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- *The Scientific Bulletin of Politehnica University of Timisoara, Transaction on Management. Economics Engineering. Transportation Engineering (ranked according to CNCSIS classification in Romania: C class).*

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Transactions on ENGINEERING AND MANAGEMENT

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Research results and achievements during the pandemic period

Editorial

Anca DRĂGHICI[1]

The Editorial Board of the "***Scientific Bulletin of Politehnica University of Timisoara – Transaction on Engineering and Management***" (ISSN 2392-7364) kindly inform our community of contributors and readers that the journal has start a new episode confronting the publication with the pandemic period. In the last few months, difficult and complex due to the Covid-19 pandemic, we managed to reflect more on some interesting scientific topics. Thus, the content of these issues of our magazine was defined. Researchers from our network were stimulated by online collaboration and thus created interesting content for our readers.

We especially appreciated the contributions of the doctoral students who, together with their doctoral supervisors, sent debut articles in research, but which reflect maturity in thought and action. We hope that in future issues we will enjoy their contributions in the action of disseminating the results of their research.

We would like to address special thanks to the reviewers (members of the *Associated Editors)* because their careful and professional (volunteer) review work has a positive impact on the quality content of this volume. In addition, we appreciate the constant implications of the members of ***the Research Center in Engineering and Management (RCEM)***[2] (from the Faculty of Management in Production and Transportation, Politehnica University of Timisoara, FMPT/UPT, Romania) in supporting each issue of the Scientific Bulletin publication. Furthermore, RCEM provide a productive and positive environment through which we share ideas and knowledge between young people and seniors involved in research activities (formal or informal).

The current issue presents a collection of articles reflecting actual topics and research thematic in the field of engineering and management (social sciences). Most of the articles in this volume discuss current topics that are approached in modern, up-to-date ways. We are happy that sustainability management, problems in logistics systems or human resources management were preferred.

The first paper, "***An Introduction to the European Union Unemployment Reinsurance System as Automatic Economic Stabilizer: Economic Policy and Management Recommendations***", proposed by Aleš TRUNK and Igor STUBELJ from high education institutions in Slovenia, examines stabilizing power and efficiency of presented unemployment reinsurance systems (URS EU). We find that the statutory contribution rate for unemployment insurance is sufficiently high only in a small part of the EU. Only certain insurance systems are sustainable. This paper demonstrates that the need for an automatic stabilizer, such as the reinsurance in the case of unemployment, has shown even more necessary. Through this paper and these recommendations, this study hopes to encourage institutional reforms, especially in the euro area, as the monetary union reduces macroeconomic stabilization policies at national level. We believe that the URS EU would represent a possible solution to the problems outlined in the paper.

The second paper "***Environmental Management Accounting: Analysis of Environmental Costs and Decision-Making in the Organisation***" has been developed by Maria Elena BOATCA, Mihaela VARTOLOMEI, Roxana Mihaela SIRBU (from Politehnica University of Timisoara, Romania). The research approach is related to the Environmental management accounting (EMA) which is a relatively new tool in environmental management. Thus, the article presents a literature review on how EMA could incorporate and integrates two of the three milestones of sustainable development (environmental and economics dimensions), as they relate to an organization's internal decisional process.

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[2] *Information available at: http://www.mpt.upt.ro/eng/research/research-center.html*

The third paper presents a study entitled: "***Overview of the Romanian Legal Framework on Crisis Management. Study Case: Pandemic Crisis in Romania***" by Rebecca Ioana CHINCEA and Matei TAMASILA (from Politehnica University of Timisoara, Romania). presents a summary of the Romanian legislation over the past two years, analyzing the changes it imposed.

The fourth paper entitled ***"Organizational Readiness for Artificial Intelligence Adoption"*** by Marta PALADE and George CARUTASU (from Politehnica University of Timisoara, Romania). This study proposes that the wheel does not need to be reinvented, but rather organizations can learn and adapt from previous digitization adoptions. Based on literature review, this study aims to develop an AI readiness model starting from already defined factors needed for digitization and innovation adoption. Based on prior academic and industrial research, each of these factors encompasses several sub-factors.

Next article entitled: "***Railway Accidents Prevention – A Systematic Analysis***" has been proposed by Vladimir VOICU and George CARUTASU (from Politehnica University of Timisoara, Romania). This article aims to present several railway accidents in history and the systems or actions which could have prevented them, respectively that were or should have been introduced after the inquiries that have taken place after these accidents.

In the next article entitled: "***Network Management Center for East European Railways***", has been proposed by Nicusor TOTOR (from the Romanian Railways West European Region, Timisoara) and the research field of interest is related to the railways in the world which are facing increasing competition with other transport facilities like electric cars, electric buses, freight trucks and aircraft. In the study there is presented a debate on using digital interfaces to electromagnetic relay-based block automation section or electronic interlocking system like LZB control center from Alcatel-Cegelec, the East European Union Railways which must manage the whole long-distance traffic in his whole railway network and the upgrade software program which is demanding the hardware part installation.

Next article presents "***An Extended Study on Motivation and Need for Multimedia Skills Development in the Case of University Staff***" developed by a team of authors Anca DRAGHICI, Larisa IVASCU (both from Politehnica University of Timisoara, Romania), Valerij DERMOL (from ISSBS Slovenia), Zivile STANKEVICIUTE (from KTU Lithaunia). the paper first, presents the specific situation and potential for multimedia competencies development in the case of the seven partners of MUST project: "Multimedia Competencies for University Staff to Empower University - Community Collaborations" (2020-1-RO01-KA203-080399, https://mustproject.eu/). The extended study refers to partners from countries as: Romania, Slovenia, Germany, Lithuania, Portugal, Spain, and North Macedonia. The preliminary state of the university staff competencies in the field of multimedia, has been the basis for the survey based on a designed questionnaire development for the training needs development. In the final part of this article the results of the survey are presented together with some comments and conclusions. The achieved knowledge and information from the extended study on motivation and need for multimedia skills development in the case of university staff have been considered for designing the MUST training program structure and content.

Last article "Massive and Repeated Molecular Testing a Tool in the Pandemic Covid-19 Prevention Management System" has been proposed by Alin GAUREANU, Paula Nicoleta NEAG, Ioan Mihai COSTA aiming, to logically associate the preventive ergonomic management system already known by OSH, with ergonomic management system of crises, through scientific research, statistic arguments, which support the massive implementation of molecular.

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An Introduction to the European Union Unemployment Reinsurance System as Automatic Economic Stabilizer: Economic Policy and Management Recommendations

Aleš TRUNK[1], Igor STUBELJ[2]

Abstract – A few months in, it is still hard to grasp the scale and scope of COVID-19's global impact. A third of the world population is under some sort of "lockdown." All the while, a second crisis, in the form of an economic recession, is underway (Schwab and Vanham, 2020). During the recession, European Union (EU) members did not use fiscal policies to ease the recession, while the reinsurance system in the case of unemployment would achieve exactly this, as it acts as an automatic stabilizer. The response to unemployment in the great recession and subsequent events related to the European debt crisis has been very heterogeneous across Europe and in population groups. This study examines stabilizing power and efficiency of presented unemployment reinsurance systems (URS EU). We find that the statutory contribution rate for unemployment insurance is sufficiently high only in a small part of the EU. Only certain insurance systems are sustainable. This paper demonstrates that the need for an automatic stabilizer, such as the reinsurance in the case of unemployment, has shown even more necessary. Through this paper and these recommendations, this study hopes to encourage institutional reforms, especially in the euro area, as the monetary union reduces macroeconomic stabilization policies at national level. We believe that the URS EU would represent a possible solution to the problems outlined in the paper.

Keywords: EU unemployment reinsurance system, automatic economic stabilizers, fiscal integration, implications for management, policy recommendations

I. UNEMPLOYMENT REINSURANCE SYSTEMS

The EU needs mechanisms that act as automatic stabilizers. After 2008, the differences in the unemployment rate have been increasing, between EU countries as well as by age groups. Boeri and Jimeno (2016) argue that the reason for these differences is related to labor market institutions, especially given their interactions with the scale and nature of the shocks of the great recession and the euro area debt crisis. They present macro- and micro-evidence that emphasize the importance of these interactions when explaining the differences between countries in adapting the labor market to the aforementioned shocks.

After having identified the labor market institutions responsible for this increase in the unemployment gap, they discuss what can be done at the EU level to promote institutional convergence. They particularly examined the "positive conditioning" approach that could even work in good times, not just in a period of recession when conditioning is strong. At the same time, they draw attention to the side effects that these reforms may have.

The existence of unemployment reinsurance is possible through the regular exchange of labor market information among the EMU members. The general problem of unemployment insurance is moral hazard - in the form of less intensive job search and receiving compensation while being informally employed (Dolenc et al., 2012; Tatsiramos and van Ours, 2014).

In addition, the functioning of the labor market and related institutions within the EU is very diverse (heterogeneous). As a solution for regular exchange of information between the EMU members, Boeri and Jimeno (2016) propose introduction of reinsurance in the case of unemployment at the EU level and the introduction of individual accounts that would enable transferring benefits within EMU (aggregation of periods of employment in the EMU) and act as a complement to existing forms of unemployment insurance in individual countries.

The EMU version of unemployment reinsurance would be attractive mostly for its simplicity. Unemployment reinsurance would be modeled after public unemployment schemes known to citizens in most countries (Ljungqvist and Sargent, 2008). An unemployment reinsurance system would really have the character of reinsurance. Contributions would be determined on the basis of current income with a certain threshold, and once an individual had paid contributions for reinsurance for a sufficient number of

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months, he would be entitled to compensation commensurate with the amount of contributions previously paid (Bover et al., 2002).

Unemployment reinsurance was introduced in the United States in 1932 because of the 1929 financial meltdown. The first beginnings of unemployment reinsurance date back to as early as 1935, when the US Federation regularly paid administrative costs for the implementation of unemployment insurance to federal states.

From 1937 onwards, each state had its own unemployment insurance co-financed by the federation (Alvarez 2014). In the following, we present previous research on reinsurance systems in case of unemployment. In the description, we identify the benefits of unemployment reinsurance and the difficulties the authors faced in modeling.

II. ELEMENTS OF MODELS OF UNEMPLOYMENT REINSURANCE IN THE EU

Based on research (Beblavý and Maselli, 2014; Boeri and Jimeno, 2016; Dolls et al., 2014; Dullien, 2007 and 2013) we present all previous models or simulations. In the study, we focused on finding answers to the following questions:

- *Should the unemployment reinsurance system completely replace or just upgrade the existing public systems?*
- *Should the models allow redistribution between countries or not?*

A. Replacement or upgrade of state systems

The European employment policy complements but does not replace the national policy in the field of employment security and unemployment insurance. As a solution, Boeri and Jimeno (2016) propose to increase the coherence of the main guidelines of employment policy in the European institutions and the introduction of certain programs at the European level.

In this regard, they suggest that European employment policy should complement, but not replace the national policies in the field of employment security and unemployment insurance. This policy should be introduced based on positive conditionality, which provides different and more effective incentives for national governments to introduce the necessary structural reforms. Such reforms would allow EU citizens to monitor access to such systems with a European Social Security ID number on their own, rather than through government, local government or intermediaries. Such an approach would increase the transparency and social acceptability of these policies.

EU-wide unemployment reinsurance would be integrated into existing national unemployment insurance schemes and would be politically acceptable to all countries. Dullien (2007) presents how strongly fiscal policy works as an optimal stabilization tool in the European Monetary Union (EMU) and how it can be improved. It is econometrically demonstrated that, despite numerous automatic stabilizers in the EMU, the discretionary fiscal policy neutralized those institutions in a way that represented a cyclical general stance of fiscal policy. As a solution, the author proposes an unemployment system for the entire EMU, which could easily get integrated into existing public unemployment insurance schemes and would be politically acceptable for all countries. The author considers that EU-wide unemployment reinsurance should not affect the motivation to seek employment and the decision to take up employment (the level of benefits is set so as not to reduce existing benefits in each country, otherwise the EU-wide unemployment reinsurance will not get public support; besides, unemployment reinsurance benefits should not be too high, as this would make the unemployed less motivated in their job search). He also suggests that the URS EU should make use of the existing bureaucracy and not expand it, as additional, parallel management of unemployment reinsurance in addition to the already existing unemployment insurance structures in individual countries is pointless.

Furthermore, it can be combined with existing country-specific unemployment insurance schemes and also apply the already established country-specific unemployment insurance structure (Beaudry and Pages, 2001).

The great recession and the consequent European debt crisis have revived the debate on stronger fiscal integration in the euro area. Dolls et al. (2014) discuss various options for how to design an unemployment reinsurance system, which could contribute to stronger fiscal integration in the euro area. To this end, they represent three versions of unemployment reinsurance schemes in the euro area, namely basic unemployment reinsurance, which partially replaces public unemployment reinsurance schemes, a supplementary benefit scheme that complements public unemployment reinsurance schemes, as well as a fully centralized system. All three options would establish the operation of automatic stabilizers at the euro area level, but would have very different consequences for stabilization, distributions and moral hazard options.

A basic reinsurance system in the case of unemployment in the euro area can provide a basic level of reinsurance, even if a member state loses access to private capital markets and its national automatic stabilizers do not work satisfactorily. The stabilizing effect of the basic system decreases as the share of the long-term unemployed increases.

A euro area-based supplementary benefit scheme, providing benefits only in connection with certain triggers, would not provide stabilization under normal circumstances, but could increase the efficiency of national unemployment reinsurance systems in the event of severe economic crises. A fully centralized unemployment reinsurance system would lead to full harmonization of unemployment reinsurance so that differences between national unemployment reinsurance systems would get unified (Lellouch and Sode, 2014).

Table 1. Overview of current reinsurance models

Authors	Model type	Balance (as a percentage of GDP)
Dolls et al. (2014)	Unemployment reinsurance	0
Dullien (2007)	Basic unemployment reinsurance	0
	Unemployment reinsurance with the possibility of extending the period of receiving the benefit; triggers are set for each country.	0
	Unemployment insurance with the possibility of extending the period of receiving the benefit; the trigger is uniform for all selected countries.	0
Dullien (2013)	Unemployment reinsurance - Scenario A	0.482
	Unemployment reinsurance - Scenario B	–0.536
Beblavý in Maselli (2014)	Harmonized compensation at the EU level (excluding the fiscal rule)	–0.200
	Harmonized compensation at the EU level (including the fiscal rule)	–0.050
	Unemployment reinsurance (excluding the fiscal rule)	0.350
	Unemployment reinsurance (including the fiscal rule)	0.400

The balance (as a percentage of GDP) is the difference between the payment of unemployment benefits and the collected unemployment insurance contributions expressed as a percentage of GDP.
Source: Own calculation.

In designing a system with acceptable stabilization properties, the authors use the structure and experience of the unemployment reinsurance system used in the USA. They note that some elements of reinsurance in case of unemployment in the US would be worth taking up in a European approach. For the URS EU, the idea of "extended benefits" with automatic triggers extending the duration of receiving benefits in times of economic recession makes particular sense.

B. Redistribution or no redistribution between URS EU countries

Dullien (2007), and Beblavý and Maselli (2014) do not envisage redistribution, contributions are set in a way that the unemployment reinsurance balance for each country is zero in the long run. Boeri and Jimeno (2016), Dolls et al. (2014) and Dullien (2013) address the unemployment reinsurance system at the EU level, allowing for the possibility of redistribution (they assume that certain countries pay for others, as helping is beneficial for them as well).

The literature review shows that the authors set the models in a way that the balance in the period under review was equal to zero or was approximately +/- 0.5% of GDP (Table 1), as otherwise the URS EU would be politically unacceptable for certain countries (especially for non-frequent URS EU users). Above all, the advantages and disadvantages of both alternatives should be emphasized.

In the case of redistribution, the benefit is greatest for countries that are often eligible for URS EU aid. At the end of the period under review, balance may be positive for some countries and negative for the others. Consequently, this could lead to a permanent absorption of funds from countries with a negative balance, which would probably not be acceptable for countries that would have to pay more contributions to the URS EU due to the negative balance of other countries. In the case without redistribution, however, the stabilizing power of the URS EU is smaller, as the balance of each country separately is zero at the end of the period under examination. However, this alternative is politically more acceptable, as each country (in terms of the whole period) receives only as much aid as it pays contributions.

III. THE MODEL STRUCTURE AND OPERATION

In the following, models of unemployment reinsurance are demonstrated. In terms of structure, the "bookkeeping logic" of individual models and the use of triggers that determine transfers between the EU and each country is shown. We therefore examined the following research: Dolls et al. (2014); Dullien (2007) and Dullien (2013).

A. Considerations about the model structure

All the research presented below is characterized by a common purpose namely, to examine the possibilities for the operation of joint reinsurance in the case of unemployment at the EU level as an automatic stabilizer and to increase efficiency and maintain the level of consumption of the unemployed. What all research has in common is that the authors determine the contribution rate and the amount, and the duration of unemployment benefits in an original way, and measure the stabilizing power as a reduction of the inflation gap on the basis of their own calculations.

The research uses data that allows the calculation of the stabilizing power of each model: GDP, unemployment reinsurance expenditure used for benefits, average pre-unemployment wage, average wage (per year), number of registered unemployed, coverage rate, number of benefit recipients, average monthly benefit, unemployment rate, average replacement rate, unemployment reinsurance benefits, statutory contribution rate for unemployment insurance, total wage bill, number of employees, production gap in percent, production gap in EUR. A potential product is a measure of the supply side

(maximum product) at full employment of production capacities without inflationary pressures. The actual product is determined by demand. The difference between the potential and the actual product is the production gap - an indicator of the utilization of production capacity.

A1. Dolls et al. (2014)

Dolls et al. (2014) note that the reinsurance system in the case of unemployment in the euro area could be implemented with a relatively small budget and wide coverage. The same contribution rate is set for all countries, namely 1.9% of the total wage bill. The system would provide a basic level of income reinsurance in terms of compensation (50% replacement rate), the maximum duration of benefit would be 12 months, and the system would provide broad coverage, as all new unemployed would be included. In the period 2008-2013, a budget of EUR 365 billion would be needed, so the average annual benefits and contributions would amount at EUR 61 billion. The system analyzed in the survey does not lead to permanent redistribution per se, as it only covers short-term unemployment insurance at the central level, and simulations show that (net) transfers from the euro area unemployment reinsurance system would be unevenly distributed due to significant differences in the euro area unemployment rate in recent years. The largest (net) payers would be Austria, Germany and the Netherlands (with annual contributions of up to 0.6% of GDP for the Netherlands in 2008). Cyprus, Estonia, Greece, Ireland, Portugal and, particularly in Spain, where annual (net) compensation would peak in 2009 (1.4% of GDP), would benefit the most.

In the period 2008-2013, the system would cover a total budget of EUR 365 billion at the euro area level. The average annual benefits and contributions would amount at EUR 61 billion. There would be a deficit in the system in 2009, 2012 and 2013, and a surplus in 2008, 2010 and 2011. Net transfers of funds would be unevenly distributed due to significant differences between euro area unemployment rates during the simulation period. Austria, Germany and the Netherlands would be the largest net contributors to the system, with a net contribution ranging from 0.27 to 0.4% of GDP in Austria, 0.31 to 0.40% of GDP in Germany, and 0.14 to 0.59% of GDP in the Netherlands. Spain, Cyprus, Greece and Ireland would be the largest net recipients. Net compensation would be up to 1.39% of GDP in Spain, up to 1.3% of GDP in Cyprus, up to 1.23% of GDP in Greece, and up to 0.9% of GDP in Ireland (Figure 1 and Table 2).

A2. Dullien (2007)

Dullien (2007) believes that countries should not be allowed for the long-term absorption from unemployment reinsurance, therefore he does not envisage redistribution in reinsurance. In his research, he presents simulations for the EU (ten selected countries) in the period 1999-2005 for three different models.

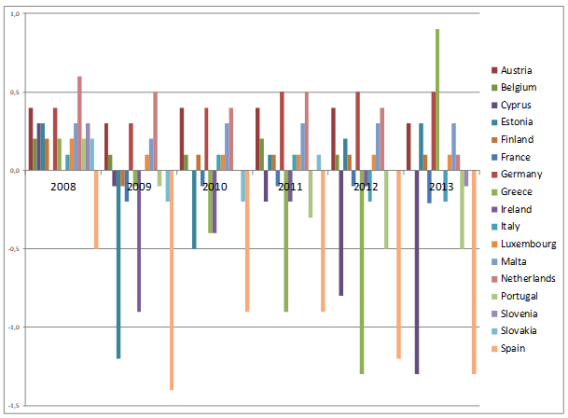

Figure 1: Net transfers of reinsurance assets in the case of unemployment (2008-2013; as a percentage of GDP per country)

Source: Dolls et al., 2014.

Table 2. Cash flow of unemployment reinsurance (2008–2013)

	2008				2009				2010				2011				2012				2013			
	B	C	B€	B%	B	C	B€	B%	B	C	B€	B%	B	C	B€	B%	B	C	B€	B%	B	C	B	B%
EMU	45.70	59.45	13.75	0.1	67.88	59.33	-8.55	-0.1	58.50	60.21	1.72	0.0	55.38	61.58	6.20	0.1	66.80	62.08	-4.72	0.1	70.67	62.28	-8.39	-0.1
Austria	0.84	1.98	1.14	0.4	1.28	2.01	0.73	0.3	1.00	2.04	1.05	0.4	0.97	2.10	1.13	0.4	1.06	2.15	1.09	0.4	1.25	2.19	0.94	0.3
Belgium	1.39	2.12	0.72	0.2	1.80	2.13	0.32	0.1	1.70	2.15	0.44	0.1	1.47	2.24	0.77	0.2	1.82	2.31	0.49	0.1	2.30	2.34	0.04	0.0
Cyprus	0.06	0.11	0.05	0.3	0.12	0.11	-0.01	-0.1	0.11	0.11	0.00	0.0	0.15	0.11	-0.04	-0.2	0.25	0.11	-0.04	-0.8	0.25	0.11	-0.14	-1.3
Estonia	0.06	0.11	0.04	0.3	0.26	0.09	-0.16	-1.2	0.17	0.09	-0.08	-0.5	0.08	0.10	0.02	0.1	0.07	0.11	0.03	0.2	0.07	0.12	0.05	0.3
Finland	1.02	1.39	0.37	0.2	1.52	1.39	-0.13	-0.1	1.30	1.41	0.11	0.1	1.27	1.47	0.20	0.1	1.32	1.52	0.19	0.1	1.42	1.55	0.13	0.1
France	8.49	8.78	0.30	0.0	12.59	8.79	-3.80	-0.2	10.79	8.99	-1.80	-0.1	10.53	9.23	-1.30	-0.1	12.26	9.37	-2.89	-0.1	13.29	9.42	-3.86	-0.2
Germany	11.33	20.87	9.54	0.4	13.48	20.87	7.39	0.3	11.97	21.53	9.56	0.4	10.25	22.45	12.19	0.5	10.13	23.16	13.03	0.5	10.77	23.58	12.81	0.5
Greece	0.92	1.40	0.48	0.2	1.65	1.42	-0.22	-0.1	2.19	1.34	-0.85	-0.4	3.05	1.22	-1.83	-0.9	3.53	1.07	-2.45	-1.3	2.65	0.96	-1.68	0.9
Ireland	1.01	0.92	-0.09	0.0	2.30	0.86	-1.45	-0.9	1.40	0.81	-0.59	-0.4	1.09	0.80	-0.29	-0.2	0.95	0.80	-0.15	-0.1	0.89	0.81	-0.07	0.0
Italy	6.18	8.35	2.16	0.1	7.72	8.40	0.68	0.0	7.44	8.57	1.13	0.1	6.41	8.68	2.28	0.1	11.17	8.55	-2.62	-0.2	11.91	8.49	-3.42	-0.2
Luxembourg	0.06	0.13	0.07	0.2	0.11	0.13	0.02	0.1	0.10	0.14	0.04	0.1	0.10	0.14	0.04	0.1	0.11	0.14	0.03	0.1	0.12	0.14	0.02	0.1
Malta	0.02	0.04	0.02	0.3	0.03	0.04	0.01	0.2	0.02	0.04	0.02	0.3	0.02	0.04	0.02	0.3	0.02	0.04	0.02	0.3	0.02	0.05	0.02	0.3
Netherlands	1.31	4.81	3.50	0.6	2.07	4.90	2.83	0.5	2.42	4.93	2.51	0.4	2.05	5.01	2.96	0.5	2.76	5.06	2.30	0.4	4.10	4.96	0.86	0.1
Portugal	0.68	1.06	0.37	0.2	1.22	1.07	-0.15	-0.1	1.13	1.07	-0.06	0.0	1.48	1.04	-0.44	-0.3	1.86	1.99	-0.88	-0.5	1.86	0.99	-0.87	-0.5
Slovenia	0.08	0.19	0.10	0.3	0.18	0.19	0.01	0.0	0.19	0.19	0.00	0.0	0.19	0.19	0.00	0.0	0.18	0.19	0.01	0.0	0.23	0.19	-0.04	-0.1
Slovakia	0.13	0.25	0.11	0.2	0.35	0.25	-0.11	-0.2	0.35	0.25	-0.10	-0.2	0.22	0.26	0.04	0.1	0.24	0.26	0.02	0.0	0.26	0.27	0.01	0.0
Spain	12.09	6.94	-5.15	-0.5	21.19	6.68	-14.51	-1.4	16.20	6.54	-9.66	-0.9	16.05	6.50	-9.55	-0.9	19.05	6.23	-12.81	-1.2	19.24	6.14	13.10	-1.3

B - Benefits (in EUR billion); C - Contributions (in EUR billion); B EUR - Balance (in EUR billion); B% - Balance (in % GDP)

Source: Dolls et al., 2014.

Table 3. Basic unemployment reinsurance

	1999	2000	2001	2002	2003	2004	2005
Benefit payments							
No. short-term unemployed (in 1000)	8,049	7,216	6,727	7,849	8,454	8,661	8,140
Assumed No. short-term unemployed (in 1000)	4,025	3,608	3,363	3,925	4,227	4,331	4,070
Nominal wage per employee (in € 1000 /year)	31.50	32.4	33.3	34.2	35.1	36	36.7
Assumed amount of benefit (in € 1000 /year)	12.6	12.9	13.3	13.7	14.1	14.4	14.7
Total benefit payments (€ million)	50,727	46,714	44,733	53,643	59,394	62,394	59,760
Contributions (1.75 % of the wage bill)							
Number of employed (in 1000)	107,817	110,687	112,459	113,506	114,307	115,079	116,155
Assumed average tax base (in € 1000)	25.2	25.9	26.6	27.3	28.1	28.8	29.4
Total contributions (in € million)	47,442	50,035	52,218	54,162	56,077	57,885	59,546
Balance (in € million)	-3,284	3,320	7,485	519	-3,318	-4,508	-214

Source: Dullien, 2007.

Table 4. Unemployment rate (1998-2005; in percent)

	1998	1999	2000	2001	2002	2003	2004	2005
Euro zone	7.7	6.9	6.1	5.6	6.5	6.9	7.0	6.5
Austria	5.1	4.5	4.5	3.9	5.2	4.7	4.5	4.7
Belgium	5.1	4.8	4.1	4.0	4.9	5.9	5.6	5.8
Finland	11.3	10.7	10.2	9.3	9.9	10.2	9.7	7.1
France	8.4	8.1	6.9	6.4	6.6	6.6	7.3	6.5
Ireland	5.6	4.5	3.7	3.2	4.2	4.2	4.1	3.9
Italy	8.7	7.7	7.3	5.9	6.3	5.9	5.6	5.3
Germany	6.1	5.4	4.8	4.8	5.6	6.6	6.7	7.0
Portugal	4.3	4.6	3.5	3.8	4.6	7.0	6.2	6.6
Spain	14.2	12.2	11.4	8.9	10.3	10.7	10.2	8.1

The trigger activation period is highlighted in gray.
Source: Dullien, 2007.

All three scenarios have the following in common: (i) the amount of unemployment reinsurance benefit is 50% of the average salary in each country, and (ii) unemployed persons who have been employed for at least 12 months in the last 24 months are entitled to unemployment reinsurance benefit.

Dullien's research maintains the existing unemployment insurance and upgrades it with unemployment reinsurance, which would be activated in the event of a prolonged and severe recession based on triggers and would temporarily extend the period of receiving the benefit. Establishment is at EU level, and two things stand out:

(i) A large increase in unemployment across the EU or
(ii) A large increase in country-specific unemployment relative to the EU unemployment rate.

Basic unemployment reinsurance

In the case of basic unemployment reinsurance, there is no extended benefits (EB). The financial volume is EUR 54 billion per year (a total of EUR 377 billion), which means 1.75% of the wage bill. This represents approximately 0.75% of GDP (ten selected countries in the period 1999-2005). To establish basic unemployment reinsurance, Dullien (2007) assumes that

(i) The average tax base is 80% of the maximum tax base (the maximum tax base is equal to the average nominal wage) and
(ii) The number of short-term unemployed eligible for benefits is 50% of all short-term unemployed.

