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The Plastic Materials in the "VUCA" World: Ambidexterity as a Necessity

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Abstract: The Plastic material, just like the Roman god Janus, has two faces. One face which emphasizes versatility and blessings of plastics, and the other, which unfortunately can be reduced to the term "reasonable concern". We live in a world marked by the crisis of growth and development, uncertain implications of technological discoveries, ecological degradation, and increased difficulty in achieving competitiveness. It is more obvious that modernity abounds with Volatility, Uncertainty, Complexity, and Ambiguity, forming a so-called VUCA world. This work considers a new conceptual and operational framework, based on understanding the VUCA world, which produces paradoxes personified in different contextual conditions in which organizations operate by balancing current and future sustainability. Considering the fact that competitive advantage is fleeting, it is necessary to critically observe the new reality and understand ambidexterity as a sophisticated concept of development and management ability. Changes should be wiser, more innovative, faster, and more effectively applied. The additional goal is to indicate the importance of a multidisciplinary and systematic approach in a time full of numerous dilemmas and unsolved issues of sustainable development, whereupon ambidexterity is a very important strategic priority.

Keywords: ambidexterity; competitiveness; innovation capacity; plastic material; VUCA

1 INTRODUCTION

Dynamic nature of the modern world, expressed by acronym VUCA, like a tsunami, changes the assumptions of development and the nature of competitiveness by itself, including the plastics industry. Complexity of VUCA leads the world to the global economy towards new configurations and new dynamics. When we think about plastics with the positive pre-sign, we can notice that it is a cheap, light, strong and durable material, corrosion resistant, with high capacity of heat and electric isolation [1]. Due to its light weight, plastics enable numerous benefits, like reduction of transport costs, and therefore, reduction of carbon dioxide emissions into the atmosphere. All of that has a positive impact on health, facilitates the supply of clean drinking water and enables the existence of medical devices ranging through surgical equipment, drips, aseptic medical packaging and blister packs for pills [2]. Nevertheless, there are numerous reasons that increase the anxiety because of (irresponsible) production and (irresponsible) plastics consumption. Plastic waste has numerous negative ecological and economic impacts. Plastic waste is accumulated in terrestrial environment, at the open ocean, on the shores of even the farthest islands, as well as in the depths of the sea. The social benefit that can bring the future technological and medical improvement is exceptional but, unfortunately, the list of negative effects is very worrying. The source of the greatest concern is the fact that our current use of plastics is not sustainable [3]. Production of plastics produces the warning ecological imprint and ecological backpack [4], conditioning the necessity of continuous development of ecological competencies aiming to improve environmental sustainability.

The market metabolism is more and more out of control. Therefore, it is not wondered that the basic tension which VUCA organizations are facing, is connected to long-term survival of the organization [5, 6]. The competitive advantage is fleeting. Therefore, it is necessary to critically realize new realities. Ambidexterity is a sophisticated concept of development and ability to manage contradictions and multiple tensions. The imposed things are: necessity of possession and continuous development of configuration skills and reconfiguration of organizational resources. Some organizations see the achievement of business success in adaptation, in adjustment to variable and dynamic environment, but it is more acceptable to realize business success as an organization's ability to survive by innovating and transforming itself [7]. The search for the extent of exploitative and exploratory activities in dynamic environment, both internally and externally, gives the insight into ambidextrous ability of finding the balance of these dichotomous activities. That presents the litmus for discovery of both ambidextrous, and therefore, innovation capacity of organization.

Organizations face, with the increasing frequency, the fact that "strategy is stuck" and that the exit has to be found in learning and acquiring the ability to progress in "the economy of transit advantage" [8], all that imposes the need to structure new conceptual and operational framework. It should give answers to challenges of modern business in VUCA time, observing the complex requirements which reality and desired future impose on plastics industry.

