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The multidimensional approach to marine industry development

Part I. Obstacles and willingness to the EU marine industry reengineering

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ABSTACT

The paper consists from two parts and generalizes traditional approaches to innovative transformations in various sectors of the EU marine industry. It is shown that shipping companies should permanently adapt and keep their business in sync with marketable changes and be ready to competitive struggle within the global economy. The critical solutions are determining the functional parameters of merchant ships at earliest stages of theirs structural designing, as and reengineering. Author offers a conceptual framework of the co-evolutionary approach to reengineering maritime transport. This problem-solving approach examines targeted ships in topological aspect as the multilayered configurations composed of various-of-a–kinds components, and in functional aspect as multicoalitional compositions. Basic attention focuses on identification of various constrains to innovative activity and choice of improvement strategies, for turning the European marine industry into the high competitive system. For completeness, in paper are presented three particular measures for an estimation of maritime transport success.

Keywords: European marine industry, maritime technology, obstacles to innovative activity, overcoming barriers strategy

INTRODUCTION

The increasing globalization is bringing in more competition in the market. In the European Union's Member States some of the shipbuilding enterprises and shipping companies operate under high overhead costs, such as labor wages, and find themselves faced with tough price-oriented competition from low-cost producers in Asia [13, 15, 16].

The ability growth of maritime transport to navigation and operation is impossible without innovative transformations (Tab. 1). However, the globalization does not bring in only challenges but also presents an opportunity to internationalize

***Table 1**. Basic innovations in history of the maritime transport*

Milestone event	Basic innovation	Period	Examples
The floating vehicles moving by man-power	Primitive raft constructed of the cane (ancient Mesopotamian)	3500 B.C. – 2700 B.C.	– Ships distinguished by a carvel-built wooden hull with constructive fastening – Ships distinguished by double hull out of high-strength steel – Ship's hull with changing configuration – Ship's hull out of a smart materials created under nanotechnologies
	Timber boat powered by oar (ancient Scandinavian)	3000 B.C. – 500 A.D.	
The floating vehicles moving by nature-power	Ship propelled by sail and constructed of the wooden (ancient Egypt, Viking)	2700 B.C.– 1900 A.D.	
The floating vehicles moving by engine-power	Ship propelled by steam- engine and constructed of the iron	1770 A.D. – 1915A.D.	
	Ship propelled by low-speed or medium-speed diesel (gas-turbine) & constructed of steel	1915 A.D.– 2030A.D.	
	Ship hull from super-light alloys differing by: ✓ renewable energy engine ✓ hull with changing geometry	2030 A.D. –	