The Unemployment reinsurance fund would receive more contributions than pay benefits during the period 2000-2002, while in the remaining years it would be the opposite. The final balance of the period is 0 (Table 3).

Unemployment insurance with the possibility of extended benefits (country-specific triggers)

Characteristics of the second model (B 2) are the same as for basic unemployment reinsurance with the addition of an extended benefits period. The trigger is activated when the unemployment rate in each country increases by 0.5% points compared to the average of the last three years (Table 4; is activated where it is highlighted in gray). In this case, the benefit period doubles. Assumptions also must be specified in this case. Dullien assumes that the number of short-term unemployed eligible for additional benefits is 75% of all short-term unemployed.

The financial volume in this case is EUR 60 billion per year (a total of EUR 402 billion), which equals 2.02% of the wage bill. This represents approximately 0.85% of GDP (ten selected countries in the period 1999-2005). A small change in the simulation greatly increases the power of unemployment reinsurance as an automatic stabilizer. The most affected countries benefit the most, as the period for receiving compensation would be extended between 2002 and 2005. Compared to the previous scenario, an additional EUR 35 billion in compensation would be paid (Table 5).

Table 5. Unemployment reinsurance with the possibility of extended benefits, various triggers

	1999	2000	2001	2002	2003	2004	2005
Benefit payments							
Standard benefits (in € million)	47,986	45,247	42,159	49,399	54,643	56,997	55,226
Supplementary benefits (in € million)	0	0	0	10,015	11,304	18,520	11,305
Total benefit payments (€ million)	47,986	45,247	42,159	59,415	65,947	75,517	66,531
Contributions (1.9 % of the wage bill)							
Total contributions (in € million)	50,890	53,642	55,845	57,760	59,730	61,597	63,338
Balance (in € million)	2,904	8,395	13,686	-1,655	-6,217	-13,920	-3,193

Source: Dullien, 2007.

Table 6. Unemployment reinsurance with the possibility of extended benefits, single triggers

	1999	2000	2001	2002	2003	2004	2005
Benefit payments							
Number of short-term unemployed (in 1000)	8,049	7,216	6,727	7,849	8,454	8,661	8,140
Assumed number of short-term unemployed (in 1000)	4,025	3,608	3,363	3,925	4,227	4,331	4,070
Nominal wage per employed (in € 1000 /year)	32	32	33	34	35	36	37
Assumed amount of benefit (in € 1000/year)	13	13	13	14	14	14	15
Standard benefits (in € million)	50,727	46,714	44,733	53,643	59,394	62,394	59,760
Supplementary benefits (in € million)	0	0	0	0	27,322	28,499	0
Total benefit payments (in € million)	50,727	46,714	44,733	53,643	89,091	93,591	59,760
Contributions (2.04 % of the wage bill)							
Number of employed (in 1000)	107,817	110,687	112,459	113,506	114,307	115,079	116,155
Assumed average tax base (in € 1000)	25	26	27	27	28	29	29
Total contributions (in € million)	55,500	58,532	61,086	63,361	65,601	67,717	69,659
Balance (in € million)	4,773	11,818	16,354	9,718	-23,491	-25,874	9,899

Source: Dullien, 2007.

Table 7. Scenario A

	Benefit payments			ntributions (1.66 % of the wage		
	Number of short-term unemployed (in million)	Assumed number of short-term unemployed (in € million)	Total benefit payments (€ billion)	Number of employed (in million)	Total contributions (in € billion)	Balance (in € billion)
1995	5.94	3.41	38.0	102.7	37.50	-0.6
1996	6.36	3.60	41.1	103.4	38.60	-2.4
1997	6.28	3.27	38.0	104.7	39.80	1.8
1998	6.17	3.30	38.5	106.9	41.10	2.7
1999	5.84	3.41	40.8	109.5	43.50	2.7
2000	5.21	3.37	41.4	112.4	45.80	4.4
2001	4.72	3.45	43.4	114.2	47.80	4.4
2002	5.56	4.17	53.4	115.5	49.60	-3.8
2003	5.90	3.91	51.5	116.3	51.30	-0.3
2004	6.07	3.77	51.4	117.1	52.70	1.3
2005	5.79	3.65	50.4	118.4	54.40	4.0
2006	5.29	3.61	51.2	120.4	56.60	5.5
2007	4.90	3.72	53.8	122.7	59.20	5.4
2008	5.48	4.43	65.2	123.9	61.70	-3.6
2009	7.60	5.85	88.0	121.8	61.80	-26.3
2010	7.17	3.75	58.1	121.3	62.50	4.4
2011	6.76	3.82	59.5	121.6	64.10	4.6

Source: Dullien, 2013.

Unemployment insurance with the possibility of extended benefits (single trigger for all selected countries)

The same applies as in the second scenario (B 2), except that the trigger is defined and uniform at the EU level (ten selected countries). The trigger is activated when the average unemployment rate in the EU increases by 0.5 percentage points compared to the average of the last three years. It would be activated in 2003 and 2004. Again, assumptions need to be defined. In this case, too, Dullien assumes that the number of short-term unemployed eligible for additional benefits is 75% of all short-term unemployed. The financial volume in this case is very similar to the previous scenario and amounts to EUR 62.6 billion per year (a total of EUR 438 billion), which means 2.04% of the wage bill. This represents approximately 0.87% of GDP (ten selected countries in the period 1999-2005). Compared to the first scenario, an additional EUR 61 billion would be paid (Table 6).

A3. Dullien (2013)

Dullien (2013) presents a possible reinsurance in the case of unemployment, in which, compared to the previous research (Dullien 2007), the possibility of redistribution of funds between countries is envisaged. Net transfers and stabilization properties of reinsurance in the case of unemployment in EMU are analyzed by

taking into account the following assumptions: (i) all employees in EMU are insured; they contribute part of their income, up to a certain threshold, which is related to the average income in each country; (ii) the average insured income is 80 per cent of the average income in each country; (iii) the compensation is 50 per cent of the insured income; (iv) throughout the cycle, contributions to the scheme are sufficient for all payments; (v) unemployment reinsurance can build up reserves and borrows capital in the capital market; and (vi) unemployment benefits are paid for 12 months.

In his research, Dullien (2013) presents simulations for the EU (12 selected countries) in the period 1995–2011 for two different scenarios. The main difference between scenarios A and B is the number of aid recipients (beneficiaries).

Model / scenario A

All short-term unemployed in the last 12 months and 3% of all unemployed are entitled to receive unemployment reinsurance benefits. The financial volume is EUR 868 billion, namely 1.66% of the wage bill of 12 selected countries. The amount of benefits paid is EUR 863.7 billion, the balance of the whole period being EUR 4.2 billion (Table 7).

The net cash flow of unemployment reinsurance in the EMU in the period 1995–2011 (as a percentage of GDP per country) is shown below; negative figures represent the aid received (Table 8).

Table 8. Net cash flow (as a percentage of GDP per country), scenario A

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Austria	-0.75	-0.10	0.08	-0.07	0.08	0.06	0.08	-0.23	0.08	0.07	0.05	0.07	0.07	0.07	-0.15	0.08	0.07
Belgium	0.07	-0.01	0.07	0.06	0.05	0.07	0.03	-0.05	-0.13	0.07	-0.03	0.06	0.07	0.07	-0.12	0.06	0.07
Finland	-1.86	-0.13	-0.10	0.06	0.06	0.06	0.06	-0.08	0.00	0.06	0.06	0.06	0.06	0.06	-0.31	0.07	0.06
France	0.07	-0.12	0.07	0.07	-0.02	0.07	0.07	0.01	0.07	-0.01	0.07	0.07	0.07	0.07	-0.25	0.07	0.07
Greece					-0.06	0.04	0.04	0.03	0.05	-0.08	0.05	0.04	0.05	0.05	-0.29	-0.23	-0.39
Ireland	0.06	0.02	0.05	0.05	0.05	0.05	0.05	-0.06	0.05	0.04	0.02	0.05	0.02	-0.15	-1.06	0.06	0.06
Italy	0.04	0.05	0.05	0.05	0.05	0.05	0.05	-0.02	0.05	0.05	0.05	0.06	0.06	-0.04	-0.10	0.06	0.06
Luxembourg	0.05	0.00	0.05	0.04	0.04	0.03	0.04	-0.07	-0.04	-0.12	0.04	-0.01	0.03	0.01	-0.09	0.04	-0.05
Germany	0.07	-0.03	0.00	0.07	0.07	0.07	0.06	-0.07	-0.05	0.02	0.03	0.06	0.06	0.06	-0.07	0.07	0.07
Netherlands	-0.06	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-0.10	-0.11	0.08	0.08	0.08	0.08	-0.14	-0.09	0.08
Portugal	0.06	0.06	0.06	0.06	0.02	0.06	0.04	-0.07	-0.25	0.06	-0.01	0.06	-0.03	0.06	-0.25	0.07	-0.29
Spain	0.07	-0.14	0.07	0.01	0.07	0.07	0.07	-0.23	-0.03	0.05	0.07	0.07	0.05	-0.63	-1.28	0.07	0.06

Source: Dullien, 2013.

Table 9. Scenario B

	Benefit payments		ontributions (0.65 % of the wage bi			
	Number of short-term unemployed (in million)	Assumed number of short-term unemployed (in million)	Total benefit payments (in € billion)	Number of employed (in million)	Total contributions (in € billion)	Balance (in € billion)
1995	5.94	1.61	17.2	102.7	14.8	-2.5
1996	6.36	1.72	19.0	103.4	15.2	-3.8
1997	6.28	1.44	16.0	104.7	15.7	-0.4
1998	6.17	1.38	15.1	106.9	16.2	1.1
1999	5.84	1.40	16.3	109.5	17.1	0.9
2000	5.21	1.21	14.5	112.4	18.0	3.5
2001	4.72	1.13	13.7	114.2	18.8	5.1
2002	5.56	1.71	21.3	115.5	19.5	-1.8
2003	5.90	1.57	20.1	116.3	20.2	0.1
2004	6.07	1.48	19.8	117.1	20.8	1.0
2005	5.79	1.35	18.2	118.4	21.4	3.2
2006	5.29	1.20	16.6	120.4	22.3	5.7
2007	4.90	1.13	15.9	122.7	23.3	7.4
2008	5.48	1.73	24.4	123.9	24.3	-0.1
2009	7.60	3.33	48.9	121.8	24.3	-24.6
2010	7.17	1.68	25.1	121.3	24.6	-0.5
2011	6.76	1.66	24.2	121.6	25.2	1.0

Source: Dullien, 2013.

Table 10. Net cash flow (as a percentage of GDP per country), scenario B

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Austria	-0.51	-0.02	0.11	-0.02	0.10	0.11	0.13	-0.15	0.09	0.12	0.10	0.13	0.13	0.15	-0.06	0.12	0.14
Belgium	0.10	0.06	0.12	0.12	0.11	0.13	0.12	0.03	-0.07	0.09	0.00	0.09	0.09	0.11	-0.08	0.07	0.07
Finland	-1.66	-0.31	-0.30	-0.16	-0.14	-0.11	-0.09	-0.20	-0.15	-0.1	-0.08	0.02	0.04	0.06	-0.30	0.00	0.02
France	-0.03	-0.17	-0.02	0.00	-0.08	0.01	0.06	0.02	0.07	-0.01	0.06	0.09	0.09	0.11	-0.21	0.05	0.07
Greece					-0.13	-0.05	-0.03	-0.03	-0.02	-0.11	0.00	0.00	0.02	0.03	-0.30	-0.32	-0.55
Ireland	0.01	0.01	0.05	0.07	0.08	0.10	0.12	0.01	0.10	0.10	0.09	0.12	0.10	-0.07	-1.03	-0.14	-0.08
Italy	-0.03	-0.01	0.00	0.00	0.01	0.03	0.04	0.01	0.07	0.07	0.08	0.08	0.10	0.01	-0.07	0.06	0.06
Luxembourg	0.19	0.08	0.12	0.18	0.12	0.11	0.13	0.03	0.04	-0.06	0.06	0.04	0.07	0.05	-0.05	0.05	-0.01
Germany	0.09	0.01	0.01	0.07	0.09	0.11	0.12	-0.02	-0.02	0.02	0.02	0.05	0.08	0.11	-0.01	0.10	0.12
Netherlands	0.03	0.14	0.17	0.18	0.22	0.23	0.23	0.23	0.05	0.01	0.15	0.17	0.20	0.22	0.02	0.02	0.16
Portugal	0.10	0.11	0.12	0.14	0.11	0.14	0.13	0.03	-0.18	0.07	0.02	0.09	0.00	0.08	-0.23	0.02	-0.33
Spain	-0.33	-0.44	-0.25	-0.26	-0.18	-0.12	-0.10	-0.32	-0.16	-0.09	-0.06	-0.01	0.00	-0.68	-1.51	-0.43	-0.39

Source: Dullien, 2013.

Model / scenario B

All short-term unemployed in the last 12 months and 20% of the remaining short-term unemployed are entitled to receive unemployment reinsurance benefits. The financial volume in this case is EUR 341.7 billion, which means 0.65% of the wage bill of the 12 selected countries. The amount of benefits paid is EUR 346.3 billion, which means that the balance of the whole period is negative (EUR -4.7 billion) (Table 9).

The net cash flow of unemployment reinsurance in the EMU in the period 1995–2011 (as a percentage of GDP per country) is shown below; negative figures represent the aid received (Table 10).

In the event of a prolonged and severe recession, triggers would be activated to temporarily extend the period for receiving compensation. The idea of "extended benefits" with automatic triggers, which extend the period of receiving compensation during an economic recession, makes special sense. From a European perspective aimed at a high degree of stabilization, these triggers need to be set more generously than they are currently set in the US. In addition, the tradition of "extraordinary benefits" (temporarily extending the period for receiving compensation by order) allows for discretionary fiscal policy, which is very effective as it is aimed at those with a high propensity to spend and can be introduced virtually overnight. Dullien (2007) presents two trigger identification options identified at the EU level: (i) a large increase in unemployment across the EU or (ii) a large increase in country-specific unemployment relative to the EU unemployment rate. A euro area-based supplementary benefit scheme, providing benefits only in connection with certain triggers, would not provide stabilization under normal circumstances, but could increase the efficiency of national unemployment reinsurance systems in the event of severe economic crises.

B. Stabilizing power and efficiency of models

In the previous sections, we present the basic principles of operation, structure and effects of models as well as triggers, and below the stabilizing power and efficiency of reinsurance systems in the case of unemployment.

B1. Stabilizing power

The positive impact of the system varies greatly between countries, and the impact of stabilization is considerable in many of them. Due to a number of serious recessions in a relatively large number of countries, stabilization is all the more obvious.

Dullien (2013) notes that in the existing literature, findings about the possible stabilizing effects of reinsurance in the case of unemployment in the US are highly controversial. Most research has been conducted for the U.S. Federal-state unemployment reinsurance system however, their findings seem to vary. While some authors, such as von Hagen (1992) and Asdrubali, Sorensen and Yosha (1996), argue that the stabilizing effect is very low, other simulation studies show a much greater effect, e.g. Chimerine, Black, and Coffey (1999) estimate the overall stabilizing effect of reinsurance for unemployment in the U.S. at between 15% and 20% of the initial GDP reduction, and Vroman (2010) notes that the stabilizing effect is nearly 30 percent, of which - depending on measurement methods - up to half can be attributed to the federal system for extended benefits and emergency unemployment benefits, and the rest to federal unemployment insurance.

Different methodologies are used in the research, so they are not completely comparable. Three main differences may explain the large differences in evaluation of the impact of stabilization: von Hagen (1992) and Asdrubali, Sorensen and Yosha (1996) examined the stabilizing effect throughout the business cycle and thus analyzed the average stabilization, while Chimerine, Black and Coffey (1999), and Vroman (2010) focused on the impact over the period of recession, which can be understood as a stabilization analysis at the time when it is needed the most. Since unemployment tends to rise sharply during periods of recession and consequently higher unemployment reinsurance payments can be detected in such periods only, it is logical that stabilization analysis during a recession will show a greater effect than an average stabilization analysis (Dullien, 2013).

Dolls et al. (2014) quantify the potential effects of the euro area unemployment reinsurance system on GDP. They follow the Congressional Budget Office (2012) and undertake a series of assessments of how the additional EUR spent on unemployment benefits would impact the GDP. This fiscal multiplier is assumed to be in the range between 0.5 and 1.5, which is also consistent with the evidence from the research (Ramey, 2011). They show the effects of the euro area unemployment reinsurance system on GDP on the assumption that pre-crisis public unemployment reinsurance systems would be replaced by a single euro area unemployment reinsurance system (Table 11). In other words, they compare the stabilizing effects of the single euro area unemployment reinsurance system with pre-crisis national unemployment insurance systems (policy changes introduced during the crisis are also considered). The results show that the effects on growth in the euro area would be moderate and increase the GDP by up to 0.2% in 2009 and up to 0.08% in 2012. In all other years, the reinsurance system in the case of unemployment in the euro area would not cause additional growth effects at the EMU level. Results vary at country level.

Dullien (2007) calculates the stabilizing power as a change in the production gap (Table 12). Column (1) shows the change in the output gap in that period as a percentage of GDP, columns (2), (3) and (4) the change in the unemployment reinsurance balance as a percentage of GDP for individual scenarios, and columns (5), (6) and (7) the reduction of the output gap in the presence of unemployment reinsurance for an individual scenario.

The operation of unemployment reinsurance as an automatic stabilizer in the case of the baseline scenario would reduce the output gap in the selected ten countries by 5% in the selected period. In the second scenario, it is not possible to calculate the overall reduction of the output gap in the selected period for the selected ten countries, as data for the Netherlands are not available. Nevertheless, we can conclude that e.g., Germany would narrow its inflation gap by 20% and Belgium and France by more than 15%. In the third scenario, the output gap in the selected period would be reduced by an average of 16% for the selected ten countries (this is approximately 70% more than reinsurance in the case of unemployment in the USA over the same period). Spain would reduce the output gap by 40%, and Germany, Belgium and France by more than 15%.

Table 11. Potential effects of reinsurance system in the euro area on GDP (as a percentage of GDP per country)

Year	2009			2010			2011			2012			2013		
Multiplier	0.5	1.0	1.5	0.5	1.0	1.5	0.5	1.0	1.5	0.5	1.0	1.5	0.5	1.0	1.5
EMU	0.07	0.13	0.20	0	0	0	0	0	0	0.03	0.06	0.08	0	0	0
Austria	0.03	0.06	0.09	0	0	0	0	0	0	0.01	0.02	0.03	0.01	0.02	0.03
Belgium	0.03	0.06	0.09	0	0	0	0	0	0	0.03	0.06	0.09	0.02	0.04	0.07
Estonia	0.63	1.25	1.88	0	0	0	0	0	0	0	0	0	0	0	0
Finland	0.05	0.09	0.14	0	0	0	0	0	0	0.01	0.03	0.04	0.01	0.02	0.03
France	0.04	0.08	0.12	0	0	0	0	0	0	0.02	0.04	0.06	0	0	0
Germany	0.04	0.07	0.11	0	0	0	0	0	0	0	0	0	0	0.01	0.01
Greece	0.13	0.27	0.40	0.08	0.16	0.24	0.13	0.26	0.39	0.02	0.04	0.06	0	0	0
Ireland	0.25	0.50	0.75	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0.04	0.09	0.13	0	0	0	0	0	0	0.14	0.28	0.42	0.01	0.02	0.04
Luxembourg	0.02	0.04	0.06	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	0.04	0.08	0.12	0	0	0	0	0	0	0.03	0.06	0.08	0.04	0.08	0.12
Portugal	0.11	0.22	0.33	0	0	0	0.05	0.11	0.16	0.04	0.09	0.13	0	0	0
Slovenia	0.12	0.24	0.36	0	0	0	0	0	0	0	0	0	0.05	0.11	0.16
Spain	0.21	0.41	0.62	0	0	0	0	0	0	0.03	0.06	0.09	0	0	0

Source: Dolls et al. 2014.

Table 12. Stabilizing power as a change in the production gap

Country	(1)	(2)		(3)	(4)	(2) as % of (1)	(3) as % of (1)	(4) as % of (1)
	Change in the production gap in % GDP (period)	Change in the unemployment insurance balance in % GDP (period)				Reduction of the output gap		
		Basic EUI	EUI with the possibility of extending the period of receiving the benefit; triggers are set for each country	EUI with the possibility of extending the period of receiving the benefit; the trigger is uniform for all selected countries	Basic EUI	EUI with the possibility of extending the period of receiving the benefit; triggers are set for each country	EUI with the possibility of extending the period of receiving the benefit; the trigger is uniform for all selected countries
Euro zone	-3.5 (2000-2005)	-0.17 (2001-2004)		-0.56 (2001-2004)	4.9%		16.0%
Austria	-3.5 (2000-2005)	-0.16 (2001-2002)	-0.47 (2001-2002)	-0.37 (2001-2003)	4.6%	13.4%	10.6%
Belgium	-3.3 (2000-2005)	-0.23 (2001-2003)	-0.56 (2001-2003)	-0.56 (2001-2003)	7.0%	17.0%	17.0%
Finland	-4.3 (2000-2004)	-0.1 (2000-2001)	-0.11 (2000-2001)	-0.56 (2000-2003)	2.3%	2.6%	13.0%
France	-3.2 (2000-2005)	-0.11 (2001-2004)	-0.53 (2001-2004)	-0.53 (2001-2004)	3.4%	16.6%	16.6%
Italy	-3.5 (2001-2005)	-0.04 (2001-2002)	-0.04 (2001-2002)	-0.25 (2001-2003)	1.1%	1.1%	7.1%
Germany	-4 (2000-2005)	-0.32 (2001-2005)	-0.8 (2001-2005)	-0.73 (2001-2004)	8.0%	20.0%	18.3%
Netherlands	-5.6 (2000-2005)						
Portugal	-5.7 (2000-2006)	-0.37 (2000-2003)	-0.66 (2000-2005)	-0.73 (2000-2003)	6.5%	11.6%	12.8%
Spain	-2 (2000-2005)	-0.21 (2001-2003)	-0.22 (2001-2003)	-0.83 (2001-2003)	10.5%	11.0%	41.5%

Source: Dullien 2007.

In his second study, Dullien (2013) determined a macroeconomic multiplier of unemployment benefits paid from the European system. Its value was set at 1. Generally, a higher multiplier can be expected from unemployment reinsurance payments, as documented by the Congressional Budget Office (2012) and Zandi (2008), and it can also be reflected in the International Monetary Fund, in a multi-country macroeconomic model (Freedman et al., 2009).

Table 13. Stabilizing power as a change in net cash flows

Country	Scenario A; Net cash flow in € billion, 1995-2011	Scenario B; Net cash flow in € billion, 1995-2011
Austria	-5.0	2.1
Belgium	1.1	3.1
Finland	-1.6	-3.9
France	7.7	3.2
Greece	-1.6	-3.1
Ireland	-1.3	-0.9
Italy	7.2	7.4
Luxembourg	0.0	0.2
Germany	11.2	21.1
Netherlands	1.8	11.3
Portugal	-0.6	0.2
Spain	-17.4	-45.5

The stabilizing power of the models is presented as a change in the EU unemployment reinsurance contributions / payouts (as a percentage of GDP), as a share of change in the output gap.
Source: Dullien, 2013.

Table 14. Comparison of stabilizing power (scenarios A and B)

Country	Period of active absorption from Fund	Scenario A; Change of in-payments/out-payments of the EU unemployment insurance (in % GDP)	Scenario B; Change of in-payments/out-payments of the EU unemployment insurance (in % GDP)	Change in the production gap (in percentage points)	Scenario A; Stabilization power	Scenario B; Stabilization power
Austria	2001-2	-0.30	-0.28	-0.5	55.8	51.7
Austria	2008-9	-0.23	-0.21	-4.8	4.7	4.4
Belgium	2001-3	-0.16	-0.19	-1.6	10.1	12.1
Belgium	2008-9	-0.19	-0.18	-3.9	4.9	4.8
Finland	2001-2	-0.15	-0.11	-1.5	9.8	7.8
Finland	2008-9	-0.37	-0.36	-9.4	3.9	3.8
France	1995-6	-0.19	-0.15	-0.7	26.3	20.1
France	2008-9	-0.32	-0.32	-4.2	7.7	7.6
Greece	2001-2	-0.01	0.00	-1.3	0.8	0.2
Greece	2008-11	-0.44	-0.57	-11.6	3.8	4.9
Ireland	2007-9	-1.08	-1.14	-7.7	14.0	14.8
Italy	2001-2	-0.07	-0.04	-0.9	7.7	3.9
Italy	2008-9	-0.10	-0.10	-5.3	1.8	1.8
Germany	2001-3	-0.11	-0.14	-3.0	3.7	4.7
Germany	2008-9	-0.13	-0.12	-5.9	2.2	2.1
Netherlands	2002-4	-0.19	-0.23	-1.1	18.0	21.7
Portugal	2001-3	-0.28	-0.31	-3.8	7.5	8.2
Portugal	2008-9	-0.31	-0.30	-2.9	10.5	10.2
Spain	2007-9	-1.33	-1.51	-6.3	21.3	24.0

Source: Dullien, 2013.

However, for the European system, the proposed multiplier would work in a slightly different way. Since E (M) U unemployment reinsurance replaces (a part of) costs of individual countries, it allows governments to spend their resources differently. Since it is not clear from the outset how state governments will use this degree of freedom, the actual multiplier could be less than just targeted transfers. Therefore, multiplier 1 seems to be an appropriate estimate. Dullien (2013) demonstrates the stabilizing power based on net cash flows of unemployment reinsurance for EMU in the period 1992-2011 (in EUR billion) (Table 13).

The period under study is 1995–2011, and only periods of recession are presented for the calculation of stabilizing power (the year before the recession until the end of the recession).

While the positive impact of the system varies greatly between countries, we can conclude that the impact of stabilization in many countries would also be significant due to a number of serious recessions in a relatively large number of countries (Table 14). In many cases, where stabilization has been weak, macroeconomic data need to be analyzed in more detail. The EMU unemployment system would not provide greater stabilization during the Great Recession of 2008 and 2009 in Germany. However, this is because the German labor market did not deteriorate much in this recession and the initial reduction in the output gap quickly returned to previous levels. In this case, the disproportionate fall in GDP in the face of rising unemployment explains the low stabilizing value.

B2. Efficiency

The EU countries have not applied fiscal policy effectively to stabilize the economic cycle, while unemployment reinsurance would act as an automatic stabilizer, thus contributing to a faster way out of the recession. Moreover, the fiscal policy of the EU countries operated cyclically (instead of counter

cyclically) at best. As an elegant solution to achieve greater economic stability in the EU, Dullien (2013) proposes a more centralized management of fiscal policy and the introduction of unemployment reinsurance.

With the onset of the recession in 2008, the EU has taken important steps to prevent and manage macroeconomic imbalances, but did nothing to strengthen the European unemployment insurance system. During the recession, it took certain measures to stabilize the economic cycle (prevention and management of macroeconomic imbalances). Among the measures, the following is mentioned in particular (ibid.): (I) closer monitoring of member states' budgets; (ii) stricter rules / measures in the event of government deficits; (iii) the long-term sustainability of public finances; (iv) management of state-owned enterprises and privatization; (v) greater labor market flexibility and reduction of undeclared work and employment. These measures, in his opinion, are going in the right direction, but the URS EU would contribute to a faster exit from the recession much more effectively.

Unemployment insurance at the EU level can be introduced without causing large and permanent transfers between countries and in such a way that possible stabilization would benefit all countries. The authors note that the reinsurance system for unemployment in the euro area could be implemented with a relatively small budget and, on the other hand, with a relatively large stabilizing power (from 2 to 16% reduction of the output gap).

IV ANALYSIS OF UNEMPLOYMENT INSURANCE SYSTEMS IN EUROPEAN COUNTRIES

The starting points for the analysis and the analysis of contributions and payouts of unemployment insurance systems in the EU 20 countries (2003-2019) are presented below. The basic elements that determine the operation of an individual system are described. We have examined and described the rules and operation of unemployment insurance systems of individual EU 20 countries in the period under study (2003-2019). We originally wanted to include the EU - 27 countries in the analysis. After reviewing the available data and national unemployment insurance systems, seven countries were excluded (Greece, Ireland, Lithuania, Luxembourg, Malta, Romania and the United Kingdom) since they were not suitable for consideration in the model simulation due to the diversity of contribution and expenditure systems (e.g., in the United Kingdom, Ireland and Malta, unemployment insurance contributions are not based on the previous salaries of the unemployed). The descriptions of individual countries show their heterogeneity. We found that countries differ in characteristics of unemployment insurance, as well as in fluctuations in the unemployment rate, the unemployment insurance balance and the dynamics of economic growth, which is presented in the section - Heterogeneity of unemployment insurance systems in the EU.