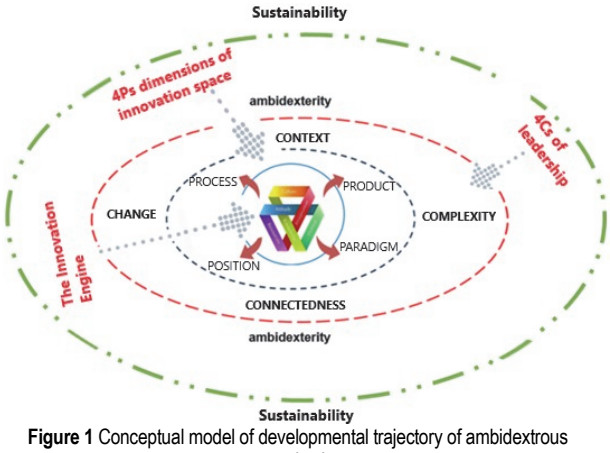

Figure 1 Conceptual model of developmental trajectory of ambidextrous organization

Conceptual model of developing trajectory of ambidextrous organization (Fig. 1), suggested by authors, is created by integration of several research frameworks: The Innovation Engine [9], Fig. 2a, 4Ps Dimensions of Innovation Space [10], Fig. 2b, and 4Cs of Leadership [11], Fig. 2c. The authors give contribution to the understanding of ambidexterity as a new paradigm of organizational

success, emphasizing the necessity of synergy of exploitation and exploration, the synergy of "the world of the past and the world of the future", as the key ambidexterity feature, providing its future and current sustainability [12]. Considering that they are facing stronger ecological pressures, organizations have to tend to socially responsible behavior, improvement of ecological sustainability, as well as ecological performances of their products [13]. In the heart of conceptual model is Innovation Engine (Fig. 2a), where there are six components (resources, habitat, culture, knowledge, imagination and attitude) which impact our ability to be creative and innovative.

By interaction of strongly twisted elements of Innovation Engine, its full functionality is achieved, which enables generation of creative and innovative potential. "Without creativity, you are trapped in a world that is not just stagnant, but one that slips backward. (…) Turn the key." [9].

When the innovation engine is initiated, innovation space is created (Fig. 2b) as a result of deliberate action of the organization. In the environment which stimulates employees, innovations are the ones that move forward the organization. Created innovation space has four dimensions [10] and these are: innovation of the products, processes, position and paradigm. Innovation of products includes changes in products or services which organization offers, while Innovation of processes includes the way of transforming how products or services are being created and delivered. Very important dimension of innovation space relates to innovation of position which is connected to the change of context in which the innovation process is being held. Finally, innovation of paradigm encompasses changes in basic mental models which frame the organization action [10], and that essentially leads to "redefining of reality".

Considering the time and context in which modern business is taking place, what we need is leadership that can initiate innovation engine and create wide innovation space. We need leaders who are skilled in observing and in work with complex variables, who understand time in which "nonlinear dynamics" has thrown long shadow on socio-economic relations and, above all, on the business world. The world of volatility, uncertainty, complexity and ambidexterity (VUCA world), has led to severe impairment of stability and security of the business environment. Efficient and effective leadership presented by model 4Cs of Leadership (Fig. 2c), is the result of the possession of capacity to understand four related areas: Change, Complexity, Context and Connectedness [11]. Change means "understanding and working effectively with the dynamics of change". In VUCA time which is in constant acceleration, it is necessary to understand changes, their dynamics and complexity, and to accept relativity of experience importance. All that requires leaders who are able to "constantly learn, look for fresh insights and inspire flexible, creative responses or initiatives" [11]. Complexity means having the skills to survive and thrive in situations of high risk and low agreement. The key role of leader, widely understood, presents the skills which enable diversity to function as an answer to complexity. The key to survivals depends on organization's ability to adapt to the changing external environment. Leaders have to understand context which implies understanding of key questions and strategic thinking abilities about how to answer to situational and relational relationships. Innovation is understood as "implementation of a new concept, breaking with existing mindsets, generating new knowledge, risk-taking and experimentation, in discontinuity with the past" [14]. Connectedness is related to ability to understand all existing and potential participants and building efficient relationships with different social networks and communities. This leadership dimension emphasizes the importance of so called relational leadership as the most adequate answer to twisted business relations in VUCA world, whereupon exactly the ambidexterity increases organization's tendency towards innovations [15].

However, developmental trajectory of ambidextrous organization does not end here. There is increasing concern connected to questions of glocal (global + local) sustainability, where plastics industry has to answer to whole series of difficult questions about environment protection. This places the plastic industry at the center of ambidexterity research as a strategic option. For a long time, science has suggested that answers should be required in the frameworks of sustainable development concept. There is a more widely accepted view that sustainability plays a crucial role in helping organizations fulfill their social responsibilities.