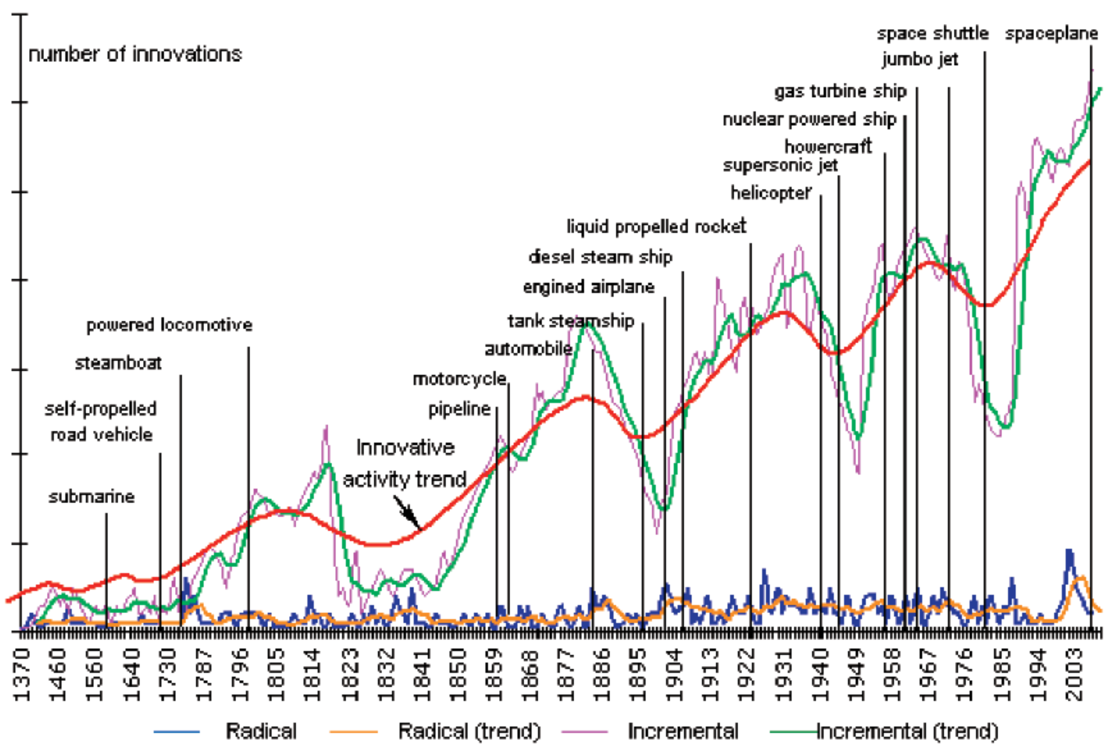

Fig. 1. Long-term cycles and short-term changes of European transport development

sales in new, rapidly growing maritime markets and thereby to generate additional revenues [27, 28].

Therefore among the European important problems within the next few years is the rapid development of energy-saving vessels and risk-free shipping technologies; implantation of ship's propulsion systems differing by high hydrodynamic efficiency, as well as improvement of onshore management techniques.

Tools towards these goals are increased partnerships both in the "knowledge triangle" – research, education, innovation and in the "innovativeness triangle" – idea, development and implementation [2]. A comprehensive investigation of business activities demonstrates that the EU Member States are important players in market, putting innovative solutions into practice by various ways [20, 21].

Herewith, in a number of the European Regions the world experience of innovative development is generalized and made use to improvement of various modes of the EU transport. Such tendency takes place for a long time (Fig. 1). Today numerous European Regions make use of world experiences of innovative development as part of their strategies for multi-purpose renovation of various sectors of staple industries, including marine industry [10, 12]. In a number of cases European Regions are focusing attention to commercial viability of various new solutions by the analysis of utility and profitability, but with less attention to quality of innovative activity. Unfortunately, some of the Regions do not take significant steps in the implementation of innovation availability evaluation a though they recognize its importance. A serious threat for the economies of such Regions is a lack of innovations as a result of scanty investment into RDI (Research, Development and Innovation), and poor cooperation of domestic researchers and various enterprises of the marine industry, as well as government and regional authorities. Developed European Regions are focused on large-scale reengineering of harbours' infrastructure as key commerce hubs, and improving of navigation activity as vital transport mode. Herewith, on the one hand takes into account social opinions about risk-free and eco-efficient shipping technologies, and on the other hand the estimation of future market demands and profitability forecast of innovative transshipment technologies. This gives an indisputable advantage as it allows the following:

- to make timely solutions with regard to the large-scale modernization of maritime transport, through the technical achievements and shipowners' wishes
- to adapt the production of the European shipyards to a large-scale commercialization, taking into account interest of freight forwarders, as well as passengers preferences.

Therefore, today's active debate is devoted to the analysis of an innovative policy and interpretation of transformation results both into various transport modes, and into shipbuilding industry [2, 12, 14]. The European Commission is key player in this area. The special attention of the EC is focused on quick adaptation of verified innovations into the European marine industry. In the author's opinion single and multipoint sources of the constrains to successful implantation of innovative solutions can take place both in the process of converting new ideas into lighthouse projects, and later into robust transportation systems. Such variety requires a systematization of these obstacles and definite proposals of efficacious strategies to their overcoming. Usually researchers are contented by the limited number of barriers, including [8, 9]:

- Lack of ability to use new technology
- Expensive human resources
- Lack of skilled human resources
- High interest rates
- Problems with access to finance
- Hard to protection intellectual property
- Lack of market demand for innovation
- Did not plan to innovation.

Such approach essentially constricts range of problems. Fig. 2 shows the importance degree of the above-listed obstacles to innovative activity for the EU enterprises on basis [8, 9, 15, 22]. The more detailed barriers classification to innovative activity follows in Tab. 3.

