Multi-criterial Analysis by Determining the Supportability Factor in the Western of the Black Sea

Catalin Anton, Carmen Gasparotti, and Eugen Rusu

***Abstract*—Identification and exploitation of the new energy sources is on the plane of all states wishing to provide security. Energy activities have gained momentum lately, and at the European Union level there is a constant concern in finding new energy solutions that ensure the well-being of the continent. A sector that is increasing in the recent years is the offshore area, where, along with the steps made in substantial research, many economic activities become possible. In this paper we propose to realize a multi-criterial analysis by determining the affordability of a threshold, which we've called ' supportability factor ", an element that can make the difference if an activity is viable or cannot be made. The supportability factor is a tool that can be used both by the planners, decision makers and other stakeholders, and can be used in the analysis of the sustainability of a project in the costal and marine area.**

***Index Terms*—Black Sea, drilling operations, offshore, platform.**

I. Introduction

Offshore petroleum activities in the area began in Romania in the 1967-1969 period. Having the stated goal to increase the production by the diversification potential, Romania has been targeted, in addition to the onshore production capabilities, and the Black Sea continental platform. Thus, it was mounted a first installation in 1975, and the oil production began in 1987. The platform was installed on the offshore, in shallow waters, and in 2012 was made the first discovery of the recoverable reserves, with a cubic capacity of 42-84 billion. It has thus been demonstrated that Romania has a significant potential for extracting the natural gas from the area of the continental shelf of the Black Sea, plus existing and potential onshore, which makes Romania an important actor in the field of energy at the European Union level.

To capitalise the fully energy potential by exploiting the reserves of the natural gas on the Black Sea, it is necessary to achieve significant investment. In this respect, Romania has issued concessions for the exploitation areas towards the famous actors worldwide exploitation of the natural gas, which have the capacity and investment management to carry out this activity. (Fig. 1) [1]. In parallel, Romania modifies the legal regulations in a consistent and predictable manner and in accordance with the provisions of the European Union in this field, considering the environmental requirements.

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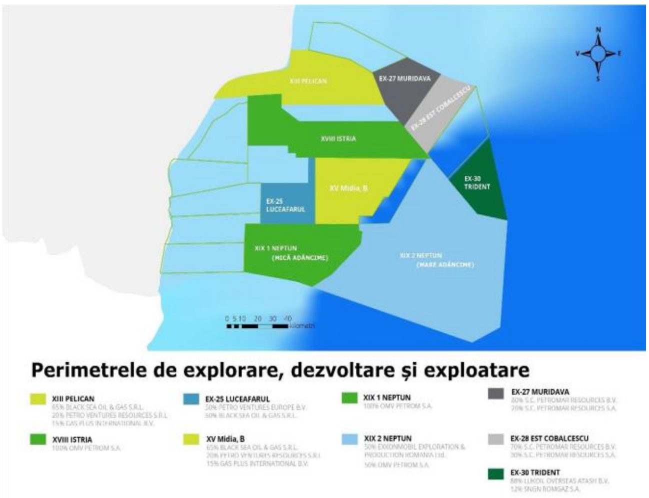

Fig. 1. Romanian Black Sea perimeters [1].

In particular, the national natural gas transmission must be improved so that it allows the access to the offshore producers from the area towards the regional gas markets. These producers have reported the access on the markets called interconnection that represents an opportunity to join the EU States to allow the access to new sources of gas (Fig. 2) [2].

One such project is the pipeline infrastructure that BRUA aims to unite the Southern Corridor of Natural gas with Central Europe. In this respect the Romanian gas operated on the continental platform of the Black Sea will be connected to the hub from CEGH Baumgarten (Austria) [3]. According to an analysis made by ENTSO-G in 2017, the stress tests shows that in a situation of prolonged interruptions to the supply of the gas from Russia in January-February, Romania presents a significant vulnerability regarding the gas supply on the medium and long term, that is necessary for the internal resources to enter a process of accelerated development [4].