The research problem is related to the issues of survival and competitive development in the VUCA time, in which modern organizations operate. In a time of increasing disruptions and complexity in the business environment, innovation stands at the core of competitiveness. At the same time, the threats to organizational survival and growth are becoming more pronounced, making ambidexterity a key factor for organizational success.

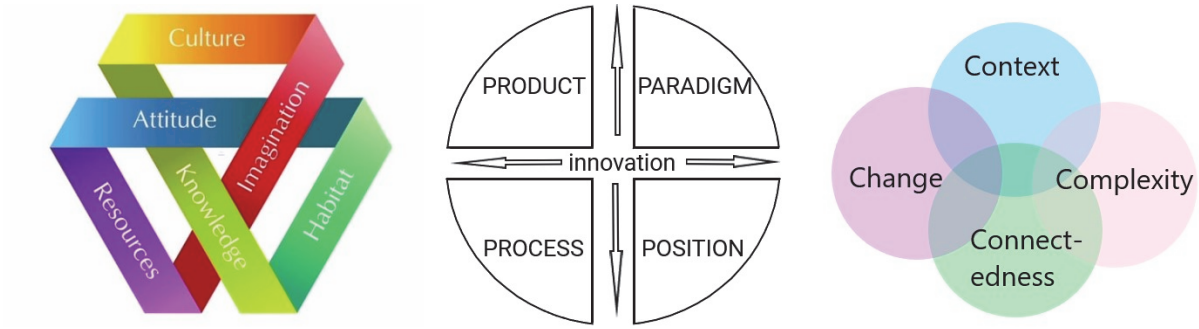

Figure 2 a) The innovation engine [9], b) Model 4 Ps of innovation [10]; c) 4Cs of leadership [11]

The subject of the research is the conceptualization of ambidexterity as a multidimensional construct. This includes defining and classifying the main theoretical frameworks and key components of ambidextrous organizations. The

research focuses on the continuous and intensive development of ambidextrous and innovation capacity, as well as the development of the necessary skills, competencies, and capabilities for generating ambidextrous organizations within the observed entities.

It follows that the main hypothesis is that ambidexterity has a positive impact on organizational performance, particularly by strengthening innovation capacity and competitiveness.

The aim of this paper is to highlight the necessity of understanding and applying ambidexterity as a key catalyst for operational efficiency and organizational adaptability - both essential for survival and growth in a VUCA environment. The paper aims to emphasize the importance of a multidisciplinary and systemic approach, which is crucial in a time filled with dilemmas and unresolved issues related to sustainable development.

2 METHODOLOGY/METHODS

Improvement in VUCA world, especially when the focus is on Plastic material, requires necessity to expand the research framework by combining more different scientific disciplines, practices and world and business views. The methodology of research is classified as explorative and descriptive study. By using comparative analyses and certain quantitative indicators, we can illuminate causal developmental trajectory of ambidextrous organization and plastics industry status in it.

Discovery of innovation impact on competitiveness in context of ambidextrous capacity is primarily achieved by collecting, studying and analyzing the available literature, professional works, theoretical approaches and so on. Review of available theoretical literature about interdependence of innovation and competitiveness enables better observation and understanding of ambidexterity and business success in VUCA world.

Considering the complexity and multidisciplinary nature of the topic, research is focused on theoretical space which is located in cross-section of various disciplines (technology, management, economics, ecology, psychology and other). They are looking for the answers to questions about interdependence of ambidexterity and business success, based on innovation and competitiveness and vice versa.

If we can agree that "numbers are thorough business language", the existence of large number of instruments for measuring innovations and competitivenesses, both at regional and global level, make this planned research trip possible. Considering the topic and coverage of this work, theoretical research and analyses were performed on the bases of official data [16-21]: The Global Competitiveness Index- GCI, The Global Innovation Index - GII, The Global Sustainable Competitiveness Index - GSCI and The Global Talent Competitiveness Index - GTCI, related to countries: Romania, Serbia, Croatia, Montenegro, Switzerland, Sweden, USA and Singapore.

3 RESULTS AND DISCUSSIONS

Numerous studies indicate that traditional organizations in VUCA times do not have much chance of surviving in the long term. The exact organizational ambidexterity aims to secure higher level of adaptability to dynamic environment, improving performances and competitiveness of organization. It is necessary to offer answers to the question on how organizations can balance exploration and exploitation processes. The aim is to achieve ambidextrous capacity with the ability to create innovations in accordance with changing conditions which organization deals with [12]. There are more numerous research findings which confirm that dynamic state of ambidextrous innovation performances in industrial system framework, so also plastics industry, can be managed [22, 23].