A. Starting points for the analysis and basic findings

Unemployment insurance provides compensation for loss of income due to involuntary unemployment. In some EU countries, unemployment insurance schemes are independent of other social security measures and may be closely linked to employment services (Claeys and Wolff, 2014). In other countries, unemployment insurance schemes are included in social security measures, which also cover other short-term risks, although even in such cases employment services can check whether a person is unemployed and provide job search assistance (Euzéby, 2010).

Unemployment insurance schemes exist in industrialized countries mostly. They are mandatory and broad-based. Some EU countries restrict assistance to unemployed people who do not meet the conditions. In many countries, in addition to unemployment insurance, which provides unemployment benefits, government organizations or employers provide grants to the unemployed. Other countries provide unemployed people with individual accounts on which funds paid in the form of severance pay are collected. The value of the latter is the value of the accumulated capital in an individual's account. In addition, in many cases, employers must provide severance pay to redundant workers (Blanchard, 2006).

Unemployment insurance is a key instrument for managing labor market risk. During the period of temporary unemployment, it enables the insurance of an individual's income and offers' assistance during longer periods of unemployment. From a macroeconomic point of view, unemployment benefits play the role of an automatic stabilizer for the whole economy, as they increase the purchasing power of unemployed people in times of economic recession (Dolls et al., 2014). On the other hand, several authors have found that unemployment benefits reduce the efficiency of the labor market since (i) due to the moral hazard, reduce the willingness of the unemployed to work, which leads to suboptimal intensity of job search (Rothstein, 2011), (ii) possible unemployment and inactivity traps are linked to the tax and social system (Schmieder et al., 2012), and there is also (iii) a decrease in the employability of unemployed people receiving long-term unemployment benefits (Van Ours and Vodopivec, 2006).

Unemployment insurance schemes vary significantly across the EU, particularly for the following items: (i) eligibility to unemployment benefits, (ii) the amount of unemployment benefits, (iii) the duration of unemployment benefits, (iv) the sources of funding for unemployment insurance and (v) the administration of the unemployment insurance scheme (Davies and Hallet, 2001).

Approximately half of the compulsory unemployment insurance schemes include the majority of employees, regardless of the type of industry.

Coverage under the remaining programs is limited to workers in industry and commerce. Certain countries exclude unemployed persons who earned more than a certain amount before unemployment (Brunila et al., 2003). There are also special regulations in certain countries governing the situation of temporary and seasonal workers. Several countries have introduced special programs for the unemployed, aimed at specific occupations. The most typical are construction workers, railway and port workers and seafarers. Voluntary unemployment insurance schemes are limited to economic activities in which trade unions open accounts to collect funds for the unemployed. Membership in these funds is usually mandatory for union members and may be available to other non-union employees. Uninsured workers, such as fresh graduates and the self-employed who become unemployed may be eligible for state-subsidized assistance (Fath and Fuest, 2005). The statutory contribution rate for unemployment insurance is reasonably high only in a small part of the EU. In EU countries, unemployment insurance is regulated in each member state. Insurances differ according to (i) eligibility to benefits, (ii) reference period, (iii) required minimum period of employment, (iv) duration of benefit period (coverage), (v) amount of benefits and (vi) contribution rate. On the one hand, it concerns the expenditure of unemployment insurance intended for the payment of benefits, and on the other hand, the sources of financing of unemployment insurance. Some EU member states are more generous with unemployment insurance, compared to the others.

In the long run, it is important that the expenditure and sources of financing unemployment insurance are equal. If the expenditures are greater than the sources of financing, the countries cover the difference from the state budget. Sources of funding are determined by the statutory contribution rate, which in most countries is set so as not to cover all expenditure. This means that countries cover the difference from the state budget.

In principle, EU countries experienced a financial and economic crisis in the same period (2009-2011), but the crisis in some countries was more pronounced and prolonged, as shown by the unemployment rate. The recession is having a knock-off effect, as increased unemployment leads to lower growth and falling consumption, which is affecting companies to lay off workers due to losses. A recession occurs when GDP growth is negative for two or more consecutive quarters. In other words, economic growth slows during recession. If the economy is experiencing a period of recession, this is reflected in the high (increased) unemployment rate and decline in (Carlberg, 2012) (i) company sales and revenues, (ii) price of securities and (iii) incomes.

With a high unemployment rate, unemployment insurance expenditure increases - expenditure is synchronized with the unemployment rate. During a period of recession, the unemployment rate increases, which also increases the number of benefit recipients. Individuals who were already unemployed before the recession find it difficult to get a new job as well, as companies in principle do not hire during the recession, but rather lay off employees due to reduced sales and lower revenues. This extends the coverage period of the unemployed, as they are unable to find new employment. An increase in the number of unemployed and an extension of the period of unemployment coverage leads to an increase in unemployment insurance expenditure.

B. Analysis of benefits and costs by EU 20 countries (2003-2019)

Below - Table 15, we show the difference between the statutory and equilibrium contribution rates (as a percentage) of unemployment insurance schemes in European countries (EU 20) - a hypothetically calculated equilibrium contribution rate at which the balance was zero in 2003-2019. The descriptions are obtained from the databases of Eurostat (2017) and the Mutual Information System on Social Protection (MISSOC, 2020) and summarize the situation on 1 July 2020. The analysis shows the heterogeneity of countries.

Table 15. Difference between statutory and equilibrium contribution rate (in percent)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Austria	0.017	0.016	0.017	0.020	0.019	0.017	0.016	0.018	0.018	0.017	0.015	0.014	0.014	0.015	0.017
Belgium	-0.038	-0.038	-0.035	-0.033	-0.034	-0.036	-0.037	-0.035	-0.034	-0.033	-0.031	-0.028	-0.026	-0.024	-0.022
Bulgaria	-0.021	-0.017	-0.012	-0.008	-0.007	-0.007	-0.008	-0.009	-0.012	-0.012	-0.010	-0.007	-0.006	-0.005	-0.004
Cyprus	0.043	0.043	0.044	0.047	0.046	0.043	0.039	-0.013	-0.017	-0.017	-0.014	-0.009	-0.006	-0.003	0.000
Czech Rep.	0.005	0.004	0.004	0.004	0.001	-0.005	-0.006	-0.004	-0.003	-0.003	-0.004	-0.004	-0.003	-0.002	-0.001
Denmark	0.004	0.011	0.021	0.029	0.029	0.023	0.016	0.013	0.014	0.015	0.017	0.020	0.022	0.024	0.026
Estonia	0.009	0.010	0.005	0.004	-0.006	-0.014	0.015	0.021	0.024	0.013	0.014	0.014	0.006	0.004	0.004
Finland	-0.041	-0.033	-0.026	-0.022	-0.031	-0.036	-0.034	-0.029	-0.028	-0.032	-0.037	-0.050	-0.047	-0.034	-0.027
France	-0.009	-0.005	-0.001	0.004	0.003	0.000	-0.002	-0.002	-0.002	-0.003	-0.004	-0.005	-0.004	-0.001	0.003
Italy	-0.017	-0.015	-0.013	-0.012	-0.017	-0.022	-0.026	-0.028	-0.030	-0.032	-0.031	-0.029	-0.027	-0.026	-0.024
Latvia	0.005	0.005	0.007	0.007	0.002	-0.005	0.012	0.005	0.000	0.001	0.001	0.003	0.007	0.007	0.006
Hungary	0.016	0.014	0.014	0.034	0.014	0.007	-0.017	-0.016	0.014	-0.023	-0.023	-0.022	-0.020	-0.016	-0.010
Germany	-0.003	0.002	0.012	-0.003	-0.011	-0.016	-0.015	-0.008	-0.004	-0.003	-0.002	-0.001	0.001	0.002	0.002
Netherlands	0.020	0.022	0.041	0.042	0.043	0.000	-0.002	-0.002	-0.004	-0.031	-0.032	-0.030	-0.027	-0.023	-0.020
Poland	-0.011	-0.008	-0.006	-0.003	-0.001	-0.001	0.002	0.003	0.004	0.004	0.004	0.005	0.007	0.009	0.012
Portugal	0.012	0.011	0.012	0.014	0.011	0.007	0.004	0.002	0.000	-0.002	0.000	0.004	0.009	0.014	0.018
Slovenia	0.008	0.007	0.006	0.004	0.001	-0.002	-0.003	-0.001	0.001	0.003	0.005	0.005	0.005	0.005	0.006
Slovakia	-0.011	-0.011	-0.009	-0.008	-0.010	-0.014	-0.019	-0.020	-0.020	-0.019	-0.017	-0.014	-0.012	-0.011	-0.010
Spain	0.028	0.027	0.027	0.022	0.011	-0.003	-0.012	-0.014	-0.012	-0.008	0.001	0.010	0.016	0.019	0.020
Sweden	-0.023	-0.014	-0.008	0.001	0.007	0.006	-0.018	0.000	-0.020	-0.021	-0.019	-0.016	-0.013	-0.010	-0.009

Source: Own calculation.

We find that the statutory contribution rate for unemployment insurance is sufficiently high only in a small part of the EU. Only certain insurance systems are sustainable, which means that the statutory contribution rate is equal to or higher than the calculated equilibrium contribution rate. The collected unemployment insurance contributions do not cover all expenditures, which means that countries cover the difference from the state budget.

After examining and describing unemployment insurance in the EU 20, we can conclude that unemployment insurance systems in the EU 20 vary widely, particularly for the following items: (i) eligibility to unemployment benefit, (ii) amount of unemployment benefit, (iii) duration of unemployment benefit, (iv) source and amount of unemployment insurance financing, and (v) administration of the insurance scheme in case of unemployment. In addition to the examined characteristics of unemployment insurance, countries also differ in terms of fluctuations in the unemployment rate, balance of unemployment insurance and the dynamics of economic growth.

V DISCUSSION AND IMPLICATIONS FOR MANAGEMENT AND ECONOMIC POLICY RECOMMENDATIONS FOR THE INTRODUCTION OF THE URS EU

The response to unemployment in the great recession and subsequent events related to the European debt crisis has been very heterogeneous across Europe and in population groups. The dispersion of unemployment rates in individual EU countries reached a historic high in 2014. The unemployment rate across countries varied according to three patterns (Boeri and Bruecker, 2011). One sample represents a group of countries where unemployment in the rate and distribution among socio-demographic groups remained relatively stable throughout the period, e.g., Austria, Belgium, Germany and Sweden. The second sample is a group of countries with a slight increase in unemployment. The latter was fairly unevenly distributed across socio-demographic groups. The third sample is represented by countries where unemployment has risen sharply and affected young workers the most, e.g., Cyprus, Portugal and Spain). Asymmetric shocks, in terms of size and nature (financial or real), and often combined with institutional differences between countries have been the reasons for the very heterogeneous responses of national labor markets to the great recession. It is difficult to predict a united Europe and the proper functioning of economic and monetary union with such divergences in labor markets between countries and with very limited instruments to insure the risk of unemployment between countries. Knowing the causes of these heterogeneous unemployment responses is very important for a better understanding of labor market dynamics. Experience is also important for assessing a coherent EU policy approach to macroeconomic stabilization and microeconomic conditionality (Boeri and Jimeno, 2016).

Institutional reforms are needed especially in the euro area, as the monetary union reduces macroeconomic stabilization policies at national level. At the same time, the optimal design of institutions is not independent of the basic cyclical conditions (Gnocchi et al., 2015). Policies aimed at reducing unemployment should address the institutional shortcomings that emerged during the crisis and learn from the best (and worst) performers. Boeri and Jimeno (2016) find that some very urgent institutional reforms aimed at restoring competitiveness can cause side effects in severe recessions. If a stabilization policy to reduce the risk of side effects of these reforms is not feasible in the context of monetary union, they believe that there are only two other solutions. On the one hand, institutional reforms need to be implemented as much as possible in better macroeconomic environments. This requires that EU conditionality be strengthened in cyclical periods of growth. On the other hand, labor market institutions should be based on counter-cyclical characteristics, which means that countries affected by asymmetric shocks would have considerable fiscal maneuvering space in the monetary union.

In anticipation of the strengthened role of European transnational institutions in improving the functioning of labor markets, Boeri and Jimeno (2016) offered some proposals for changing the functioning of labor markets. To strengthen the role of the European transnational institutions, they propose greater coherence between the main guidelines for employment policy in the European institutions and the introduction of certain programs at European level. In this regard, they suggest that European employment policy should complement, but not replace the national policies in the field of employment security and unemployment insurance. The proposals should be introduced in the context of positive conditionality, which provides different and probably more effective incentives for national governments to introduce the necessary structural reforms. Finally, they would focus on EU citizens and, if possible, monitor their access to these systems by using the EU Social Security Number, which means that the system would be more transparent and socially acceptable.

We believe that the URS EU would represent a possible solution to the problems outlined in the previous paragraphs. Other authors have come to similar conclusions, e.g., Dullien (2007) presents how strongly fiscal policy works as an optimal stabilization tool in the European Monetary Union (EMU) and how it can be improved. In his research, he showed econometrically that although there are many automatic stabilizers in the EMU, discretionary fiscal policy has neutralized these institutions by making the general stance of fiscal policy cyclical. As a solution, the author proposes an unemployment case system for the whole of EMU.

It would be appropriate to introduce the URS EU in the EU - based on the data examined, it can be argued that the EU needs mechanisms that act as automatic stabilizers, as monetary union at national level reduces the scope of macroeconomic stabilization policies. In the crisis, the EU URS would mitigate the fall in production and increase the level of consumption by increasing the income of the unemployed.

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Environmental Management Accounting: Analysis of Environmental Costs and Decision-Making in the Organisation

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Abstract – Environmental management accounting (EMA) is a relatively new tool in environmental management. EMA can be defined as the identification, collection, estimation, analysis, internal reporting, and use of information regarding materials and energy flow and environmental costs for both conventional and environmental decision-making process within an organisation. Thus, EMA incorporates and integrates two of the three milestones of sustainable development (environmental and economics dimensions), as they relate to an organisation's internal decisional process.

Keywords environmental management accounting, environmental costs, cost management, decisional process

I. INTRODUCTION

There is a stringent need for a sustainable approach regarding the environmental impact of businesses. In addition to initiatives such as reduction of carbon footprint and compliance to environmental regulation, companies need to have a better understanding on the financial impact of their environmental-related actions. This is mostly significant in the context of underestimation of internal environmental costs and reduced productivity [6]. Environmental Management Accounting (EMA) can be regarded as a set of accounting and performance tools dedicated to companies' actions towards improvement of their environmental impact [10]. EMA deals exclusively with the company's internal costs, as it does not include the external costs of individuals, society or the economic environment over which the company has no decision-making power. The main focus of EMA is on environmental costs, due to the fact that it processes information related to the cost of the environment and, also, explicitly deals with information on movement and consumption of material resources and energy. It is straightforward to specify that a company will primarily use EMA for environmental protection activities, but this type of accounting is not limited to this, the output data being used in a variety of management and decisional processes [12].

II. UTILITY AND BENEFITS OF EMA

Decision-makers in an organisation can use physical consumption information and costs provided by EMA to make decisions that impact both the organisation's financial performance and the environment. It is important to note that, while EMA provides support in decision-making, its implementation is not a guarantee of obtaining financial or environmental performance. However, EMA provides useful information to achieve goals referring to cost minimisation and reduction of negative environmental impact [8].

EMA is considered in the context of a company's environmental strategy, being a major vector for identification of economic benefits, improvement of both environmental and economic efficiency, and for revealing key financial data for strategic optimisation [8]. EMA not only presents the cost data needed to estimate the financial impact of these initiatives, but also data on physical consumption (using raw materials and their renewal rates) that help characterise how these initiatives will influence the environment. Among the environmental initiatives that benefit from using EMA are the following [7]:

- Pollution prevention;
- Environmental improvement design;
- Design and estimation on the costs of the life cycle in the environment;
- Management of products movement from an environmental perspective;
- The environmental perspective on procurement and supply chain;
- Responsibility of the product or manufacturer;

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- Environmental-centred management systems;
- Evaluation, testing, and reporting of performance in environmental activities;
- Identification of potential investment opportunities and associated long-term decisions.

However, EMA is not just a tool for managing interaction with the environment among so many others, it is rather a set of principles and methods that provide data on material and energy consumption and costs, indispensable for the success of any activity [9]. In this context, EMA is becoming increasingly important not only for environmental management, but also for other routine managerial activities, such as: design of processes and products; allocation and cost control; capital budgeting; the supply process; price policies; and performance evaluation.

Table 1. Key benefits of EMA

Benefit	Explanation
Improved information support	Separate disclosure of environmental costs (otherwise hidden in the classical accounting systems) will lead to improved information provided to decision-makers, influencing as a result of the increase of profitability
Discovery of new opportunities	While the analysis of environmental costs can identify new opportunities, they can be used to save resources by recycling or re-use
Assistance in the data reporting process	Identification of environmental costs supports organisations in collecting environmental impact data necessary for internal/external reporting
Increased competitive advantage	Due to the early stage of development of environmental management accounting, its use and appropriate publicity can give a competitive advantage to an organisation
Improved organisational image	Efforts to reduce environmental costs constitute valuable image capital
Attracting and motivating staff	By demonstrating that an organisation tries to take into account the effects of its operations on the environment, the organisation attracts better staff, also benefiting from a high employee retention rate
Social benefits	Efforts to reduce costs and influences on the environment (which will lead to a cleaner environment) will generate benefits at the society level

Table 1 presents key benefits of implementing an accounting management system for environmental purposes. Besides the prominent benefits regarding diminished environmental impact (through initiatives such as waste reduction, efficient water usage or reduction in energy consumption), implementation of EMA has the potential to stimulate productivity and improve public perception on the company [1].

Based on the snowball effect, a positive public image and strong reputation generate competitive advantage and the possibility of revenue gains due to consumer preference for purchasing products from companies that are actively engaging in sustainable and environmental-related initiatives [1]. Nevertheless, such initiatives raise employees' awareness on environmental protection and adequate practices, generating improved organisational culture and higher employee retention rate.

III. IMPLEMENTATION OF EMA

Proper identification and collection of physical and financial data enhances decisional process within the company and environmental data are no exception. Environmental accounting brings more information to management by identifying and quantifying measures such as [13]:

- Obligations associated with significant influences on the environment;
- The cost of alignment with the legal provisions in the field;
- The benefits (or cost savings) achieved from the implementation of environmental management systems;
- Economic advantages of other initiatives (effective growth and improvement of business conduct).

A broad view of the steps an organisation needs to take in order to implement an environmental accounting system follows the following algorithm:

Step 1: obtaining the support of higher-level management;
Step 2: defining the limits of the system to be implemented;
Step 3: identification of significant environmental impacts of the organisation;
Step 4: the determination, if any, of the forms of environmental impact already taken into account;
Step 5: the definition of environmental costs;
Step 6: setting up the analysis team;
Step 7: review of the existing accounting system;
Step 8: identification of income or savings opportunities (expenditure reductions) not yet considered;
Step 9: issuing proposals to amend the existing accounting system;
Step 10: testing the environmental management accounting system.

The first step in developing an environmental accounting system is to link environmental management to financial accounting. This is achieved by determining the environmental aspects of the organisation and selecting those that are considered significant and about which managers want information; these are environmental cost objects [9].

Table 2. Example of connection between environmental aspects and environmental costs

Environmental issue	Environmental impact	Potential costs/benefits
Use of electricity	Greenhouse gas emissions; use of non-renewable resources	- activities oriented towards reduction in electricity consumption; - reduction of electricity costs.
Dust	Environmental damage — potential danger for dust to affect the development of photochemical reactions	- fines and penalties from state authorities; - assessment of impact on affected areas; - negative public image.

The identification of significant environmental aspects for environmental accounting will largely depend on the purposes of the old environmental assessment system. Many organisations have, or are in the process of implementing, environmental management systems that focus on the environmental aspects of the company's activity and identifies the resources and results obtained from those activities (Table 2). However, the purpose of a management system that favours environmental accounting may differ somewhat from the model indicated by international environmental management standards, such as ISO14001.

By identifying the associated activities at organisational or company level, the relationship between environmental management and costs becomes more visible. If the activities, and the resources they use, can be quantified by costs, then the costs and the benefits of managing environmental problems are closer to the level of perception of managers [13]. Financial responsibilities and objectives may also be designated.

Unfortunately, traditional accounting methods do not provide the ideal framework for identifying the necessary information, as they generally focus on the costs of the used resources and on their aggregation, without taking into account environmental-related activities. As a result, many actual and potential environmental costs will be 'lost' in indirect costs [7]. For example, the labour cost required to remedy an environmental incident may be included (amalgamated) in a financial accounting system, combined with other labour costs, without being allocated to the specific activities that generated them. If these costs have been generated by the correction of an environmental incident, it is more appropriate to identify and allocate responsibility criteria for their control.

Once environmental cost objects have been identified, one further step is to establish a method for quantifying the cost associated with each of them. Identifying the activities associated with each of cost categories provides the link between what actually happens in the organisation and the costs and revenues generated by the consumption of resources corresponding to each activity [4]. Each activity requires certain resources (work force, vehicles, cleaning materials, etc.), thus comprising a lot of associated costs [3]. Identifying how resources are consumed within the framework of the activity keeping and selecting the most suitable forms of measurement for the resources consumed, an organisation can start to allocate the corresponding costs (resource carriers) on each activity [4]. They are then linked to cost items by identifying the characteristics of the relevant activities for each cost object, selecting the most appropriate measures for the activity concerned (activity measures) [3]. Traditional accounting methods overlook the activities, at best allocate the cost of resources directly to cost objects (such as the cost of labour). Resource carriers and activity measures sometimes require special monitoring.

Implementation of EMA is, in fact, a process where companies start from using a tool for a specific category of data (e.g., water management) and move towards expansion of applicable areas until the company reaches implementation of a comprehensive and well-established system operating with both short-term and long-term data [5].

IV. APPLICABILITY OF ENVIRONMENTAL ACCOUNTABILITY

A more recent use of EMA comes from the increasing adoption of ISO 14000 family of standards regarding environmental management. In the complex process of certification for ISO 14001, EMA provides relevant data on potential approaches to benefits measurement [7].

The first frameworks proposed for environmental management accounting had a series of shortcomings generated, on the one hand, by the fact that environmental accounting includes both monetary and physical elements, and, on the other hand, by the misleading perception regarding the main focus of environmental management [2]. As presented in the previous chapter, EMA pertains to the corporate perspective of environmental costs and, therefore, does not deal with the ecological implications at the society level. The most comprehensive and generally accepted framework for EMA was developed by [2] and includes five dimensions: (1) external and internal, (2) short-term and long-term, (3) monetary and physical, (4) past and future-oriented, and (5) information gathering ad-hoc and as a routine. The framework (presented in Fig. 1) has the major advantage of offering a wide array of accounting tools to use for various purposes, from the operational level (where physical and short-term dimensions are more prominent) to strategic planning (where aggregate, long-term data is preferred) [11].

		Environmental Management Accounting (EMA)			
		Monetary Environmental Management Accounting (MEMA)		Physical Environmental Management Accounting (PEMA)	
		Short-Term Focus	**Long-Term Focus**	**Short-Term Focus**	**Long-Term Focus**
Past Oriented	Routinely generated information	Environmental cost accounting (e.g. variable costing, absorption costing, and activity based costing)	Environmentally induced capital expenditure and revenues	Material and energy flow accounting (short term impacts on the environment – product, site, division and company levels)	Environmental (or natural) capital impact accounting
	Ad hoc information	Ex post assessment of relevant environmental costing decisions	Environmental life cycle (and target) costing Post investment assessment of individual projects	Ex post assessment of short term environmental impacts (e.g. of a site or product)	Life cycle inventories Post investment assessment of physical environmental investment appraisal
Future Oriented	Routinely generated information	Monetary environmental operational budgeting (flows) Monetary environmental capital budgeting (stocks)	Environmental long term financial planning	Physical environmental budgeting (flows and stocks) (e.g. material and energy flow activity based budgeting)	Long term physical environmental planning
	Ad hoc information	Relevant environmental costing (e.g. special orders, product mix with capacity constraint)	Monetary environmental project investment appraisal Environmental life cycle budgeting and target pricing	Relevant environmental impacts (e.g. given short run constraints on activities)	Physical environmental investment appraisal Life cycle analysis of specific project

Fig. 1. EMA framework according to [2]

EMA comprises three main categories of tools: measurement tools, auditing and benchmarking tools, and control tools [10]. While the traditional approach in accounting would typically ignore non-monetary benefits of environmental management, EMA consists in framework for assessment of all elements and activities with potential environmental implications [10]. To meet environmental targets, companies ought to compare their performance with relevant standards and guidelines, as well as to key competitors' performance (through auditing and benchmarking tools); nonetheless, the requirement of an established management control system as part of EMA generated control tools to serve the larger companies' purposes [10].

V. CONCLUSIONS AND FINAL REMARKS

Despite the major benefits and importance of EMA advocated by the research literature, certain studies demonstrated that a number of companies did not consider justified the cost-benefit ratio for implementation of such an accounting system [7]. Moreover, applicative research on this matter concluded that EMA is implemented as an isolated tool, despite that it should be integrated in the overall accounting activities of a company [7]. This leads to the conclusion that even though EMA represents a key component for efficient and successful implementation of environmental management systems, without a systematic approach EMA will remain just a remote tool used for the sake of compliance with legislative requirements. In fact, EMA is the best vehicle towards achieving environmental-related goals, supporting key decisions with relevant data and reliable forecasts. In the context of increasing adoption of ISO 14000 family of standards, implementation of EMA tools will become an element of major interest, the main drawbacks regarding its implementation becoming a matter of the past.

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Overview of the Romanian Legal Framework on Crisis Management. A Debate on the Pandemic Crisis Case

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Abstract – The periods affected by a crisis call for changes in the social framework with which we have been used and for new rules of coexistence to emerge. These rules affect both human behavior and the economic sphere of a state. All these rules are designed to overcome the crisis, but also to learn how to live in a time of crisis. Often of crisis and their management require the restriction of human freedom to reach solutions. But for this new way of living to be accepted, democratic states have only one solution: the law. This article presents a summary of the Romanian legislation over the past two years, analyzing the changes it imposed.

Keywords: Crisis Management, Human Behavior, Legislation, Romania.

I. INTRODUCTION

Today, we are witnessing a global crisis that affects the daily lives of each of us. Moreover, the pandemic crisis generated by the Covid-19 virus launches social challenges that modern states have never faced before.

To understand how crisis management and law can protect citizens of a state, this study analyzes the connection between the crisis and the normative acts issued (emergency ordinances) to maintain balance in a period of uncertainty. Thus, this Article outlines the connection between the pandemic crisis and the law at regional level in Romania.

The article contains four parts as follows: Introduction, which presents the context and the reasons why we have addressed the chosen topic. The second part defines the key concepts of the study (law and crisis management) and the third part considers empirical analysis through observation, but also the element of novelty brought into the field. The last part of the Article is the conclusions of the study.

This article considers both the theoretical part that summarizes the views of researchers on crisis management and law in a democratic state, but also brings an element of novelty. The main addition to the field with the help of research is presented in the third part, under subchapter "C": The relationship between law and crisis management.

The result of the article outlines that the law and crisis management must be in a strong causal relationship to achieve their goal: Maintaining social balance.

This article links laws with crisis management aimed at resolving a large crisis (offering a scientific approach of the crisis management situation considering the legal framework and power).

The first part of the Article is focused on the definitions of "law" and "crisis management". Defining these concepts is the starting point that help us to answer the question "***What is the link between law and crisis management?***".

The third part of the Article focuses on the analysis of the laws that emerged during the pandemic crisis and their connection with the maintenance of social order and public security. With the help of these observations it is concluded, in the last part of the Article, that in the situation of crises with a global avenging, it is necessary that the law be imperative, with precise rules.

The third part of the article consists of three sections presenting:

(1) Romania's pandemic crisis legislation;

(2) The decision-makers in the lawmaking process;

(3) The connection between laws and crisis management.

To understand the topic of the article, we have used mixed research methods: observation of the social context, documentation on literature and analysis of normative acts.

II. CONCEPT DEFINITION

Of the oldest timings, the law is of particular importance to the humans because "force does not create the right and we are obliged to obey only legitimate powers". This statement made by Jean

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Jeaques Rousseau in 1762 best reflects today's social reality, which is the premise from which many other specialists have developed their legal theories. Although the law was viewed from the humanist, positivist or naturalistic perspective, its important characters remain unchanged: "general, impersonal and mandatory" [1]. Thus, the law appeared as "a response to the human need to know what is good and what is evil" [2]. Table 1 summarizes the definitions of law made by some experts in the field.

If the law is general and imposes a set of rules dedicated to human behavior, we can see that crisis management also refers to a set of rules that apply to human behavior. The term crisis comes from the Greek word "kwaste", which refers to "making a decision" or "changing the situation" [3], and crisis management has also come as a response to the need to deal with "more or less unpredictable situations in a company, organization or department" [4]. Table 2 shows the definitions of crisis management of some specialists. Thus, from Table 1 and Table 2 it can be observed that both the law and the crisis management represent a set of rules aimed at social normality and overcoming events that run counter to this normality.

Table 3 shows similarities between law and crisis management at conceptual level to better understand their interconnection.