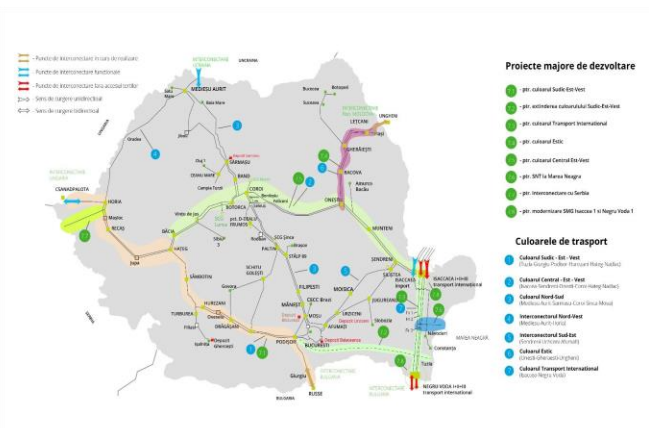

Fig. 2. Natural gas corridors in Romania [1].

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II. Methodology

Multi-Criteria Analysis is a method that is based on the equity valuation through a weighted average. In this way it takes into account the comparison of the different actions or solutions depending on the variety or public policies.

The multi-criteria analysis method can be used to determine which solution best suits to the decision makers' expectations. But, in order for this to happen, together with the decision-makers, a number of indicators and analysis criteria must be determined. In our example, we analyzed the indicators from four different areas, namely environmental, economic, social and governance [5]. Finally, this method can explain why a particular solution has been chosen.

In this paper we took into consideration the impact of the planned drilling operations carried out within the block 30 EX TRIDENT by the LUKOIL OVERSEAS. "LUKOIL is one of the largest oil companies in the world, being a leader on international markets with a share of 2.1% of oil production globally. His work includes both oil and gas production and refining into the petroleum and petrochemical products. Lukoil Overseas Atash BV. is present in Romania in 2011, its branch located in Bucharest, the activity of which is connected with the second concession blocks for exploration and development in the area of the economic exploitation-exclusive Black Sea." (according to the study Report of environmental impact assessment project: "the EXECUTION of PLANNED GEOLOGICAL DRILLINGS of HYDROCARBON RESOURCES IN BLOCK 30 EX TRIDENT OFF the BLACK SEA COAST"[6]).

Trident Ex-30 Block is located in the western part of the continental shelf of the Black Sea, in the exclusive economic zone, which legally has the status of "open sea", consisting of sailing, free surveilling aerial installation, subsea pipeline, resource harvesting (Fig. 3). Designate the proposed project lies outside the limits of the (potentially) 0076 ROSPA protection "Black Sea", and the Danube Delta-Sea (ROSCI 0066), Ex-29 Rhapsody block is situated in the following distances:

- Constanta ----------aprox.170 km
- Sevastopol(Ucraina)------aprox.180 km
- Sulina --------------aprox.120 km
- Kavarna (Bulgaria)---------aprox.226 km

The distance between the probes and the location of on the shore operations-Midia Shipyard is about 192 km (Daria-probe 1) and towards the point of the intervention for the emergency situations, namely Tuzla Airfield, the distance is approx. 197 km (Daria probe 1). Geological drillings execution will be carried out using a conventional system mounted on a rotating platform semi-submersible saw (MODU) called "GSF Development Driller II" (hereinafter referred to as "DD" GSF), designed and built in 2004, but entered into the service of drilling in 2005.

On the platform there are storage tanks for ballast, fuel, water, drilling mud, drilling fluids, and other bottled waters. The platform is provided with 4 independent rooms of pumps, containing pumps for seawater ballast, fuel, water for drilling and one drinking water.

The platform is provided with:-systems of the intervention in case of emergency-it come to life-saving appliances, fire detectors, protective equipment, systems of combustible gas detection and rescue ships. -Systems for the environment protection-unit wastewater treatment plant, Blowout Prevention System (BOP), equipment for cleaning and drainage systems for the hazardous and non-hazardous waters (in which the rainwater and/or small leakage is collected in a tank manifold in order to treatment before discharge into the sea, or transferred to the tanks that are shipped to shore in order to eliminate the corresponding to an authorized company) (Fig. 5).