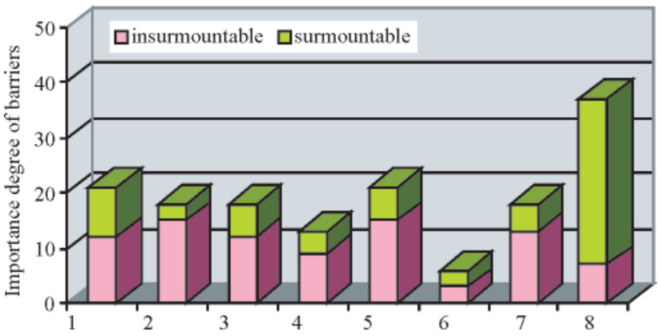

Fig. 2. The main constraints to innovative activity in the EU-27

First let's analyze modernization features of the European Union's marine industry.

MODERNIZATION FEATURES OF THE EU MARINE INDUSTRY

The marine industry is a complex and diverse branch of international economy with many sectors, which are confronted with an increasing international competition on all market shares. The worldwide economic cycles are very important to the European marine industry development too [24, 25]. It is typical for all sectors of the marine industry including shipbuilding, maritime transport, marine tourism, fishing, as well as maintenance and transshipment of various ships. A leading position in the European trade still is identified with merchant fleet and passengers' conveyance. Centuries-old experience reveals that both cargo carriers and cruise ships are complex engineering systems. As rule, each ship belongs to a shipping company, which is supercomplex socio-technical system, and consequently can be classified by various attributes. Such systems classify according to their topological space, as well as to functional parameters, e.g., [6].

In context with the problem of presented article, technical systems can be classified through their structural features, which determine occurrence of those or other obstacles to the subsequent modernization of these systems:

- ☆ structurally linear systems; an obstacles to their modernization are cumulative (the predictable) barriers;
- ☆ structurally nonlinear system, i.e., system which does not satisfy the principle of superposition; an obstacles to their modernization are both cumulative barriers and unpredictable synergetic barriers[1].

Any enterprises of the marine industry can be considered as multilayered systems including several levels. Then, full number of indivisible components, including both the units of standard-based equipment and the units of innovative equipment determine the bottom layer (the mini-level) of such enterprises. Some number of the standard equipment and the innovative equipment can be coalesced into target coalitions. These coalitions determine the average layer of the enterprise (the middle-level). Set of the targeted coalitions represents the higher hierarchical layer (the meta-level). For example, a shipyard as multicoalitional system includes the slipways, dry-docks, the productions lines to fabricate engine rooms etc. Principle of shipyard modernizations assumes that the top-managers beginning to improve one or a few coalitions, first of all should identify eventual barriers; to introduce only profitable decisions, and also they should step-by-step overcome all barriers to innovative changes in shipbuilding activity, as well as keep shipyard's production balance. On the first step, structural composition of the modified shipyard will be a poorly-compatible. At the next stage of modernization such enterprise should be transformed to a mature-compatible composition by significant improvement of compatibility between standard-based equipment and the new embedded coalitions through overcoming internal and external barriers, and as result, reconfigurations of intercoalitions connections. Analogical sequence of equally likely events is characteristic for modernization process of any enterprises including shipping companies.

Every next effort of the top-managers should be focusing to maximum increase in interoperability of the modernized enterprise with its business environment. Any firm of the marine industry is called a highly-compatible enterprise, if it does not contain a redundant coalition or component, as well as if works performs without errors or inconsistencies. In the author's opinion, only such companies should be target of the top-managers because of their resilience to global market influence. One more status of any future-oriented enterprise is theoretically possible, namely so-called ideally-compatible state, if it's impeccably cooperates with every business share, and always ready to overcoming various barriers even under asymmetric influences (market, inflationary expectations, restrictive laws etc.). Therefore, can be formulated the following substantive recommendations relating to successful modifications of enterprises of the marine industry into highly-competitive companies:

- to meet of market requirements, including a freight forwarders' needs and a shipowners' wishes, as and to identify critical barriers to implantation of new solutions
- to promote of verified and proven innovations, as well as risk-based techniques focused to overcoming eventual barriers
- to use technique SWOT or method CBA for comprehensive assessment of opportunities and vulnerabilities of possible strategies of the planned changes, and at last
- to systemic reorganization of the enterprise's infrastructure through implementing advanced software, hardware and orgware for efficiently planning, control and development.