The most important similarities between law and crisis management: both create rules, both manage conflicts, and the focus is on human behavior, being generally applicable. In addition, both those who manage the crisis and those who write the law must have expertise in the field.

Tabel 1. Law: main definition synthesis

No.	**Literature resource**	**Law is defined as:**
1	Susemihl et al., 1894	Law, simply described, is reason [logos] defined according to the common agreement [homologies] of the city-state, regulating action of every kind
2	Webster, 1898	Nothing else than an ordinance of reason for the common good, made by him who has care of the community, and promulgated
3	Austin, 1822	… law is aggregate of rules set by men politically superior or sovereign to men as politically subject.
4	Dias, 1965	Law is an instrument which regulates human conduct/behavior. Law means Justice, Morality, Reason, Order, and Righteous from the viewpoint of the society …
5	Cambridge Dictionary, 2019	… a rule, usually made by a government, that is used to order the way in which a society behaves.
6	Mateut, 2020	The law is everything that can be respected and not.
7	Zbarcea et al, 2021	Today the law is not made to be pleasant, but useful.

Tabel 2. Crisis management: main definition synthesis

No.	**Literature resource**	**Crisis management is defined as:**
1	Pearson, 1997	… crisis management…is helping avert crises or more effectively managing those that do occur"
2	Fink, 2002	A crisis is defined here as a significant threat to operations that can have negative consequences if not handled properly
3	Mitroff, 2004	Crisis management…is primarily reactive. It addresses crises only after they have happened.
4	Regester et al., 2005	Is about recognizing you have one, taking the appropriate actions to remedy the situation, being seen to take them and being heard to say the right things.
5	Devlin, 2007	…to confirm or minimize any damage"
6	Dilenschneider, 2009	Crisis management is a process designed to prevent or lessen the damage a crisis can inflict on a domain."
7	Hayes, 2021	… crisis management involves reacting to negative events during and after they have occurred"

Tabel 3. Similarities between law and crisis management

Similarities
1. Rules
2. Conflict management
3. Human behaviour
4. Generally applicable
5. Experts

III. LAW AND CRISIS MANAGEMENT

In the second part of the article, we outlined the conceptual definitions of the law in general. But when a state is confronted with a crisis, a set of special normative acts are to be promulgated. These laws are meant to solve the crisis as part of crisis management and provide it with the necessary framework to be applied. In Romania, these laws are called emergency ordinances, and they are analyzed in the following lines.

A. An overview of the Romanian legislation on the pandemic crisis

The Emergency Ordinance of the Governance (OUG) is stipulated in the Romanian Constitution under Article 115(4) "the Government may adopt emergency ordinances only in extraordinary situations whose Regulation cannot be postponed and must explain the urgency within them" [5]. Thus, the fundamental law in the state does not offer a definition of the emergency ordinance, but only when it can be reproduced. However, in the doctrine of the law emergency order is defined "the provision written by an authority in exceptional circumstances" [6].

Starting with March 2020, the Romanian state, like any other state, was affected by the pandemic crisis caused by Covid-19. Starting with March 2020, the Romanian Government adopted 201 emergency ordinances and 190 of them regulate the crisis caused by Covid-19. Among the most important measures adopted in these normative acts are: Alert state, limitation of fundamental rights, health obligations. According to specialists, "the emergency ordinance does not violate the fundamental human rights, but it does restrict them in order to protect it" [7].

Apart from the Emergency Ordinances, the National Committee for Special Emergencies Situations (CNSSU) holds a major seat in the Romanian state when it is faced with a crisis like the pandemic one. Thus, according to the official site of the Romanian Government [8] between March 2020 and December 2021, Committee for Special emergency issued more than 150 resolutions, this number is double then decisions taken by the institution between 2017 and 2019.

The first resolution issued by Committee for Special Emergency Situations in the Covid-19 crisis is resolution number 6 of 09.03.2020. This decision was the first to change Romania's social context because it had imposed the restrictive measures [9]. Thus, a group of specialists representing the "crisis center" [10] took the first steps to react to the events. But these norms, which change the lives of people in a state, are respected only if they fulfill 3 conditions "come from a legitimate authority, are legal and there is the force of the coercion" [12].

After this decision, several laws were followed that complemented it, depending on the magnitude of the pandemic crisis. For example, although the alert state was prolonged by numerous decisions (e.g., Decision No. 476 / 16.06.2020, Decision No. 540 / 05.08.2021) the measures taken have changed according to one factor: *incidence rate of infection*. It is noted in the lawmaking process that all decisions taken by the Committee for Special emergency and the Government are the result of a CMP (crisis management plan) [11].

To show how these acts play a major role in crisis management, the emergency ordinance No. 29/2020, contains several measures applicable to the economic sphere. This law is to help companies that have major financial losses due to the pandemic crisis. However, the companies must meet certain conditions to be able to be assisted by the state. Thus, if this law did not regulate the decisions necessary to overcome a crisis, the measures taken at management level could not to be applied.

If the emergency ordinance and Committee for Special emergency judgments are applicable nationally in a crisis, other laws are applicable particularly. These laws are the decisions taken by the prefect at county level whose effects take place on a particular territory. For example, in Romania, depending on the number of infections in a city, it may be placed in quarantine. The decision is taken by the Committee for Special emergency, but its implementation and the assurance that this measure is respected lie with the Prefect. Thus, by law the crisis is "acknowledged, measures are taken on it and we are assured that the measures are respected" [12].

Although a few measures are adopted by law to combat the pandemic crisis, the law does not require vaccination. Although many experts in the field have stated that "vaccine is the only weapon against the virus" [13], in Romania there is 40.3% vaccinated population.[14] This percentage, which is below the European average, is due to the lack of a long-term crisis management plan. All the measures adopted by the government (e.g., ban on circulation, wear the mask) are short-term solutions. Although the Romanian state did not consider the vaccine requirement, many European countries adopted the measure [15].

The lack of a law about vaccine is a real example by which we notice that a large crisis cannot be overcome if certain measures are not imposed by law. Every rule transposed by law is respected by people because "breaking the law means punishment" [16]. At the present time the decision belongs to man and the civic spirit.

B. Decision makers

Each crisis requires a plan to be followed, and the factors influencing the management plan for the crisis

differ according to the type of crisis we are facing [17] given that a pandemic crisis is characterized as unpredictable and of a huge scale, it depends on many factors to resolve it. The most important of these factors is the political one.

In Romania, on December 4th, 2020, the "vaccination strategy against Covid-19" was adopted, which represents the management plan for pandemic crisis [18]. However, the aim of this plan was not achieved because political institutions did not focus on crisis resolution, but on other related activities. Considering that "the leader is the one who points the direction" [19] the political factor occupies a major place in managing the pandemic crisis by example.

It is important for people that when it comes to unpredictable things have certain models to follow because each crisis affects the individual's needs [19]. According to "*The pyramid of Maslow*" [20] humans have five needs: physiological needs, security needs, the need for esteem, the need for belonging and the need for self-updating. We can see that the pandemic is a crisis that has affected one of the most important needs: *the need for security*.

According to Fowler if the need for stability is not met can create chaos in society because people are not used to living in a mystery, we live in a planning world [21]. Thus, crisis management must ensure both: viable solutions and people's needs.

C. The relation between law and crisis management

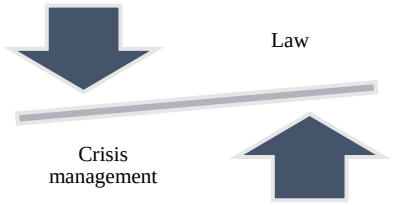

Fig 1. Crisis management vs. Law.

Figure 1 is presented the relationship between crisis management and the law for a better understanding of it. In view of the above, we can say that in a crisis, both the management and the law have decision-making roles. When a crisis is global, such as the pandemic one, the state leaders have the role of carrying out a management plan to establish a set of measures applicable to the given situation. This set of measures can only be complied with if it is given a legal framework by which it is imposed and respected by everyone. Thus, the crisis management and the law (represented by the two arrows) have the force to stabilize the crisis (represented by the rectangular dial) if the two are in a causal relationship.

IV. CONCLUSIONS AND FINAL REMARKS

First, we note that the law is a tool to apply the measures taken at management level to be generally valid and respected in a crisis such as the health crisis generated by the Covid-19 pandemic. When we talk about a crisis affecting the whole state, it takes the law enforcement to diminish the negative effects of a crisis on people.

Secondly, in Romania there are special laws meant for crisis situations that strengthen the idea of connection between management and law. As I have shown, emergency ordinances are issued only in special situations because of the unpredictable occurrence.

Thirdly, crisis management and the law aim to change human behavior. By changing behavior, habits are created that help people become adaptable to the situation they are facing until the crisis is overcome.

Lastly, we believe that a pandemic crisis can be overcome if the primary needs of people are being taken up and imposed on decisions. The more the rules will provide certainty, but also a long-term solution, the greater the impact on people.

Furthermore, we expect that the state institutions continue to apply a set of measures indispensable to the situation we are in, and that these measures be linked to the purpose: overcoming the pandemic crisis.

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Organizational Readiness for Artificial Intelligence Adoption

Marta PALADE[1], George CARUTASU[23]

Abstract – Technology evolves with a rapid speed and organizations are facing the need to adopt AI technologies to keep up with innovation. Although new compared to other technologies, AI readiness adoption can and should be normalized under an existing model for digitization.

Keywords: AI Readiness, Digitization, Innovation

I. INTRODUCTION

AI adoption necessitates a significant level of implementation complexity [1]. This is due to the design specifications and intellectual obstacles associated with AI, aspects which differentiates it from other digital technologies that are often simple to use and install [2]. Despite its complexity, its nature as general-purpose technology [2] allows to assign it under the digitization and innovation adoption within organizations. Studies [3, 4] suggest that organizations are not able to successfully adapt new technologies.

In this sense, this study proposes that the wheel does not need to be reinvented, but rather organizations can learn and adapt from previous digitization adoptions. Based on literature review, this study aims to develop an AI readiness model starting from already defined factors needed for digitization and innovation adoption. Based on prior academic and industrial research, each of these factors encompasses several sub-factors.

II. ORGANIZATIONAL READINESS FOR DIGITAL INNOVATION

Technology advances at a breakneck pace, making it challenging for both individual and organizations to stay up with digital innovation. Multiple components, such as top management support for adopting an innovative culture, IT infrastructure preparedness, and human resources openness to change management, are required for digital innovation adoption in a business. Previous research [3, 4] suggests that companies continue to fail into innovation adoption, regardless the digital technologies easiness to use and implement [5].

Because the organization are not ready and do not pursue to implement new technologies, fresh ideas do not materialize into products or services. “Readiness” and “innovation” terms have two connotations [6]:

a) the new technologies adoption capacity and

b) fostering and facilitating innovation.

This study aims to describe organization’s readiness to deliver innovation through AI and adopts a previous definition of organizational readiness [6], namely “an organization’s assessment of its state of being prepared for effective production or adoption, assimilation and exploitation of digital technologies for innovation”.

The literature contains a vast number of restudies on organization’s readiness for digitization and innovations. However, the scope of this research is not to present a literature review on the readiness of organizations to adopt innovations and digitization, but rather use an already existing model on organizational readiness for innovation and from there adopt some of the factors which, based on the literature, can be relevant for AI adoption. A recent study on the topic was conducted by Lokuge et al. [6].

The structure of this article is split into the following parts:

(a) A qualitative study aiming to develop a prior model based on interviews conducted within nine organization, more exactly with the chief information officers (CIOs) based on the ‘readiness theory” [7, 8, 9];

(b) The developed prior model is tested with a group of 26 top IT executives that attended a monthly CIO business seminar series. According to the model, the below areas must be considered when questioning the organizational readiness for digitization and innovation adoption.

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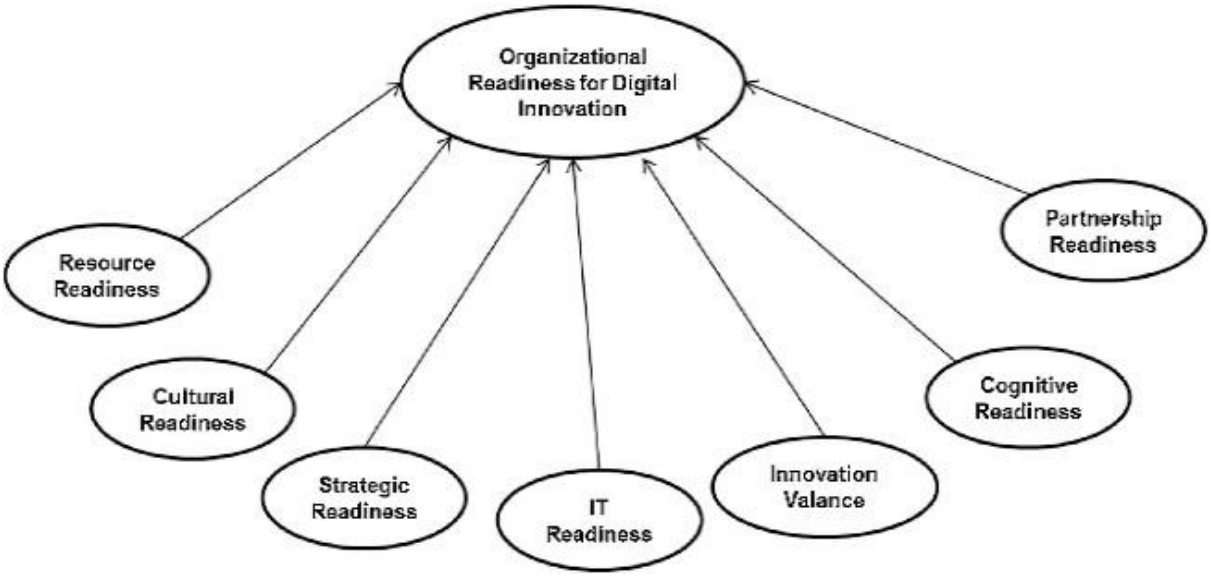

Fig. 1: Digitization Readiness in organizations [6].

As AI technologies are also under the digitization and innovation umbrella, this study will use the same factors as a starting point for aspects which need to be looked at to define an organizations readiness for AI adoption. The detailed factors chart is presented in the below section "Organizational *readiness for AI adoption*".

III. AI ADOPTION

The need for AI adoption in organizations

In its simplest form, an AI model is a tool or algorithm that is trained on a certain data set, and it can make a judgment – all without human participation. AI models are becoming increasingly valuable in most business due to their capacity to perform a wide variety of problem-solving tasks.

The rising usage of modern digital technologies is revolutionizing industrial processes and product development activities [10, 11]. AI adoption represents an important topic in the organizations. According to the McKinsey & Company [12], in 2021 AI adoption had a rise to 57 percent from 47 percent in 2020 according to the respondents. These were the case of organizations with headquarters in emerging economies such as China, the Middle East and North Africa. According to the study [12], the most common scenarios for the AI adoption were in the below areas:

- Service-operations optimization
- New AI-based enhancements of products
- Contact-center automation
- Product-feature optimization
- Predictive service and intervention
- Customer-service analysis

By having a highly flexible and efficient manufacturing system, such adoptions enable enterprises to make customized items under mass production economic conditions [13]. This is especially relevant for AI, one of the most frequently mentioned in this context, which although not long ago was considered a futuristic approach, the fast-forward availability of Big-Data and more powerful computers had an immersive impact on AI evolution as well. The three aspects are closely related since AI algorithms need large amounts of data to be trained against, data being available due to Big-Data and powerful computers allowed a shorter time for training the algorithms on the now available data.

AI adoption in organizations is also supported by the decision-making theory. As mentioned above, the management makes repeated decisions and with time it tends to use their instinct instead of using the pure processed data. One of the reasons for such behavior can be the large amount of available data and the lack of a system that supports in presenting it in a systematic form. Cost savings is yet another need for organizations to adopt AI and can become a competitive advantage. According to [12], although the revenue benefits remained steady compared to the previous survey done in 2020, AI adoption represented a great tool in decreasing the costs in areas such as product development, marketing and sales, strategy and corporate finance.

AI adoption readiness

Considering the AI's complex nature, before designing usage scenarios, the comprehension of the new technology is mandatory [14]. This represents one of the reasons why most of the organizations remain in the interest or piloting phase and not adopt AI in its core activity. AI readiness and adoption research are still in their immaturity. As a result, researchers and practitioners lack direction on how to implement AI.

One of the studies on this topic was described in [13]. The authors of this paper address five separate categories of AI preparedness aspects and the actionable signs that accompany each of them. In this study 25 AI experts were interviewed, and the results have been cross-checked using the scientific and

practitioner best practices. The results were drawn into a schematic fashion (Fig. 2).

They demonstrate that readiness is a natural aspect of the adoption process, rather than a pre-requisite condition [16]. As a result, they argue that creating preparedness once prior to technology adoption is unsustainable because the two concepts are inextricably linked and mutually reinforcing. To enhance the perspective over the company, as a hole, it should reinforce the investigation, by inquiring together the readiness and the adoption of the new technologies.

From the interviews, the authors found out that there are five assessments areas on the organizational level, namely: *Strategic alignment*, *Resources, Knowledge*, *Culture*, *Data*. A detailed definition of each factor that have an impact on the AI adoption readiness can be found in the specific study.

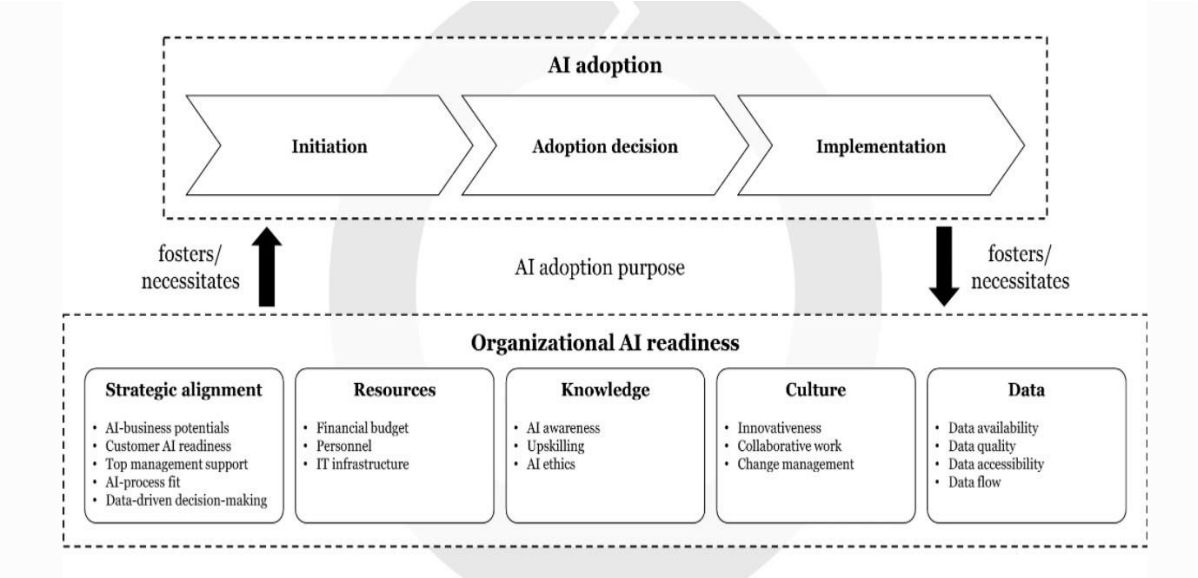

Fig. 2: Integrating AI Readiness in the AI Adoption Process [15].

Organizational readiness for AI adoption

Adoption of Artificial Intelligence is relatively new idea for most of the organizations. Although this technology's adoption is visible in a vast number of academia researches or large consulting companies reports, the lack of a proper framework for AI readiness represents an impediment for companies in seeking to include AI models in their operations or to define what are the missing pieces that represent a blocker for such a system to be adopted.

An earlier study [17] noticed that, because of a lack of preparation, around 90 percent of ideas never make it to the clients. It`s worthwhile to know that forty years later another research undertaken by Gartner [18], a technology consulting firm, derives very similar conclusions, emphasizing the fact that firms miss out on significant possibilities due to a lack of preparation.

As above mentioned, AI readiness is deeply connected to digitization and innovation readiness in an organization. Previous research [15] suggests a model in which AI readiness concept is part of the entire adoption process. This is however isolating AI technologies adoptions and putting a complexity stamp on them. While it is important to always come back and improve the process through the adoption phase, it is beneficial to have some factors which can be checked when discussing an organization 's readiness for AI adoption. Also, although AI technologies have some properties which differentiate them from other digitization projects (e.g., CRM or ERP adoption), for organizations would be easier to embrace a process with which they are already familiar. Organizations (should) adopt always to new technologies and having the possibility to determine the affected areas in the business which should receive attention when contemplating the organization's position towards AI adoption would increase the percentage of companies which enroll in testing its readiness.

In this sense, this study makes use of the template for digitization and innovation readiness developed by previous literature [6]. Using these factors as main areas towards which organizations should turn their attention to check its readiness for AI adoption, to each of these factors several sub-factors that should be considered are added. The sub-factors are collected from literature such as [15] and combined with the output of the research conducted by the consulting company McKinsey & Company [12]. The last study is important because it is not so much based on the literature review as the first one, but rather conducted among 1843 organizations from different regions, industries, company sizes and occupations. Moreover, it showcases approaches which make the difference for a company in becoming an AI outperformer.

The proposed model has six factors [6], each of them containing other sub-factors:

- **Resource Readiness**: focuses on the company`s "flexibility" in designing and reconfiguring its resources to meet the needs of digital innovation. Broadly speaking, resource

readiness illustrates how relevant resource flexibility is, when it comes to changing the configuration of IT [19, 20]. The resources also include human capital and information technology infrastructure, both of which are considered factors of innovation

  - *AI processes fit:* it explains how an organization's AI strategy and practices must work together to improve AI readiness. As per [10, 11] high performance companies adopt process such as "Protocols in place to ensure data quality" and "well defined processes for data governance".
  - *Financial budget*: refers to the amount of money that companies put into AI adoption.
  - *Change Management*: aids employees in com- prehending and adapting to AI-induced organizational change

- **Cultural Readiness**: is described as having strong enough fundamental values to support digital innovation in an organization. For example, Google, Apple, and Facebook all have robust corporate cultures that foster creativity [21, 22]:
  - *Decision making mechanism* - AI adoption is more welcome in an environment where Data Driven Decision making is encouraged [15];
  - *AI ethics*: presents novel ways for avoiding unethical AI outputs due to biased learning or incoming data.
- **Strategic Readiness**: consists of a collection of managerial activities carried out by a company to promote digital innovation:
  - *AI business potential* - the fit and compatibility of an organization with AI developments is described by AI-business potentials. Because AI technologies are highly connected to data, data availability and data quality support this potential, as the first is a fuel to the AI solution, whereas the second characteristic determines the accurate outcome;
  - *Top management support in adopting AI*: indicates a willingness to begin AI projects from the top down while simultaneously supporting bottom-up initiatives.
- **IT Readiness**: is the IT portfolio's ability to foster digital innovation in a firm. Companies that use information technology to support core capabilities will have more strategic flexibility, which could lead to increased innovation and performance, according to the literature [19]:
  - *Create artificial data to train models when there isn`t the possibility to generate enough genuine data sets;*
  - *Take a full life-cycle approach to developing AI models;*
  - *Capability to refresh the AI/ML tech stack at least annually to take advantage of the latesttech;*
  - *IT infrastructure*: should enhance the AI integration and to be prone for data intensive training.
- **Partnership Readiness**: refers to the degree to which an organization's digital innovation is supported by external stakeholders. Customers and users play complementary roles in fostering digital innovation, according to previous study [23]:
  - *Customer and other stakeholders AI readiness Innovation valence* - when considering AI adoption, discussing customers and other stakeholders' capacity to positively react to the new technology adoption;
  - *Capability to teach users how the models work;*
- **Cognitive Readiness**: established as a company's ability to promote digital innovation through its knowledge base. Personnel knowledge, skills, and adaptability are emphasized in previous work [24, 25] as essential ready components for digital innovation:
  - *AI awareness* – cognitive AI capabilities such as perception, prediction, and generation should be understood conceptually by personnel.
  - *Have well-defined AI capability* – building programs to develop personnel`s AI skill capabilities.

For visual convenience, the model is captured in Fig. 3.

IV. LIMITATIONS OF THE STUDY AND FURTHER RESEARCH

This study aimed to create a readiness model for AI adoption in organizations. The goal has been achieved but with some limitations which can be conquered in future research. Although the proposed model has a strong base, having as steppingstone findings from the previous research, it has not been tested in the industry yet. Hence, the first step in improving this study is to conduct interviews with organization 's CTOs/CIOs and understand if this model is indeed something they can use when discussing the organization 's readiness for AI adoption. In addition, finding the order in which these factors should be discussed can improve this research. Another further study could be done by looking at what readiness for each of the sub-factors means in a more detailed perspective (e.g., the economics of AI adoption - the investment which needs to be done versus the benefits brought by AI adoption).

Next, modalities to embed AI models into other already adopted digitization projects (e.g., adding AI on top of an Enterprise Resource System) represents a topic which could be discussed.

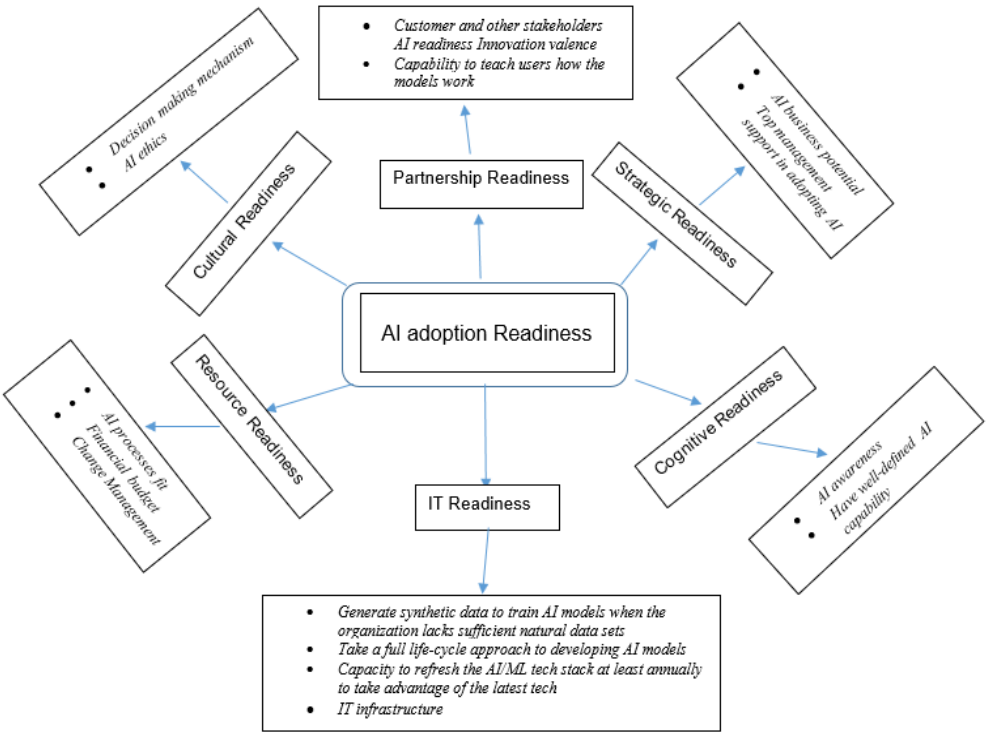

Fig. 3: Organizational Readiness for AI adoption Source: Self – made

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Railway Accidents Prevention – A Systematic Analysis

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Abstract – Rail transport is one of the safest means of transport. However, there have been in history some accidents with high death tolls, which could have been prevented had specific train protection systems been in place or had specific courses of action been correctly carried out. This article aims to present several railway accidents in history and the systems or actions which could have prevented them, respectively that were or should have been introduced after the inquiries that have taken place after these accidents.

Keywords: Train Accidents, Train Incidents, Accident Prevention, Train Protection Systems

I. INTRODUCTION

Throughout history rail transport has proven to be quite safe. It is much more probable, as studies like [1] have shown, to suffer a fatal accident for instance when traveling by car, but also less probable to die while traveling by plane. The aforementioned article postulates that the risk of death is 17 times higher for road transport by car then for rail transport (7,28 deaths per 1 billion passenger miles for the transport by car opposed to 0,43 deaths per 1 billion passenger miles for rail transport). However, transport by plane has proven to be 6 times safer than rail transport when considering the same statistic mass of 1 billion passenger miles.

This is somewhat surprising, if we factor in the subjective perception of the general population – aviophobia or the fear of flying has a lifetime prevalence rate of roughly 13.2% [2], while siderodromophobia or the fear of trains is very rare – nowadays virtually non-existent. What this tells us: there is no connection between the perceived risks of a type of transport and its actual safety.