Organizational ambidexterity is, at national level, very relevant topic, with wide application possibilities in different industry sectors. The authors have, using respectable quantitative indicators at country levels (GCI, GII, GSCI, GTCI), determined potential developmental capacities which present valid basis for accepting the challenge of building ambidextrous organizations as strong defense against crises produced by the VUCA world.

Economic, social and ecologic tensions master VUCA world, requiring solutions that will enable achieving satisfactory level of competitiveness. The Global Competitiveness Index - GCI emphasizes the importance of so called "initiators" of competitiveness, leaning on competitiveness phases led by resources, efficiency and innovation (Fig. 3). Middle-income countries are under dominant influence of efficiency factors (efficiency-driven), while developed market economies are characterized by innovations and business sophistication (innovation-driven). All the countries located between the first and second phase, as well as between the second and third phase, are considered as countries "in transition".

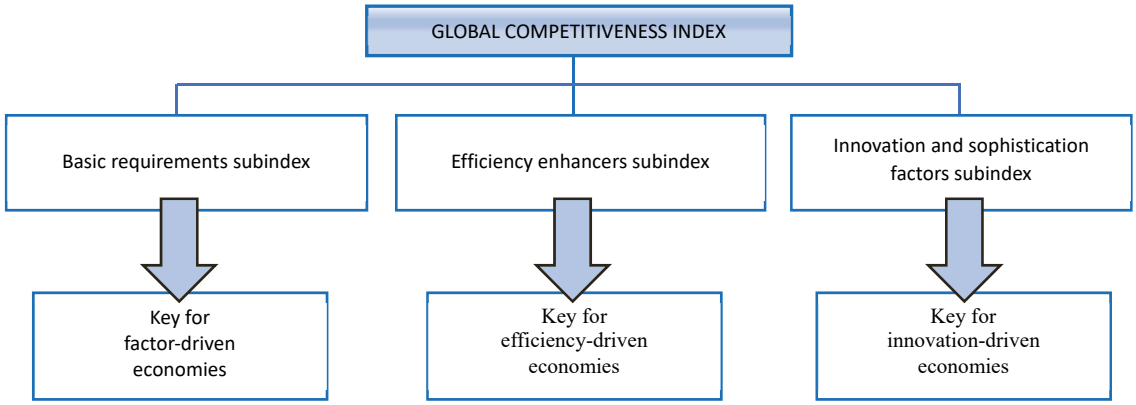

Figure 3 The global competitiveness index framework (adjusted according to [16])

Beside Romania, Serbia, Montenegro and Croatia, the countries whose status was considered are countries standing out with high rank of considered subindexes (Singapure, Sweden, Switzerland, United States). Serbia and Montenegro are in a group of countries whose progress is determined by efficiency factors (efficiency-driven). Hence, they are forced to base their development on efficient production processes and increase of product quality, primarily by using existing developmental potentials. However, these countries show potential to enter transition phase which leads to more innovative growth models. Romania and Croatia are in transition phase between efficiency-driven and innovation-driven, with significant step forward into the innovation fields. Singapore, Sweden, Switzerland and United States belong to innovation driven economies (Tab. 1). With an emphasis on improving the business environment and cultivating innovation, they serve as excellent representatives of highly ambidextrous organizations. Ways to reshape the patterns of economic and business growth, in order to strengthen competitiveness, relate to strengthening innovation capacity (organizations, industries, countries), with accent on sustainability and environmental protection. Innovation and sustainable growth are in solid synergistic relationship. Published research results [24] indicate positive correlation between ambidexterity and sustainability. This correlation reinforces the importance of building ambidextrous organizations connected to all industries, including plastics industry which is loaded by more urgent and complex ecological requirements. The influence of ecological context is more visible in research focus of organizations which notice the significance of developmental trajectory ambidexterity-sustainability-innovation-competitiveness.

By using quantitative indicators of expressed values GII, GSCI and GTCI for selected countries (Tab. 2 to Tab. 5), it is available to estimate existing ambidextrous capacity, its manageability, therefore the capacity of its improvement.