Modernization of the EU maritime transport

Maritime transport systems are supercomplex systems, characterizing by dual logic. On the one hand, such systems require stability for maintenance of users' enthusiasm, but on the other hand, realization of effectual innovative policy. For reduction of this self-contradiction, the author has offered new approach to the innovative support of maritime transport systems. This approach unifies the methodological basis for investigations of change/conservation rate and describes by parameter "Dimensions of Systems' Renovation". Further in the article, this methodology is referred as DSR approach. Under condition that dimensions number more than one ($N \geq 2$) such approach increases both simulation veracity of renovation of engineering systems, including maritime transport systems, as well as identifies best way to convertibility of the new ideas. Let's explain this thesis.

Early methods in the design of engineering systems and their subsequent modernization were based upon the use of informal procedures obtained empirically. Obvious disadvantages of taking cut-and-dried decisions on the basis of an empirical approach have led to development of the deterministic

[1] The word "synergy" originates from the Greek language and is composed of the word "syn", which means "together", and "ergon" meaning "work" [17].

approach. Such approach considers the designed system as a structurally-stable composition of various components. At that, each of these components is a discrete indivisible element and adaptive interactions between them are linear and weak. In a general sense the deterministic approach was developed on basis of formalized procedures for solving such problems as screening of structural compositions of simple engineering systems, e.g. single hull tankers or tramp bulk carriers (1960-70 years); reducing of an informational uncertainty, e.g. of shipping management (in succeeding years); and at last, problem of large-scale standardization of decision-making and the solutions verification.

It tries to predict the properties of a revised system under very limiting conditions, and under only one control variable, most often variable "*Components Number*" (the informational measure of system's renovation), and as the result, reflects readiness of top-managers for overcoming situational barriers (Fig. 3). Therefore, the deterministic approach is called D1SR (the one dimension of system's renovation) according classification offered by author. The each maritime transport system has a unique nature because it consists of various coalitions [26].

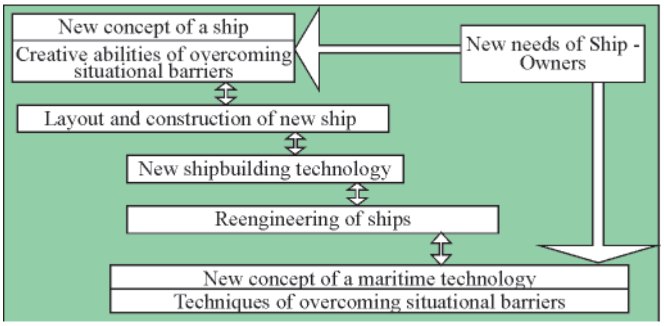

Fig. 3. *Deterministic approach (D1SR) to development of a new ship's concept*

Table 2*. Compound- chain of converting new idea-into-product*

Stage	Activities in an innovative reengineering	Results
Basic research	– identification of market demand, including of shipowners needs	Lighthouse project
	– definition of reengineering problem and eventual barriers	
	– research of critical barriers to maritime transport reengineering	
Applied researches (lighthouse project)	– estimation of worldwide experience in reengineering	Experimental development
	– definition of problem that aimed at the application of innovative idea into reengineering process	
	– analysis of eventual barriers to maritime transport reengineering	
	– definition of complete and unambiguous set of functional & legislative requirements for activities in an innovative reengineering	
	– identification necessary resources for overcoming barriers, taking into account funds, personal skill, public opinion	
	– conceptual view and planning process of reengineering, taking into account of shipowners' needs and eventual barriers	
	– problem and data structuring	
	– development of applicable requirements sufficient to enable satisfactory performance of the targeted system's life-cycle activities, taking into account informational compatibility	
	– choice of innovative solution, taking into account structural and functional compatibility as a verification results of it practicality	
	– development of the analytical model and design-making tools	
	– identification of real barriers and tools for their overcoming using historical experience, as well as integrated analysis of best practice and cumulative knowledge	
	– revision and correction of the reengineering conception, taking into account extent of its conformity to market's trends	
Experimental development	– converting of new idea into the prototype model and its testing	Decision-making about realization of innovative project
	– identification of the weak points of the novelty prototype, as well as probable barriers at the future realization of innovative project	
	– revision and modification of the prototype, taking into account conformity extent of the prototype to ideally-compatible model	
	– definition and description of requirements to competencies and working environment, e.g. for crew of new ship	
	– forecast how the required technical, quality, and human-centered activities will be fitted into the life-cycle of maritime transport	
Implementation	– maritime transport of demanding	Decision-making about large-scale production
	– creation of the in-line documentation and training procedures for overcoming barriers to large-scale commercialization of new object	
	– development of the strategy for large-scale commercialization, taking into account maturity and readiness extent of a business environment to implantation of maritime transport	
Large-scale production	– commercial production of the targeted object, e.g. top-class ships	Wide expansion of new ships or technologies
	– realization of selected strategies for competitiveness support of the new ships during period of large-scale commercialization	
	– standardization of new solutions for the EU maritime transport	