It is also important to consider which death tolls these types of transport claim in the case of a catastrophic event [3]. The highest death toll in aviation was 583 in the Tenerife airport disaster in 1977, when two passenger jets collided on the runway. When regarding road accidents, the Salang tunnel fire stands out by far as the deadliest event, claiming an ultimately unknown number of lives (up to 3500)! For comparison: the second most deadly road accident in history (the Sange road tanker explosion in Congo) has claimed 230 lives.

The deadliest rail accident in history is considered by far the Sri Lanka tsunami train wreck in 2004, when more than 1700 lives were lost. This train accident was not caused by human error or a faulty technique (as is often the case in railway disasters), but by the tremendous force with which the overcrowded Matara Express was hit by a tsunami. The train was travelling on the Sri Lankan coast between the cities Colombo and Galle on a track that runs only about 200 m away from the sea.

It is important to note, that the second-most deadly rail accident in history happened in 1917 in Romania during World War I and is known as the Ciurea catastrophe. While there was no formal investigation into the event (as Romania was at the time in a state of political turmoil caused by the taking of the capital city Bucharest by the Central Powers), the main cause of this catastrophic event was break failure, further aided by the overcrowded train. The exact death toll is in this case uncertain, but it is estimated at 600 to 1000.

While human errors or mechanical failures can never be fully excluded, there are certain accident causes which can be at least mitigated by diverse security systems or actions.

II. MAIN CAUSES OF TRAIN ACCIDENTS

To be able to correctly recognize the main causes of train accidents and the possibilities of precluding them, it is necessary to define what counts as a train accident. In [4], these events are defined as "accidents in which moving trains are damaged, and

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persons either inside or outside trains may be killed or injured". Another important distinction is the type of train accident – train derailment, train collision or train fire. This distinction does not aid in identifying the underlying causes of the accidents, only defining the outcome of a series of events.

Train accidents are complex catastrophic events and more often than not there isn't a single cause, but a string of factors which lead to the final event (either a derailment, a collision or a train fire). Accordingly, when analyzing which course of action could have precluded the train accident there isn't only one right answer – many known train accidents would not have taken place if either of the factors leading to it would have been avoided or mitigated.

The aforementioned article by A.W. Evans centralizes data for the entire European Union plus Norway and Switzerland. In total train accidents from 27 countries (as EU member countries Malta and Cyprus do not have railways) between 1980 and 2019 were considered and analyzed regarding their causes.

A. *Signal passed at danger*

The most common cause of train accidents in the aforementioned study was the unauthorized passing of a halt signal known as signal passed at danger (SPAD) – every third train collision or derailment was caused by this fatal course of action.

The SPAD occurs when a train driver mostly accidentally passes a halt-showing signal. The road equivalent of this action would be the passing of a red traffic light – however with more serious consequences.

Accidentally occurring SPAD can be caused by a number of factors:

- Not acknowledging the meaning of the signal due to inattention or fatigue;
- Impaired sight on the signal (for instance due to weather conditions);
- Misunderstanding or miscommunication [5];
- Medical conditions (heart attack, stroke).

There are some cases in which train mechanics have also committed SPAD purposely – mostly with suicidal reasoning. However, such cases are fortunately enough very rare.

A well-known example for such an accident caused by a SPAD is the Ladbroke Grove rail crash in 1999 (31 casualties and 417 injuries) – an inexperienced train mechanic was blinded by the low sun and overran a halt-showing signal thus causing a head-on crash with another passenger train.

B. *Over speeding*

The second most common cause of train accidents was over speeding – the situation in which the train travels at a higher speed than the maximum allowed speed on the respective track. This is almost always caused by an incorrect behavior of the train mechanic – in most cases this resides in not decelerating the train when the track requires the driver to do so (for instance when nearing a curve).

A high-profile example for over speeding ending in disaster is the Santiago de Compostela disaster in 2013 leaving 79 dead and 143 injured. In this case the train driver failed to reduce the speed after a long stretch of track with a maximum speed of 200 km/h for a stretch of track with a maximum speed of 80 km/h thus entering a curve with about 160 km/h and causing the derailment of all thirteen train cars.

C. *Signaling or dispatching error*

Train accidents can also be caused by signaling or dispatching errors committed by the train dispatcher of the infrastructure company. These situations occur when the train dispatcher is inattentive or distracted, thus setting the wrong signals for one or more trains. When these trains follow the wrongly set signals, it usually comes to a train collision.

One example for a signaling error with dire consequences is the Bad Aibling train crash in February 2016 – a Deutsche Bahn train dispatcher distracted by a mobile phone game he was playing while on duty firstly allowed two trains to proceed on a single track and then also failed to launch a life-saving emergency call causing them to collide head-on, killing 12 and injuring 85 passengers onboard the two trains.

D. *Infrastructure failure*

In some cases, train accidents do not have anything to do with human errors, like in the three most common causes under A, B and C. Although offering a high degree of security, railway infrastructure is also susceptible to failures – like a railway bridge collapsing under the load of a train or a signal failure.

The Clapham Junction rail crash in 1988 (with 35 deaths and 484 injured) was caused by faulty wiring which prevented a signal from falling on red when the track circuit behind the signal was occupied by another train. This led to a passenger train ramming another stopped passenger train from behind.

E. *Rolling stock failure*

Not only infrastructure failure can cause train accidents, but also rolling stock failure – this occurs when trains or their components experience failures. This was for instance the case in Germany's most horrific train accident to date – the Eschede catastrophe [6].

This train derailment was caused by a crack in the rubber damping ring of one of the wheels of the ICE train – when the wheel failed, a part of it became caught in a railroad switch, whose setting was hereby changed. The train's wagons split into two tracks derailing and crashed in a concrete road bridge, killing 101 passengers and injuring 88 others.

F. *External causes*

Not all identified causes regard human errors or component failure. Sometimes, as seen in the introduction of this article in the case of the 2004 Sri Lankan train disaster, external factors (like extreme weather conditions) lead to catastrophic railroad accidents.

III. PREVENTING OPERATIONAL ERRORS

In modern times all train accidents are investigated in-depth and in most cases the causes are correctly identified, while also defining courses of action or developing technical systems which would preclude a similar accident from happening in the future. Of course, not all causes can be avoided through specific courses of action or technical systems – there is no possibility of avoiding the devastating effect of an earthquake or a tornado taking place in an area the train is passing through.

The two most-common causes for train accidents – the signal passed at danger (SPAD) and over speeding – can both be mitigated and, in some cases, completely avoided when the necessary advanced train systems are installed and in use.

There are three main types of systems in use with European railroads specifically designed to avoid such causes [7].

The simplest and earliest developed system is the so-called train stop or tripper – when the signal is showing halt, a moveable mechanical element is oriented towards the rail, so that a counterpart mechanical element of a train committing a SPAD would be physically activated – this in turn triggers the emergency braking. This system is still in use on some important tracks like the S-Bahn Berlin in Germany or the London Underground in the United Kingdom.

The train stops are usually positioned so that the train can be stopped before it reaches a certain danger point (like a switch or another stationed train). This system is however nowadays not considered safe enough: the train would only be stopped before it reaches the danger point if its speed is not greater than the maximum allowed speed, as there is no speed monitoring when this system is in use. If a train driver is travelling at a higher-than-normal speed, the train stop is ineffective and the train would come to a halt only after passing the danger point, thus possibly causing a train collision or a train derailment.

The aforementioned limitation is one of the reasons why other systems had to be developed (and also the reason why railway companies that still use them – like the S-Bahn Berlin – are phasing them out successively). The nowadays widely used inductive system bypasses this crippling limitation: in the case of this system track and locomotive communicate through magnets installed on both rolling stock and track. In the base version of the inductive system, communication is intermittent, as information is exchanged between locomotive and track only at given points, where magnets are installed on the tracks. These magnets (with different frequencies) are usually placed near signals and have the role of checking whether the speed of the train lies below the maximum speed of the track, but also whether the train has acknowledged an upcoming signal and already reducing its speed [8].

There are many local versions of this inductive system being used in EU countries – such as PZB/Indusi, which is used in Germany, Austria, Romania or Croatia or Crocodile which is used in France and Belgium.

PZB Indusi operates on three frequencies with different purposes (500 Hz, 1000 Hz, 2000 Hz) – requiring the train driver to acknowledge a warning regarding an upcoming main signal and/or to reduce the speed of the train. Failure to acknowledge the warning by pressing a button, not complying with the maximum speed at the location of the track magnet or even too timid braking (not respecting the calculated braking curve) lead to a forced stop of the train.

PZB is used for instance in Germany on virtually all lines and has proven throughout its use history to be quite safe. It is however possible for the train driver to override the forced stop, by pressing a button, which releases the train allowing it to travel with a speed up to 40 km/h. Use of this command button (Befehlstaste in German) is marked in the train recorder and should only take place after consulting with or being instructed to do so by the train dispatcher. This overriding option theoretically opens the possibility for the train driver to continue his journey without consulting with the dispatcher – an example for such an action was the 2000 Hannover-Langenhagen train crash. In this case the train was halted by the PZB well ahead of the danger point, but the train driver released the train and went on to hit another passenger train, injuring 16 passengers. The German railway authority specified after this incident, that the use of the command button to free a halted train is only allowed after consulting with the train dispatcher [9] – this is however not technically enforced in any way.

A more advanced train protection system is in use in Germany, Austria or Spain on high-speed tracks – this system is an upgraded version of the PZB (punktuelle Zugbeeinflussung in German) called LZB (Linienzugbeeinflussung in German – continuous train control). Evolving from PZB, the LZB no longer relies on strategically placed magnets, but on a wire placed on the middle of the sleepers, between the two rails.

The LZB system boasts a few crucial advantages. These are:

- The continuous exchange of information between track and train (regarding

maximum speed, current speed, speed changes);
- Included automatic train protection (any overspeeding leads to a warning, not decreasing the speed after the warning leads to a forced stop);
- Included automatic train operation system called AFB (Automatische Fahr- und Bremssteuerung in German, an autopilot function).

To date there are no accidents registered on tracks fitted with the LZB system – there have been however some minor incidents or near-accidents, mainly caused by software errors or miscommunications between databases. This was the case for instance in 2001 in Oschatz when the LZB system showed an allowed speed of 180 km/h although the set route was over the junction of a switch which could only be passed with 100 km/h – the train driver managed to slow the train down to about 170 km/h avoiding derailment [10].

Although virtually flawless, LZB and other similar systems in Europe (like ATB in the Netherlands – introduced after the country's most disastrous railway accident in Harmelen in 1962) will be replaced by 2030 in the whole EU by the new harmonized European Train Control System (ETCS), allowing rolling stock to travel through the EU without needing to have all national systems installed. This harmonized system defines 4 levels, with level 0 defining rolling-stock-only technique (no communication between track and train, only admissible in Germany for instance on tracks with a maximum speed of 50 km/h), level 1 defining the punctual communication (like PZB Indusi), level 2 defining the continuous communication (like LZB) and level 3 (currently under development) defining an improved level offering additionally track vacancy detection and train integrity check [11].

Coming back to the accidents mentioned in the last subchapter, we can conclude that both the Ladbroke Grove and the Santiago de Compostela accidents would not have taken place, had the advanced inductive system been in place. For instance, the Spanish infrastructure company Adif installed three ASFA (Anuncio de Segnales y Frenado Automatico in Spanish – Automatic Announcement of Signals and Braking in English) following the investigation into the accident, effectively monitoring the correct decrease of the speed before the curve where the accident took place.

Another important system used to avoid medically-caused SPAD is the so-called dead man's switch – a button or a pedal which must be pressed or released in a set interval of time (every 30 seconds for the German system Sifa). If the train driver fails to press or release the button or the pedal, a warning is heard, after which the train is halted, as there is no way to know whether the train driver is still alive.

To prevent errors committed by the train dispatcher, other systems have to be taken into consideration – such systems are sadly not widely used at the moment. For instance, trains fitted with the Railway Collision Avoidance System (RCAS) communicate their geographical position and speed as soon as two such trains are in radio range one to another. If the system should detect an imminent collision, both train drivers are warned and assisted in avoiding the train collision [12]. A comparable system is in use with the Indian railways and bears the similar name Train Collision Avoidance System (TCAS).

RCAS or TCAS would have probably prevented the Bad Aibling train collision in 2016. Thus, we can conclude that such a system would also aid in correcting albeit not precluding fatal errors of the train dispatcher.

IV. PREVENTING TECHNICAL ERRORS

The prevention of technical errors (like infrastructure or rolling material failures, as stated in II D and II E) is far more complex, as there isn't a system which can prevent each and every mechanical malfunction.

In order to mitigate risks of technical failures, the regulations in each EU country provide for thoroughly defined inspections at certain fixed intervals. These inspections are carried out by specially trained personnel of the infrastructure or rolling stock company.

For instance, the German railway infrastructure company DB Netz AG defines cyclical inspections for every component, like signals, railway crossings or track switches. Through these inspections the infrastructure company aims to assess the degree of wear of the facilities and to derive courses of actions (like repairing or changing certain components) allowing to avoid an infrastructure failure.

The subjective factor is however here also present: while there are strict rules for the conducting of any given inspections (defining what to look for and which course of action is necessary if a defect is found) and in most cases more than one employee respectively another employee as in the last inspection (4-eyes-principle) is tasked with an inspection for any infrastructure component, there is still room for human error. The Clapham Junction rail crash under II D took place because new wiring was installed, while the old wiring was left in place uninsulated. Furthermore, the signaling technician was heavily overworked, having worked for 13 consecutive 7-days-weeks and his work was not supervised and controlled by any other employee. While there is no way to know for sure, the faulty wiring could have been avoided had the signaling technician not been exhausted or could have been fixed had another employee supervised the action, thus effectively saving the lives of the victims.

The Eschede train disaster in 1998 might have been prevented if the inspection of the rolling stock had been more thorough. At the time, there was no possibility of actually testing the fatigue limit of wheels in Germany; furthermore, the new rubber damping ring used on the wheels of the ICE1 was not tested in high-speed conditions before launch. After the accident all wheels were replaced with monolithic wheels without the applied rubber damping ring.

These two accidents (Clapham Junction and Eschede) show that inspections of rolling stock and infrastructure bear a great importance for the safety of rail transport. While respecting all regulations and using well-rested employees is a minimum requirement, advanced testing and inspecting techniques are necessary in order to mitigate the risks of fatal railway accidents.

V. CONCLUSIONS

Trains are a safe way to travel – there is very little risk when boarding a train. However operational errors and mechanical failure must be prevented accordingly in order to achieve an even higher transport safety. While operational errors can be prevented by using modern safety systems (like PZB Indusi, LZB or the new harmonized ETCS), the mechanical failures can be avoided through punctual, in-depth inspections conducted by highly skilled, top-trained and well-rested employees using state-of-the-art techniques and tools.

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Network Management Center for East European Railways

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Abstract – Railways in the world are facing increasing competition with other transport facilities like electric cars, electric buses, freight trucks and aircraft. By using digital interfaces to electromagnetic relay-based block automation section or electronic interlocking system like LZB control center from Alcatel-Cegelec, the East European Union Railways must manage the whole long-distance traffic in his whole railway network and the upgrade software program is demanding the hardware part installation.

Keywords: Computer Integrated Railroading (CIR), Intelligent Management System (IMS), Total Integral Automation ™ (TIA)

I. INTRODUCTION

Competition means not only lower force for passenger and freight but shortest possible travelling times. Special requirements of the idea *just in time* of industrial companies demand for special conditions of information and the possibility to quickly react upon unexpected events.

Railways in Europe have been reformed to allow for market competition. As a result, railway services and infrastructure management have been vertically separated, allowing many operators to compete. Vertical separation, capacity allotment, and rail access charges have all taken on new forms. This article examines key issues of deregulation in several European nations. The research evaluates how competition has been implemented and controlled, with a particular emphasis on characterizing capacity distribution and tracking access prices. We find that, although being regulated by the same European legislation, the analyzed railroads had varied deregulation results, such as market organization and capacity allocation. Furthermore, few nations have so far achieved effective and transparent capacity allocation. Despite being permitted by law, market-based allocation is either nonexistent or never employed [1, 2]. According to the report, most European railroads still need to develop and experiment with more efficient and transparent capacity distribution systems to create greater competition, which can result in significant societal benefits [1, 2, 4, 6]

Railways private operators are transport providers which usually dispose of traffic route and transport equipment. Therefore, main tasks of the railways are [3, 4]:

- Modular design with a high level of integration and automation;
- Recognition and management of conflicts;
- Extensive statistical functions;
- Ergonomic user interface.

These tasks need a specialized solution, that's why the Romanian Railways West Region has chosen the concept of the Network Management Centre (NMC) [4-8].

II. CONCEPT

The NMC concept is based on the idea of concentrating all systems for operation and dispatching in one location, together with the systems for maintenance and information, and and to integrate all functions to manage the rail network with all trains in one system. **LZB** system is based on constant exchange of data and dual processing [4 - 7]. Functions which must be integrated are the remote control of the interlockings and the train protection, monitoring and dispatching facilities for the supervision of the trains. The function of the whole rail network depends on the good performance of lot of technical equipment like signals, point machines and Automatic Train Protection (**ATP**) equipment, together with the equipment for the convenient of passengers, like passenger information systems, elevators and ticketing machines [4, 5]. The heart of high-speed railway operation safety is an ATP system. Now, the system's failure rate change rules are not well understood, and the maintenance approach is not developed [8, 9].

It becomes much more important to integrate the monitoring and maintenance tasks for all technical equipment in the NMC. Furthermore, the systems for customer services and tele-informatics re-linked with the information of the original train and track functions and therefore should be integrated in NMC as well [4, 7].

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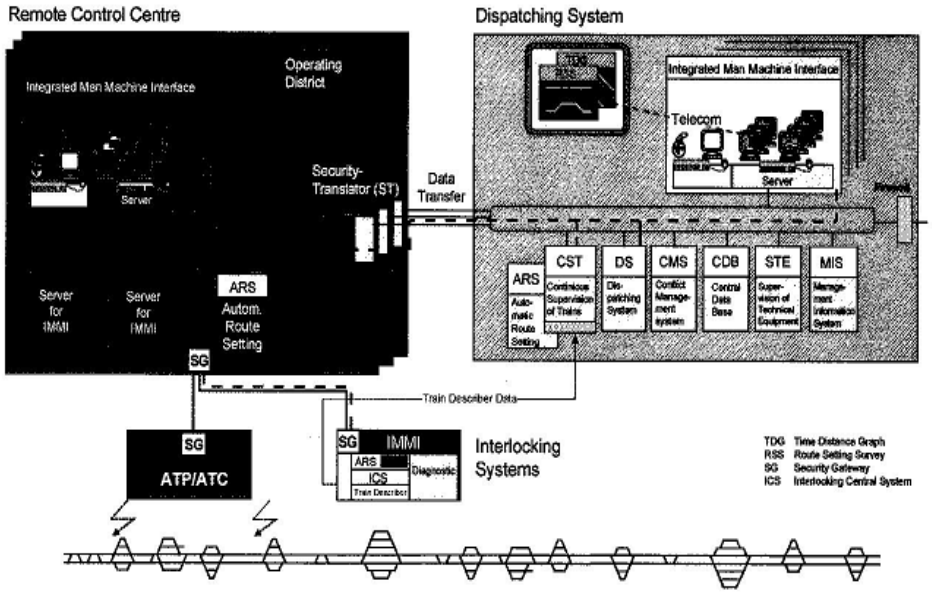

Fig. 1 The Network Management Center **RBL/RZBL** [4]

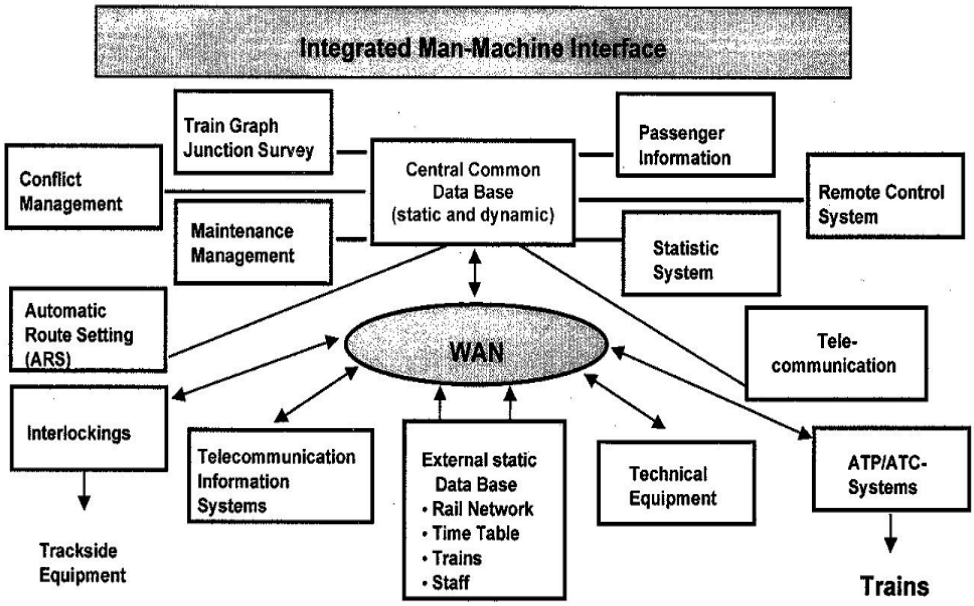

Fig. 2 The architecture of NMC [4]

III. SYSTEM NETWORK ARCHITECTURE

Fig. 1 gives a system structure overview and the core of the Network Management Centre (**NMC**). The main feature is, to combine a dual computing network architecture system (**SNA**) with a lot of operator positions via a Local Operated Network (**LON**). The design of LON, i.e., use of routers, hubs, etc. depends on the client requirements. Dedicated tasks in the center are distributed to dedicated servers, all using the same database. All field elements are connected using Security Gateways (**SG**) via Wide Area Networks (**WAN**) to this **LON** (similar with the developments of [10, 11]).

The interlocking system such as LZB system, or relay-based systems are complete controlled via the multifunctional operator positions in the center and ensures safe movement at speeds of up to and more than 300 km/h. To have the full range of the functions of NMC, like remote control and automatic route setting (**ARS**), it may be necessary to provide for the relay-based systems a computer interface. In east European countries all interlocking status is former presented in the center has to a fail-safe, to allow special interventions like setting a single signal or activating a point machine manually. Although we are using standard PC compatible computers with standard communication interfaces, the presentation of information is fail-safe (similar with the developments of [1, 2, 7, 10, 11]).

A software-based procedures assures the operator, that what he can see on the screen is the exact image of the status of interlocking. If there is any hardware failure of an interruption of the transmission is

detected, the system will give an alarm to the operator. Fig. 2 shows the main idea, how MCR is designed. It is based on the idea to distribute tasks on different hardware for reasons of performance, for reasons of redundancy and for an easy extension in future for extended tasks (as supported by the studies presented in [5, 6, 8]).

The core element is the common data base, filled with data information of all trains and their time schedulable outside equipment with their planned status. On the other side there is dynamic information coming from the interlockings, the ATP-systems and real-time status of all technical equipment. All this information is available for all subsystems of the NMC.

You can now define events, on which these sub-systems will be informed to support the operator, i.e., the conflict management system solves unexpected problems. On the other side the common data base is combined with a powerful statistic system the base for a man-agreement information system (**MIS**). All operator places have access to all servers, therefor on all places you can have the complete overview of the status of the whole railway network.

IV. ADVANTAGE OF CONCENTRATION

The idea of concentrating all functions in one location requires location of man and machines in proximity. This will harmonies the needs of the operational and supervisory roles by allowing planned interruption even in real-time.

It also permits prioritization of repair by reference to the actual status of the rail network and meet the needs of the technical services for a complete overview to deploy staff as effectively as possible.

The arrangement is necessary during planned maintenance work and much more important in case of fault detection and restore of any technical, unexpected error conditions often can handle like planned interruptions.

The concentration of staff in one center avoids the need for expensive communication between operational and supervisory staff and increase the quality of information exchange.

Another important advantage is the ability to assign the staff flexibly to different conditions like rush hour traffic and in off peak and to give the responsibility for more than only one interlocking to one person.

Concentration in one center has the advantage of providing a direct access in real-time to the complete data of the whole technical equipment and permits the development of better diagnostics systems for better quality of information.

It is also possible to provide information to all relevant personnel, including the actual and predicted status of all trains, to optimize services.

V. ADVANTAGE OF INTEGRATION

The integration of all services within one center together with modern signaling and control technologies permits the use of high-performance computers. The large - scale computerization and automatization of systems and procedures, with access to all significant data and the ability forecast the status of all trains permitting control over extensive areas.

Flexibility and reaction to changing conditions over a large network needs computer aided tool (CATs).

The most important tool is computerized conflict management, i.e., automatic detection and resolution of conflicts in the railroad network.

Another tool often combined with conflict management, is the direct implementation of routing strategies trough the Automatic Route Setting System (**ARS**). The integration in central systems allow to establish overlapping statistic systems for: capacity and service quality measurements; error analysis and fault synthesis; timetable design; optimized staff disposition.

VI. MAIN FUNCTIONS

The modular design of the NMC in hardware and software, combined with communication via standard protocols allows economic adaptation to different situations. The modules will be put together to form an integrated solution, like building a house with prefabricated panels. Any NMC will have to be frequently adapted to changing operational conditions, therefore the system must be designed to work data – based.

The system design permits integration of new features by adding new software or hardware modules. It is possible to start with a small implementation and extend this according to growing needs without losing the initial investments. For increasing performance, the modularity allows to add more micro-computers to share the or to change hardware for another powerful model.

The use of standard protocols makes it possible to install “tailor-made solutions with standard components”, the only economic way to meet the needs of east European railway operators, and maybe central European operators too.

The basic functions, which will be explained later, are the integrated man machine interface, the standard interface to all subsystems of the NMC, the continuous supervision of trains, the system for a permanent overview of the railroad network, the automatic route setting system, the link between the dispatching tasks and the access to the interlockings and the conflict management system, the computer-based tool for handling an extended area.

VII. INTEGRATED MAN MACHINE INTERFACE

The access to all subsystems of the NMC, the center is designed via standard user-friendly windows techniques. The technical solutions allow operators to select each dialogue on each monitor.

The private operator must log in to the system with his identity code, i.e., name or/and function, and a password.

Note: the login procedure provides different authority levels.

It allows selected operators access to selected dialogues or selected regions.

It is also possible to change dynamically the authority levels for easy change of responsibility during a special forced time-period, e.g., in case of accident or maneuver incidents. The main features are:

- Display the status of all trackside equipment, like signals, points etc. and of the trains, with their location, the train number and the magnitude of delay.
- Operating with the train describer system via mouse and standard monitor, to identify trains by adding a train number or to add information to trains which are not completely registered automatically.
- Facilities to change the data base of the automatic route setting system, like timetable or track occupying list.
- Work with the central data base for generating reports, adding information or changing the basic static information.
- Facilities for telecommunications are integrated, the only integrated equipment is one mouse and one standard keyboard to up to eight monitors.

VIII. CONTINUOUS SUPERVISION OF TRAINS AND AUTOMATIC ROUTE SETTING

The continuous supervision of trains is based on information coming from the train describer system. By identifying a train with a unique train number and deriving its route by analyzing the status of the elements of the interlocking, the system automatically traces all train movements, and the system shows the train on all screens in the right position. The operator can choose the presentation as a map-oriented route display, all stations as lines display or for dispatching the most frequent way as time-distance-graph or junction display.

Most of the trains with a dedicated timetable can move through the rail network by setting the route automatically. The basic information for ARS is the actual status of the interlocking, the actual train position on section, generated by the train describer system, the actual status of the train, the dedicated timetable. Together with a route setting list linked to this train, the system automatically sets the route when the train reaches a predefined section or when the time for station departure has come.

The system checks the status of the interlocking, and when all conditions are met, the route will be set automatically, and the setting will be displayed.

IX. CONFLICT MANAGEMENT SYSTEM AND ELECTRONIC INTERLOCKING

The supervision and control of extensive areas requires computer aided conflict management. It is the most powerful tool to reach the key target of the railway. The goal is to achieve increasing quality of traffic. It is only way to react in real-time to unexpected traffic conditions by predicting the outcome and choosing the right solution to avoid problems.

There are basically three kinds of conflicts, the concurrent occupation of a section, i.e. two trains wants to occupy the same section at the same time, the connection conflict, i.e., rolling stock or personnel is dedicated to a train which is late or early, or as a changeover conflict for passengers, when the coming train is too late for connecting with another train, and time table conflicts where a train has a delay against the time schedule (similar with [8, 9]). The base of a powerful conflict management is to obtain nearly complete information, including static information about trains, rail network and timetables as well dynamic information of all trackside equipment. Actual conflicts and predicted conflicts must be indicated and solved quickly.

If the system detects that two trains will occupy the same section, the conflict management system will solve the problem by changing the route of the train, changing train speed or delay or giving the train with higher quality type the priority (as mentioned even in the studies [2, 3, 10]). The solution would be automatically converted into commands via automatic route setting system or direct to the trains by the **ATP/ATC**-system. Another feature of the conflict management system is its use for optimizing timetable design or staff disposition, using the system for training the staff and using it together with the **MIS** for statistics diagnostics. The NMC only has direct access to an interlocking center, when this is built up as an independent subcenter, see Fig. 3.