Table 1 Classification by each stage of development (adapted according to WEF: [16])

Stage 1: Factor-driven (35 economies)	Transition from Stage 1 to stage 2 (15 economies)	Stage 2: Efficiency-driven (31 economies)	Transition from stage 2 to stage 3 (20 economies)	Stage 3: Innovation-driven (36 economies)
		Montenegro Serbia	Croatia Romania	Singapore, Sweden Switzerland, United States

Table 2 The scores and ranks of the GII [17-19] and GSCI [20] (2022-2024); GTCI (2022-2023) [21] Romania and Serbia

Country Romania	2022	2023	2024	Country Serbia	2022	2023	2024
The Global Innovation Index – GII				The Global Innovation Index - GII			
Score	34.1	34.7	33.4	Score	32.3	33.1	32.3
Rank	49	47	48	Rank	55	53	52
The Global Sustainable Competitiveness Index - GSCI				The Global Sustainable Competitiveness Index - GSCI			
Score	49.4	49.4	49.48	Score	46.4	46.3	47.29
Rank	36	37	41	Rank	51	55	49
The Global Talent Competitiveness Index - GTCI				The Global Talent Competitiveness Index - GTCI			
Score	44.25	47.39		Score	44.91	48.56	
Rank	54	54		Rank	52	53	

Table 3 The scores and ranks of the GII [17-19] and GSCI [20] (2022-2024); GTCI (2022-2023) [21] Croatia and Montenegro

Country Croatia	2022	2023	2024	Country Montenegro	2022	2023	2024
The Global Innovation Index - GII				The Global Innovation Index - GII			
Score	35.6	37.1	36.3	Score	30.3	27.8	28.9
Rank	42	44	43	Rank	60	75	65
The Global Sustainable Competitiveness Index - GSCI				The Global Sustainable Competitiveness Index - GSCI			
Score	53.4	52.9	52.18	Score	45.0	46.2	44.49
Rank	20	23	30	Rank	62	56	68
The Global Talent Competitiveness Index - GTCI				The Global Talent Competitiveness Index - GTCI			
Score	47.19	50.38		Score	46.83	49.05	
Rank	46	45		Rank	47	50	

Table 4 The scores and ranks of the GII [17-19] and GSCI [20] (2022-2024); GTCI (2022-2023) [21] Switzerland and Sweden

Country Switzerland	2022	2023	2024	Country Sweden	2022	2023	2024
The Global Innovation Index - GII				The Global Innovation Index - GII			
Score	64.6	67.6	67.5	Score	61.6	64.2	64.5
Rank	1	1	1	Rank	3	2	2
The Global Sustainable Competitiveness Index - GSCI				The Global Sustainable Competitiveness Index - GSCI			
Score	58.3	59.1	56.68	Score	60.7	59.6	61.2
Rank	3	4	4	Rank	1	1	1
The Global Talent Competitiveness Index - GTCI				The Global Talent Competitiveness Index - GTCI			
Score	78.20	78.96		Score	73.93	73.86	
Rank	1	1		Rank	5	9	

Considering that between innovation capacity and competitiveness positive correlation exists [12, 22, 25], it is necessary to create environment where creating enviable level of innovation capacity will be achieved. Feasibility study of these goals is achieved by quantification of innovation based on Global Innovation Index - GII. Increasing environmental pressures and the need to develop environmental competencies add to the aforementioned

interdependency of the requirement of sustainability, which is quantified through the Global Sustainable Competitiveness Index (GSCI). If we observe these requests in context of harder achievement of competitiveness, possession of talent quantified through Global Talent Competitiveness Index - GTCI becomes conditio sine qua non. This I-S-T triad (Innovation, Sustainability and Talent) is in constant interaction and expressed interdependence.

In order to assess the strength of the relationships among the elements of this triad for the observed countries, a correlation analysis was conducted (Tab. 6).

