ..., Slovenia), *good performers* (above the EU-28 average, but up to 110% of this value; e.g. Cyprus, Spain, ..., France), and *excellent performers* (above 110% of the EU-28 average; e.g. Germany, Sweden, Luxembourg, Netherlands, United Kingdom and Denmark).
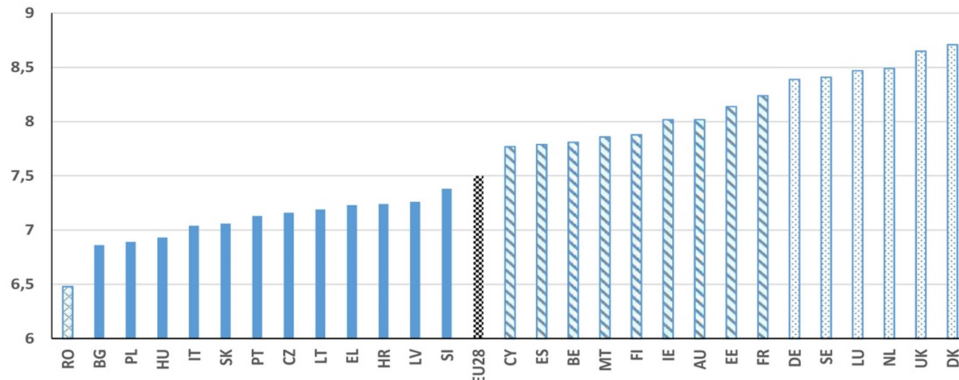
156

Figure 1: The EU-28 countries ranked by their ICT Development Index 2017
Source: Chart made by the authors using MS Excel, based on data published in MISR 2017

In 2017, ITU has decided to revise the IDI indicators, in order "to reflect changes in technology and markets over time, and improvements in the availability and quality of data" (MISR 2017, p. 27). The "new" IDI will have 14 indicators: 3 have been dropped (2 from Access sub-index, and 1 from Use sub-index) and 6 new indicators have been added (see Table 2).

Table 2. The future structure of the ICT Development Index (IDI)

ICT Development Index (IDI)		
ICT access		**40%**
Fixed-telephone subscriptions per 100 inhabitants	dropped	
Mobile-cellular telephone subscriptions per 100 inhabitants	dropped	
1. International Internet bandwidth (bit/s) per internet user	20%	
2. Percentage of households with a computer	20%	
3. Percentage of households with Internet access	20%	
4. Percentage of population covered by mobile networks (at least 3G and at least long-term evolution (LTE/WiMax) (NEW)	20%	
5. Fixed-broadband subscriptions by speed tiers (% of total) (NEW)	20%	
ICT use		**40%**
6. Percentage of individuals using the Internet	20%	
Fixed-broadband subscriptions per 100 inhabitants	dropped	
7. Active mobile-broadband subscriptions per 100 inhabitants	20%	
8. Mobile broadband Internet traffic per mobile-broadband subscription (NEW)	20%	
9. Fixed-broadband Internet traffic per fixed-broadband subscription (NEW)	20%	
10. Percentage of individuals who own a mobile phone (NEW)	20%	
ICT skills		**20%**
11. Mean years of schooling	25%	
12. Secondary gross enrollment ratio	25%	
13. Tertiary gross enrollment	25%	
14. Proportion of individuals with ICT skills (NEW)	25%	

Source: Made by the authors using the information on "The ICT Development Index (IDI) - Methodology, indicators and definitions (as of Feb. 2019)", pp. 7-9 and MISR 2017, p.29

The introduction of the new IDI indicators imposed additional efforts for all countries to collect data. Unfortunately, the 10th edition of the MISR – MISR 2018 – could not publish IDI 2018 (due to the lack of data) and the launching of the "new" IDI was postponed for 2019 or even later. This means that, for the moment, there is no composite index available – on a yearly basis – for the ICT sector/development, since NRI (Networked Readiness Index, published by INSEAD in Global Information Technology Report series) ceased to be published in 2017, and now, IDI is confronting with problems (last available data for IDI being IDI 2017). Recently, in October 2019, ITU formulated a new proposal in order to calculate IDI 2018 and 2019 – to use the old methodology (applied until 2017) - but there is no consensus yet [12].

2.2. The Summary Innovation Index (SII)

The 2019 European Innovation Scoreboard (EIS 2019) is the 19th edition of the European Innovation Scoreboard (EIS), published yearly by the European Commission, since its introduction in 2001. The innovation performance of each country is measured using a composite indicator called *Summary Innovation Index (SII)* – an aggregation of 27 indicators, grouped into 10 dimensions, in 4 areas (Figure 2). SII is calculated as unweighted average of its 27 indicators.

AREAS	DIMENSIONS	INDICATORS
1. Framework conditions	1.1 Human resources	1.1.1 New doctorate graduates 1.1.2 Population aged 25-34 with tertiary education 1.1.3 Lifelong learning
	1.2 Attractive research systems	1.2.1 International scientific co-publications 1.2.2 Top 10% most cited publications 1.2.3 Foreign doctorate students
	1.3 Innovation-friendly environment	1.3.1 Broadband penetration 1.3.2 Opportunity-driven entrepreneurship
2. Investments	2.1 Finance and support	2.1.1 R&D expenditure in the public sector 2.1.2 Venture capital expenditures
	2.2 Firm investments	2.2.1 R&D expenditure in the business sector 2.2.2 Non-R&D innovation expenditures 2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel
3. Innovation activities	3.1 Innovators	3.1.1 SMEs with product or process innovations 3.1.2 SMEs with marketing or organizational innovations 3.1.3 SMEs innovating in-house
	3.2 Linkages	3.2.1 Innovative SMEs collaborating with others 3.2.2 Public-private co-publications 3.2.3 Private co-funding of public R&D expenditures
	3.3. Intellectual assets	3.3.1 PCT patent applications 3.3.2 Trademark applications 3.3.3 Design applications
4. Impacts	4.1 Employment impacts	4.1.1 Employment in knowledge-intensive activities 4.1.2 Employment fast-growing enterprises of innovative sectors
	4.2 Sales Impacts	4.2.1 Medium and high-tech product exports 4.2.2 Knowledge-intensive services exports 4.2.3 Sales of new-to-market and new-to-firm product innovations

Figure 2. The structure of the Summary Innovation Index (SII) in 2018
Source: Chart made by the authors based on data published in EIS 2019

Using the SII indicator, EU-28 Member States are classified, every year, into four groups (Figure 3):

- *Innovation Leaders* (Sweden, Finland, Denmark and the Netherlands) – perform in innovation above 120% of the EU-28 average;
- *Strong Innovators* (Luxembourg, Belgium, United Kingdom, Germany, Austria, Ireland, France, and Estonia) – the innovation performance is between 90% and 120% of the EU-28 average;
- *Moderate Innovators* (Portugal, the Czech Republic, Slovenia, Cyprus, Malta, Italy, Spain, Greece, Lithuania, Slovakia, Hungary, Latvia, Poland and Croatia) – the innovation performance is between 50% and 90% of the EU-28 average;
- *Modest Innovators* (Bulgaria and Romania) – innovate well below the EU average, their innovation performance level being below 50% of the EU-28 average.
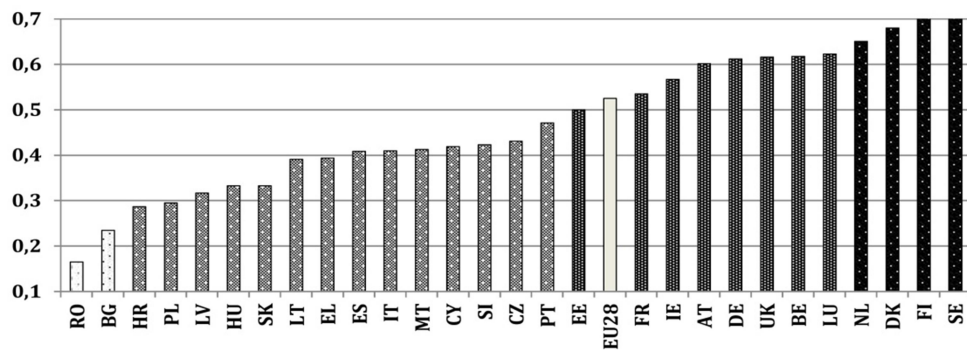
Figure 3: The four groups of EU-28 countries by their innovation performance (SII 2018)
Source: Chart made by the authors using MS Excel, based on data published in EIS 2019

A similar structure at EU level can be noticed for the 2017 year (Figure 4).
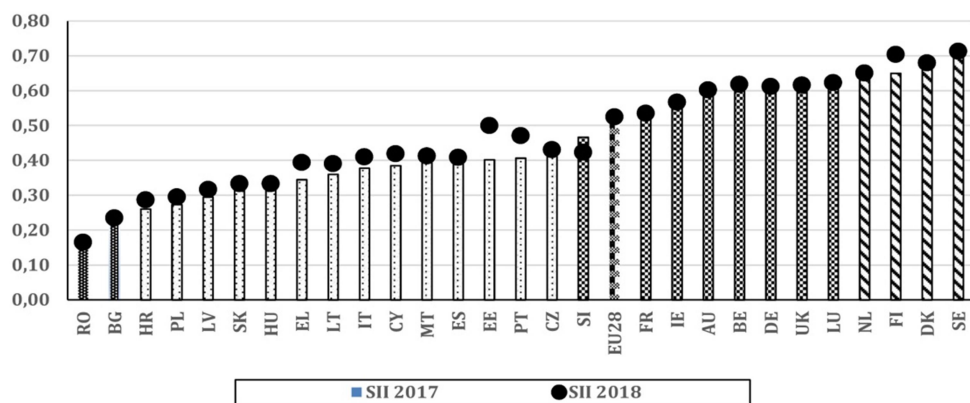
Figure 4: The EU-28 countries by their innovation performance (SII) in 2018 vs. 2017
Source: Chart made by the authors using MS Excel, based on data published in EIS 2019

It can be noticed that the Innovation Leaders are also leaders in ICT Development terms (see Figure 5), and the Strong innovators follow them.
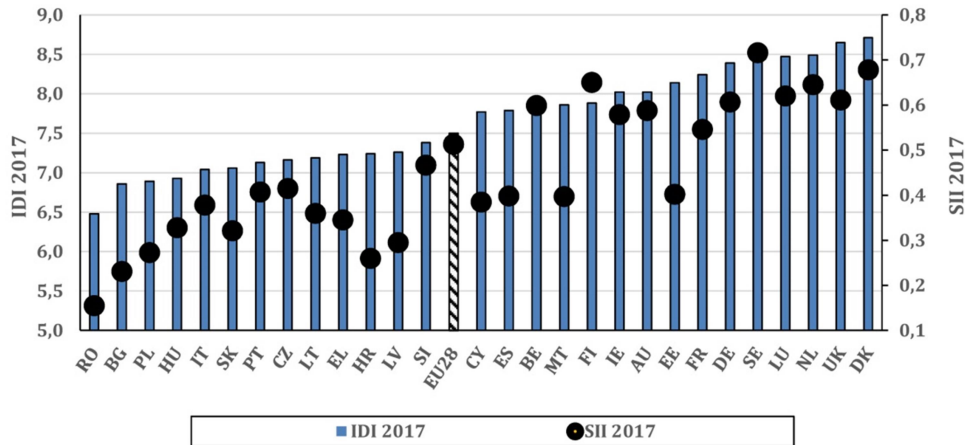
Figure 5: Comparison between the IDI and SII indicators for the 28 EU countries in 2017
Source: Chart made by the authors using MS Excel, based on data published in EIS 2019 and MISR 2017

Strong innovators register high values in ICT. On the other hand, the Modest innovators, Romania and Bulgaria register modest results in ICT as well. This observation yield to the question: are the two indicators linked together? How strong is this link? In the next sections we'll try to describe this relationship.