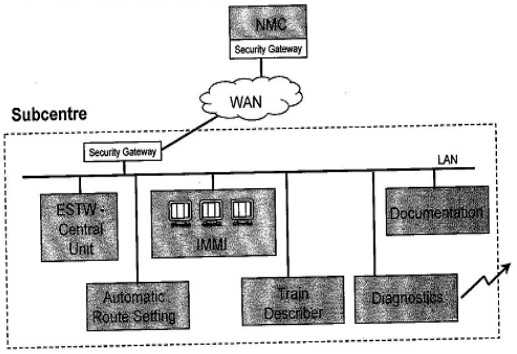

Fig. 3 Interlocking subcenter [4]

To fulfill this task, it is necessary, to extend the standard functions of an interlocking with some special NMC-features. Obviously, it is necessary to give them the feature to communicate with the NMC over a WAN. To run with the automatic functions of the NMC, each interlocking must contain decentralized functions of the ARS and train describer (similar with [10, 11]).

The documentation and the diagnostic systems also must allow remote access from de NMC. Although, the Subcenter is working without any decentralized staff, it has an Integrate Man Machine Interface (**IMMI**) for testing and for times with broken connection to the NMC. The Subcenter is designed to run about two hours stand alone, in this time normally an operator will reach the Subcenter to ensure the running of the traffic.

The LZB from Alcatel-Cegelec perfect fulfill the needs for a decentralized operation.

Due to the modular design, see Fig. 4, the interlocking can build up step by step in line with the growing of a new rail line or with the gradual replacing relay-based interlocking by electronic equipment, when a line is modernized. LZB is designed with three main modules, each fail safe and redundant. The interface to all trackside equipment, the element control module (EAM) is connected via serial lines to the interlocking module (SM). Therefore, it can be placed on each place along the line with no need for the overhead system nearby (as described by the studies [3 – 6]).

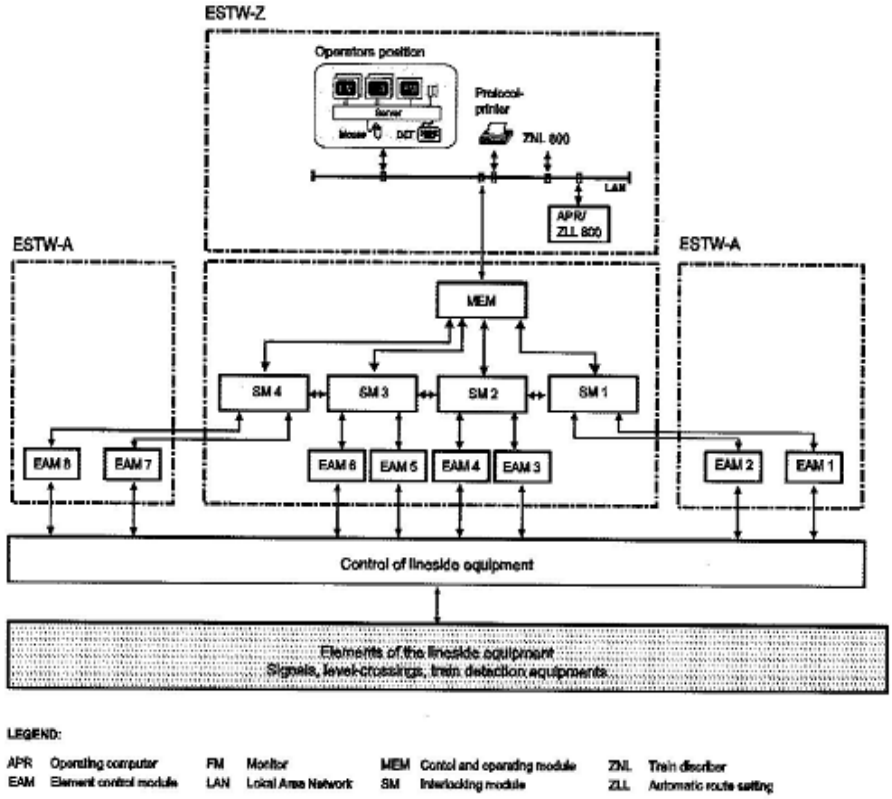

Fig. 4 The RBL/RZBL NMC [1]

The serial transmission method is independent of the transmission technology. The interface to the operator places is built by the control and operating module (MEM). All modules are designed as two out of three systems logic. The modular design, together with the serial link structure, allows a testing and proving strategy with a maximum of work already done in the test center, with independent testing of the overhead to hierarchically superior systems (MEM and SM) and the field level (EAM). The testing and proving time at trackside will decrease to a minimum.

X. CONCLUSIONS

The use of computer-aided management systems in transport automations improve the infrastructure through advanced technical solutions. While headways decrease, route capacity and speed must be increased. Interconnections must be assured throughout the network. Overall performance has multiple requirements: careful planning, the processing of data for traffic management, the application of microcomputers for train routing, on-board controllers for automatic train control, and dynamic passenger information system.

Future developments and studies are related to the Transport White Paper that outlines two categories of the transportation market where rail would benefit from a bigger share. These are long-distance overland freight and medium-distance passenger travel, particularly with the expansion of high-speed rail. Milestones for the next years are depicted in the table below, where the baseline is 1990 and the metrics are

calculated per passenger-km (passenger service) and ton-km (freight service).

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An Extended Study on Motivation and Need for Multimedia Skills Development in the Case of University Staff

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Abstract – University staff has been the most vulnerable actor (or even stakeholder) in the process of the online transition of all the academic activities (education, scientific, communication, internationalization, involvement in the community etc.). University missions has been re-shaped and re-designed considering the new ways (methods and tools) for communication, opinion expressions, dialogue, for scientific argumentations and negotiations, promotion of different results, achievements, events or the university activities. Multimedia competencies have become more valuable and together with the digital creativity has been considered the new "weapon" for creating a new image of the online universities (defining the new online world of the academic environment). In this context, the paper first, presents the specific situation and potential for multimedia competencies development in the case of the seven partners of MUST project: "Multimedia Competencies for University Staff to Empower University - Community Collaborations" (2020-1-RO01-KA203-080399, https://mustproject.eu/). The extended study refers to partners from countries as: Romania, Slovenia, Germany, Lithuania, Portugal, Spain, and North Macedonia. The preliminary state of the university staff competencies in the field of multimedia, has been the basis for the survey based on a designed questionnaire development for the training needs development. In the final part of this article the results of the survey are presented together with some comments and conclusions. The achieved knowledge and information from the extended study on motivation and need for multimedia skills development in the case of university staff have been considered for designing the MUST training program structure and content.

Keywords: Multimedia skills and competences, training need, motivation, university staff, survey, questionnaire

I. INTRODUCTION

COVID-19 pandemic has paralyzed the education process, the education institutions all over the Globe. According to the available data provided by UNESCO through the online Global Monitoring of Schools Closures Caused by COVID-19 (information available at: https://en.unesco.org/covid19/educationresponse, access on June 14, 2021) the situation is unimaginable (see Fig. 2):

- 1,579,634,506 affected learners,
- 90,2% of total enrolled learners World-Wide that are affected and
- 191 country-wide closures with education entities close.

Governments, educators and learners are faced with the unprecedented challenge of ensuring that education continues, even whilst pupils, children, students must remain at home for a long period of time. Some extraordinary facts are:

- Till now, there have not been used the indicator number of closed schools to characterize the educational process!
- Till now, there have not been restricted the access to education, culture and art institutions, including libraries and other learning life experiential hubs for such an extended area of the Globe and for such many people!
- We are confronted with a high autonomy in providing teaching and learning activities online, virtually using new technologies!

Instantly:

- Schools, universities were moved (pushed) on-line and thus, they were confronted with a huge knowledge, resources and technology gap (including personal computers/devices and Internet availability for everyone, educational resources available, the information and communication technology, less personal support etc.),
- Teachers and learners' digital competencies value a lot … and it was the main condition for continuing studying, having access to education resources, collaborations.

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Crisis period and restrictions have pushed us to socialize and share knowledge, new experiences using virtual tools but there was and is still a lack of collaborative work between teachers/educators in the same or different school/university. Furthermore, there have been manifested a weak collaborative work between academic staff and business actors due to the economic crisis. The main question that arises is:

How will be the education and research processes after the restriction rules will be cancelled? The question has become one with various answers depending on education local conditions and resources, including the ITC infrastructure, capacities, and teaching staff skills (digital skills and creativity in develop online resources, communicating and nurture the virtual communities of learners). The problems are similar for university teaching staff which has been the most vulnerable actor (or even stakeholder) in the process of the education process (the university communication process and also, the scientific communication) transition online.

In the following chapters, there will be briefly presented the specific situation for multimedia training needs of university staff in the case of university partners included in MUST project: "Multimedia Competencies for University Staff to Empower University - Community Collaborations" (2020-1-RO01-KA203-080399, https://mustproject.eu/). The preliminary inventory of facts and aspects related to university staff competencies in the field of multimedia, has been the basis for the creation of an extended research (survey based on a designed questionnaire) of the training needs development. In the final part of this article the results of the survey for the training needs development are presented together with some important comments and conclusions.

The knowledge and information collected during the development of the extended study on motivation and need for multimedia skills development in the case of university staff have been considered for designing the MUST training program structure and content.

II. ARGUMENTS FOR MULTIMEDIA SKILLS DEVELOPMENT BASED ON A BRIEF LITERATURE REVIEW

A. Definition and importance of multimedia skills development

Cardillo (2010) defined multimedia information technology integrated learning as words and pictures. The former referred to verbal form, containing printed words and spoken words; and the latter referred to pictorial form, including static pictures (illustrations, coordinate graphs, diagrams, photos maps) and dynamic pictures (animation, films). Multimedia learning referred to learning with words and pictures that multimedia information technology integrated learning could be called dual-code learning or dual-channel learning, i.e., the presentation of multimedia was to present information with words and pictures. The multimedia information technology integrated instruction information or the presentation of multimedia instruction aimed to assist in learning with the presentation of words and pictures (Geoffrey et al., 2012).

The theories and points of view related to multimedia information technology integrated learning proposed by Assaraf & Orion (2010) are proposed to discuss the methods applying multi-sensory instruction to deal with multimedia information and the teaching design. Deriving theories from multimedia information technology integrated learning, Kim (2011) emphasized three processes of selecting, organizing, and integrating words and pictures for all learning. Selection referred to selecting relative and important information from word and non-word information to be stored in the working memory, organizing such selected word and non-word information for establishing the structure to form two logic situated models, and finally integrating and combining such organized situated models (Varma & Linn, 2012). Since the three processes occurred in the limited working memory, the learning effect would be effectively promoted when a multimedia system could be utilized for designing the process for helping learners be good at operating the memory and preceding the processes of selection, organization, and integration. The multimedia information technology integrated learning theory suggests that receiving information from multiple channels could help learning. However, the multi-form information presentation could enhance learning burden.

Multimedia could eliminate/minimize the disadvantages of the the e-learning (Arkorful & Abaidoo, 2015):

1. E-learning as a method of education makes the learners undergo contemplation, remoteness, as well as lack of interaction or relation. It therefore requires a very strong motivation and time management skills to reduce such effects.
2. With respect to clarifications, explanations, and interpretations, the e-learning method may be less effective that traditional methods of learning. The learning process is much easier face-to-face with instructors or teachers.
3. When it comes to improvement of learner's communication skills, e-learning may have a negative effect. Though learners might have an excellent academic knowledge, they may not possess the needed skills to deliver their acquired knowledge to others.
4. Since tests and assessments in e-learning are frequently supervised by proxy, it may be difficult, if not impossible, to control or regulate activities such as cheating.
5. E-learning may also be subject to piracy, plagiarism, cheating, inadequate selection skills, and inappropriate use of of copy and paste.
6. E-learning may negatively impact socialization skills and limit the role of instructors as directors of the educational process.

7. Not all disciplines can effectively use e-learning in education. For instance, scientific fields that require hands-on practical experiences may be more difficult to study through e-learning. Researchers have argued that e-learning is more appropriate in social science and humanities than the fields such as medical science and engineering where there is the need to develop practical skills.

8. E-learning may also lead to congestion or heavy use of some websites. This may bring about unanticipated costs both in time and money.

The multimedia materials could animate and encourage the collaborative learning/working through the created e-learning campuses of different training entities. It is obvious that e-learning involves the use of digital tools for teaching and learning and blended learning is a reality extended use today. It had been recognized by users of e-learning solutions of that multimedia learning materials are excellent ways to create more vivant and realistic learning experiences and that has been supported by the variety of devices (computers of different types, mobile phones, tablets etc.) that could be used to access different resources or materials!

The new learning experiences are more powerful and more learner-oriented:

- It makes use of technological tools to enable learners' study anytime and anywhere.
- It involves training, delivery of knowledge and feedback though the associated e-learning tools.
- It motivates, stimulates students to interact quick and more effective with each other, exchange, and respect different point of views (animate and nurture the e-learning community).
- It eases communication and improves the relationships that sustain learning.

Despite some challenges discussed above, the literature has sought to explain the role of e-learning and how e-learning has made a strong impact in teaching and learning. Its adoption in some institutions has increased faculty and learner access to information. A rich environment for collaboration among students can improve academic standards (Arkorful & Abaidoo, 2015) but also their feed-back could be of real benefit for training materials improvement.

The overall literature which explains the advantages and disadvantages of e-learning and multimedia use suggests the need for its implementation in higher education for faculty, administrators and students to enjoy the full benefits that come with its adoption and implementation (Arkorful & Abaidoo, 2015).

B. Research studies on multimedia use and impact in education

(Kurzel et al., 2002) describe the development of an adaptive multimedia learning environment that utilizes multimedia presentation techniques in its interface while still providing internet connectivity for management and delivery purposes. The system supports the WWW as its addressing space but uses the local client areas to store media items that are costly in terms of delivery time. Learning objects that provide frameworks for tasks and other summative assessment activities are stored on a server and delivered when required. The system supports link annotations in its adaptivity and employs an overlay student model with stereotyping when accessing the course content. With such powerful and flexible software, it is possible to organize several creative activities for learners.

The study involved Alien Rescue (Liu at al., 2002), a new media enhanced problem-based learning (PBL) environment for sixth-grade space science, designed to engage sixth-grade students in solving a complex problem and learning about our solar system and processes of scientific inquiry by applying tools, procedures, and knowledge of space science. Beginning with a video presentation, the Alien Rescue curriculum explains that a group of six alien species, each with unique characteristics, have traveled to Earth because their home planets have been destroyed. Students are tasked with the mission of finding a planetary home that can support each alien species, thereby ensuring their survival. To accomplish this goal, students must engage in a variety of problem-solving and information-gathering activities. They must discover the critical scientific characteristics of the planets and moons in our solar system by querying the provided databases and collecting direct observations using simulated probes. New media technologies are employed to immerse students in the interactive experience and create tools for scaffolding.

The study of Liu et al. (2011) examines middle school students' learning and motivation as they engaged in a multimedia enriched problem-based learning (PBL) environment for middle school science. Using a mixed-method design with both quantitative and qualitative data, we investigated the effect of a multimedia environment on sixth graders' science learning, their levels of motivation, and the relationship between students' motivation and their science learning. The analysis of the results showed that: Students significantly increased their science knowledge from pretest to posttest after using the PBL program, they were motivated and enjoyed the experience, and a significant positive relationship was found between students' motivation scores and their post science knowledge scores.

(Duygu et al., 2011) showed the procedure and results of research with the aim of revealing students' opinions about the use of PDAs (Personal Digital Assistant) in a learning environment within the context of multimedia-based applications in Turkey. The procedure was tested on a purposive sample of 17 undergraduate students attending an elective course in computer education and instructional technology. Although the students belonged to the Net Generation, they had quite a few critical remarks concerning the software offered and the way it helped them in the learning process.

Neo and Leow (2014), authors from Malaysia, also study the inclusion of digital multimedia projects in teaching and learning and the influence of digital media on the selection of classroom teaching strategies. In their research project, the authors provided students with relevant content in a conventional learning environment (classroom), and content related to an animation course and its impact on learning. The research follows from Gagnes' learning theory (as supported also by (Jono et al., 2016)). The results of introducing multimedia in teaching and learning were positive and encouraging

The study of (Matijevic & Opic, 2016) developed in Croatian observe that teaching scenarios used in practice follow the features of constructivist and traditional teaching theories and that there exist combinations of teaching didactics that are student centered and those that are teacher centered. Teachers struggle to find their way in the selection and design of a media environment that fulfils the developmental needs and ways of learning of the Net generation. In many classrooms, learners still spend most of their time seated in twos at tables aligned in three columns listening to and watching what the teacher is saying and doing (in other words, teacher-centered instruction). Teaching equipment and furniture are mostly adjusted to the needs of the traditional theories of teaching and frontal instruction.

The research was carried out on a total sample of 435 pupils in the upper secondary level of education in four counties in the continental part of Croatia to examine the predictors of using the new media environment for learning. The results of this study indicate how important it is to examine the role of using the new media environment. The media environment is no longer an auxiliary (secondary) didactic activity; it has assumed a primary role in the process of upbringing and education. Naturally, it follows that it is necessary to examine its use in upbringing and education, so that it does not become an end. Voluntarism, without a well-designed didactic-methodological scenario, prevents the media environment from fulfilling its purpose, the purpose of the new age, the new Net generation.

More recent, the study of Castro-Alonso (2019) debates the learning process from multimedia modules and visualizations and stress the case of the students with low abilities of the visuospatial component of working memory. The study underlines problems in using multimedia learning materials and point some issues regarding their design and use for creating an effective learning environment. For learners with visuospatial low abilities, more effective multimedia designs, such as those following cognitive load theory principles, should be pursued.

C. Preliminary conclusions

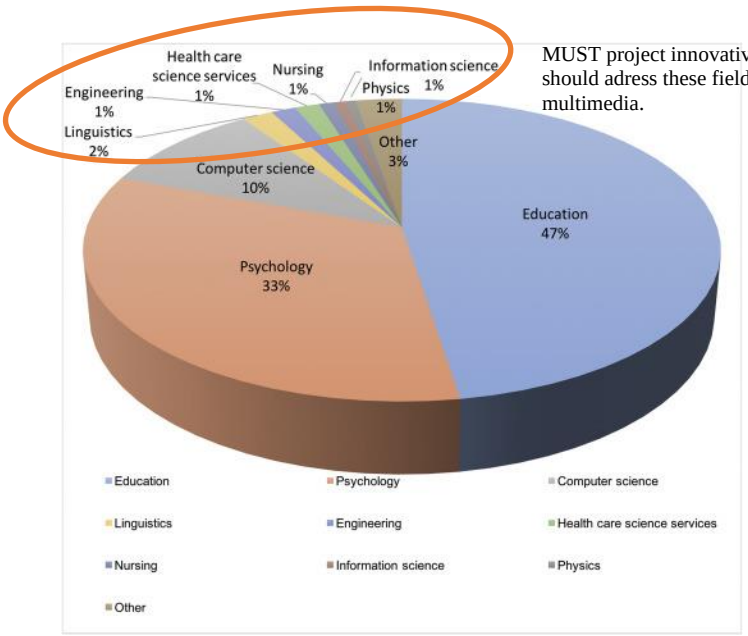
The brief literature review presented above, as well as many others aimed at enriching teaching scenarios with multimedia, indicate that the future of teaching in terms of multimedia instruction lies in digital media and the internet. ICT experts refer to such a type of instruction as blended learning, but in the tradition of Europe's didactic theory and terminology the term multimedia learning is more prevalent and accepted.

Trends and issues in multimedia learning research have been provided by a recent article of (Li et al., 2019). They recognized that parallel to the recent advancements in information and communications technologies, research on multimedia learning has generated several theories and empirical findings. Numerous trends and issues have emerged, showing the complex and dynamic nature of multimedia learning and the associated scholarship.

To provide a comprehensive knowledge map and an overview of recent research on multimedia learning, 411 peer-reviewed articles from 1996 to 2016 were analyzed to describe the empirical work in multimedia learning. A bibliometric approach was applied to reveal the most common keywords and terms and their interactions via co-word analysis. The results showed that cognitive load is the highest co-occurred keyword, and that animation provided the highest number of co-occurrence relationships with other keywords in our sample.

Five clusters of research trends were identified: theoretical foundations of multimedia learning, representations and principles, instructional design and individual differences, motivation and metacognition, and video and hypermedia. Despite the high co-occurrence of the terms' "memory", "working memory", and "cognitive load", only a few studies examined the role of individual differences in cognition such as working memory capacity in multimedia learning. The multimedia learning principles most discussed in the last two decades of research are redundancy, contiguity, and coherence.

According to the findings of (Li et al., 2019) that are shown in Fig. 1, there is a KNOWLEDGE GAP of research on using multimedia technologies and knowledge in engineering, health care services, nursing, information sciences, social sciences (as management, marketing, sustainable development management etc.), linguistics (1%-2%). Thus, MUST project should address these fields of education, research and university-community projects related to these.



MUST project innovative contribution should adress these fields of exploiting multimedia.

Fig. 1. Scientific and economic domains that uses/exploit multimedia resources (for education, learning, research and development, marketing etc.) as find by (Li et al., 2019)

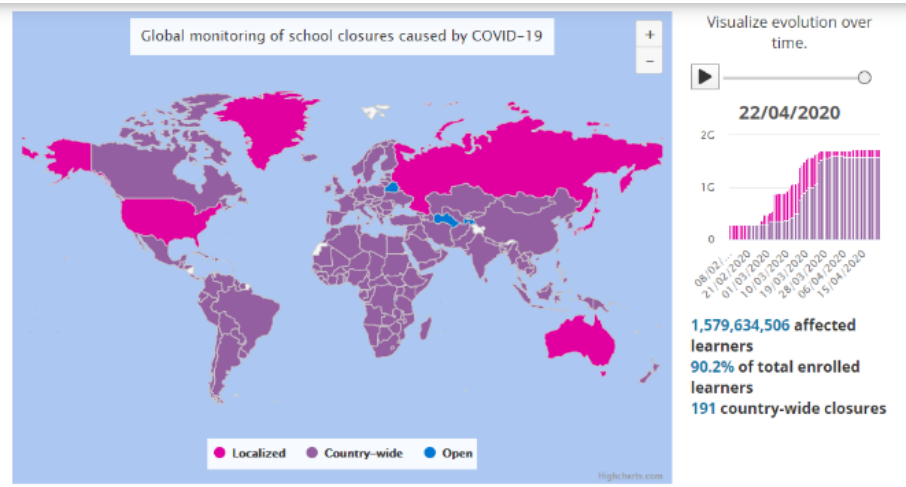


Fig. 2 Global Monitoring of Schools Closures Caused by COVID-19 (Retrieved from: https://en.unesco.org/covid19/educationresponse. Access on June 23, 2021)

Thus, more research and development should be conducted in accordance with other principles recently discussed by (Mayer, 2019) and address the issue of individual differences in attention and cognition during learning with multimedia technology and resources.

III. DESCRIPTION OF THE SPECIFIC CONTEXT OF MULTIMEDIA SKILLS DEVELOPMENT BY UNIVERSITY PARTNERS (A SYNTHESIS OF COLLECTED OPINIONS IN EACH COUNTRY)

In the following sub-chapters, there will be briefly presented the specific situation for multimedia training needs of university staff in the case of university partners included in MUST project.

Romania

The current situation at the Politehnica University of Timisoara and at the West University of Timisoara, Romania was presented through the webinars available at: https://elearning.upt.ro/ro/impreuna-online/ (Access on June 23, 2021). The presentations conclusions and the market research developed with students and teachers have underlined the following aspects (related to the need for MUST project implementation):

- A large proportion of university teaching staff has lack of skills for supporting online trainings. The last extended training program that has been dedicated to the digital skills development for university staff was under the DidaTech project, a national project finance by the structural funds having partners other technical universities in Romania (POSDRU/86/1.3/S/60891, https://www.cm.upt.ro/didatec/);
- The average age of the teaching staff is between 45 and 50-year-old and they are confronting with an aversion and difficulties

on training/teaching/examining students online; they are not digital natives, and they need continuous support and trainings;
- There is a lack of online pedagogy training for university teaching staff;
- There is a lack of online/virtual communication technologies and pedagogy for university teaching staff;
- Using the Virtual Campus facilities (https://elearning.upt.ro/ro/campus-virtual/) there have been developed a training module dedicated to university teaching staff in using the Moodle platform (Curs de Tutoriale pentru Profesori);
- There is a lack of multimedia skills to develop resources for engineering studies … this fact has been seen during the restrictions period for COVID-19 pandemic when professors teaching in university laboratories were not allowed to make real classes and they do not have record lessons.

Spain

For more than a decade, the University of Alicante has been working on various projects that seek to encourage the use of technologies among teachers to adopt new and more innovative practices through various programs, among which we can highlight those developed by ICE (Institute of Education Sciences). Specifically, in the last three years it has been developed a program called Redes-Innovastic (https://web.ua.es/es/ice/redes/redes.html) in which it is intended through meetings and specific training actions to promote new teaching systems. In the academic year 2019-2020 the program of continuous learning of the university teaching staff is available: PROGRAMA DE FORMACIÓN DOCENTE OFERTADO POR EL ICE, https://web.ua.es/es/ice/seminarios/oferta-formativa-ice.html.

This training programme is aimed at the University of Alicante academic staff members, organized through courses and workshops providing practical experiences and specific demands of the UA Faculties and Schools. The ICE thus establishes a training system based on the demands and experiences of the different university offices as a mediation element between the needs and contributions of the university academic staff, individually and/or as a team, and organizing the corresponding courses and workshops.

To make the communication of the parties involved easier, effective, and dynamic, a direct system is established through a link for suggestions on the ICE home page. In addition, to promote and keep the programme updated, a coordinator has been appointed for each Faculty or School. The syllabus is planned in four academic terms. The aim is to establish a maximum of eight training courses each academic term (two per month). These courses and/or workshops must be combined with the actions developed through the Lifelong Education Programme for public servants in the region of Valencia. This training programme is open and flexible, with the aim of finding a way to develop all the courses proposed by teachers. It is also a way to promote the courses offered and generated within the University of Alicante. As an internal study and informal discussions with university staff members, there is a specific need for training programs in the field of digital/multimedia skills development for enhancing university education, research, and university-community projects. Thus, the proposed actions in the MUST project could be framed within this philosophy and would suppose the definitive impulse to systematize and empower the UA to better respond to social needs.

According to the UNIVERSTIC report (2017), Spanish universities are quite well prepared for a digital transformation, structure-wise. ICT helped teaching to take on a more virtual perspective, ranging from internet connection in all campuses to offering MOOCs. However, the potential offered by digital technologies is not fully exploited yet. Lecturers realize the positive outcomes of using digital technologies and multimedia in university research and teaching activities, but there is a need for training to use them effectively in their daily activities. Training activities for extending operational capacity for reaching new generations, enhancing security and data protection competences and promoting research would be useful for improving their professional skills in general (according to the public information presented at: https://tic.crue.org/wp-content/uploads/2018/03/UNIVERSITIC-2017.pdf, access June 20, 2021).

Germany (opinion reflected by associated university partners in Regensburg)

SoWiBeFo (Germany) has rich expertise in designing innovative learning arrangements and in creating media for community, non-traditional learner and work-based learning; concepts developed are work and learning assignments, multi-media representation of work processes, one point work instructions etc. SoWiBeFo is therefore capable to transfer innovation from the German context and to develop concepts and material within the project.

SoWiBeFo Regensburg: SPS e.V.: Cluster of the Sensors Technology Industry in Bavaria: experience in business education cooperation (85 companies, 2500 partners from industry and universities); University of Regensburg, IT Training department: consultation and access to information. The associated partners will share their prior expertise on the topic with the partners. The associated partners will incorporate the knowledge gained through MUST project in their own practices and consultancy offers. Also, SoWiBeFo Ltd. Is in closed contact with the University of Regensburg which can profit of the MUST training program (the university staff!).

The solution support by the SoWiBeFo Ltd. is presented in the following. Transfer and further development of two modular online learning programs

that have been developed, implemented, and evaluated with very good results in Germany by the University of Regensburg in cooperation with ISOB GmbH and SoWiBeFo e.V. The material from the projects "Media Pedagogy for Teachers" and the major BMBF initiative "CoDiClust" (Digital Learning in Cluster of the Sensors Industry (SME) will be transferred to Universities and Institutions of Higher Education in additional countries.

Portugal (opinion reflected by associated university partners in Porto)

Storytellme (PT) has expertise in design-implement products/services combining entertainment with literacy through personalization based on the tools of Design Thinking, storytelling, creative design methodologies for learning and process. Their innovative approaches and experience will refine processes as instructional design and design thinking, pedagogic consulting, multimedia and digital content development, technical resources to support platforms, using different methodologies (e-learning, b-learning, m-learning, responsive/cross platforms).