Table 5 The scores and ranks of the GII [17-19] and GSCI [20] (2022-2024); GTCI (2022-2023) [21] USA and Singapore

Country USA	2022	2023	2024	Country Singapore	2022	2023	2024
The Global Innovation Index - GII				The Global Innovation Index - GII			
Score	61.8	63.5	62.4	Score	57.3	61.5	61.2
Rank	2	3	3	Rank	7	5	4
The Global Sustainable Competitiveness Index - GSCI				The Global Sustainable Competitiveness Index - GSCI			
Score	51.2	50.9	50.98	Score	48.5	49.4	50.36
Rank	30	32	35	Rank	40	36	37
The Global Talent Competitiveness Index - GTCI				The Global Talent Competitiveness Index - GTCI			
Score	73.93	76.60		Score	75.80	77.11	
Rank	4	3		Rank	2	2	

The relationships between GII, GSCI, and GTCI were examined using Pearson's linear correlation coefficient. The results indicate a statistically significant strong positive correlation between the Global Innovation Index (GII) and the Global Sustainable Competitiveness Index (GSCI). This suggests that the likelihood of this association occurring by chance is very low (less than 5%).

Table 6 Correlations between GII, GSCI and GTCI

		GII	GSCI	GTCI
GII	Pearson Correlation	1	0.718	0.986
	Sig. (2-tailed)		0.045	< 0.001
	N	8	8	8
GSCI	Pearson Correlation	0.718	1	0.624
	Sig. (2-tailed)	0.045		0.098
	N	8	8	8
GTCI	Pearson Correlation	0.986	0.624	1
	Sig. (2-tailed)	< 0.001	0.098	
	N	8	8	8

Moreover, the analysis reveals an extremely strong correlation between the Global Innovation Index (GII) and the Global Talent Competitiveness Index (GTCI). This implies that countries with higher innovation capacity also tend to have greater ability to attract, develop, and retain talent.

A moderate positive correlation was also observed between the Talent Competitiveness Index (GTCI) and the Sustainable Competitiveness Index (GSCI), although this relationship was not statistically significant, as the p-value exceeded 0.05.

A correlation coefficient below 0.7 indicates a moderate level of association. However, the *p*-value greater than 0.05 suggests that the results are not statistically significant. This outcome may be attributed to the relatively small number of countries included in the analysis, or possibly to ineffective talent management in organizations that are more focused on growth than development.

Given that the plastic industry demonstrates insufficient concern for environmental protection, this further reinforces the need to apply ambidexterity, which should help balance efficiency and effectiveness, as well as growth and development.

Using VOSviewer software tool [26], primarily designed for analyses and visualization of bibliometrical networks, authors have networked elements of I-S-T triad which resulted in achieving aggregate competitiveness index for every observed country.

By visualization process, VOSviewer software showed network indexes as two clusters (Fig. 4), giving us new, qualitative information about (inter)relation and position of certain countries included in this research. In the network visualization, items are represented by their label and by default also by a circle. The higher the weight of an item, the larger the label and the circle of the item. The distance between two items reflects the strength of the relation between the items. A smaller distance generally indicates a stronger relation. Coupling between USA-Singapore is stronger than coupling between Sweden-Switzerland, although these four countries belong to the same cluster and show enviable closeness in values of composite index. Cluster Romania-Serbia-Croatia-Montenegro is significantly distant from the first cluster, showing somewhat stronger closeness between Serbia-Montenegro and Croatia-Romania. This research does not claim (but it does not deny either), that this kind of associated countries (only eight countries were taken into account), can create high-power clusters. This research suggests that ambidexterity, combined with full talent realization and encouragement of all forms of creativity, strengthens innovation capacity. In that process, specific clusters hold a 'privileged' position in enhancing (international) competitive advantage.

Why does plastics industry have a necessity for ambidexterity? Non calculation with limitation of natural resources presents dangerous developmental mistake. "Any society that continues to use critical resources unsustainably will collapse" [27]. The only exception from this rule is a society that has the ability to find replacement resources. This is the sufficient argument for constant innovation necessity and that leads us to ambidexterity as a must and to sustainability as a goal.

Global plastics production is in constant growth. There is a strong consent that plastic materials are of great significance, that they have numerous industrial applications and that they are very useful for modern society. However, black ecological clouds have dangerously bended over plastics industry. Plastics use results in a high production-related carbon footprint, high volumes of waste, persistent pollution [28]. This imposes a conclusion that modern

civilization implements the process of "disabling energy", often forgetting the existence of The Second Law of Thermodynamics - entropy.