3. *Regression analysis between Innovation and ICT development for the EU-28 Member States*

The relationship between Innovation and ICT development is obvious, as Figure 5 shows. But how strong is it? We tested this linkage using a regression analysis at national level between SII and IDI.

It has been verified that SII and IDI indicators in the year 2017 for the EU-28 Member States follow a linear regression model:

$$SII = 0.22 \times IDI - 1.20 \quad R = 0.88$$

Figure 6 shows the four groups of innovators and their ICT development levels. The correlation coefficient R=0.88 proves that there is a strong link between the two indicators in 2017. This linkage is not accidental – the second analysis will use historical data from the last 7 years (see Table 3).
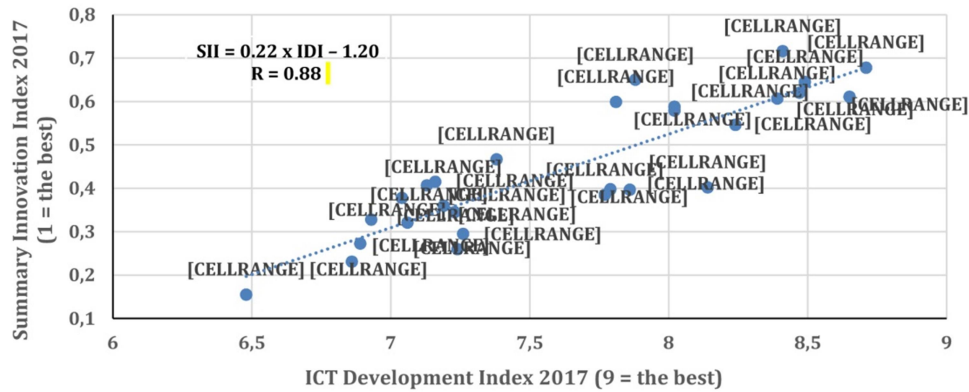
Figure 6: Correlation between SII 2017 and IDI 2017 indicators for the EU-28 Member States

Source: Chart made by the authors using MS Excel, based on data published in EIS 2019 and MISR 2017

Table 3: Correlation between SII and IDI in the period 2011-2017 at national level, for the EU-28 countries

Year	2011	2012	2013	2014	2015	2016	2017
Correlation Coefficient	*0.85*	*0.88*	*0.87*	*0.89*	*0.85*	*0.89*	*0.88*
Slope	0.18	0.16	0.17	0.19	0.20	0.20	0.22
Intercept	-0.82	-0.74	-0.79	-1.00	-1.12	-1.07	-1.20

Source: Computed by authors, based on data published in EIS 2019 and MISR 2011-2017

The correlation coefficient for each year shows the existence of a strong link between Innovation (measured by SII) and the ICT Development (measured by IDI).

5. Conclusions

As statistical data has shown, innovative countries have remarkable results in ICT, while regarding modest countries in innovation, there is a gap even in ICT. Therefore, a natural concern is to investigate if there is a relationship between the two characteristics and how it can be described.

In recent years, the authors of this paper have investigated this relationship and the results have been promising: there is a close statistical correlation between ICT and innovation, at the global level of the European Union, but also at the country level.

Different indicators were used to test the working hypotheses: Networked Readiness Index (NRI) as a measure for the absorption level of ICT, and, respectively: Summary Innovation Index (SII) and Global Innovation Index (GII) for the innovation degree.

In this article, the indicators used were Summary Innovation Index (SII) and ICT Development Index (IDI). The tests used most recent available data and historical data, and they confirmed the linkage exists and has a similar structure for the last 7 years.

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IINTEROPERABILITY OF MEDICAL DATA FROM CONCEPT TO APPLICATION

Madalina Elena RAC-ALBU[1]

Abstract: ***Nowadays,*** *interoperability of medical data is a very important issue, when mobility is the key factor of developing a robust economic system. This article presents a proposal of an interoperable medical system and underlines the advantages of this system. Furthermore, an application based on the above presented interoperable system is also detailed. In order to achieve an interoperable medical system, there are two main important goals that must be fulfilled. The first one is to have all medical records gathered in an electronic information system. All the hospitals or other healthcare providers must record the medical data electronically and accept to share this medical data with other medical systems. The second goal is to have a similarity standard when gathering these medical records. This means that standardisation of medical record is a must in order to achieve interoperability.*

Keywords: *interoperability, medical data, electronic medical data, standardisation, HL7, interoperable system, healthcare information system*

1. Introduction

Interoperability represents the ability of two or more computer systems or components to exchange information and use the information that has been changed [1]. *In the medical field, interoperability* is the ability of different information technological systems and communication software applications to exchange data and use the exchanged information. Changed data layouts and standards should allow data sharing between clinicians, laboratories, pharmacy hospitals and patients regardless of the application provider [2].

Through interoperability, the medical data is securely and correctly shared with specific architectures, using international standards accepted in all medical fields, including with the owners of this data.

The interoperability of the medical data aims to obtain better quality health services, as a result of the correct and rapid information of the medical service providers (doctors, etc) regarding all the medical data of his patient, which ultimately leads to making a correct medical decision in a shorter period of time. Obtaining interoperability in the medical field is a goal that is currently not fully

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achieved in any country, it is currently implemented in various stages, depending on the degree of economic and informational development of each country. Internationally, huge efforts are needed to achieve the interoperability of medical data, which translates into high costs. Currently, there are difficulties in integrating health information systems, either because of the large number of system and technology providers, or because there are many programs used to exchange clinical and administrative information between applications within the same organization, as well as the fact that each application can support multiple communication interfaces that need constant maintenance and updating [3].

Why do we need interoperability? Achieving interoperability between heterogeneous health information systems is very important, as it reduces the associated health costs and contributes to more effective treatment of patients.
So, the benefits of medical data interoperability consist in:
   • increasing the efficiency of medical and administrative personnel;
   • elimination of redundant data from the system;
   • streamlining the process of providing medical services;
   • avoidance, to a very large extent, of medical errors;
   • obtaining important information for doctors by conducting research with modern machine learning or deep learning techniques, information that may represent future diagnostic methods or correlations between previously unknown medical data. This actually means advancement in medical research, so a better future in treating patients;
   • producing reports and statistics at local or national level regarding the health status of population at a given time.

Looking ahead, the development of medicine and future patient-care technologies will surely require a great deal of information that will need to be rapidly exchanged between existing IT systems, which is easily achievable through interoperability. In order to achieve interoperability, we should talk about standardization. Without the existence of standardization, it is impossible to achieve interoperability in the medical field. This is the key element that can make interoperability possible both in Romania and between Romania and the rest of the EU member states.
What does standardization of medical data represent and what standards are available in order to achieve interoperability of medical data? The standard is a technical document designed to be used as a rule, orientation or definition. It is a consensual built and repeatable way of doing something [4]. The standards used in the medical field include methods, protocols, terminologies and specifications that are used for the collection, exchange, storage and retrieval of medical information, EHR, medicines, radiological or other medical imaging, patient monitoring devices, etc. There are also standards used for administrative processes in the

health field (billing, payment, reimbursement, etc) [5]. There are four types of standards of medical data [6]:

- Content standards - these refer to the medical documents, to the content of the data in the exchange of information. They define the structure and organization of the content of the electronic message of the documents. They also include the definition of common data sets for certain types of messages. Examples of such standards are HL7(Health Level Seven) v2 and HL7-CDA (Clinical Document Architecture)

- Transport standards - these refer to the format of messages exchanged between different computer systems. Examples of such standards are: HL7, HL7-FHIR (Fast Healthcare Interoperability Resources) and DICOM (Digital Imaging and Communications in Medicine).

- Terminology standards - these are based on sets of codes, qualification systems, structural vocabulary and terminologies used in medical fields. Examples of such standards are: LOINC (Logical Observation Identifiers Names and Codes), SNOMED-CT (Systematized Nomenclature of Medicine-Clinical Terms), MEDCIN, ICD-9/10 (International Statistical Classification of Diseases and Related Health Problems), RxNorm, etc.

- Security and confidentiality standards - Confidentiality standards refer to the protection of the patient's rights. He has the right to know if, why, when, where, by whom and for what purpose his medical data is collected or used. Security standards define a set of administrative, physical and technical actions to protect health information. There are therefore two types of standards, the first are the HIPAA (Health Insurance Portability and Accountability Act) Security Rules, and the other are security standards (ISO, COBIT - Control Objectives for Information and Related Technologies, HITRUST, NIST - National Institute of Standards and Technology and CIS-Centre for Internet Security) and technical security standards (ISO 27001).

HL7 is the standard that is generally used all over the world and in all types of medical systems. This standard creates the framework for the exchange, sharing and use of electronic health information. They define how information is "packaged" and exchanged from one system to another, determining the language, structure and types of data needed for seamless integration between systems [7]. The HL7 standards define a series of messages that cover all the activities specific to the medical units. An HL7 message is made up of segments, domains, components, and sub-components and is characterized by the message type (a 3-character code). The types of messages are organized on different domains (for example: admission, discharge, transfer, scheduled clinical studies, etc) [8].

Interoperability of medical data can be obtained by using Electronic Health Records (EHR). For every medical services provider, in now days, there is an

information system, where medical data are captured and stoked, but this information system is closed and it cannot communicate to each other if they are not designed to do that. This information system is called HIS (Hospital Information System) and there are many ways to make them interoperable, but in order to do that, we must take in consideration using the interoperability standards for documents and other medical information (images, etc).

2. The design concept of an interoperable system

At a national level, interoperability of medical data represents the ability of a national health information system to interchange medical information in every medical field, such as:

• Interoperability with medical equipment that captures (generates) medical information (for example- EKG, MRI, etc);

• Interoperability with the 112-emergency assistance system;

• Interoperability with the system of drug suppliers (pharmacies);

• Interoperability with the courier system that can quickly and efficiently provide the necessary medicines to immovable patients;

• Interoperability of medical information by creating medical social media portals for physicians, where they can access the latest medical news presented at congresses, studies, updated medical guides, etc.

In Romania was implemented a national information system Unique Integrated Informatic System (UIIS) and this system is functional and has three main branches: Health Card, Electronic Prescription and EHR (Electronic Health Record). This medical information system referees only to public healthcare providers [9].

For private medical providers exists only separate medical information systems, but they don't communicate to each other.

An interoperable system in medical health field, both private and public, can be achieved only by creating a private medical information system, which can be interoperable with UIIS (Figure 1).