The increase of compulsory education in Portugal has created optimal conditions for more students to reach higher education, mobilizing a great mass of teaching professionals all over the world and posing countless challenges for the teaching profession, especially in the transition of the 20th to the 21st century, including: teaching has become student-centered; there is greater access to information; there is an interception of the digital era in teaching tools; and training interventions for online environments have been created and adapted.

The explosion of information, in a multimedia and digital context, has become a fertile area for exploring, communicating, and spreading information, thus enabling new knowledge to be learned, created, and taught. This scenario poses questions regarding the skills future and in-service teachers must acquire and develop.

These skills will give them more intervention capacity, because not only will they benefit their role as spreaders of information, but they will allow them to develop the ways in which they learn and are updated.

It is important for university staff in Portugal to develop new skills and ensure sustainability, as this is the only way they will be able to be an asset to their increasingly multidisciplinary students (which combine with rigorous theoretical teaching and highly interdisciplinary training applied in the specialized fields of multimedia). Thus, the aim is to reinforce lifelong learning and knowledge of new skills.

Lithuania

Kaunas University of Technology (KTU) has a EDU_Lab Center for Excellence in Learning and Teaching that experience in developing and introducing the system for development of the contemporary didactic (learning and teaching) competences at the University. It believes and promotes different philosophy of teaching and learning consistent with the contemporary educational trends. It has got experience in delivering consultations, helping teachers to collect the latest knowledge of teaching, to rediscover what was forgotten during the long-standing teaching practice. In addition, EDU_Lab encourages sharing good practices and organizes workshops for teachers. Together with KTU E- Learning Technology Center, EDU_Lab seeks to deep professional knowledge and contemporary work methods of educational staff.

Nevertheless, multimedia is quite new tool that is not used efficiently at our university. COVID-19 forced our lectures to evaluate their skills in virtual learning and clearly lectures of university lack skills in this field, especially multimedia skills. That would lead to more effective education while using pure distance of blended learning at our university.

Slovenia

International School for Social and Business Studies (ISSBS, Slovenia) postgraduate programme provides an excellent opportunity to continue your studies and take on new career challenges. They offer a 1-year Master's programme (Management and Quality in Education programme) and a 3-year PhD programme in English (Knowledge Management) as seen at: https://mfdps.si/en/study-programmes/. Both programmes allow for the optimum balance of work and study commitments. Students can gain expert knowledge of management, business studies, learning and education, as well as practical experience through case studies of local and foreign organizations. The PhD programme also provides excellent opportunities for research and international publication.

The e-ISSBC platform support the educational process: https://eucilnica.mfdps.si/login/index.php.

Furthermore, professors from different subjects and administrative staff need to update and improve their digital/multimedia skills and MUST project is considered a great opportunity. Regarding this project partner's specifics some issues have been identified:

- ISSBS has expertise in management and quality in education and in European projects dedicated to fostering the skills of community developers and others working with non-traditional learners, as intercultural mediators. They have a strong network in the Balkan area which will be used for transferring and dissemination actions (https://mfdps.si/en/research/).
- ISSBS has experience in the development and implementation of e-learning; they have developed their concept of blended learning as well as distance learning using Moodle and LearnDash platforms.
- ISSBS brings this experience to the project and aims to further develop its digital learning skills along principles of interactive transmedia use and stronger engagement with the community and non-traditional learners.

- ISSBS, Slovenia will use the MakeLearn international community of universities to support MUST project solution sustainability and dissemination actions, including the initiative od supporting exchange of good practices and experiences of teaching and educating online.

The North of Macedonia

The South East European University Tetovo (SEEU, North Macedonia) has a strong tradition in the practical dimension of learning (e.g., of social workers, of NEETs and nontraditional learners etc.). The existing Max van der Stoel Institute (MVDSI), Business and Innovation Center (BIC) and the Technology Park (https://techpark.seeu.edu.mk/) experience and networks will be used for MUST project implementation. SEEU offers to its students and staff a range of online services for efficient communication and management of the learning processes (https://www.seeu.edu.mk/en/current-students/online-services) and they will be use for the MUST project developments. The specific of teaching-learning-assessment at SEEU is using online/digital/virtual/multimedia technologies … But the teaching staff need continuous training programs for their skills update and development. Thus, the proposed MUST solution of training and assessment could better support the LLP in the field.

IV. PRELIMINARY CONCLUSIONS AND REMARKS

Technology is evolving at a faster rate than ever before and is transforming many aspects of our lives. This also holds true for the labor market: the introduction of different technologies is changing most professions across all industries. The situation has been proved true and real even in the university context where the e-learning capacities were less exploited and only some teaching staff were able to operate on-line despite. The COVID-19 pandemic has demonstrated the need for online resources created by existing university teaching staff (with support of technical and administrative staff where available). Also, the education crisis has proved that in academic fields as engineering sciences, human sciences, art (including music) etc. the multimedia materials (visual resources developed by exploiting the existing infrastructure in the universities) are of great importance and they could support even online classes.

This, these implications require a proper response from our university educational systems if we are to educate the citizens, employees, employers, and entrepreneurs of the future. In everyday life, basic administrative practices and social interaction often presuppose basic levels of digital competence. In the workplace, automation, robotization and digitalization will have an impact on existing jobs. Some of them might disappear, while new jobs will be created. What is certain is that most professions and most everyday tasks will change as technologies are rolled out in society and within the workplace.

With all these rapid technological changes, universities are struggling to adapt, not only in terms of how to use the technologies, but also in terms of teaching the skills and training the teachers and trainers we need to do that.

The preliminary research study stresses that:

I. The acquisition of digital, including multimedia skills goes hand in hand with a lifelong learning approach.

Not only is it necessary to transform educational and training systems at all levels to meet the demands, but it is also necessary to provide opportunities to upskill and reskill across all age groups. Thus, existing departments or offices for teaching staff development in the universities must manage, support post-graduate programmes in the field. This action will be supported by Politehnica University of Timisoara, Romania through the DPPD Department (http://dppd.upt.ro/).

II. Universities are the starting point for digital skills education (using online platforms and creating multimedia resources in particular) and teachers should be at the core of the transformation.

There is a large disparity across university partners in the MUST project when it comes to the level of digital/multimedia skills development. The study stresses that the lack of connectivity results in a lack of digital/multimedia skills education for university teaching staff. Thus, will be full filled by the international consortium and the common activities of the MUST project.

III. The digital transformation does not only require education in digital/multimedia skills. Rather, its implications also have the potential to transform teaching methods. Thus, MUST project must contribute to the improvement of the online pedagogy methods and tools.

Unfortunately, this potential is not being fully tapped into as university teachers need to be educated themselves. The study conclusions insist that, for this transformation to be successful, teachers need to be properly assisted and trained (online and face-to-face). As teachers are already under considerable work pressure, this should not come as an extra task that will increase the pressure even more.

IV. A strategy at for the digital/multimedia skills development for the teaching staff is required at each university level.

Many initiatives exist at EU level schools, such as the recent Digital Education Action Plan and several promising, but small-scale initiatives (e.g. EU Code Week, Digital Skills and Jobs Coalition, media literacy initiatives).

The proposed approach could be attached to the present annual strategic plan for teaching staff development, and it will be more effective if:

- There is a strong implication of the departments or offices for teaching staff development in the universities;

- There were more coordination and cooperation across the different departments in the university (multidisciplinary learning environment).

The strategy should be viewed as the first step towards a more over-arching strategy. At the department and individual level, the strategy should be correlated with the results of the teaching staff assessment (of their didactic activity) by students, other colleagues (peer-review) and their direct managers.

V. A harmonized method for the assessment of digital/multimedia skills of university staff should be developed.

Currently there are tools to assess the level digital skills, such as the Digital Competences Framework. Yet, such tools operate on a self-assessment basis, similar that has been planned in the case of MUST project implementation. The study calls for a MUST specific schema/module to test the level of digital/multimedia skills of trainees after they follow the training program. This would provide an insight into educational methods across university partners and create opportunities for the exchange of best practice.

The digital transformation offers many opportunities for education and the economy. However, it needs a proper policy response. Without such a response, there is a risk that a new social divide will emerge.

V. THE EXTENDED STUDY FOR MULTIMEDIA COMPETENCIES DEVELOPMENT AND THE DESIGNED OF THE TRAINING PROGRAM

A. The extended study for multimedia competencies development (results and debate)

The methodology uses for the pilot study was the survey based on designed questionnaire (agreed by all partners) that was circulated/distributes among several university communities in Europe with the support of MUST partners implications. The questionnaire is presented in the Annex and consists only of close questions; respondents answers have been ranked using a Likert scale with 5 points (1 – less needed/important …., 5 – strongly needed/important). The distribution of the questionnaire has been done via Google Forms (https://docs.google.com/forms/d/1pFJ4sBXZ2zSWGXEdo5YyT8epSZkv4HNMEQpPrrxd_YI/edit), and the generation of the graphs and tables results have been facilitated by this. Research results (Fig. 3 to 6) are shown in the followings and also, data about the research sample demography.

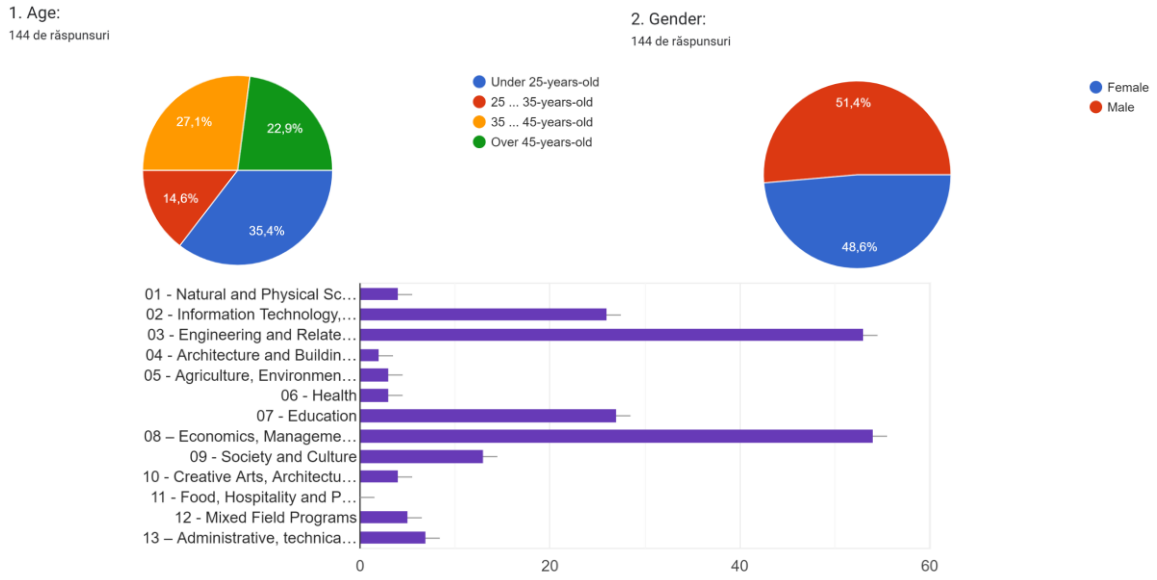


Fig. 3 Characteristics of the research sample (age, gender, field of teaching and research or for the administrative staff, the department where they are employed)

Fig. 4 Discovering the usefulness of the training program in the field of multimedia skills development

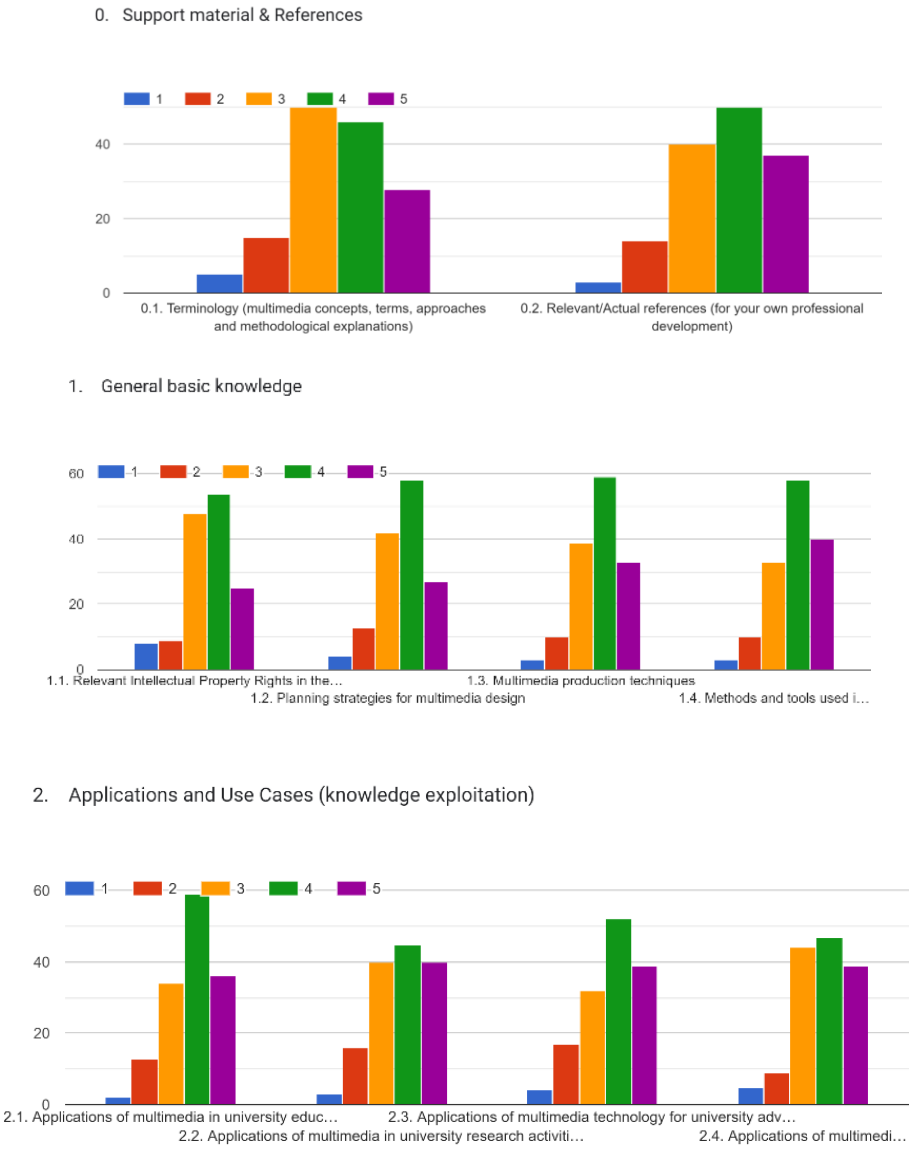


Fig. 5 Discovering the level of training needs in multimedia production and exploitation fields with respect to the training subjects listed

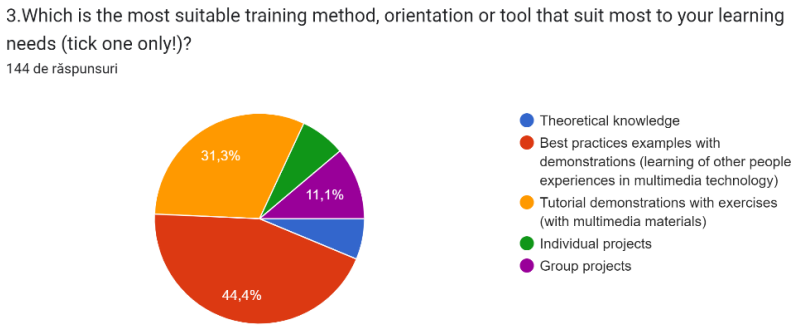


Fig. 6 Discovering the most suitable training method preferred by the potential trainees (university staff involved in the survey)

During the month of January – February 2021 when the research has been developed, there have been received 144 completed fill-up questionnaires that has been processes. Most of the respondents were males (51.4%) and most the respondents age was under 25 years old (35.4%). Most respondents belong to:

- Economics, Management and Commerce (37.5%) field of teaching and research or administrative staff activity field;
- Engineering and technologies (36.8%) field of teaching and research or administrative staff activity field;
- Education (18.8%) field of teaching and research or administrative staff activity field;
- Information technologies and computer sciences (18.1%) field of teaching and research or administrative staff activity field.

As can be observed from Fig. 3, the research sample is well balanced from the analyzed dimensions, but most of the respondents were from Romania (47), Slovenia (20) and Lithuania (15). Thus, there have been considered the extension of the research in the future (2022) after the intensive dissemination and multiplier events will be developed and implement by each partner in The MUST project.

The responses analysis in Fig. 4 shows that most of the respondents totally agree that getting involved in a training program in the field of multimedia skills development, will be useful for their professional life improvement; respondents' expectations are very high for all the investigated domains (see the Annex, questions' topics: I.a, I.b, I.c and I.d). Similar results have been achieved in the case of the express your level of training needs in multimedia production and exploitation fields with respect to some specific training subjects (as presented in the Annex, questions topics in section II of the questionnaire), as they have been presented in Fig. 5. Thus, the general opinions collected via this survey have underlined the followings:

- Respondents are less interested, or they expressed a moderate need for terminology in the field of multimedia, but they have a strong need for relevant and actual references in this domain (connected with their own professional development);
- Respondents have recognized a strong need for general basic knowledge in the field of multimedia (according to their answers for the questions related to chapter II of the questionnaire, 1.1 … 1.4, see Annex);
- Respondents have recognized a strong need for the applications and use cases with multimedia technologies (considering the knowledge exploitation) according to their answers for the questions related to chapter II of the questionnaire, 2.1 … 2.4, as presented in the Annex;
- Most respondents agreed that the most suitable training method, orientation or tool that suit most to their learning needs is "*Best practices examples with demonstrations* (learning of other people experiences in multimedia technology)" (44.4% of the respondents agree on this). In addition, 31.8% of the respondents have considered that "*Tutorial demonstrations with exercises* (with multimedia materials)" is the most suitable training method for them (Fig. 6).

B. MUST training program designed (preliminary results)

Based on the presented conclusions of the literature review and the extended survey developed with the support of MUST project partners from: Romania, Slovenia, Lithuania, Spain, Portugal, Germany and North Macedonia there have been created a knowledge and information base for designing the training program in the filed of multimedia competencies development (target group being the university staff). Thus, Table 1 presents the preliminary structure of the program that should be supported by the different intellectual outputs created during the project implementation (see the Free Tools section fo the project web page: https://mustproject.eu/free-tools/). This theoretical training units will be accompanying by a group of applicative units dedicated to the exploitation of multimedia knowledge in the didactic field (teaching), research and development (e.g., demonstration of research approaches and projects), for university activity promotion (including the educational offer presentation to different target groups) and to support university – community projects.

Table 1 The structure of the MUST training program (training units and elements + teaching methods)

Training Unit 1	**Training Elements (Lessons)**	**Teaching/learning material**	**Teaching methods**
Relevant Intellectual Property Rights in the Context of multimedia design, production and exploitation	1.1 Overview of digital skills in Europe (definitions, terminology, typology, relevant info at the EU level)	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings & further readings) 3-6 questions for evaluation of competencies	Presentation and interactive discussion
	1.2 Guidelines for intellectual property rights for multimedia	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Presentation with explanation, Self-directed learning, best practices

	1.3 Plagiarism prevention and protection of various media – video, audio, music, readings	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Lecture with explanation and examples.
Unit 2	**Lesson**	**Teaching/learning material**	**Teaching methods[1]**
Planning strategies for multimedia design	2.1 Content marketing	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates
	2.2 Digital communication	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Presentation, interactive discussion
	2.3 Planning & Script Writing for multimedia design	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Presentation, interactive discussion
	2.4 Story Boarding and timeline for multimedia design	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Presentation, interactive discussion
	2.5 Online Networking and Communities	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates
Unit 3	**Lesson**	**Teaching/learning material**	**Teaching methods**
Multimedia production techniques	3.1 Audio and video program production Video recording: video editing and publish (Zoom, MS Teams, Loom and others)	PowerPoint presentation (5-10 slides) Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Self-directed learning, lecture, presentation, groupwork
	3.2 Web design and publishing	PowerPoint presentation (5-10 slides) Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates, invited speaker
	3.3 Libraries of multimedia resources (video, music) Video repositories: Youtube, Vimeo and alternatives OR organizing	PowerPoint presentation (5-10 slides) Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Self-directed learning, lecture, presentation, groupwork
	3.4 Interactive materials (videos, text)	PowerPoint presentation (5-10 slides) Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates, invited speaker
Unit 4	**Lesson**	**Teaching/learning material**	**Teaching methods**
Tools used in multimedia production	4.1 Designing multimedia	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates
	4.2 Organizing learning	PowerPoint presentation (5-10 slides) + multimedia material for explanations	Demonstrations, cases,

		Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	interactive debates
	4.3 Finding ideas and discussing knowledge	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates
	4.4 Organizing, documenting and testing knowledge	PowerPoint presentation (5-10 slides) + multimedia material for explanations Reading with references (2-3 pages & 2-5 references & further readings) 3-6 questions for evaluation of competencies	Demonstrations, cases, interactive debates

V. CONCLUSIONS

The Covid-19 pandemic crisis has changed the university life and activities and force them migrate online. Thus, university staff needs special attention for the development of their digital competencies. Furthermore, specific attention has been given to the multimedia competencies that need to be strengthened and thus, multimedia technology should be better exploited in the university community.

The presented literature review and the preliminary investigation of seven university environment cases on multimedia development (existing specialists and infrastructure, groups of support, organizational structure, past projects in the filed etc.) have underlined the strong need for building and development of a training program dedicated to university staff.

The training needs were identified through an online market research conducted with the support of respondents from some universities from Romania, Germany, Lithuania, North Macedonia, Spain, Portugal and Slovenia. Respondents expressed their strong needs for all proposed subject of teaching (related to the development of multimedia competencies) and they appreciate "*Best practices examples with demonstrations* (learning of other people experiences in multimedia technology)" and "*Tutorial demonstrations with exercises* (with multimedia materials)" as the most adequate pedagogical methods that must be used for their training.

In conclusion, MUST project ("Multimedia Competencies for University Staff to Empower University - Community Collaborations") has become a necessity and the designed training program has been proved as of great need! In addition, the (preliminary) training program structure is the result of the collaborative work between all partners and has been agreed in the MUST project international consortium (see Table 1).

Future research and developments will support the applicative part of training program with training materials development (multimedia presentations, demonstrations and best practices and cases), the e-learning platform definition and guidelines for tutors and trainers.

ACKNOWLEDGEMENT

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ANNEX

The designed questionnaire used in the survey

This questionnaire is a part of a marketing exploratory research that aims to identify the training/learning needs and motivation of university staff for multimedia learning. The research aims to identify the way to support university leaders, managers and employees to understand the strategic implications of achieving multimedia skills and using/exploiting the multimedia skills and to develop innovative and creative approaches for education, research, advertising and university-community projects.

The target group for this survey consists of university staff which are involved in activities related to design and use of multimedia Products/Services. The research results will be used to design a training program aligned to your expressed needs/requirements and adapted to your university context particularities. We intend to develop this program through international cooperation (European consortium of partners from universities and companies), using the experiences and knowledge of certain trainers with extensive expertise in the field. Also, the exploratory marketing research aims to define a target group that will benefit from this program of professional skills development.

Please, involve yourself in this research! We ensure the confidentiality of your given answers. Please tick or formulate, where appropriate, answer(s) that best fit to your opinion, in accordance with your work.

I. Do you consider that getting involved in a training program in the field of multimedia skills development, will be *useful* for you?

a. I expect my professional competencies related to my current job, to be improved:

Not at all	Less	Much	Very much	I don't know
1	2	3	4	5

b. I expect to get additional skills and to extend my professional competencies in education field, to improvement of my operating capacity to face the new challenges for education Z Generation of students (better face the new challenges!):

Not at all	Less	Much	Very much	I don't know
1	2	3	4	5

c. I expect to get additional skills and to extend my professional competencies in research field to better support my research results results visibility and dissemination actions:

Not at all	Less	Much	Very much	I don't know
1	2	3	4	5

d. I expect to get additional skills and to extend my professional competencies in university-community projects development (social projects, promote entrepreneurship education, advertising for admission process of our university, working with industrial/business partners, support visibility of our work, cultural projects, extracurricular activities with students etc.):

Not at all	Less	Much	Very much	I don't know
1	2	3	4	5

II. Express your level of training needs in multimedia production and exploitation fields with respect to the training subjects listed in the table below. For each topic, select using "X" mark, one of the five options that best suits to your needs, using the scale below:

Scale: 1= no need; 2= low level of need; 3= moderate need; 4= strong need; 5= very strong need

Learning/Training needs:	**Level of training need**				
	1	**2**	**3**	**4**	**5**
0. Support material & References					
0.1. Terminology (multimedia concepts, terms, approaches and methodological explanations)					
0.2. Relevant/Actual references (for your own professional development)					
1. General basic knowledge					
1.1. Relevant Intellectual Property Rights in the context of multimedia design, production, and exploitation					
1.2. Planning strategies for multimedia design					
1.3. Multimedia production techniques					
1.4. Methods and tools used in multimedia production					
2. Applications and Use Cases (knowledge exploitation)					
2.1. Applications of multimedia in university educational processes (theoretical framework + use cases for subjects/disciplines of Bachelor, Master and PhD. programmes that can use multimedia technology)					
2.2. Applications of multimedia in university research activities (theoretical framework + use cases for research and development activities)					
2.3. Applications of multimedia technology for university advertising and communication processes (theoretical framework + use cases demonstrations)					
2.4. Applications of multimedia in university-community projects (theoretical framework + use cases of social responsibility projects, university-industry collaboration projects, university-business units collaborations projects, university-SMEs projects, projects with other public bodies and NGO, cultural projects etc.)					

Which is the most suitable training method, orientation or tool that suit most to your learning needs ***(tick one only!)? – multiple answers!***

- ☐ Theoretical knowledge
- ☐ Best practices examples with demonstrations (learning of other people experiences in multimedia technology)
- ☐ Tutorial demonstrations with exercises (with multimedia materials)
- ☐ Individual projects
- ☐ Group projects

III. In the following, please provide us some information about yourself (research sample definition):

1. Age:

Under 25-years-old	25 ... 35-years-old	35 ... 45-years-old	Over 45-years-old

2. Gender:

F	M

3. Subjects/Disciplines where you activate and areas of university where you are employed (for the case of administrative staff ***(multiple answers)***:

01 - Natural and Physical Sciences
02 - Information Technology, Computer Sciences
03 - Engineering and Related Technologies
04 - Architecture and Building, Civil Engineering
05 - Agriculture, Environmental and Related Studies
06 - Health
07 - Education
08 – Economics, Management and Commerce
09 - Society and Culture
10 - Creative Arts, Architecture and Design
11 - Food, Hospitality and Personal Services
12 - Mixed Field Programs
13 – Administrative, technical staff (not involved in education process)

4. University name:
   _____

5. Department:
   _____

6. Country _____
   (defined sample, only)
   - Germany
   - Lithuania
   - North of Macedonia
   - Portugal
   - Romania
   - Slovenia
   - Spain

7. Position (multiple answers)
   - Management position (rector, vice-rector, dean, department manager, director), executive or senior managers of university
   - Administrative, technical staff
   - Research staff (not involved in education processes)
   - Teaching staff
   - Student

If you are interested to participate in "multimedia skills development" training program, please provide us an e-mail (and/or phone number) where to be contacted:

_____
_____

THANK YOU VERY MUCH FOR YOUR INVOLVEMENT!

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Massive and Repeated Molecular Testing a Tool in the Pandemic Covid-19 Prevention Management System

Alin GAUREANU[1], Paula Nicoleta NEAG[2], Ioan Mihai COSTA[3]

Abstract – The management of a crisis must be integrated into an ergonomic framework of the necessary measures. These measures need to be, efficient and providing the yield according to expectations, with minimal impact of the people and provide to change crisis processes to the normality. Crisis management involves applying pre-existing measures, preparatory for the entry of the crisis, for deployment (to eliminate the causes and to diminish the effects), for adaptation. In addition to generic measures, it is necessary (like the preventive system of management of occupational safety and health - OSH), to use appropriate tools: risk assessment, feedback for the measures taken, and for implementation of adaptive measures. These tools must be used periodically or updated with any change/evolution of the situation. In the situation of the COVID-19 crisis, a gold instrument. Similar with some findings in the literature, trivalent for evaluation, verification, adaptation, is the massive and periodic testing for suspects. When we have a new virus, the whole population is suspected because there is no immunity already created or administered. The paper aims, to logically associate the preventive ergonomic management system already known by OSH, with ergonomic management system of crises, through scientific research, statistic arguments, which support the massive implementation of molecular.

Keywords Crisis Management, Ergonomics, OSH, Testing, Covid-19

I. INTRODUCTION

Because we are going through a period of crisis regarding the spread and effects of COVID-19, it is topical to consider the ergonomics of the systems that deal with the necessary measures that are required to be taken in such crises, even if these measures are not always taken quickly enough and effectively [4].