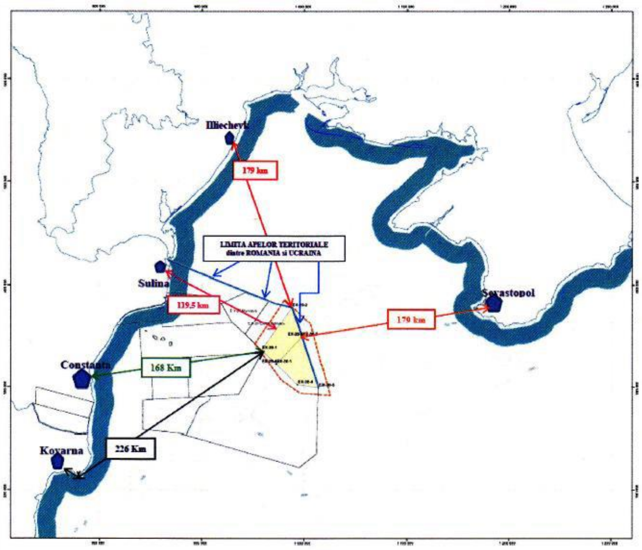

Fig. 3. Block EX-29 Rapsodia [6].


Fig. 4. Platform GSF Development Driller II [6].

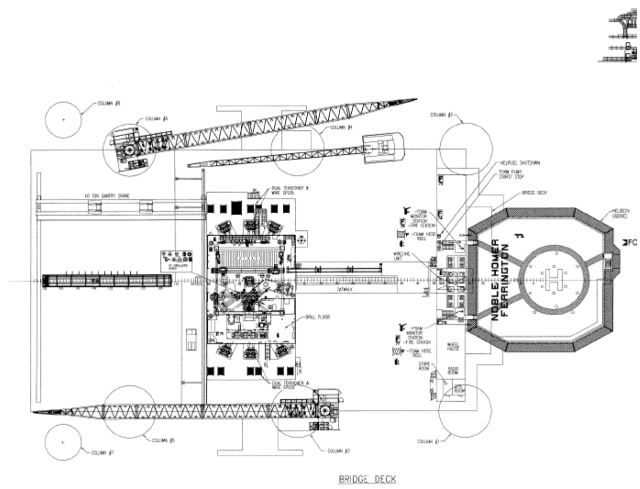

Fig. 5. Transversal section of platform [6].

Considering their production activities carried out they will be divided in three stages, namely

- Phase of installation the extracting equipment
- Phase operational
- Phase of decommissioning of the equipment.

We also took into consideration the impact of social, economic and environmental, but also the impact on the administrative activities of the proposed project. Last but not least we accomplished a delimitation of the area into three zones, namely the impact on costal and bathing area, nearshore and offshore area [7].

-Coastal and bathing area refers to the area of economic activities physical geographic location, tourist and natural ecosystems related to the marine environment. In this sense, in this area belong to protect the natural areas such as the Danube Delta Biosphere Reserve or Protected area of the Techirghiol Lake, but also the economic activities or tourist shipyards from Midia, Constanta or Mangalia, as well as tourism Mamaia, Eforie-Costinesti or Olympus-Mangalia, with bathing areas.

-Nearshore zone is the area close to the shoreline to a depth of 12-15 meters, and includes both the economic activities and environmental protection.

-Offshore area stretches from 12-15 m isobath where up to the proposed objective.

Although the operational area of the project lies outside the boundaries of the human settlements, and at the considerable distances from the land, it cannot be asserted that there is no environmental impact of the social environmental and economic or cultural conditions, ethnic or cultural heritage from the human settlements on the Black Sea coast[8]. The work of mining for the natural gas from the offshore area of the Black Sea can have an impact in terms of the quality of people's living conditions offered so drilling platform and support vessels, but also upon the communities in the coastal area. The noise level during the drilling operations and equipment on the platform (pumps, motors, etc.) can create discomfort, as well as the handling and use of chemicals with toxic properties may be hazardous in the handling and use of them. Establishing a set of indicators of social, economic and environmental, but also governance is absolutely necessary in evaluating this important activity. [9]

In making this assessment we have approached a new technique that we are trying to develop in the coastal area technique called "supportability factor". Factor of supportability threshold that represents the limit of the moment activities performed can be conducted in the optimal conditions and when the proposed activities cannot be implemented.