This scheme represents a vision of the interoperable IT system that includes all health care providers in Romania. In the public health environment, there is an already implemented information system at national level as it was presented above. The proposed system provides interoperability with pharmacies (including drug stocks) and presents the way in which the flow of medical information, although in the private health environment there is nothing, no steps or premises

from which to go in order to obtain interoperability, however, the two environments of the healthcare providers are presented in Figure 1 as interoperable.
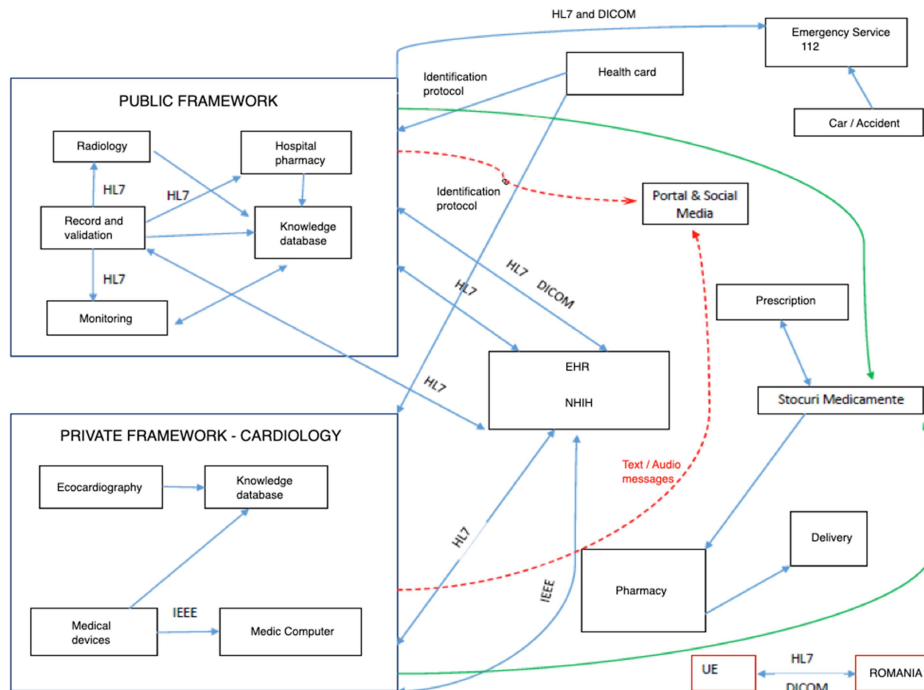

Figure 1: An interoperable system at a national level.

It is the general scheme of an interoperable medical informatics system that could facilitate medical services in Romania. Also, at the level of the pharmaceutical field it can be very easily obtained(as can be seen in the diagram) with the help of interoperability both the supply of the necessary medicines and the transmission by courier of the necessary medicines to the patients, right from the moment the prescription was written in the cabinet doctor's cabinet. This interoperable system allows the patient to receive the medicine at home immediately after writing the prescription through a single agreement on the price of the prescription drugs.

This approach brings the following advantages:

• Reduction of data transfer time between private offices and / or hospitals;

• CNAS (National House of Health Insurance) has the possibility to reduce the errors of the increased medical data;

• Standardized communication - the same ontology as other medical entities in the EU;

• The security of data secrecy by using the proposed system;

• The possibility of eliminating any possible clarities regarding the medical decision making by using a portal or the services offered by the social media for doctors;

• Creation of a central area of stocks in which all pharmacies participate, and to which all medical units that issue prescriptions are addressed, developing an alert system regarding the medicines that can be delivered directly to the patient, if he wants this service;

• Use of interoperability for the exchange of necessary data within a hospital unit as well as with medical devices that generate information about patients (examples: MRI, Tomography, Ultrasound, etc);

• Transmission of medical data and video images in real time from the ambulances serving the 112 service, to the hospital units, absolutely necessary in making the medical decision and sending them to the ambulance, in order to be implemented by paramedics in the shortest time;

• Obligation of the standard implementation, on any type of manufactured car, of an alert system to the 112 service in case of a collision.

Romania is an European country and breaking it out of this European context is impossible nowadays, when Romanian citizens are also European citizens. That is why the interoperability of medical data with Europe is as necessary as in our country. Interoperability at European level involves solving certain issues related to ethics, security, utility, etc [10].

The model of interoperability of medical data with EU Member States can be realized by using Point of Single Contact (PSC); medical data (provided by public hospitals) can be easily exchanged between EU countries (starting December 2009), all EU countries being invited to implement this PSC. The Point of Single Contact is actually an online platform where economic agents from all European countries can find the information needed to carry out any economic activity in that country. PSC's are e-government portals for businesses operating in the services sector.

Starting from this idea, we can use the PSC to achieve the interoperability of medical data between European countries. As it can be seen even in the definition on the PSC website, it is addressed to the companies that operate in the field of services. Health is a vital service for any society, so the PSC can be easily adapted to enable the interoperability of medical data [11].

To finalize the proposal of an interoperable system with the concept of one completely interoperable medical system it is necessary to involve the Ministry of

Health, where all this concept can be fulfilled. As it can be seen in Figure 2, this ministry must be in the centre of this concept.
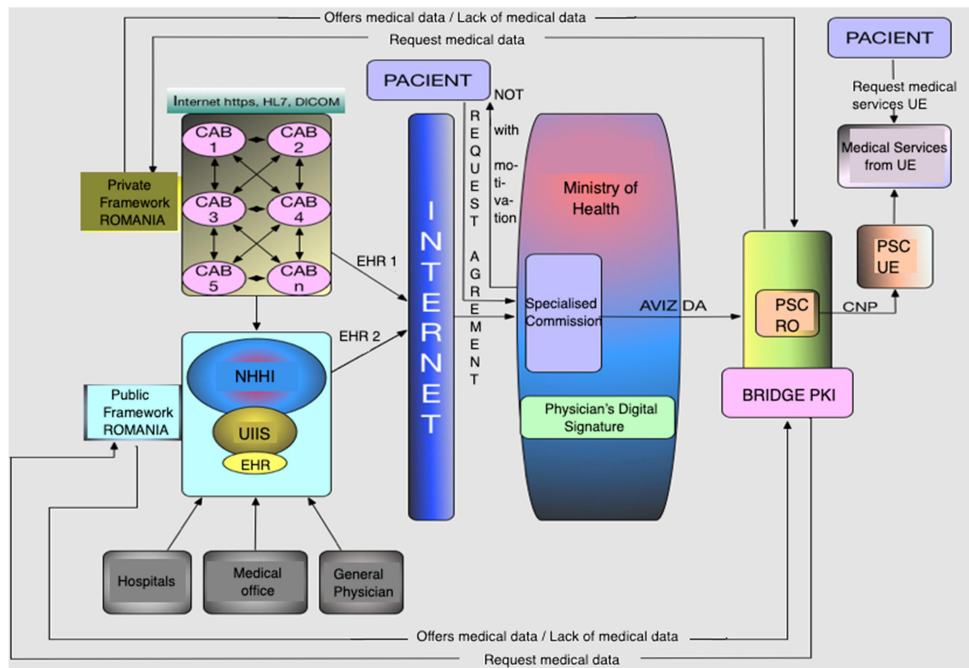

Figure 2. The concept of a fully interoperable medical system

At the PSC RO level, the aggregation of the medical data from the two sectors: EHR1 and HER 2 is done, in order to be able to be accessed by the medical clinics in Europe through the PSC.

Both sectors communicate via Internet with the Ministry of Health which is the top forum at which the qualified electronic signature is performed by the doctor, this being the most efficient way of authenticating and identifying all participants in the elaboration of the two files related to any patient highlighted in Figure 2. Medical files who reach the ministry will have to be signed by all the participants at the medical in a hierarchical order.

At the ministry level there is the Specialty Commission that can analyse and approve the medical applications of the Romanian patients who need medical care performed in medical units from other European states (example: a surgery that cannot be performed in Romania). This commission has the role of requesting all the medical data necessary to make the decision to approve the transfer of the patient. After analysis, the commission's response to the patient may be affirmative or negative. In case of negation, the reason for this should be clearly explained. In

conclusion, the patient submits the request online and receives the answer all online, without having to move it with all the necessary medical documents.

After the medical file has been notified, it reaches Romanian PSC (Figure 2), where all the medical files related to a patient will be aggregated (those from the public and from the private health). From PSC RO through VPN the aggregate file will arrive in Bridge PKI (the Bridge PKI system in Romania contains its own signature which marks the validated or invalidated documents to clearly determine who did the verification of the qualified electronic signature) where the RO file is signed, further by SSL transfer the file reaches PSC IT (Italy) where the RO signature is verified by STORK (Secure Identity Across Borders Linked) and the file is accepted or not. STORK is a platform used to achieve the interoperability of existing European IDs [12].

The exchange of personal data (by transfer) implies, first of all, the ability to understand the significance of this data in all the countries (14) covered by this program. STORK is a European project dating back to 2009, which guarantees that data can be used correctly and safely in the country of destination, allowing a European citizen to register for a service first and be able to authenticate later. This protocol describes which common functionalities will be implemented, the functionalities being specified for each Member State, as well as the links between them, as well as the way of obtaining the interconnection of the interface between the common parts and the specific parts. For European data transferred at European level, this European project can be adapted and used or other ways of pseudonymizing the data can be found, using European standards in this regard or by designing an interoperable system to provide this facility. If the file is approved, it will go directly to the medical unit that made the request in the first instance, the medical unit where the patient for whom the application is made is located [13].

3. Application proposal in order to create an interoperable system

For the private medical environment, an interoperable system has a unique purpose: *the secure transfer of all types of data between all participants in this system.*

Data transfer within the system between any two entities participating in the system is performed using specific technologies for machine-machine communication.

As a practical implementation, the subsystem of the private medical field in Romania was chosen. Here there is no interoperability of the medical data and a computer application was created to demonstrate the benefits of interoperability for this subsystem.

This application has in the centre a Central Authority (CA), where are enrolling all the participants of the system: *patients and healthcare providers (Medical Units-MU).* When the participants at this system are enrolling in CA they are offering all

171

personal data, and the system will assignee to each participant a code. This code provides the acceptance in the system and the identification of the participant. The personal data of the participants are stored in the CA database, and the medical information are stored at every medical services provider database. So, when the medical data are interchange, they will not carry the personal data of the patient, just his ID, which is different for every medical unit that is enrolled in the system [14].

This application was created in Python, and has two logical levels: Backend and Frontend.
The Backend part consists of the following modules:
• the database module (as PostgreSQL database was chosen)
• level of data abstraction
• the level of business logic.

The Frontend part is composed of the following modules:
• the module / level of data communication within the subsystem;
• the module for the web services that make possible to communicate the data between the various actors;
• Application module (fully developed).

Thus, the application will contain for each participant in the system the frontend part as well as the backend part (for the central authority and the medical offices).

In the CA the patients are registered, as well as the medical units. This module defines the participants in the system and will automatically generate a unique identity, with which each of them will be recognized by the CA.

Thus, in the Frontend part of the CA, patients have access to view their personal medical information as well as all the actions taken by a MU. The information that is viewed by the patient when he / she has been authenticated in the system with his / her credentials the following:
• the date and time when he was admitted in a MU;
• the unique code that is automatically assigned by the system when enlisted. This unique code is only known to the patient and the CA;
• the private cabinets / hospitals where the patient requested medical services;
• the medical investigations that the patient has been benefited from;
• the status of medical information (approved or rejected by the patient). Any request to view the patient's medical data must be approved or denied by the patient in order to protect his medical data.

In the BACKEND part of the Central Authority, it is possible to enrol patients and medical offices and to automatically assign unique codes that give them identity in the system. This approach complies with the BPMN scheme for enrolling a medical unit in the system [14].

172

Once logged in, the system administrator will have access to the administration part for groups and users.

The authentication and authorization part refer to:

• creation of user groups based on criteria established by the CA (cardiology cabinet group, group of patients who have had a heart attack);

• adding / deleting groups;

• enrolment of users (which may be patients or MU). Given the complexity of the system generated by the large number of patients, it is preferable for this enrolment to be made at birth by delegating this responsibility to the system administrators within the maternities. An example of registered users in the system can be seen in Figure 3.

Figure 3. Visualising the participants of the system.

This application was created in Romanian language and Figure 3 is just one example of the layout of this application.