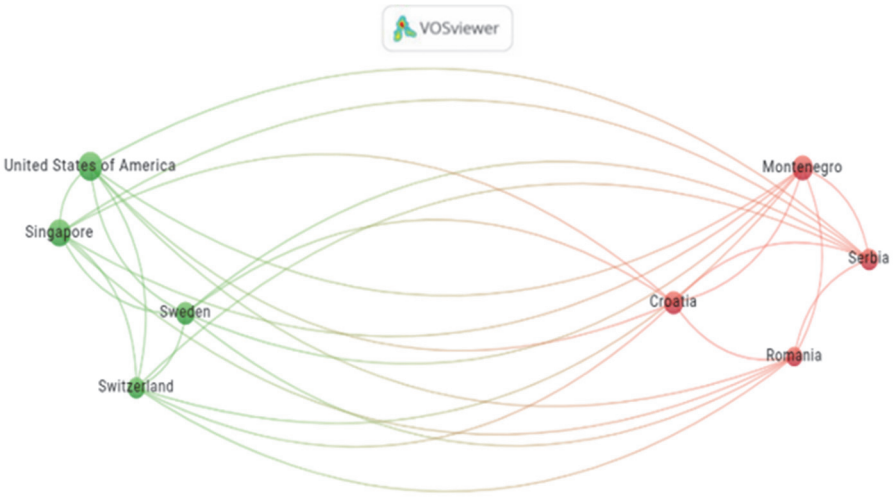

Figure 4 Clusters of global competitiveness: a network analysis and visualization

The laws of thermodynamics are relentless. Entropy and disorder are related sizes, and the increase of one causes the increase of the other. Economic process is obviously entropic [29] and full of natural limitations. It is clear that life and development are possible only in the environment of low entropy, so overall human action is necessary to observe from the point of entropy laws.

In spite of unstoppability of the overall disorder quantity growth, how to organize social life (economy in its widest meaning), and at the same time, to respect ecological requests as the basis of survival for current and future generations? [30]. The laws of thermodynamics warn us that usage of larger quantity of resources also means accumulation of larger waste quantity. It is enough to seriously think about destiny of sustainability and sustainable development, all the more so our "inevitable and irreversible future" is exactly defined as the time where there will be more waste than now. Therefore it is necessary to observe the place of modern man in endangered ecosystem and constantly warn about the need of effective action. A call of wisdom imposes that "man is more useful to himself and others when he is gifted with larger degree of honesty and honor" [31], so the obligation of every scientist and researcher is that all the activities they deal with and knowledge that they come to, should be observed also through ethical diopter.

Every organization which is dedicated to ecological goals, motivated by ecological responsibility, tends to holistic approach during making decisions related to ecological behaviors. The result of this approach is also the openness of the organization (company, university, industry, country), to observe plastic waste recycling with areas that differ from their narrowly observed professional preferences. The example of connection of seemingly distant areas, and essentially tending to the same goal, is the connection between plastics industry and art, which offers its visions of solutions to plastic waste accumulation.

The art projects which distract attention in urban spaces appear in sculptural form. The evidence is a large number of emerged sculptures, made from thrown plastic bottles. One of the examples is the sculpture of Marta Thoma Eart Tear [32], placed in American Lesher Regional Center for the Arts (Fig. 5a); Globus (Fig. 5b), by Israelii industrial designer Itzcovitch, [33], placed in the town Petah Tikva near Tel Aviv on the Earth Day in 2011.; Save our home **(**Fig. 5c), by the artist Andrej Josifovski - "The pianist" [34], whose setting occupies a surface of 240 m^2. It is about the first artistic endeavor of this type, where a character is drawn by assembling mosaic from 4000 thrown plastic bottles collected by rivers. The work was performed in Belgrade, on International River Day in 2020., for official UN holiday, which comprises various actions for cleaning riverbeds and habitat restoration, educational programs, as well as ecology promotion.

These examples indicate the necessity of connecting various scientific disciplines in process of searching for solutions in the times that are loaded with numerous problems. Good example is observing the economy of growth by application of thermodynamic laws - entropy [29], or searching for the cause of success (or failure) of business alliances by entering the area of fluid mechanics [35], smart plastics as a result of combining plastics functionality with electronics intelligence, so called integration of sensors and electronics [36], etc.