III. Results

In determining of the supportability factor has been established as the factor of supportability to have value 1, as the maximum value for an event, an action or activity can be accepted. For example, the height of waves that may affect the structure of the platform irreparably can be 10 meters. In this case, the supportability of the platform with the waves is 1 that is h = 10 m (Fig. 6). Similar the supportability factor is established for the other indicators of the economic, social and environmental issues, considering that in coping with the values indicated, the work would not be possible.

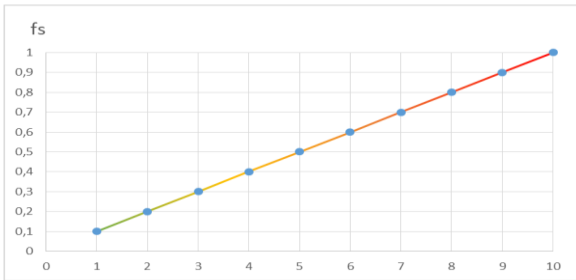

Fig. 6. The graph of the affordability factor.

Supportability factor analysis results for the various indicators in the following way to the environmental factors (Table I), economic factors (Table II), social factors (Table III) and governance factors (Table IV).

TABLE I: Determination of the Supportability Factor by Analysis of the Environmental Indicators

INDICATORS	Description	Installation			Operational			Decommissioning		
		Coastal & bathing zone	Nearshore	Offshore	Coastal & bathing zone	Nearshore	Offshore	Coastal & bathing zone	Nearshore	Offshore
1. reduces waste, prevents air, water and soil pollution and stimulates material reuse and recycles	air	0.3	0.5	0.8	0.4	0.6	1	0.3	0.5	0.8
	water	0.2	0.3	0.9	0.3	0.6	1	0.2	0.3	0.9
	soil	0.4	0.5	0.8	0.4	0.7	1	0.4	0.5	0.8
	waste	0.2	0.3	0.8	0.2	0.3	0.9	0.2	0.3	0.8
2. Flood prevention, protection and mitigation	storm, tornades	NA	NA	0.6	NA	NA	0.9	NA	NA	0.6
	earthquake	NA	NA	0.8	NA	NA	0.9	NA	NA	0.8
3. improves the status of water (ecological and chemical)	water installation	0.4	0.5	0.9	0.2	0.3	0.7	0.4	0.5	0.9
4. protecte key natural sites (including marine and nature scenic, cultural, and wild landscapes)	pollution plan	0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9
	emergency plan against meteo phenomena	0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9

5. effects land use planning and management, supports environmentally friendly rural activities		0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9
6. affecting natural habitats, biodiversity and their quality		0.2	0.2	1.1	0.4	0.4	0.9	0.2	0.2	1.1
7. improves sustainable management of coastal erosion		NA	NA	1	NA	NA	1	NA	NA	1
8. increases the resilience and reduces vulnerability to climate change impacts		NA	NA	1	NA	NA	1	NA	NA	1
9. increases energy efficiency		NA	NA	1	NA	NA	1	NA	NA	1
10. impact of the use of low-impact transport and supports sustainable mobility in the destination	quality and quantity of vessel	0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9
	aircrafts	0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9
11. increase environmental awareness of the population	campaign	0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9
	reports	0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9
12. promotes environmentally-friendly processes and products		0.5	0.5	0.9	0.5	0.5	0.9	0.5	0.5	0.9

TABLE II: DETERMINATION OF THE SUPPORTABILITY FACTOR BY ANALYSIS OF THE ECONOMIC INDICATORS

Indicator	Initial	Operational	Final
1. effects financial policies and instruments to support economic stability and resilience	0.7	0.1	0.5
2. increases economic diversification	0.3	0.2	0.3
3. an acceptable employment and training opportunities for local residents	0.4	0.2	0.7
4. increases payments and investments in coastal management	0.3	0.6	0.7
5. promotes infrastructure development and increases environmental friendly transport	0.5	0.6	0.8
6. increases culturally and environmentally friendly, low-impact tourism	0.8	0.9	0.9
7. increases investment in innovation for green economy	0.7	0.8	0.8
8. increases productivity and use of sustainable agriculture and fisheries	0.8	0.8	0.9
9. increases investments on climate change and flood risk management	0.6	0.5	0.7