The medical information flow depends on *requests for medical data*. In the Backend of CA, the medical data requests are displayed having a unique code generated automatically by the system, the MU where the data was requested, the patient for whom the data were requested, and the status of the request. It can be approved by the patient or waiting to be approved by the patient. It also can be seen what kind of documents were requested, their unique code, their status, the cabinet from which they were requested and the patient to whom the request is allocated.

The basic rule of CA is to not be involved in the medical system. So far, there has been no more interoperable medical information system, which does not allow the physician to know the patient's identity, to keep the patient's personal data in a location other than the one where the medical data is, which complies with all the required data protection regulations implemented at European level.

This interoperable system allows absolute control of the flow of medical data, the transfer is made automatically, without the involvement of the human factor and without focusing on this. The medical documents are created identical as a structure for all patients of a medical specialty, being able to be improved whenever the doctors in the offices of the system are needed.

Regarding the medical offices, in the proposed model, a medical unit is any healthcare provider that offers health services to patients, services that are not settled at the Insurance House, regardless of whether these are called hospitals, medical analysis units, cabinets dentists, medical imaging centres, ambulances or any kind of medical services in the private health system. Moreover, in this system, the pharmaceutical units can be integrated, although they were not introduced in the designed model; this step can be easily carried out, the pharmaceutical units being treated in the system like any medical office.

For medical units there is, as in CA, a component of FRONTEND and one of BACKEND.

For FRONTEND component, the user can only be the doctor from the respective medical unit that consults the patient. Doctors who can access this system receive a username and password when entering a practice. If a doctor works in several offices, he will have a different username and obviously a different password for each practice. This distribution of physicians is beneficial for both the system and the patient, who can thus find out which doctor consulted him and which medical data were acquired, shared or viewed.

After identification, the doctor can only see patients consulted by a code. He does not know to which patient the medical data belongs to. There is also a field where you can pass the patient code to be consulted. This code is entered by the patient or can be done by a card scan, or by a phone application that allows the patient to be identified in the system. The doctor does not know the patient's personal data, whatever the method of entering the code for access to the system.

Each request for medical data automatically receives a unique identification number of the request and the patient can view all requests for data that have been made, as well as the date and time at which they were made and at which office they were requested. After approval, the data requested by the doctor appear in the frontend MU1. Before the data will be transferred, the system needs the approval of the patient. After the approval, the system sends requests for those specific

medical data needed for the patient, to all MUs, and automatically MU1 will receive the data needed if they are available in any MU even MU1.

At the end the doctor can visualise the medical data needed and they will automatically be deleted after.

4. Conclusion

The application of the proposed interoperable system is a small part of a national informatic medical system that was presented in this article, but it can be a viable solution that can be adjusted in order to be completely viable. The benefits of this application consist in:
1. Sharing medical data in the system - the possibility that the patient's medical data can be viewed and used at any time is needed
2. Existence of multiple databases in which the medical data is stored; the medical data is dispersed to each medical service provider that a patient uses at a given time
3. Continuous completion and updating of medical information in real time - once a patient is consulted by a doctor, his/her medical data is automatically stored in the database and immediately visible in the system (of course with the patient's agreement)
4. Easily create reports at regional or national level regarding population health parameters at a given time - medical data can be used to obtain medical information at macro or micro level
5. Use of artificial intelligence for medical research and for establishing trends (prognoses) regarding the medical pathologies studied using the medical information from the system
6. Reduce costs for medical services for both patients and the national health system by accessing existing medical information, without having to repeat the same investigations in the case of a second medical opinion
7. The possibility of a correct prevention based on concrete medical data on different pathologies.

Additional advantages of the proposed interoperable medical information system:
1. It offers the highest degree of anonymization of the medical data that is the object of sharing in the medical system
2. The European regulations regarding the protection of personal data are fully respected, even by designing the system
3. The security of the medical data is obtained by clearly separating the two basic components of a system: personal data and medical data
4. The personal data of the patient are stored in a different location from the medical data, without a visible correlation between them
5. Due to its design, the system itself has the role of protecting the patient and his personal interests

6. The patient is the only entity in the system that has access to all the information. The doctor, the Medical Unit or the Central Authority, each have partial access to patient information or medical data.

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IMPACT OF 5G TECHNOLOGY IN GLOBAL ECONOMY. CYBERSECURITY AND LEGAL ISSUES

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Abstract: *5G technology is nowadays seen as a step in the category of "revolutionary" steps in humankind history, related to the industrial and communications environment. This ubiquitous term now signifies the evolution of the industrial technologies that changed the face of the world through the introduction of new concepts on large scale industrial processes: printing press (15th century), steam engine (18th century), electricity (18th century), telegraph (19th century), the internet (20th century). The 5G tech, while not revolutionary in concept, is a complete game-changer in terms of enhancing previously available capabilities. The speed and amounts of data that can be reached and transferred would be enormous. As we see and live through an interconnected future, the focus on cybersecurity must increase exponentially. As more and more devices will be linked to the global network, will upload and download data through 5G connections, all these connections hold a very dangerous potential for being hacked and this exposing sensitive or even vital information to unauthorized people.*

Keywords: *5G, digital economy, cybersecurity, digital human rights*

1. Introduction

The 5G term has now become almost a mantra for all the foreseers of the interconnected future. It seems that everything will be solved by deploying and using the 5G world-wide network – the fields of communications, automotive, energy or even medicine will greatly benefit this technological upgrade. There are a few steps in humankind recent history that are considered milestones for general purpose technologies. These steps have triggered huge changes in the social landscape of their respective era, establishing completely new ways for different areas of life. Among these milestones we consider: the printing press that changed knowledge spreading around the world, the steam engine that modified all the transportation habits of humankind, the electricity that became impossible to live without, the telegraph that started the long-distance communication systems and, of

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course, the ubiquitous internet that we cannot exist during the 21st century. The 5G technology we consider worthy of staying in line with there game changers. Even though the 5G is not an absolute newcomer but actually an upgrade, its huge improvement over the predecessor 4G will absolutely trigger a new era for interconnected devices – a real implementation of the already widespread term of Internet-of-Things (IoT).

The plethora of 5G improvements are of course very, very important and bringing lots of new and existing possibilities but, on the other hand, there still stand some doubts related to the security and legal issue that might arise within this changed electronic landscape. While we will be able to interconnect huge amounts of devices, send and receive huge amounts of relevant data in a very short time, take advantage of different opportunities in a nick of time, we must think of the fact that all these data might be susceptible also to unauthorized access. The huge amounts of data we will be able to receive and process might not only give us a full view over a certain topic but also bring new challenges related to personal data collection, processing and storing.

2. The 5G environment

This 5G concept is actually, quite unspectacular, baptised as an augment of the 4G mobile connection (which had among its predecessors the plainly named 3G and 2G). The technology has seen its first real-life implementations during 2018 (with pre-5G, not standardized deployments starting even from 2011), has continued to spread in 2019 and is expected to explode world-wide during the 2020-2022 interval. The 5G implementations will deliver consistent speeds of at least 1Gbps for mobile data connections, a number that is more than suitable to sustain applications which were not usable in such remote-access scenarios. The self-controlled vehicles (autonomous or semi-autonomous) and the IoT devices will finally jump to become real game changers for the society we live in.

Of course, the technology companies are always trying to market new revolutionary names and techs, for normal commercial reasons. Besides this scenario, the 5G really has the potential to deliver on its promises, becoming the most important transformational concept in the IT communications. It will not only deliver a faster and improved mobile connectivity for the existing scenarios, but it will also offer ultra-connectivity between different devices, persons and applications, increasing both quality of life and industrial capabilities. The greatly improved reliability, together with the lower latency values, will greatly benefit the IoT applications and enable the definitive switch from the wired to wireless industrial environment. The smart-phones will be accompanied by a new breed of smart-cars, smart-drones and other more or less mobile "things" that will benefit from a cloud brain that will deliver its computing results over the network path.

We consider that among the first industrial areas that will adapt, adopt and then embrace the 5G mantra, are transportation, utilities, health, retail, manufacturing and construction. The dream of a fully reconfigurable factory, time sensitive machines, very high-mobility robots, automatic interconnection of moving parts, fully automated transportation is on the verge of becoming reality. Even the long-waited or dreaded, depending on the point of view, Artificial Intelligence controlled big systems will become a target easier to achieve.

Usually, in the field of data communications, something better means actually something that is faster. The wireless data transmission 5G refers to actually work over a certain range of radio frequencies. These frequencies are actually limited but the 5G technology uses an algorithm to aggregate different frequencies (bands) in order to obtain a cumulative bandwidth greater than 1 Gbps. The transfer of data within a 5G network will go around a "super-highway" – a way to hugely improve not only the speed for one device streaming a certain set o data, but to all the devices streaming the same data in the same time. This concept will actually give the possibility of tens or hundreds of thousands, even millions, of devices being interconnected in a certain physical area.

Taking into account an estimation by GSMA [1], in 2019 there were more than 5 billion mobile devices connected to the internet. All these devices require reliable, fast and secure connections in order to provide the services they were intended to deliver. We do not to think only about laptops, mobile phones or tablet in this respect – a huge array of wireless sensors (gas/electricity/water readers, positioning systems, automated industrial controllers, camera recognition access controllers etc.) must also use the internet. All these internet devices are forming the IoT world.

Fig.1 - The 5G future diagram[3]

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[3] Source: https://meridiancoms.com/new-5g-network-coming-soon/

Among the new technological features boasted by the 5G concept we have already mentioned two before:
- Reliability
- Low latency

The lower latency characteristic refers to the time needed for a full round-trip of data, between a request is launched and an answer is received. The present latency level of the 4G data networks is around 100ms. The 5G offers an impressive improvement of no less than 10 times, providing an average latency of no more than 10ms (and even lower). This lower latency means that the dreaded "lag" met during a video conference, the lack of fluence when watching video content or the delayed response of a remote sensor controlled system will become a thing of the past. This low latency capacities are already target for fast and large-scale developments of applications in fields such as:
- Drone management
- VR and AR (Virtual and Augmented Reality)
- Remote sensors
- Remote medical surgery
- Industrial level automations
- Military real-time applications

To provide a very easily understandable example, we can think of a video file with an 8 GB size. In the best-case scenario with a present 4G mobile connection we could download it in around 7 minutes. The same file might arrive on our device in 6 (six) seconds with a modern 5G mobile connection [2] … almost an instantly available result for such a size.

Another huge advantage brought by the 5G technology relates to the positioning of the connected devices. Places with a lot of people gathered together (actually connected devices are the important thing for us at this time), like during special events for example (games, concerts, airports, public squares, aulas etc.), can bring down the current 4G networks quite easily. The 5G mesh provides a stable and fast mobile connection for everyone present in the same area, without anybody being left out, missing connection or having very limited speed.

3. 5G Hardware

The 5G technology is a great feat of technical prowess – no doubt about it. But the technology needs a champion to fully perform as the IT analysts predict. We should remember that the touch screen handheld devices were invented prior to the iPhone but almost everybody consider the iPhone as the game changer in this field.

For the technology to reach its full potential it has to be embraced by the vastest majority of users, not only the high-tech enthusiasts or the highly expensive and rare pieces of equipment. Most of the top companies in the filed of smartphones already presented 5G enable devices. Countries like South Korea already deployed a large-scale network of 5G infrastructure, other big players in the field, like USA

or Great Britain have deployed 5G infrastructure to highly populated zones and will continue the rollout during the next years, even smaller countries like Romania have their eyes set on the 5G large-scale deployment starting in 2020. But truth be said, by combining these things we can only argue for an evolutionary step in communications and for a revolutionary one. 5G will for sure bring "faster anything and everything" compared to today. The smartphone is today the ubiquitous companion which never leaves our side, which has to be tended and charged permanently, which keeps us up to date with everything in both personal and work areas. But we do not think that the smartphone is capable of sparking the 5G revolution. On the present category of devices there is actually nothing completely new that can over-excite the users. The 5G will bring lightning-fast downloads, 4/8/X K movie streams watched online but all these are just augmentations (smaller or bigger) of what we can already accomplish today. We need a new idea, an iconic device that can shake the world and bring real and unique value to the usage of 5G mobile communications.