With changes, we have to deal wiser, more innovative, quicker, more efficient, and we have to meet them. It is necessary that various scientific disciplines constantly exchange advice. This "exchange" is possible in conditions of established ambidexterity. The growing consciousness about problems rising from (irresponsible) production, consumption, pollutions made from that irresponsibility, is more visible, but insufficient. Ambidexterity enables finding the "right measure" of observing and understanding the new reality loaded with numerous dilemmas and complex questions of sustainable development. Thinking about future has to include the change of understanding the world from mechanicistic and fragmented, towards holistic and ecological understanding. It is necessary to understand causes and depth of the problem, so it is more obvious that solution comes by multidisciplinary and systematic approach, where ambidexterity is a very important strategic priority for plastics industry.

Figure 5 a) Eart Tear [32]; b) Globus [33]; c) Save our home [34] (a face of an ecological activist made of plastic bottles)

4 CONCLUSION

Growth and development crises, uncertain implications of technological discoveries, ecological degradation, more difficult competitiveness achievement, are characterizing VUCA world where all of the processes related to plastics are held. The laws of thermodynamics warn us that usage of larger amount of resources implies accumulation of larger waste quantities. The source of the greatest concern is knowledge that the current use of plastics is not sustainable. Plastic materials have great significance for modern society. However, competitive advantage is hardly achieved and very hardly sustained. Green technologies are one of key links on the road to sustainability, which makes introduction of ambidexterity as sophisticated concept necessary.

Ambidexterity enables: strengthening of innovation capacity, leadership which implies changes, their complexity, context in which changes take place and connectedness of all participants who deal in complex and dynamic surrounding. Research focus of the work is on innovation and competitiveness of Romania, Serbia, Croatia, Montenegro, Switzerland, Sweden, USA and Singapore, and on determination of (non)existant key conditions for ambidextrous capacity development. By using quantitative indicators expressed by values GII, GSCI and GTCI for determined countries (Tab. 2 to Tab. 5), evaluation of existing ambidextrous capacity is enabled. Research has shown that Switzerland, Sweden, USA and Singapore point out the advantage in every used index.

The results of the study, based on Pearson's linear correlation between GII, GSCI, and GTCI, indicate a strong and statistically significant positive relationship between the Global Innovation Index (GII) and the Global Sustainable Competitiveness Index (GSCI) ($r = 0.718$; $p < 0.05$), as well as between GII and the Global Talent Competitiveness Index (GTCI) ($r = 0.986$; $p < 0.001$).

A moderate positive correlation was found between GTCI and GSCI, but this correlation was not statistically significant ($p > 0.05$). The lack of statistical significance may be due to the relatively small sample size of countries included in the analysis, or to poor talent management, possibly stemming from a stronger organizational focus on growth rather than development.

Considering that the plastic industry shows insufficient attention to environmental protection, this further emphasizes the need to adopt ambidexterity as a strategic approach to balance efficiency and effectiveness, as well as growth and development.

The aggregated competitiveness index, generated using VOSviewer software, forms a cluster characterized by an innovation-led economy and a high competitiveness ranking. Having in mind that their development is based on improving quality of business environment, creating innovation culture, etc., these countries are great representatives of achieving high ambidexterity degree. Serbia and Montenegro are in a group of countries whose improvement is determined by efficiency factors (efficiency-driven), above all by using existing developmental potentials; the visible fact is necessity for more agile work on building pre-conditions for creating ambidextrous organizations, which would enable strengthening of innovation capacity and their entering transition toward phase innovation-driven. Romania and Croatia, unlike Serbia and Montenegro, are in transition phase between efficiency-driven and innovation-driven, with significant and visible step forward into innovation field.

Further research could give answers to questions which activities would help desired phase of developmental trajectory, where the desired goal is getting closer to the position held by high-rank countries, like Switzerland, Sweden, USA and Singapore.

Growth and innovation are in solid synergistic relation, where the future of desired development is to be based on better balance between quantity and quality [36]. Solutions are found in actualization and problematization of all processes related to plastics, in sensitization of professional and wider public about the necessity of respecting ecological and ethical norms, in building ambidexterity and strengthening innovation capacity.

Why are these messages so loudly sent to engineers and academic society?

It is because they can feel in the greatest sense how plastics industry and plastic materials "breathe" under the pressures of VUCA time. Understanding that organizations do not innovate in isolation, but in constant interactions, is not strange to them. It fixes in their mind that they have to be part of teams which create and accept strategies giving solutions to the largest number of problems in given area. Ambidexterity as a concept offers solutions. Scientific observation is always polemical, but things are foggy only to the ones who still apply the old logic.

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