TABLE III: DETERMINATION OF THE SUPPORTABILITY FACTOR BY ANALYSIS OF THE SOCIAL INDICATORS

INDICATORS	Installation			Operational			Decommissioning		
	Coastal & bathing zone	Nearshore	Offshore	Coastal & bathing zone	Nearshore	Offshore	Coastal & bathing zone	Nearshore	Offshore
1. promotes social justice and equal opportunities for all members of society	NA	NA	0.5	NA	NA	0.6	NA	NA	0.6
2. improves quality of life (all people have a home and access to basic infrastructure and services)	NA	NA	0.5	NA	NA	0.6	NA	NA	0.6
3. provides educational opportunities, supports life-long learning and increases awareness about sustainability	0.3	0.4	0.7	0.3	0.4	0.2	0.3	0.4	0.7
4. protects, monitors, and safeguards local resident access to natural, historical, archaeological, religious, spiritual, and cultural sites	0.8	0.8	0.2	0.5	0.5	0.1	0.8	0.8	0.2
5. supports the conservation of cultural heritage (includes rural heritage)	0.3	0.3	0.1	0.3	0.3	0.2	0.3	0.3	0.2
6. contributes to crime prevention and increase perception of safety among population	NA	NA	0.2	NA	NA	0.2	NA	NA	0.2
7. increases production of local and fair trade goods and services	NA	NA	0.2	NA	NA	0.2	NA	NA	0.2

8. promotes communication, cooperation between citizens and local authorities	0.2	NA	0.3	0.3	NA	0.2	0.2	NA	0.5
9. reduces vulnerability of people to climate change and promotes comprehensive risk based assessment and prioritised action in area	0.4	NA	0.2	0.3	NA	0.2	0.4	NA	0.3

TABLE IV: DETERMINATION OF THE SUPPORTABILITY FACTOR BY ANALYSIS OF THE GOVERNANCE INDICATORS

INDICATORS	Initial	Operational	Final
1. A management team with broad competences and sufficient representation was built to lead the planning process	0.4	0.2	0.5
2. Human activities and associated stakeholder groups were determined	0.8	0.5	0.4
3. The issue was chosen driven by ecological, social or economic needs and targets were set	0.9	0.5	0.5
4. All possible measures were identified and compiled into alternative hypothetical scenarios	0.9	0.7	0.9
5. A strategy was developed how to assess the effect and ESE (Economic, Social, Ecologic) consequences of different scenarios (e.g. modelling)	0.9	0.8	0.8
6. Different alternative scenarios were simulated and results discussed with stakeholders	0.9	0.8	0.8
7. Assessments were made of impacts on different stakeholders	0.3	0.3	0.5
8. Costs were calculated for different optional measures considered in the scenarios	0.5	0.4	0.5
9. There was a strategy for the issues of missing data and uncertainty in implementation process	0.8	0.9	0.9
10. The feasibility, costs end efficiency of scenarios were reviewed and evaluated	0.7	0.7	0.7
11. The entire process was documented and publicly available	0.6	0.5	0.5
12. The concept was implemented and accepted by the public	0.8	0.7	0.8
13. Effects of implemented measure are monitored on regular basis with respect to identified targets	0.8	0.7	0.8
14. The success of measure was evaluated	0.8	0.7	0.8

Taking into consideration these analyses of the economic, social, environmental or governance, we set out for each of these indicators of the supportability factor the total value (Tables V-VIII).

TABLE V: ENVIRONMENT INDICATORS SUPPORTABILITY FACTOR

Environment indicator	Coastal & bathing zone	Nearshore	Offshore	Total
1. reduces waste, prevents air, water and soil pollution and stimulates material reuse and recycles	0.50	0.62	0.50	0.54
2. Flood prevention, protection and mitigation	0.70	0.90	0.70	0.77
3. improves the status of water (ecological and chemical)	0.60	0.40	0.60	0.53
4. protect key natural sites (including marine and nature scenic, cultural, and wild landscapes)	0.63	0.63	0.63	0.63
5. effects land use planning and management, supports environmentally friendly rural activities	0.63	0.63	0.63	0.63
6. affecting natural habitats, biodiversity and their quality	0.50	0.57	0.50	0.52
7. improves sustainable management of coastal erosion	1.00	1.00	1.00	1.00
8. increases the resilience and reduces vulnerability to climate change impacts	1.00	1.00	1.00	1.00
9. increases energy efficiency	1.00	1.00	1.00	1.00
10. impact of the use of low-impact transport and supports sustainable mobility in the destination	0.63	0.63	0.63	0.63
11. increase environmental awareness of the population	0.63	0.63	0.63	0.63
12. promotes environmentally-friendly processes and products	0.63	0.63	0.63	0.63