As Jasmeet Singh[4] said "When we've spoken with consumers who carry the latest smartphones today, and you talk with them about 5G, what these users are saying is that the current form factor and feature sets cannot take advantage of the promise of 5G".

Maybe we did not even think of the best way to take advantage of the 5G potential. The technology enables new possibilities to connect data way beyond watching different forms of information on a beautiful screen. One of the possible game changers might actually be a reload of a discarded project. Those who remember the Google Glasses will probably remember that, besides the security and privacy issues, the equipment was actually not capable of really delivering some revolutionary experiences… at that time. In 2020, based on a whole armada of almost instantly connected sensors, a Google Glass like device might become a science fictional all-around piece of hardware that can act as seeing glasses (with optical and digital vision improvements), augmented reality helper (giving us instant statistics/information about the subject or landscape we look at), navigational system, personal assistant, smart phone, access control identificator or remote view screen. We consider that the highest potential for a 5G winning device is now found in the augmented reality area.

4. 5G for computers

Yes, 5G is a mobile connection concept. Nevertheless, because of the speed it boasts, the reliability and the low latency characteristics (even though the latency of 5G is not yet similar to an optical or even copper cable) the 5G might enter in power into the realm of the computer networks located in defined geographical areas (MANs, WANs or even LANs). Because of the excellent speed of a 5G

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[4] Lead researcher at Ericsson electronics company

connection – which might actually surpass most older computer networks on cables not only relying on wireless solutions – we consider that a lot of companies might actually migrate to an environment more and more based on VPN (virtual private networks). If the speed of the connection would not be an issue anymore, the enterprise environment can expand to use the remotely build private networks (which by design inflict a speed decrease) as a standard practice. Entire LANs (Local Area Networks) can in fact migrate to a VLANs (Virtual Local Area Networks) which would provide a completely similar environment to a present-day LAN, but with computer nodes coming together from Bucharest, Singapore, New York or Melbourne.

Any future laptop or tablet would actually offer a better and more personalized experience when connected to the network through a 5G mobile SIM instead of the classical Wi-Fi. We should also mention that this fact is considered only through the prism of the quality of connection (speed, latency, overall experience) and does not take into account the economic side – the possible cost increases inferred by the acquisition and deployment of 5G enable devices and the 5G data plan subscriptions.
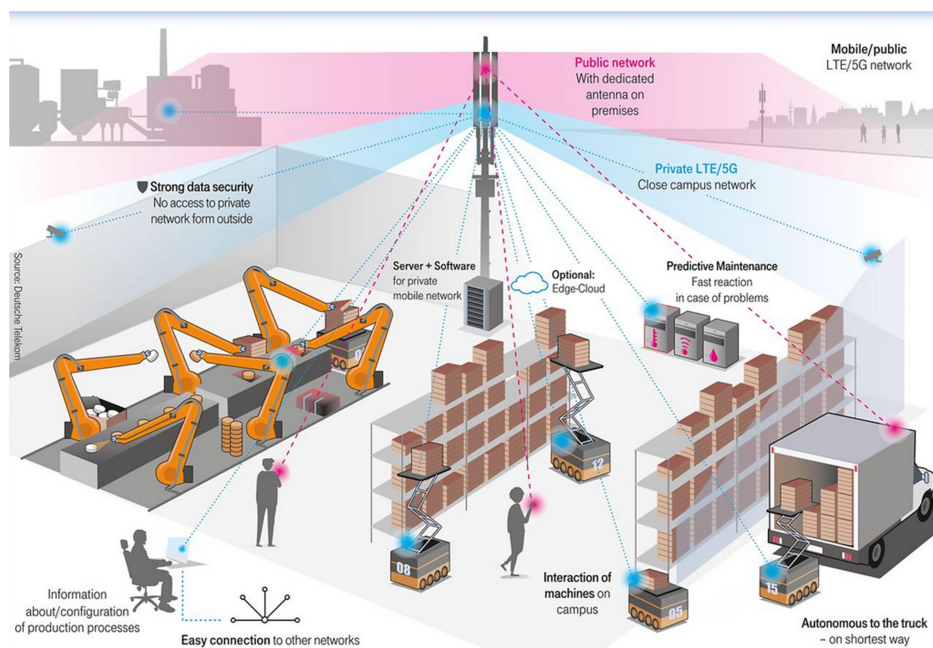

Fig. 2 – A diagram of an industrial interconnected area[5]

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[5] Source: https://www.telekom.com/en/company/details/5g-technology-in-campus-networks-556692

The 5G capabilities will also be used to develop and secure new industrial areas that might take full advantage of the 5G led opportunities. The present-day Wi-Fi (wireless) networks cannot actually meet the demands of such an intensively connected environment. The 5G capabilities offer features like huge bandwidth, very low latency and improved reliability. An industrial interconnected area is different from a normal public area which has to provide access to individual users. All the machines/equipment inside the area has to be connected and interconnected through wireless solutions and be able to get/send information in real-time. The current WLAN solutions are not enough for a mobile solution like autonomous transportation vehicles. The vehicles/equipment must be permanently and seamlessly connected to the network, otherwise they would have to "stop" and re-establish a connection each time they move into the area of another access point.

5. Economic impact estimates

By reviewing the latest reports of GSMA, the largest market (by far) for the mobile electronic world is the USA one. Most specialists in the field estimate that the end of 2019 will bring a total yearly revenue of around 280 billion dollars [1] for the mobile electronic field in North American (USA and Canada, but the biggest part comes from USA).

These huge numbers have pushed the North American operating telecom companies to forecast an amount of no less than 350 billion dollars to be invested in this field during the 2019 to 2025 timeframe [1].

The future use of 5G interconnected devices might also have a big impact on other economic and social issues of our present-day society. Perhaps the most important collateral advantage can come from the "eco" approach. The usage of large-scale remote sensors and the possibility to work/activate remotely, based on the benefits of 5G infrastructure, will help decrease the costs (in both financial and other resources terms) and reduce the pollution caused by transportation. This fact might help our society to make important steps towards a (closer to) 0-carbon economy that seems to have become the main target nowadays.

Further looks at the possible future economic trends that might appear based (primarily) on the widespread use of 5G mobile infrastructure let us summarize at least the following main areas that we consider having a very high probability of becoming real:

- Further consolidation of the telecom/TV/ISP businesses, with the largest companies becoming more and more capable of providing every type of connected service. The classical "cable TV" companies will have a hard time keeping their business afloat in the same conditions, as the wireless internet networks move to provide at least the same quality of experience as a standard cable TV can offer.

- The globalization (which seemed to stop a bit a take a break during the last couple of years) will come back strong, as the most important companies providing 5G infrastructure are actually quite few in numbers and they will have to integrate products all over the world. The Chinese Huawei, the Swedish Ericsson, the South Korean Samsung and the Finnish Nokia are in fact (and maybe surprisingly for most consumers) the only real solutions today. The legal issues faced by Huawei during the last years will have to end in one way or another, simply because the rest of the main producers cannot fill the market with enough infrastructure equipment instead of the Chinese company. On the other hand, even though the business is clearly a winner, any newcomer on this market would have to face huge obstacles in order to be able to compete with the established names (budgets for research and development, patent acquisitions, marketing, client trust etc.)

- Last, but not least, the hardware infrastructure will change the urban (mostly) landscape. The 5G technology allows for a change of implementation paradigm – from the very powerful 4G towers, covering large areas, to smaller and more efficient towers that consume/require way less power but also provide a smaller coverage area. According to TechRepublic[6] [3], the current estimate for urban areas that will completely move from 4G to 5G infrastructure shows a staggering ratio of 400 : 1 needed replacements, in the case of a standard large-area 4G tower being replaced with the smallest and most modular 5G tower. These numbers will of course bring a lot of issues but on the other hand, the very small size, low requirement regarding power and reliability of the new devices can help them to be integrated almost seamlessly inside any urban area. We will probably have 5G (mini)towers all over the cities, maybe one on every street, and even more on longer ones.

6. Security and privacy in the 5G world

Another set of issues which has to be very seriously watched, in relation with the 5G concept, are possible security issues, management of collected personal data and privacy concerns.

The 5G interconnected devices will be found in (just to name some of the most futuristic cases) autonomous cars, critical infrastructure and medical equipment. Imagine what can happen if an unauthorized person gets access to read or even control the device activity. Similar to catastrophic movies, we could actually see hundreds of cars colliding, power plants taken down from afar or murders done through a remote surgical procedure.

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[6] TechRepublic is a highly recognized community of technical blogs, forums, vendor white papers and published research results.
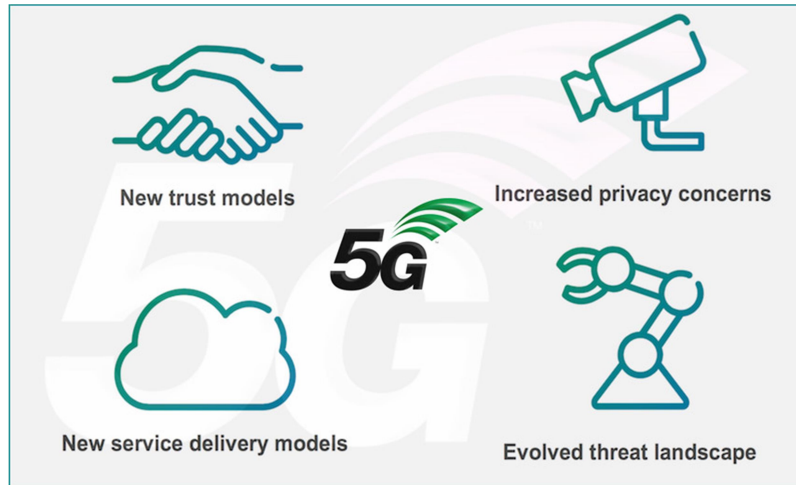
Fig. 3 – 5G specific security concerns overview[7]

The huge increase in sensors and other connected devices brings along an also hugely increased attack surface for the malevolent electronic experts. The delocalized computer networks and the heavy reliance on the "cloud", made easier and very comfortable by the 5G speed and latency, also bring a larger boulevard for any possible attackers to try an get a hold of unauthorized data/processes.

One of the best guideline directions we consider pertinent is to continuously require the software producers to implement individual security solutions built into their applications. The data transmission process (either 5G or previous versions) have their own security measures in place, of course. But, any (almost) simple process of encrypting data inside a certain application operational environment brings an exponentially more difficult challenge to any attacker. Basically, instead of having to "break" one security procedure (the 5G transmission for example) he has to tackle at least two (the second one being the encryption of the respective application). All IoT considered devices (sensors, automation switches, Wi-Fi plugs, Web/security cameras, smart TVs etc.) must upgrade their security protocols and/or internal applications. If they are to become the new surrounding reality, we must be (reasonably) sure that they do not bring more harm than good into our way of life.

Another very important aspect of 5G security defers on the well-known problem of the hardware infrastructure. The case of USA against Chinese Huawei company is of public news and many other countries have started to question the way in which

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[7] Source: https://www.bankinfosecurity.com/whats-riding-on-5g-security-internet-everything-a-10618

Huawei equipment operates. There are several governmental or private reports that show the results of different analyses made on Huawei networking equipment.