To prevent the risky, unprecedented and unpredictable situations, we usually we use for the measures of Occupational Safety and HEALTH (OSH), which we inevitably met at our places of work, but here these measures, in crises transcend and in personal/civil life, of the community in which we live.

If until now, the compliance obligations regarding the generation, implementation, improvement, and accountability for preventive measures were the responsibility of the employers (Directive 89/391/CEE), then we are all in the position that in emergencies all these activities and responsibilities will be transferred to civilian life by the presidential decree regarding the establishment of the state of emergency and by observing the military ordinances, including recommendations or orders, the decisions of the authorities responsible for coordinating and managing this state.

The fundamental role of ergonomics is to coagulate interdisciplinary the conclusions of many scientific fields (including management and OSH), so that, by designing conditions of well-being in the workplace of the workers, they will be able to easily regenerate forces, to provide expected yield and productivity.

Starting from the generic and reinterpreted definition of ergonomics, related to the work process, we can reformulate this concept outside of work, observing a similarity of interests and expected effects, transposed from the workplace within our contemporary civil/private life.

Ergonomics is a preventive system for analyzing and configuring recommendations, based on interdisciplinary scientific research, which aims at the well-being of the members of the society so that they can constantly ensure a predictable and efficient return to the community of which it is part.

If at the workplace the ergonomic principles are imposed and supervised by a law of Occupational safety and HEALTH - OSH (this discipline of ergonomics as a watchdog of ergonomic principles), they cannot act in the civic life, since with the issuance of the presidential decree establishing the state of emergency. This OSH measures regard especially HEALTH, becomes an obligation and motivation for every member of the society, so that it can undergo optimal crisis and can adequately restart immediately after this crisis.

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It is important to understand the ergonomic system as such and how it works, in this unique situation, to have an overview of the measures arising from this system, the role of these measures, the application and the effects, to contribute to management or application of these perceptions.

This understanding of the system not only gives us the motivation to actively interact with the system, but it also opens the way for us to understand the necessity of foreshadowing for the future some general proactive concepts of preparation and reaction to other possible crises.

From the systemic point of view, the role of ergonomics is not only to create viable and efficient systems, but these systems must include proactive or generative concepts of prevention, even if at the time of system design the prospect of improbable events was not seen.

For crises, the ergonomically designed preventive system must protect and exploit values like the intangible ones (Know-how, procedures, intellectual capital composed of human, structural and relational, etc.). This should be considered both during the design phase of the system, during the application and immediately after the normalization of the situation.

Examples of approaches include both the forms of preventive measures and those of the actions and tools needed to carry out the measures It is not enough to take a measure if there is no appropriate action or tool to implement it properly. Actions and instruments need to be checked to see if they have sufficient adaptive versatility to achieve the purpose of the measure.

II. EXAMPLE OF COVID 19 CRISIS STRUCTURES REACTIVITY

The timeline shows the dynamics and adaptability / one-point guided reactions from World Health Organization (WHO) vs. national RO:

- 31.12.2019 China warns WHO about unknown pneumonia
- 02.01.2020 WHO activates the incident management system at the regional level
- 10.01.2020 WHO recommends the first travel prevention practices
- 12.01.2020 China internationally distributes the genetic sequence of the new coronavirus discovered on 07.01.2020.
- 20.01.2020 China officially declares 278 cases of COVID-19, the majority in the Wuhan - Hubei Province. The first cases appear in Thailand, Japan, and South Korea
- 22 and 23.01.2020 WHO takes the first intervention and coordination measures, creating intermediate guides for diagnosis, clinical management, and infection prevention
- 11.02.2020 RO approves GEO 11 for emergency medical stocks and quarantine measures
- 26.02.2020 RO announces the first case of infection with COVID-19
- 04.03.2020 RO meets the Strategic Communication Group made up of specialists, which proposes to the Committee for Special Emergency Situations headed by the Minister of Interior to take measures.
- 11.03.2020 WHO declares pandemic for 118,000 cases in 114 countries and constantly updates recommendations and restrictions
- 16.03.2020 RO establishes a state of emergency with restrictions of constitutional rights and the empowerment of the Ministry of Interior to take measures through Military Ordinances to manage the situation. The measures concern mandatory social distance through travel restrictions, isolation, quarantine, verification, and sanction for non-compliance.
- 16.03.2020 WHO - The Director-General recommends testing.
- 25.03.2020 RO in the Military Ordinance 3, the army receives prerogatives of security, support of law enforcement and borders, and all subsequent measures will be more restrictive [5] to ensure and verify the social distance and stop the spread of the virus.

These developments and measures conclude that the actions for treatment must have as preventive actions guided in two basic directions Fig. 1:

- For NOT spread social distance (incl. isolation and quarantine), hygiene, and personal protective equipment (PPE),
- For Identification: early prevention testing [6] and continuous testing.

Failure to comply with the parameters of one measure requires a counterbalance to increasing the other. If it were possible, in the ideal case, all people should stop circulating for 14 days (if the virus evolves) and at the same time, all of them will be tested to quarantine those already infected, for which an epidemiological investigation will be carried out establishing contacts to be extracted from the community and preventively isolated.

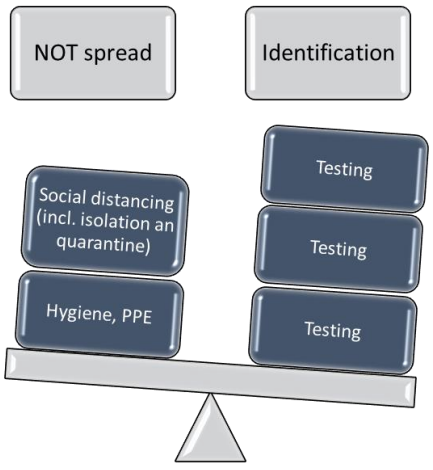

Fig. 1 Basic prevention directions for pandemic treatment.

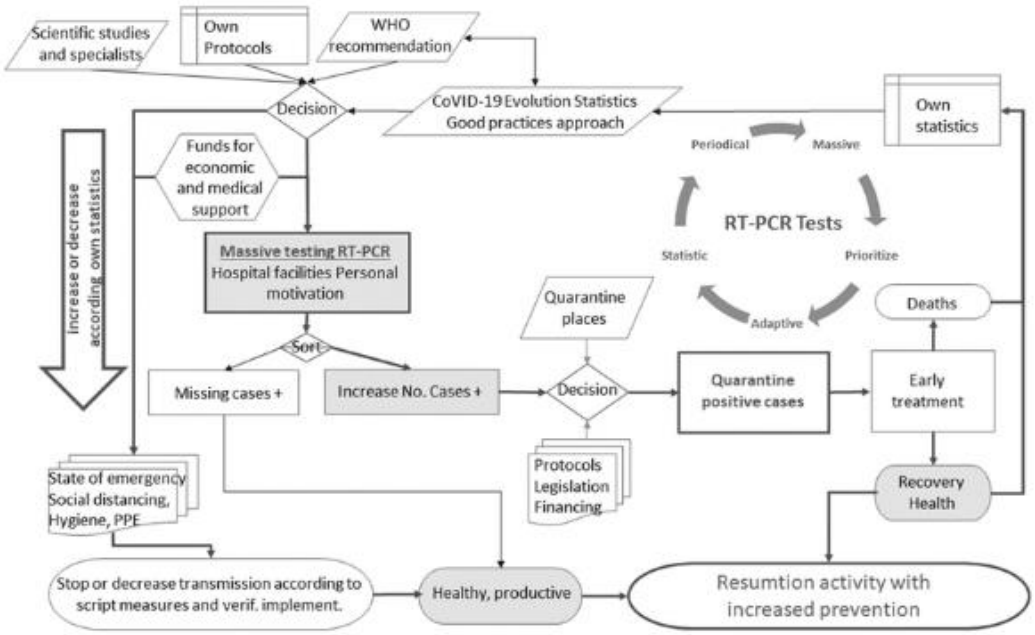

Fig. 2 The logical scheme for COVID-19 pandemic management with the testing measure.

II. OBJECTIVES

The following objectives have been followed during the development if the study (they will be explained in deep in this chapter):

a) Revealing good practices and attitudes for crisis management of Covid-19 pandemic

b) Analysis of international data on the evolution of the Covid-19 pandemic, to identify the role of molecular tests in the prevention management system.

A. *Revealing good practices and attitudes for crisis management*

For a clearer picture of the preventive context applicable to the COVID-19 pandemic situation, we outlined in a logic scheme which means designing the measures insisting on testing, as a multivalent tool in the logic of ergonomic prevention, and we will then discuss the issues related to this scheme.

B. *Structuring a crisis management scheme*

The logical scheme in Fig 2, to be viable and efficiently applied, contain three directions:

- Information/communication, legal regulations, financial support,
- Social distancing, hygiene, PPE, and testing,
- Treatment and again testing.

In this image we can see the role of molecular testing as a sorting tool in the ergonomic management of prevention as well as a reference point for creating new tailored measures. We see how the massive test measures are counterbalanced (increase or decrease) with those of social distancing, hygiene, or PPE. At the same time, do not forget the important role of information, statistics, good practices, scientific papers and scientists specialized in the field, because all these are involved in the decision-making and continuous adaptive process.

C. *Increasing the level of culture and civilization through*:

a) Preventive education or training for a crisis, disaster, war; OSH in school disciplines, hygiene, first aid [7],[8];

b) Correlation of the level of civilization with the level of understanding and application of prevention.

Understanding and compliance of restrictive legislative measures cannot be achieved, if there is no culture regarding the need for such measures at any given time. The members of the society must know and develop attitudes and reactions appropriate to situations that they have been familiar with at least. Metaphorically, we cannot expect a seed thrown on barren land to sprout and bear fruit.

The ability to understand and react is based on culture [9] and the level of civilization. If the state does not consider education towards increasing the level of civilization, as a preventive measure, each of us must lose from a financial perspective.

c) Legislative training:

Policies of application, awareness, implementation and continuous training [10] differentiated between the ordinary laws (no one can invoke the ignorance of the law), compared to the preventive legislation for which there must be the certainty that the entire population was informed and aware.

Legislative awareness (as they were made public - through the media the legislative bodies, forcing them to be remedied to the public);

In recent times, SARS, MARS, Ebola or H1N1 [11], [12] or other pandemics have also been reported and they will likely that they will occur again, and the preparation is not necessarily necessary for those who

have gone through such a crisis, but preparation and awareness for the next generations.

D. *Specialization of programs and training of crisis and intervention personnel [27]*

The operability of a national medical and managerial statistical platform related to the world statistics [28], with software programs for analysis and generation of mathematical predictions using algorithms used by artificial intelligence within learning machines and prescribing decisions, symptoms and clinical predictors of the states light and severe depending on the risk of the associated diseases, protocols based on the already existing cases and the histories up until then.

Applying to a unitary platform for informing, directing and managing crises applied to the department, agency or relevant ministry dealing with the crisis [29], interconnected according to needs with other online platforms, for example for volunteering as a medical volunteer [30] or for centrally managed [31] offers or donations [32]. Bilateral link and collaboration for global pandemic management with WHO - World Health Organization and other international organizations or states.

WHO provides the latest publications and scientific research on COVID-19 [33], with the possibility of searching and filtering?

The entire scientific world can be connected to the latest data discovered or analyzed in scientific articles, information, correspondence, reports or other articles (even audio), some journals specifying the lack of the pear review before publication.

Design and regulation of ergonomic preexisting systems, reaction, and attitude during the crisis period. Applying to computational prediction systems for study the evolution of unpredictable events with the help of mathematical algorithms [13, 14], artificial intelligence and learning machines, IT and mathematicians' specialists' communication resist [15].

Forecasting of pandemic COVID-19 is based for SEIR algorithm (Susceptible → Exposed → Infected → Removed) [17]. The most important indicator regarding the spread of the pandemic is the Ro - reproduction number. A sampling of the estimates for epidemic Ro parameters are presented in Table 1.

Table 1 – Parameter of reproduction number depending on which pandemic evolution is predicted – source https://gabgoh.github.io/ - epidemic calculator SEIR

ISSUER	Location	Reproduction Number (Ro)	Incubation Period	Infectious Period
Kucharski et. al	Wuhan	3.0 (1.5 — 4.5)	5.2	2.9
Li, Leung and Leung	Wuhan	2.2 (1.4 — 3.9)	5.2 (4.1 — 7.0)	2.3 (0.0 — 14.9)
Wu et. al	Greater Wuhan	2.68 (2.47 — 2.86)	6.1	2.3
WHO Initial Estimate	Hubei	1.95 (1.4 — 2.5)		
WHO-China Joint Mission	Hubei	2.25 (2.0 — 2.5)	5.5 (5.0 - 6.0)	
Liu et. al	Guangdong	4.5 (4.4 — 4.6)	4.8 (2.2 — 7.4)	2.9 (0 — 5.9)
Rocklöv, Sjödin and Wilder-Smith	Princess Diamond	14.8	5.0	10.0
Backer, Klinkenberg, Wallinga	Wuhan		6.5 (5.6 — 7.9)	
Read et. al	Wuhan	3.11 (2.39 — 4.13)		
Bi et. al	Shenzhen		4.8 (4.2 — 5.4)	1.5 (0 — 3.4)
Tang et. al	China	6.47 (5.71 — 7.23)		

E. *Implementation of digital epidemic control tools*

This is where artificial intelligence (AI) with learning machines (LM), far from reaching human capabilities, can be mentioned, can help identify and diagnose patients, useful in disinfecting infected areas, or even helping to accelerate the process of obtaining treatments. The concept that computer vision algorithm used to authenticate owners to self-driving cars, is already contributing to China's identification of body temperature using infrared sensors applied to the cameras of a train station in Beijing.

The application is made by the Baidu technology giant. The system scans more than 200 subjects, signaling those who exceed the temperature of 37.3 degrees Celsius, the margin of error being 0.5 degrees Celsius. Another Chinese technology giant, Alibaba, has developed a system with 96% accuracy in identifying Coronavirus at chest scan with a CT scan, being able to distinguish between common pneumonia and a COVID-19 infection.

F. *Facilities and policies to ensure buffer funding for crisis situations*

These could be causes by:

a) Food stocks and their transport insurance;

b) Sanitary personal protective equipment (PPE) and hygienic materials, medical devices for life support and medical testing (devices, materials, specialists);

c) Support and protection for production, population, and strategic economic branches and defense.

G. *Correct reporting*.

It is need for finding adequate preventive measures and evolutionary calculation [16], estimating the consequences in time [18] on the safety, financial aspects, before any estimation of the psychological-moral consequences, as well as creating stimulant measures for accurate reporting. The quality of the reported data is important because because of these data, one goes from one stage to other measures. If the reporting is deficient or inaccurate, the measures are ineffective. Possible causes for inexact reports are:

- The historical appetite for interpreting reports according to interests, which can lead to
- Intentional fraud (fraudulent and incriminating) of reporting to maintain leadership positions (politically supported and not meritocratic)
- Manipulation, truncation of reports through psychological justifications.

H. *Continuous reporting of cases identification*

Test, test, test [19], with accurate and immediate reporting of their results can give a clear picture of the cases and implicitly the preparations needed for prompt and effective response. An effective reporting must be accurate, contributing to the analysis and dimensioning of the gravity of a situation from several points of view, or relationships between the reported data, the following list is exemplary and non-exhaustive:

1. To know the extent of the phenomenon, there must be as many tests as possible - it is the primary measure regarding prevention [20], namely evaluation.

2. Through a massive test, knowing the actual number of cases, they can be isolated, and healthy or cured ones [21] can contribute to restarting the economy.

3. If there are certain assessments [22] and appropriate measures can be taken for different stages of data evolution, and if there is no reliable data based on the risk assessment following the test, there certainly cannot be adequate preparation for the intervention or preventive action.

4. If the data are as close to the truth, that is, the evaluation is as accurate as possible [35], we can find out exactly the rate of recovery of the patients confirmed positive and cured. If there is no comprehensive testing, this recovery report is false, without being able to estimate the mortality rate or illnesses so that the structures, materials and specialized personnel can be optimally dimensioned.

5. The nominal value of the data is not relevant if this value is not related to the population number of a country.

6. By reporting to correct statistical data, several indicators can be evaluated, such as:

a. The efficiency of the health system (system, doctors, treatment schemes, etc.), by relating the number of infected cases to the number of cured cases.

b. The efficiency of the organization system (measures to stop the pandemic, purchase of sanitary materials, etc.) by limiting the number of infected people to the number of the population, accelerating certain specific measures that distort this report.

7. The last aspect, which seems to be propagated by the authorities to hide the situation, is the psychological aspect against panic, but this unconscious approach only harms in the future, the unknown cases of the infected leading to widespread and implicitly widespread many more deaths.

III. METHODS

The study started from the empirical observations regarding Table 1, where variations of the statistical data it was revealed by scientific papers regarding the spread rate of COVID -19 especially in China.

The methodology for achieving the objectives is related to the investigation and analysis of statistical reports on the evolution of Covid-19 cases in European Union countries, compared to the number of molecular tests per 1 million inhabitants of each country, as seen in the data of the Table 2.

For the analysis of the results, we performed mathematical calculations (equation) by reporting the values in Romania with other countries in the European Union that have significant data.

IV. RESULTS

From Table 2 several reports and results can be drawn, regarding the following aspects:

A. *The test rate for Romania*

The rate is 2008 tests per 1 million inhabitants, being the lowest in the EU according to Table 2 and Fig. 3, with the following details:

Table 2 – Extract from COVID-19 statistics of number of tests at 1 Million pop. for 05.04.2020
Source wordometers.com

Country	Population	Total cases	Total Deaths	Total Recovered	Tot.Cases (1Mil. pop.)	Deaths (1Mil. pop.)	Total tests	Tests (1Mil. pop.)
Luxembourg	625.978	2.729	31	500	4360,0	50,0	22.793	36.412
Malta	441.543	227		2	514,0		10.358	23.459
Estonia	1.326.535	1.097	15	62	827,0	11,0	21.004	15.834
Slovenia	2.078.938	997	28	79	480,0	13,0	27.764	13.355
Austria	9.006.398	11.930	204	2.998	1325,0	23,0	108.416	12.038
Latvia	1.886.198	533	1	1	283,0	0,5	20.680	10.964
Germany	83.783.942	97.351	1.479	26.400	1162,0	18,0	918.460	10.962
Italy	60.461.826	124.632	15.362	20.996	2061,0	**254,0**	657.224	**10.870**
Lithuania	2.722.289	811	12	7	298,0	4,0	23.645	8.686
Denmark	5.792.202	4.369	179	1.327	754,0	31,0	49.249	8.503
Portugal	10.196.709	11.278	295	75	1106,0	29,0	86.370	8.470
Cyprus	1.207.359	446	9	33	369,0	7,0	10.154	8.410
Spain	46.754.778	130.759	12.418	38.080	2797,0	266,0	355.000	7.593
Czechia	10.708.981	4.475	62	78	418,0	6,0	80.304	7.499
Ireland	4.937.786	4.604	137	25	932,0	28,0	30.213	6.119
Belgium	11.589.623	19.691	1.447	3.751	1699,0	125,0	70.000	6.040
Finland	5.540.720	1.927	28	300	348,0	5,0	31.714	5.724
Netherlands	17.134.872	17.851	1.766	250	1042,0	103,0	75.415	4.401
Sweden	10.099.265	6.830	401	205	676,0	40,0	36.900	3.654
France	65.273.511	89.953	7.560	15.438	1378,0	116,0	224.254	3.436
Slovakia	5.459.642	485	1	10	89,0	0,2	15.155	2.776
Croatia	4.105.267	1.182	15	125	288,0	4,0	10.847	2.642
Greece	10.423.054	1.735	73	78	166,0	7,0	25.453	2.442
Bulgaria	6.948.445	531	20	37	76,0	3,0	15.899	2.288
Hungary	9.660.351	733	34	66	76,0	4,0	21.250	2.200
Poland	37.846.611	3.834	84	134	101,0	2,0	80.757	2.134
Romania	**19.237.691**	**3.864**	**148**	**374**	**201,0**	**8,0**	**38.623**	**2.008**

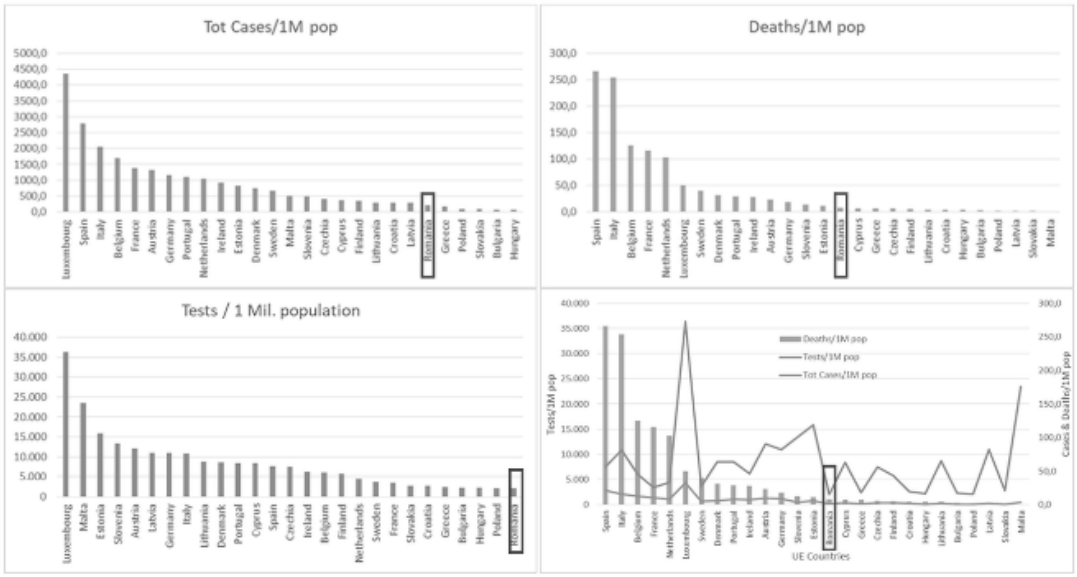

Fig. 3 Graphical situation of COVID-19 data in RO vs. EU on 05.04.2020, regarding testing related to cases and deaths at 1 mil / pop.

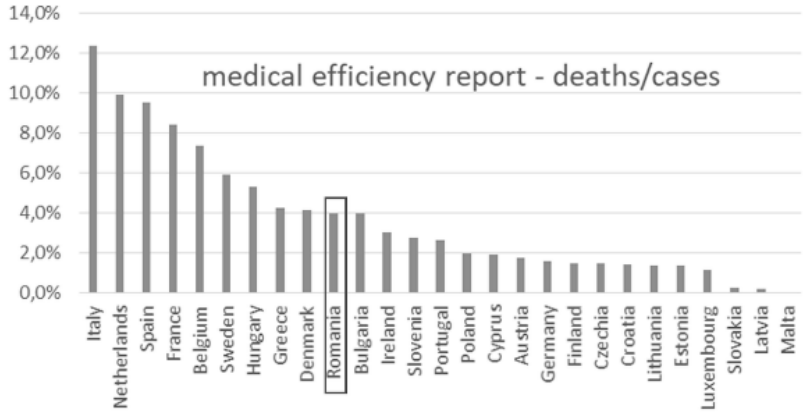

Fig. 4 Medical efficiency graphic indicator.

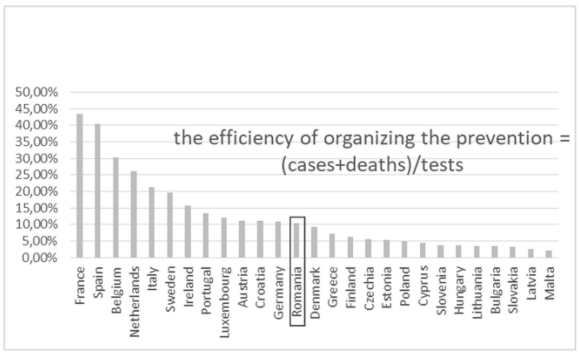

Fig. 5 Prevention test efficiency graphic indicator.

a) Even though in Romania there are the fewest tests, in Italy which has a 5 times higher rate, which is 10,870 tests per 1 million inhabitants, Italy has 254 deaths per million inhabitants compared to Romania which it has 8, mean almost 32 times less;

b) The previous finding excludes the proportionality of the tests with the death rate;

c) As Romania has the lowest test rate, at the opposite pole we observe Luxembourg which has the highest rate of EU tests 36,412 tests per one million inhabitants, 3 times more than Italy and 18 times more than RO. However, Luxembourg has 50 dead/1 mil. pop. compared to 8 dead/1 mil. pop. of RO, mean 6 times less;

d) Both comparisons give totally different death rates, which reinforces the observation that the test rate is not proportional to the number of tests.

B. *Medical efficiency*

According to Fig. 4, as the percentage ratio between the numbers of deaths compared to the number of confirmed cases, with follow characteristics:

$$Med.eff = \frac{N° \, of \, deaths}{N° \, of \, cases} \quad (1)$$

Equation 1 proposed a coherent way for the medical efficiency measurement:

a) The lowest values denote medical efficiency, and the high values express the outbreak of the pandemic

b) Here we see an average of 3.66% in the EU, compared to 3.84% in the world, Romania having a medical efficiency ratio of 4%, compared to the extremities in the EU - Italy of 12%, respectively Malta of 0 % (without any death)

c) It is significant to note that the EU countries that reached and exceeded the 6% threshold of this report had an exponential evolution of deaths, as can be seen in the graph in Fig. 3 how the columns with the number of deaths exceed the line with the number of tests in the following countries (Belgium, France, Spain, Holland, Italy),

d) exceeding 6% in conjunction with crossing the line, at significant tests - above average, demonstrates that once the capabilities of the healthcare system are exceeded, it collapses and no longer has the same yield, testing cannot stop the evolution

e) tests do not stop the evolution but only prevent it, crossing a certain limit is too late for testing and everything is based on the organization and power of the health system.

4.3. Organizational efficiency for prevention

According to the representations in Fig. 5, as the ratio between the number of tests (organizational and financial capacity) and the sum of cases and deaths (isolation and medical management) with the following characteristics:

$$Prevention\ eff = \frac{N^{\circ}\ cases + N^{\circ}\ deaths}{N^{\circ}\ tests} \quad (2)$$

Equation 2 proposed a coherent way for prevention test efficiency

a) The highest values attest the lack of organizational efficiency, and the small ones express the immediate organization with major evidence in the chapter on prevention and minor effects for citizens.

b) The extremes are owned by France with a score of 43.48%, the best stand in EU Malta, with a score of 2.19%

c) The EU average score is 12.24, and Romania is below average. With 10.41%, demonstrating a preventive organizational attitude like Germany, and Denmark, which are near Romania's position.

d) As Denmark and Germany are in the top of the tests, due to their financial power, it remains as a conclusion that Romania has compensated organizationally in prevention through measures of social distance and hygiene, established quickly and drastically, even if it does not have financial funds for effective prevention through testing.

e) It is important that the social distance measures are continuous and drastic in the absence of mass testing.

V. CONCLUSIONS AND FINAL REMARKS

If generic ergonomics uses preventive work rules to streamline and sustainably maintain the workforce and institutional system, similarly, the Covid-19 crisis management system use like a tool the molecular testing, which fulfills the main ergonomic goal of prevention and continuous verification for adaptability and efficiency of results.

It is important to organize the prevention in the aspect that the tests must be able to be done preventively to identify and stop the transmission and before the explosion of this transmitter, after that the tests having only the role of keeping under control.

Basically, within an ergonomic prevention management system, RT-PCR testing is used as a trivalent tool: firstly, and significantly for the early prevention, verification and control of the pandemic.

In the prevention management system, the principles of ergonomics dictate maintaining a balance between the measures taken and the efficiency of the expected results. Considering this postulate, the number of tests must be in balance with social spacing, in the sense that, if from the beginning we were not taken massive testing measures, these should be supplemented by more drastic social spacing, or vice versa, if from in the beginning, massive testing measures were taken, other measures can be more relaxed.

If it is not possible, financially or technically reaching an effective preventive testing rate is compulsory to compensate with measures supported, verified and sanctioned drastically by social distance and hygiene.

The most important conclusion is that testing does not stop the virus unless it is massively applied from the first case according to the epidemiological report with all contacts or those in the contact area, but it must be accompanied by social distance, hygiene and PPE (mask, gloves), to a degree counterbalanced by balance.

Now, in Romania, is a real tendency to increase the number of tests, which shows three aspects:

1. Achieving the benefits of mass testing by the best results method Reverse Transcription-Polymerase Chain Reaction (RT-PCR) [24] and control spreading [25];

2. Strengthening the organization and breaking of bureaucratic inertia in procurement and professional dedication in treatment;

3. Overcoming the lack of funds, this can be linked to the necessary priority organization, obviously influenced by the obscurity of the benefits of mass testing, as it is already outdated.

Another short briefing is that:

- The virus could only survive in those who are untested [23];

- The biggest danger is that asymptomatic people could infect others;

- To understand the global pandemic, we need global testing [26].

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