TABLE VI: ECONOMIC INDICATORS SUPPORTABILITY FACTOR

Indicator	Total
1. effects financial policies and instruments to support economic stability and resilience	0.43
2. increases economic diversification	0.27
3. an acceptable employment and training opportunities for local residents	0.43
4. increases payments and investments in coastal management	0.53
5. promotes infrastructure development and increases environmental friendly transport	0.63
6. increases culturally and environmentally friendly, low-impact tourism	0.87
7. increases investment in innovation for green economy	0.77
8. increases productivity and use of sustainable agriculture and fisheries	0.83
9. increases investments on climate change and flood risk management	0.60

TABLE VII: SOCIAL INDICATORS SUPPORTABILITY FACTOR

INDICATOR	
1. promotes social justice and equal opportunities for all members of society	0.57
2. improves quality of life (all people have a home and access to basic infrastructure and services)	0.57
3. provides educational opportunities, supports life-long learning and increases awareness about sustainability	0.41
4. protects, monitors, and safeguards local resident access to natural, historical, archaeological, religious, spiritual, and cultural sites	0.52
5. supports the conservation of cultural heritage (includes rural heritage)	0.26
6. contributes to crime prevention and increase perception of safety among population	0.20
7. increases production of local and fair trade goods and services	0.20
8. promotes communication, cooperation between citizens and local authorities	0.28
9. reduces vulnerability of people to climate change and promotes comprehensive risk based assessment and prioritised action in area	0.30

TABLE VIII: GOVERNANCE INDICATORS SUPPORTABILITY FACTOR

INDICATORS	
1. A management team with broad competences and sufficient representation was built to lead the planning process	0.37
2. Human activities and associated stakeholder groups were determined	0.57
3. The issue was chosen driven by ecological, social or economic needs and targets were set	0.63
4. All possible measures were identified and compiled into alternative hypothetical scenarios	0.83
5. A strategy was developed how to assess the effect and ESE (Economic, Social, Ecologic) consequences of different scenarios (e.g. modelling)	0.83
6. Different alternative scenarios were simulated and results discussed with stakeholders	0.83
7. Assessments were made of impacts on different stakeholders	0.37
8. Costs were calculated for different optional measures considered in the scenarios	0.47
9. There was a strategy for the issues of missing data and uncertainty in implementation process	0.87
10. The feasibility, costs end efficiency of scenarios were reviewed and evaluated	0.70
11. The entire process was documented and publicly available	0.53
12. The concept was implemented and accepted by the public	0.77
13. Effects of implemented measure are monitored on regular basis with respect to identified targets	0.77
14. The success of measure was evaluated	0.77

Considering these values we calculated the supportability factor for each factor separately, as it can be seen in the following table (Table IX).

TABLE IX: SUPPORTABILITY FACTOR (SF)

Type of factor	SF
Environment factor	0,71
Economic factor	0,6
Social factor	0,37
Gouvernance factor	0,66

This table shows graphically in the following way (Fig. 7).

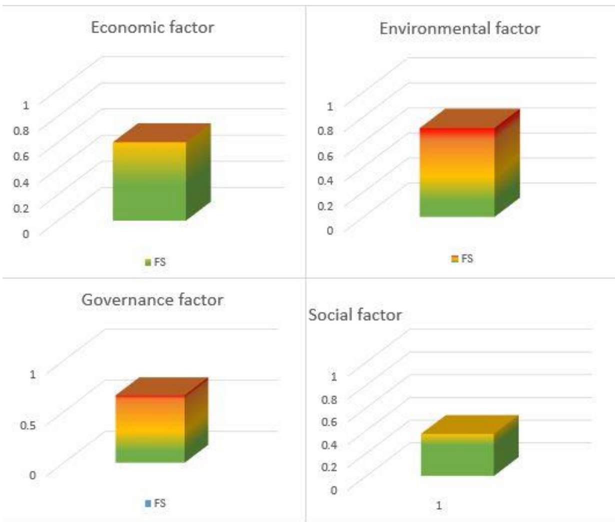

Fig. 7. Supportability factor graphics.