The most reliable report on such an issue comes from a widely known and first-grade player on the telecom market – Vodafone.

Between 2009 and 2012, several network devices used by Vodafone (primarily in Italy but in many other countries too) and bought from Huawei were found as having a security breach by being accessible through a possible backdoor based on a telnet connection [4]. The simple use of a telnet server inside networking equipment is not uncommon, as lots of manufacturers implement this for testing and remote configuration/access. What was uncommon it was the fact that Huawei did not mention this characteristic to the buyer Vodafone. While the first stage of this dispute might have been indeed considered as an error from Huawei and not a deliberate backdoor left on the devices, the internal Vodafone documents made public by the media show that the escalation of the issue almost surely point to a deliberate backdoor. At Vodafone's specific request Huawei updated the devices software/firmware in order to block the telnet access. A later audit made by Vodafone together with an external security company showed that in fact Huawei just concealed the telnet better, but it was still there and accessible! Because the manufacturer specifically answered Vodafone that the exact signalled issue was solved it is a clear case of lying from Huawei. One might argue for different causes, beside espionage-prone backdoors, of these backdoors: to difficult to create new firmware, to expensive to operate maintenance processes remotely at a later stage etc. But even in such a case, the security issue is huge and the "why" becomes almost irrelevant. The equipment has a backdoor and from the security point of view the cause is irrelevant – the possible damage has to be taken into account. Both Vodafone and Huawei, publicly at least, considered the problem solved at a later time and the equipment deemed safe after further updates. Anyway, Vodafone seems not to keen to rely on Huawei equipment for 5G infrastructure, even with the lowest market-prices for such components boasted (and real) from the Chinese company. In fact, at this time, Vodafone publicly restricted the use of Huawei equipment in the critical areas of its British 5G infrastructure to be deployed.

From a 2018 IMF report, countries which have a combined GDP of almost one third of the entire world have banned or restricted Huawei equipment for 5G infrastructure development. Romania has also agreed to a joint US-Romania memorandum in the field of 5G infrastructure development, a fact that might be followed by at least some restriction in the deployment of Huawei equipment in Romania.

Stance on Huawei	Percentage of World GDP
Ban in effect Australia, Japan, Taiwan and U.S.	**32.6%**
Likely to ban Canada and New Zealand	2.3%
On the fence Belgium, Czech Rep., Denmark, India, Norway, Poland, Sweden, U.K. and Vietnam	9.9%
Unlikely to ban Argentina, Austria, Brazil, France, Germany, Italy, Philippines, Russia, Singapore, South Korea, Spain, Switzerland and Thailand	21.6%
Embracing Huawei China, Indonesia, Saudi Arabia, South Africa, Turkey and UAE	**19.8%**
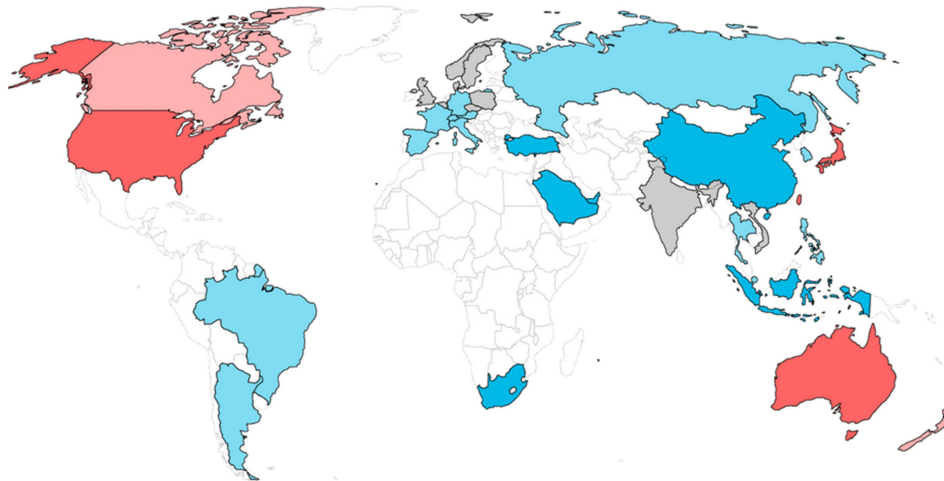
Fig.4 – Huawei stance in 5G infrastructure at world level[8]

Regardless of any governmental or international organization rule that might have to do this issue, we consider that, as a general rule, all companies/bodies involved in the development, deployment and maintenance of 5G hardware and software should abide by the following guiding lines:

-   The final users must be fully informed about the technical and practical aspects and given the possibility to fully control their connected devices
-   The enterprises should use an encompassing envelope as regarding electronic resources security, taking into account the levels of protections need for three different layers of the environment fabrics: users, devices and communication channels
-   Implement the highest possible security and data protection measures, keeping the amounts of collected data to the absolute minim (both from the point of view of quantity and retaining time). These measures must be

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[8] Source: https://www.bloomberg.com/news/articles/2019-04-30/vodafone-found-hidden-backdoors-in-huawei-equipment

constantly monitored and audited by both an internal body as well as an external, independent body
- Corporate responsibility and transparency must be in full accordance with all the requirements implied by respecting human rights.

7. Human Rights and the 5G environment

The 5G infrastructure will allow a lot more companies/individuals/bodies to collect and hold huge amounts of data. The human rights activists and the national/international bodies with legitimate interests in this field should already discuss with the governmental entities (or supra-state ones) in order to make sure that those entities fully understand what the challenges might be and how best to address them, from the point of view of respecting the human rights in this new social context.

Since 2011, Finland stated that internet connection is a right enforced by the law [5]. The intervention of the internet in virtually all aspects of modern life has led the society to even think of enlarging the human rights list with an item related to the internet [6]. During 2016 the UNHRC[9] made a first official step towards this goal, by publishing a resolution (even though without enforcing power) that condemns internet interruptions by national governments, arguing that the right to access the internet is similar to any of the other established human rights [7].

For the coming years, as we will most probably rely more and more on the connected universe based on 5G infrastructure, the right to internet access might become even essential. Unfortunately, over the last couple of years we have seen more on-purpose internet interruptions than during all the previous years, since the global network emerged. Countries like Turkey, India, Bahrain, Algeria and China have all implemented different restrictions based on political reasons. Even more, while the first countries from the above list usually restrict on temporary bases, China has a lot of restrictions and censorship rules that are permanently in place.

8. Conclusion

To sum up our review of 5G related issues from the point of view of the economy, security and human rights, we can conclude that the impending revolution has the main characteristics of a… real revolution. It might bring a whole new paradigm in place, with lots of advantages and new (maybe not even discovered) directions but also with a whole new plethora of possible issues to be addressed.
Our society must pay all the due attention to these issues, as not to waste a very promising opportunity to make a huge step forward towards an interconnected

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[9] UNHRC = United Nations Human Rights Council

future that might bring us closer to 20 or 30 years ago science fiction blockbusters. In the same time, if we keep to the same type of analogies, we might also end up in science fiction nightmare, similar to a dystopic universe in which hackers rule the underworld and the machines rule the formal society.

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THE RECESSION RISK FOR THE EUROPEAN COUNTRIES

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Abstract: *Each economy among European countries is a cybernetic system, characterized by several properties: it has agents that action by established rules, there are relations between agents, there is a feedback in the system and a small action that affect the balance of the system might cause a severe imbalance. Therefore, analyzing the European economy as a whole, composed by countries' economies, we can identify the answer of the question raised in the past few years: "there are signs of a new European economic crisis?". The aim of this paper is to analyze and compare European countries economies for the past 5 years (between 2014 and 2018) using HCPC methodology, in order to identify what country/countries change the class and if there are signs for recession or depression. The factor analysis (FA) is preferred for reducing the number of variables, Ward's method to identify the best number of classes and k-means for allocate each country to a class. The analyses show that there are signs for the start of a new economic crisis in Europe because of the spreading of a high recession risk.*

Keywords: *economic crisis, HCPC, Europe, 2020, cluster, hierarchical*

JEL classification: E32, C38

1. Introduction and literature review

The answer for the question: there are any signs of a new European economic crisis? Is a new challenge for researchers, because a direct answer is difficult to provide. The number of economic indicators that show the signs for an economic crisis increased and caused the difficulty of choosing the most relevant indicators. However, the problem of working with high dimensionality is nowadays possible using methods of variables reducing that help express more information in few variables.

The latest research is about the last economic crisis that start in United States in 2007. So, the "struck the European economies" (Pottier, C. and Delette, G, 2019) is the "first signal forecasting the evolution of the crisis was the downgrading of

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Greece's sovereign debt at the end of 2009 from A to BBB+ by the rating agency Fitch" (Pottier, C. and Delette, G, 2019). Authors suggest that what happened in Greece was a "phenomenon with unclear information that allowed various policy entrepreneurs to promote different explanations for the crisis in accordance with their interests". Knowing the start and the austerity measures that were considered, it is important to focus on what were the consequences of the crisis for individuals, because "this crisis resulted in higher inequalities and put a lot of people at risk of poverty" (Novo-Corti, M Isabel et.all, 2019). The authors use regression analysis and cluster analysis. They demonstrate that "labor market is key in promoting economic policies in order to achieve social sustainability" (Novo-Corti, M Isabel et.all, 2019).

Starting from knowing the history and details about the economic crisis, the recent one being started in 2009, it is possible to learn from the past and think forward to the new economic crisis because the cyclicality of economy. It is considered that the new economic crisis in Europe, "the world's second-largest trading market, would have ripple effects on the world's economy"[3].

2. Methodologies

The main methodology used is HCPC (Hierarchical Clustering on Principal Components) that is a methodology composed by three data analysis methods: a dimensionality reducing method (principal components analysis, factor analysis or correspondence analysis), an hierarchical clustering method to determine the number of classes (usually Ward's method, because it provides the best results) and an algorithmic clustering method (k-means in general).

In this case, we choose the factor analysis (FA). This method is similar to principal components analysis, a variables dimensionality reducing method that extract the essential information from data. The main purpose of the method is to extract a small number of hidden factors from variables, factors that are responsible for correlations between variables. The factor analysis results should establish the number of factors necessary for explaining the patterns between variables, the nature of these factors and the amount of specific variance taken by the factors.

On the other side, the unsupervised learning techniques used in HCPC methodology are the Ward's hierarchical method and k-means algorithm. Both methods have close solutions, but Ward is used here in order to identify the best number of classes (by dendrogram), while the k-means algorithm provides the class for each country. Although the number of classes suggested by dendrogram is advisory, it remains one of the most used criteria in choosing the number of classes.

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[3] https://www.barrons.com/articles/is-europe-ready-for-the-next-economic-crisis-51553901914

3. Datasets and results

The data selected represent 46 European countries and 17 macroeconomic indicators for the last five years: 2014-2018. For analysis, we did not keep all the countries because there are outliers' countries, so we had eliminated them. These countries are Azerbaijan, Bosnia and Herzegovina, Belarus, Cyprus, Ireland, Luxembourg, North Macedonia, Malta and Montenegro. The main source of data is the WorldBank website.