IV. DISCUSSION

Determining the supportability factor shows a picture of the activity proposed in the context of a multi-criteria analysis of the environmental factors, economic, social and governance. Use indicators are indicators already consecrated, use both at Sea level (determined by Coast projects learn or Pegasso) but also at the level of the Baltic Sea (project Baltcoast). Furthermore, the sustainability matrix was developed within the project Baltcoast and used by us to calculate the supportability factor.

In order to achieve a more realistic value of the factor of supportability, must be used with a higher accuracy. These data may be collected to the spot (weather, water, and data about economic and social activities) as well as the statistical data or other sources. [10] Calculate affordability factor will take into account the limits stipulated in the national and international official documents, list or other sources used in an official and recognized widely. Each indicator in part must have at least one method of calculating the supportability factor. There are indicators that can be calculated more affordability factors. For example, the environmental factor, we have the indicator "1. Reduces waste, prevents air, water and soil pollution and stimulates material reuse and recycles ", for which you will calculate the affordability factor for each of the elements: water, air, soil, waste. In this case, if we take only the element "water", it must be analyzed in light of the water framework directive, by performing qualitative and quantitative analysis for the determination of good water status [11]. If the values recorded for this item do not fulfill the requirements of the directive, this means that the element analyzed do not fit within the affordability factor. Similar must proceed with other elements. In the example used regarding the exploitation of the natural gas in the Black Sea, we used the three stages of this activity, namely the initial phase, the installation phase extracting platform became operational and the uninstall phase of the equipment used. [12]. In the case of the environmental factors and social analysis of the indicators was done and in terms of the influence of activity on offshore, nearshore zone or coastal and bathing zone. In the case of the economic factors and governance, this influence does not exist or is insignificant between these areas. Supportability factor model shows us the threshold up to which an activity can be conducted in optimal conditions using the multi-criteria analysis method and taking into account the different phases of the project. Inter-relations of the various indicators and the cause of conditionality between them are elements that make supportability factor analysis method applied to determine a specific State of affairs. Validation of the model substantially depends on the quality of the data entered to determine the threshold of the affordability. Also, the pattern is dependent upon the inter-relations between different indicators established for the coastal area and marine [13]. For example, when we take into account the marine waves, these must be related to the prevailing winds in that area, bathymetry area, topography, existing marine currents, steelwork, etc. Supportability threshold is given in this case by the multi-criteria analysis of all elements that have an influence on the item concerned [14].

V. CONCLUSION

From our point of view, an analysis of the supportability is a factor up to a certain point. The data used should be of a high accuracy and current. Analysis of the factor of the affordability should be conducted periodically, because some elements can have a different evolution over time and can provide other values after a certain period of time. Analytical model of the affordability factor which is focussed on the impact of the planned drilling operations carried out within the block 30 EX TRIDENT by the LUKOIL the investor shows us that this activity has some elements (in particular those of the environmental protection) that are affected, may irreparably, but, at the same time, it is noticed that the social and economic activities, improving the operational period of the project. The analysis was conducted only on a single drilling operation planned, namely that the block 30 EX TRIDENT. As we already know at this time, on the continental shelf of the Black Sea there will be more such activities, and the results of all these activities could substantially alter the thresholds laid down in this supportability analysis [15].

Analysis of the factor of supportability is part of doctoral research within the paper "Implementing of an integrated coastal management through the application of the sustainable development principles", to determine the supportability factor, determining the threshold between the inter-relations and proposed indicators are still in the early stage, and the future models developed to be validated in time.

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The main topic of this paper is the management of the economic, social, environmental and governance factors, which must be harmoniously combined into a desirable model.

The applicability of the research themes has reached both the coastal area and the marine area - onshore and offshore - and models from the area of energy, transport, waste, or protected areas have been studied.

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