Table 3. Key macroeconomic indicators

Indicator name[4]	Indicator code
"GDP growth (annual %)"[3]	V1
"GDP per capita growth (annual %)"[3]	V2
"Inflation, consumer prices (annual %)"[3]	V3
"Services, value added (annual % growth)"[3]	V4
"Industry (including construction), value added (annual % growth)"[3]	V5
"Agriculture, forestry, and fishing, value added (annual % growth)"[3]	V6
"Foreign direct investment, net inflows (% of GDP)"[3]	V7
"Foreign direct investment, net outflows (% of GDP)"[3]	V8
"Employers, total (% of total employment)"[3]	V9
"Claims on central government, etc. (% GDP)"[3]	V10
"Commercial bank branches (per 100,000 adults)"[3]	V11
"Domestic credit provided by financial sector (% of GDP)"[3]	V12
"Domestic credit to private sector by banks (% of GDP)"[3]	V13
"Unemployment, total (% of total labor force)"[3]	V14
"External balance on goods and services (% of GDP)"[3]	V15
"Manufacturing, value added (% of GDP)"[3]	V16
"Trade (% of GDP)"[3]	V17

Analyzing the possibility of a new economic crisis in Europe, the choice of indicators is the most challenging issue. The increase or the decrease of a several key indicators might show the phase of the economic cycle, so the macroeconomic variables will considered for several years. Table 1 presents the most relevant indicators that show, by their fluctuation, the state of the economy. While the growth of GDP indicated directly the economic cycle phase, the consumer prices

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[4] https://www.worldbank.org/

reflect in general the purchasing power of individuals and is very sensitive to any change of the economic system.

The added value of each GDP component considered in annual percentage growth is the first indicator of a potential economic crisis. Each industry is strongly correlated with all other industries, so that a small change of a component will imbalance the entire system. In this respect, it is possible to identify the component of the system that imbalanced the entire system and started the new crisis.

On the other side, the foreign direct investment (both inflows and outflows) as well as trade are variables that are highly correlated with the interest shown by external individuals for each economy as a whole. The variable V11 show the trust that banks have in economic and political system of a country, so that a small number of bank branches per 100000 adults demonstrate the lack of this trust. Either the domestic credit provided by financial sector or banks as percent of GDP also indicate a trust of creditors into the economic system and an eligibility of clients for credits.

```
> kmo
         [,1]    [,2]    [,3]    [,4]    [,5]
[1,] 0.50857 0.43817 0.44125 0.5205 0.5462
> b
         [,1]    [,2]    [,3]    [,4]    [,5]
[1,] 405.99 433.56 465.95 447.75 391.96
> qchisq(0.05,136,lower.tail=F)
[1] 164.22
```

Figure 1. KMO indicator and Bartlett's test statistic

The figure from above show the results for Bartlett test of sphericity and KMO indicator for all five datasets. The KMO indicator is computed as the sum of correlation indicators divided by the sum of correlation indicators added with the sum of partial correlation indicators and show the utility of factor analysis on each dataset. Because the values of KMO indicator are high, the utility of FA is confirmed.

On the other side, the Bartlett test computed statistic is above 164.22 (the critical value) for all five datasets and show the rejection of null hypothesis that states that the variables in datasets are orthogonal, so the extraction of common factors is not justified.

Table 4. FA results

Dataset	Cumulative Var.						p-value
	F1	F2	F3	F4	F5	F6	
2014	0.16	0.29	0.43	0.52	0.61	**0.69**	0.401
2015	0.16	0.30	0.41	0.52	0.62	**0.68**	0.0632
2016	0.19	0.31	0.44	0.54	0.64	**0.70**	0.00956
2017	0.20	0.35	0.46	0.57	0.66	**0.69**	0.0672
2018	0.16	0.28	0.39	0.49	0.57	**0.65**	0.613

The table from above show the cumulative variance explained by all six factors and the statistic test that show if the selected number of factors for each dataset is sufficient. Tests were performed for a lower number of factors (starting from 2) until the p-value statistic associated to each test is higher than 0.05. In this respect, the null hypothesis is accepted and there is a perfect fit of factors.

The only exception is for 2016 dataset, the p-value is lower than 0.05, but not significantly lower. Still, for 2016, there were selected six factors, in order to compare the results with all other datasets. The total amount of variance explained by factors in each model is between 0.65 and 0.7.
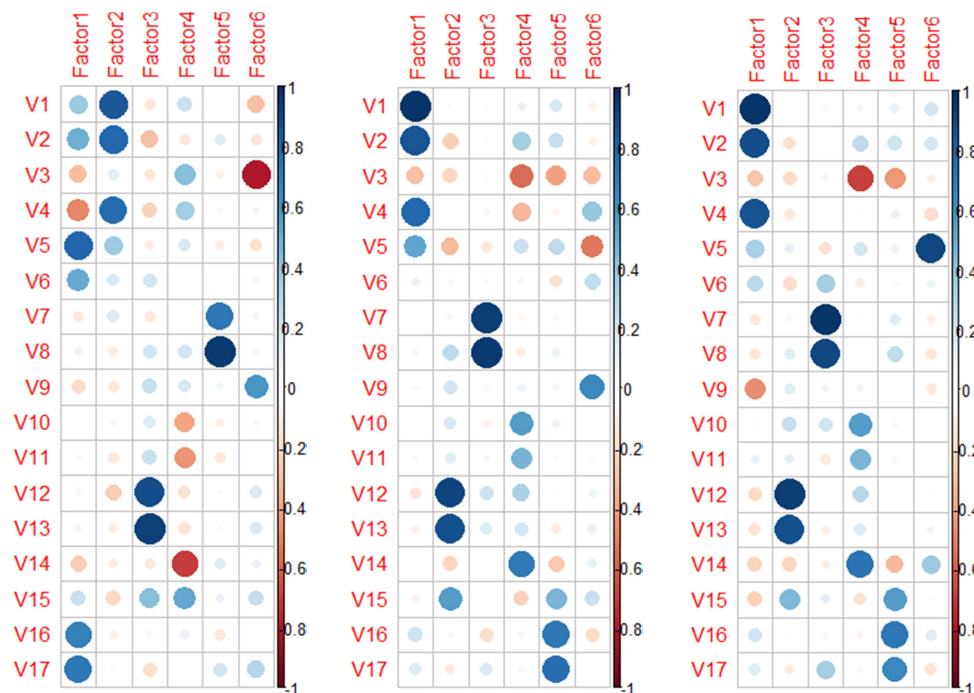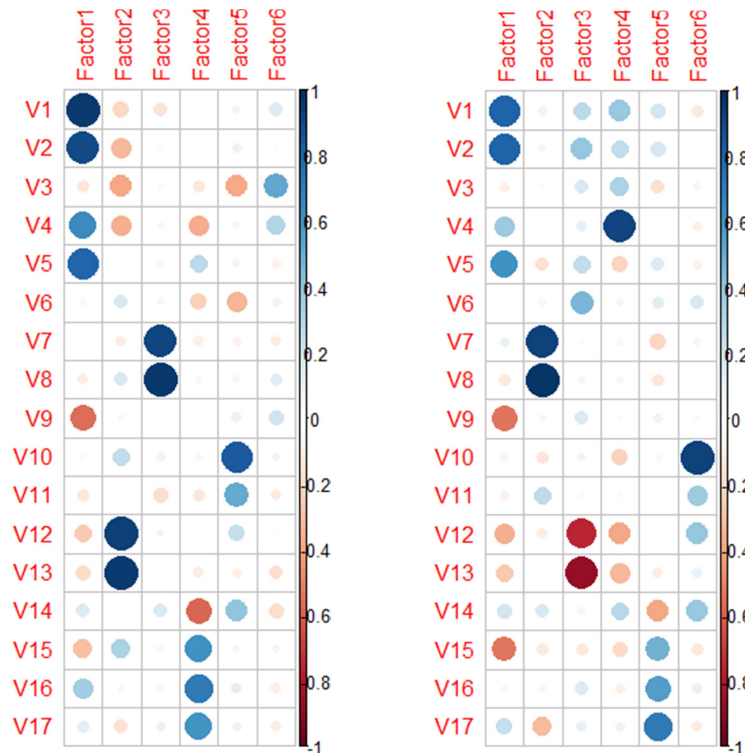
Figure 2. Factors correlations with original variables

The correlations between factors and the original variables (for all datasets: 2014 to 2018 from left to right) are presented in the figure from above. Using the correlations we observe that each factor is highly correlated with one or several variables and its signification may be determined through these correlations.

All six factors considered for each dataset have almost the same signification (with slightly different composition) though datasets (even if the factor name is different) as:

- One factor is highly correlated with variables V1, V2, V4 (even V5) - GDP growth
- One factor correlated with V7 and V8 - direct investments
- One factor correlated with V15, V16, V17 - trade
- One factor correlated with V12 and V13 - domestic credit. For 2018, dataset has a negatively correlation.
- One factor is correlated with V14 and V3 (for some datasets) - unemployment, prices
- One factor correlated with V10 and V11 - banks and claims on central government.

195

There are also variables that have a high uniqueness value, so that factors cannot take much information from these variables. Even so, the interpretation for all six factors are almost the same in all five datasets, so classes in cluster analysis could have the same interpretation.
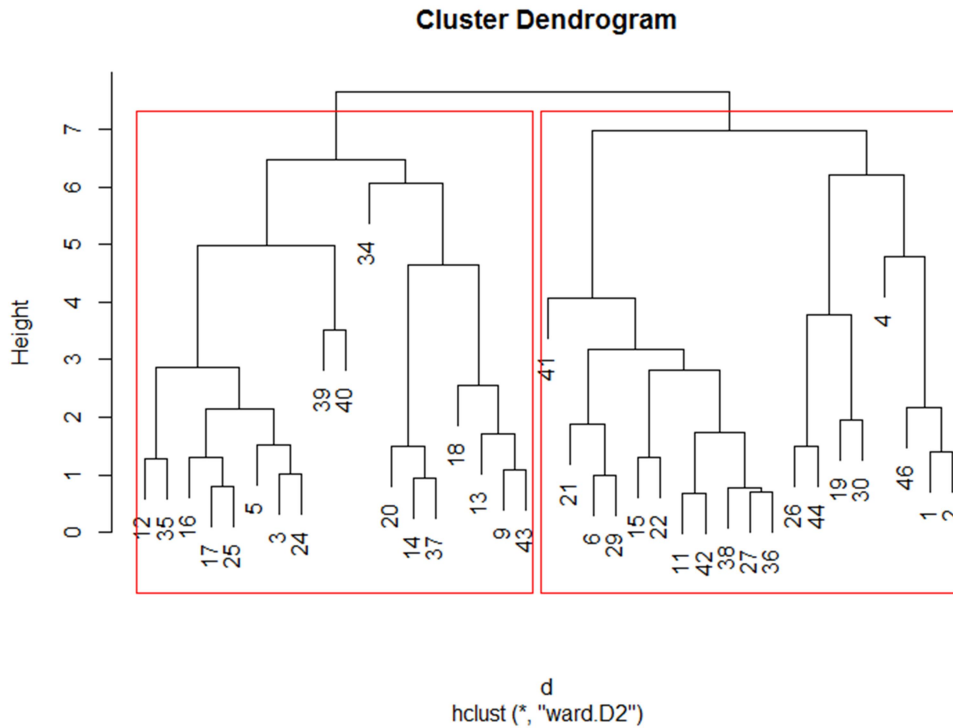
Cluster Dendrogram

Figure 3. Ward's cluster method dedrogram - 2014 dataset

The factors extracted and interpreted above are used as new variables in Ward's hierarchical unsupervised cluster method in order to identify the best number of classes. For 2014 dataset, the dendrogram presented above shows that the best number of classes is two (it could be selected even three classes). In order to maintain the comparability between all five years, it selected only two classes. These two classes describes better the situation from factors point of view.

```
> round(k2014$centers,4)
        F1       F2       F3       F4       F5       F6
1   0.6295   0.2128  -0.2545   0.3672   0.3594  -0.4860
2  -0.4797  -0.1622   0.1939  -0.2798  -0.2738   0.3703
> round(k2015$centers,4)
        F1       F2       F3       F4       F5       F6
1   0.0578   0.1349   0.0472  -0.5678   0.3249  -0.0196
2  -0.0848  -0.1978  -0.0692   0.8327  -0.4765   0.0287
> round(k2016$centers,4)
        F1       F2       F3       F4       F5       F6
1   0.1367  -0.1727  -0.2215  -0.2918   0.1732   0.8914
2  -0.1041   0.1316   0.1688   0.2223  -0.1320  -0.6791
> round(k2017$centers,4)
        F1       F2       F3       F4       F5       F6
1  -0.4499   0.8998  -0.1509  -0.0135   0.2064  -0.0314
2   0.3427  -0.6856   0.1150   0.0103  -0.1572   0.0239
> round(k2018$centers,4)
        F1       F2       F3       F4       F5       F6
1   0.7287   0.0279   0.3655   0.3218   0.2000  -0.1749
2  -0.6904  -0.0264  -0.3463  -0.3049  -0.1895   0.1657
```

```
> k2014$size
[1] 16 21
> k2015$size
[1] 22 15
> k2016$size
[1] 16 21
> k2017$size
[1] 16 21
> k2018$size
[1] 18 19
```

Figure 4. K-Means results

Figure from above presents the results for the third method of HCPC. The number of observations in each class is presented in the left side, while the classes' centers are in the right side. Interpreting the centroids of each class and dataset by taking into account the six factors, each class can have a low or a high risk of recession.

Therefore, the characteristics of each classes are:

- One class have positive values for the average values of factors, so that represents high values for original positive correlated variables (except F3 in 2018, that is negatively correlated with variables V12 and V13). This class have a low recession risk, with low inflation, low domestic credits, high GDP growth and is class1 in 2014, 2015, 2016 and 2018 datasets (except that in 2018, the credits start to grow) and class2 in 2017 dataset.

- Another class have the opposite description than class1: high domestic credits, low GDP growth (maybe negative values for GDP growth), high inflation, low trade. This class have a high recession risk.

The dynamic of classes components in time show that there are countries that "changed" their class membership and that something in that economy lead to an economic imbalance. In addition, if we consider a new categorical variable provided by WorldBank and named Income Group, we notice the difference between the evolution in time of the obtained classes and the current income class.

cls_2014

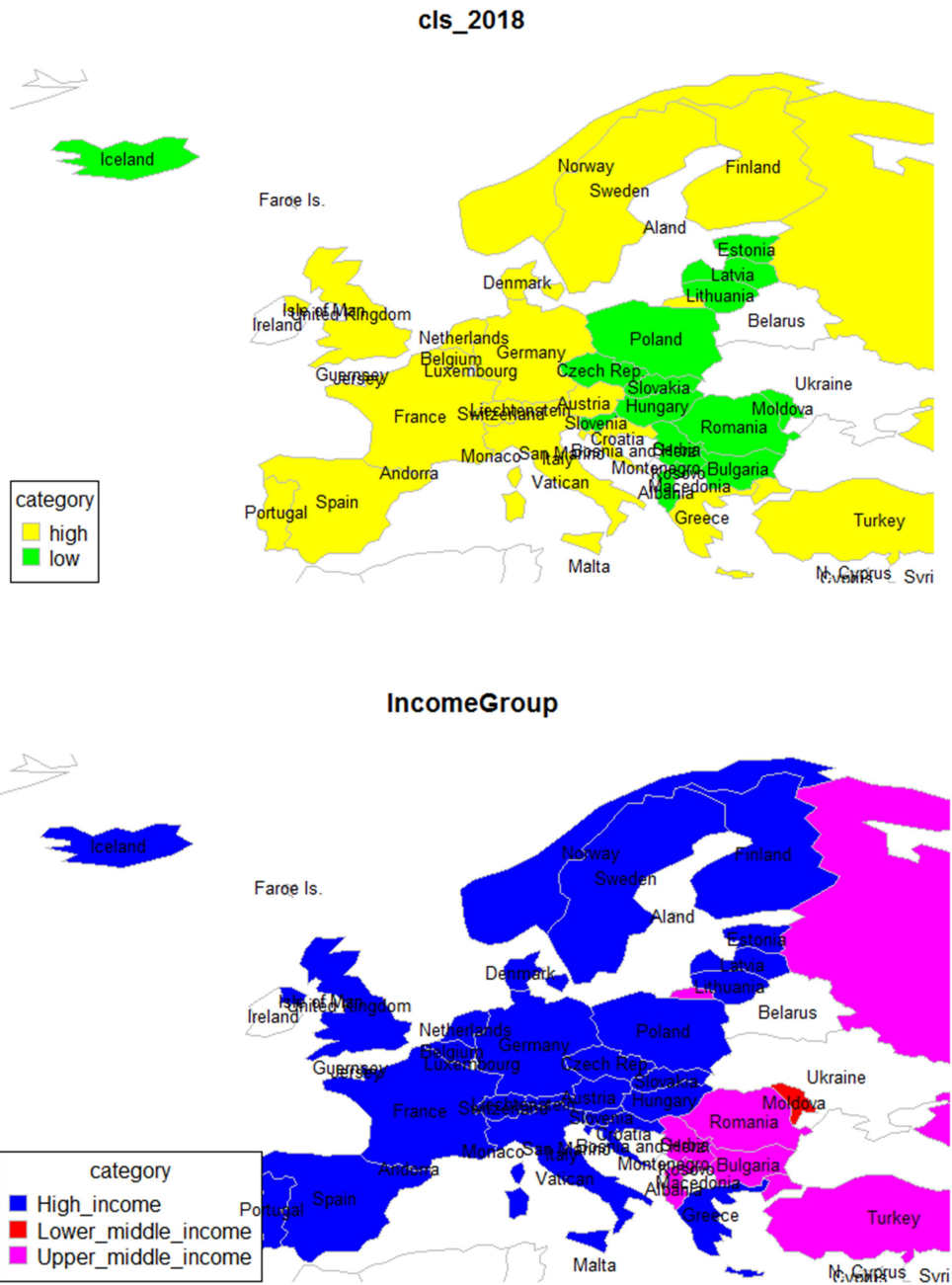
cls_2016

cls_2018

IncomeGroup
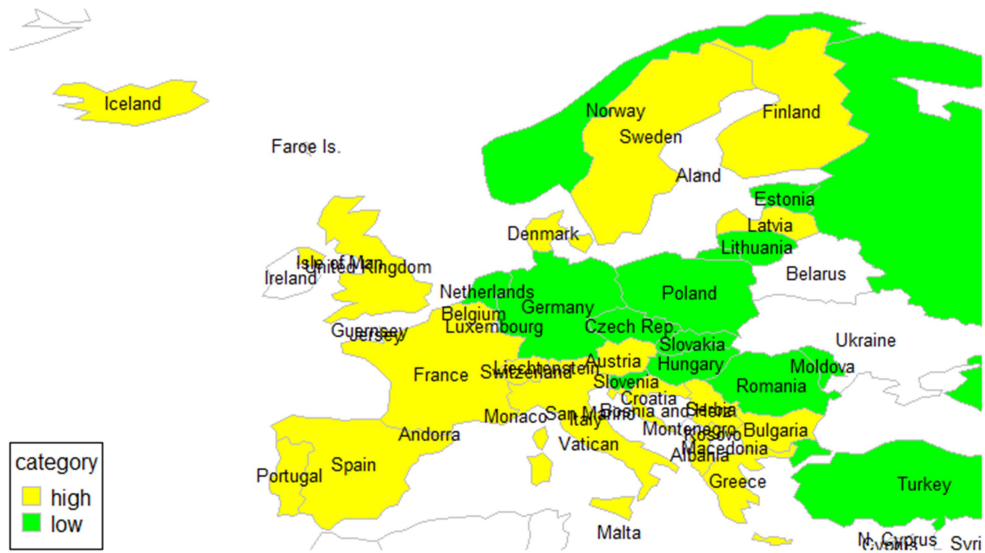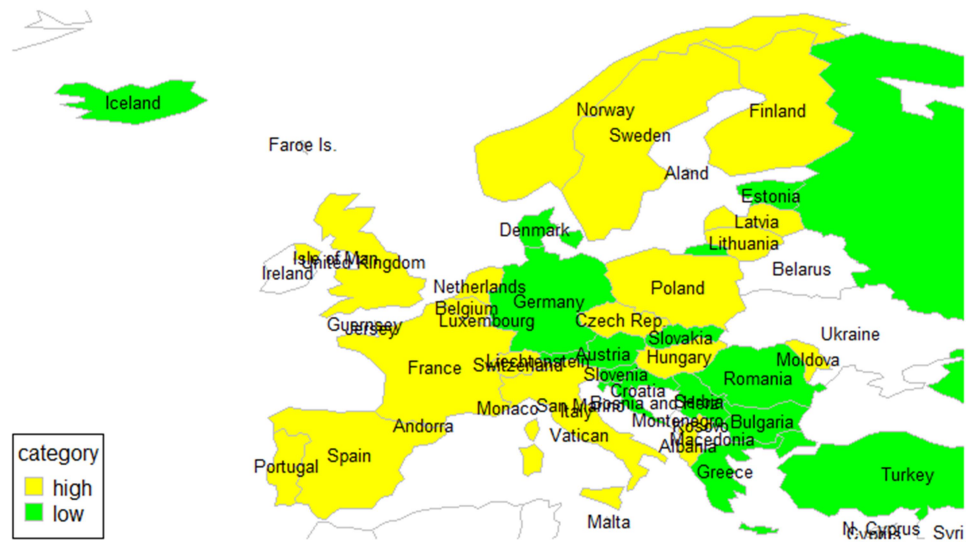
Figure 5. Risk of recession in Europe

The figure from above show the situation of the European countries selected for analysis (and not removed as a result as outliers' analysis for many variables). The

199

first three maps present the class distribution for 2014, 2016 and 2018, while the last map present the income group. It is visible that the yellow area (corresponding to high recession risk class) is spreading from one map to another for large countries, considered as high income countries.

There are some several conclusions here:
- There are countries that passed (from 2014 to 2018 or from 2016 to 2018) from high recession risk to low recession risk, like Albania, Armenia, Bulgaria, Czech Republic, Hungary, Lithuania, Latvia, Moldova, Poland or Serbia. Most of these countries have an increase of GDP growth, an increase of inflation (except for Moldova and Serbia), a decrease of number of banks branches and an increase of trade.
- there is a group of countries (Austria, Germany, Denmark, Greece, Croatia, Netherlands, Norway, Russia, Turkey), most of them with high income, strong economies in Europe that change the class from low to high risk of recession (from 2014 to 2016 or from 2016 to 2018). Most of these countries have a decrease of GDP per capita growth, an increase of inflation, trade and decrease of unemployment.

4. Conclusions and discussions

The HCPC methodology is used here in order to identify a possible answer to the question: there are signs of a future European economic crisis. The FA performed to extract a smaller number of aggregate variables and reduce the dimensionality of datasets. Ward's method used to confirm that the number of two classes is a good choice, while k-means algorithm was applied to allocate each observation to a class.

The interpretation of classes through factors and the evolution of classes suggest that in the future, starting with 2020, a new economic crisis in Europe might be possible. However, in order to stop the potential crisis, politics (economically, monetary, socially) should be implemented.

The further research should be represented by analyzing each European country that "changed" the class among years and identify the cause and the factors (economy, politics, social) that lead to the change for each case.

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