Unfortunately on initiative stage of renovation process, new coalition embedded into the modernized transport system rarely will improve its quality; similarly new qualities' giving to such system of isn't always accompanied by positive functional effects. The author proposes the following sequence of converting new idea into a new shipbuilding product or putting maritime technology (Tab. 2).

In the middle of XX century for study of engineering systems as a whole, including both its complexity and development dynamics was proposed systemic approach by L. von Bertalanffy [1]. This approach integrates a synthetic and the analytic methods, taking into account the informational and topological measures of systems design (the second dimension of system's renovation), as and enables to investigate the cumulative internal and external barriers. Therefore, the systemic approach should be called D2SR according to classification offered by author (Fig. 4). Later investigations allow formulating the so-called principle of co-evolutionary development. Its earliest use was connected with research by biologists and concerned the analysis of community evolution and the reciprocal aspects of interaction between organisms of different species in nature. Subsequently the co-evolutionary dimension began to be used by scientists from the other scientific domains.

The qualitative modernization of the EU industry sectors requires the multilevel compatibility and interoperability of approved innovations through multilateral adaptation of standard and innovative solutions, taking into account both the interactions diversity and the eventual barriers to innovative changes, i.e. evolutionary measure of system design (the third dimension of system's renovation). The combination of the evolutionary measure with structural and informational measures (the first & the second dimensions) enables a modernization of transport system through the so-called Three-Dimensional (D3SR) approach. Such approach allows use of various tools, covering numerous aspects of systems modernization, e.g., increase of safety and competitiveness, as well as an amplification of operational and economic efficiency through integration of transportation modes into the local, regional or global maritime transport systems distinguished by a user-friendly, environmentally sustainable development and stable resistance to critical failures. The D3DA focuses on process research of converting in the "from-idea-to-product" chains, using:

- ♦ unified designing space for conjoint analysis of transformed maritime transport systems via structural, informational and evolutionary measures
- ♦ the integrated index of conformity degree of innovation with the ideally-compatible model for estimation of renovation decisions' efficiency, taking into account various positive effects as a consequence of innovative activities.

This process include the basic and applied researches, an experimental and implementation phases, as well as diffusion phase of a standardized solution, which covers the improvement actions. Let's consider this assumption in details:

- ★ the first stage is all attention on initial choice of innovative solutions satisfying to modernization requirements of the maritime transport systems; as a rule, on this stage make up a complete multitude of verified and proven innovations, as well as identification of critical barriers to their using. These barriers have cumulative nature
- ★ at the second stage is paying attention on the embedding of innovative coalitions into the maritime transport systems with permanent verification of inter-coalitional compatibility; as a rule, this stage leads to formation of targeted system, characterizing by partial compatibility in view of existence of a latent barriers. These barriers have synergetic nature
- ★ the third stage is focused on improvement of inter-coalitional compatibility; as a rule, this stage leads to targeted system, characterizing by mature internal compatibility on the one hand, but on the other hand, requiring the further improvement through overcoming residual barriers. These barriers have synergetic nature, as and cumulative nature
- ★ at the fourth stage is focused on overcoming barriers to implantation of the improved maritime transport system into a business environment; this process allows to increase compatibility of inter-system up to greatest possible level, and at last
- ★ the fifth stage is listening carefully consequences of diffusion of the improved maritime transport system, as well as it's prepare to subsequent standardization, i.e. creation of regulative barriers for widening life-cycle of the modernized system.

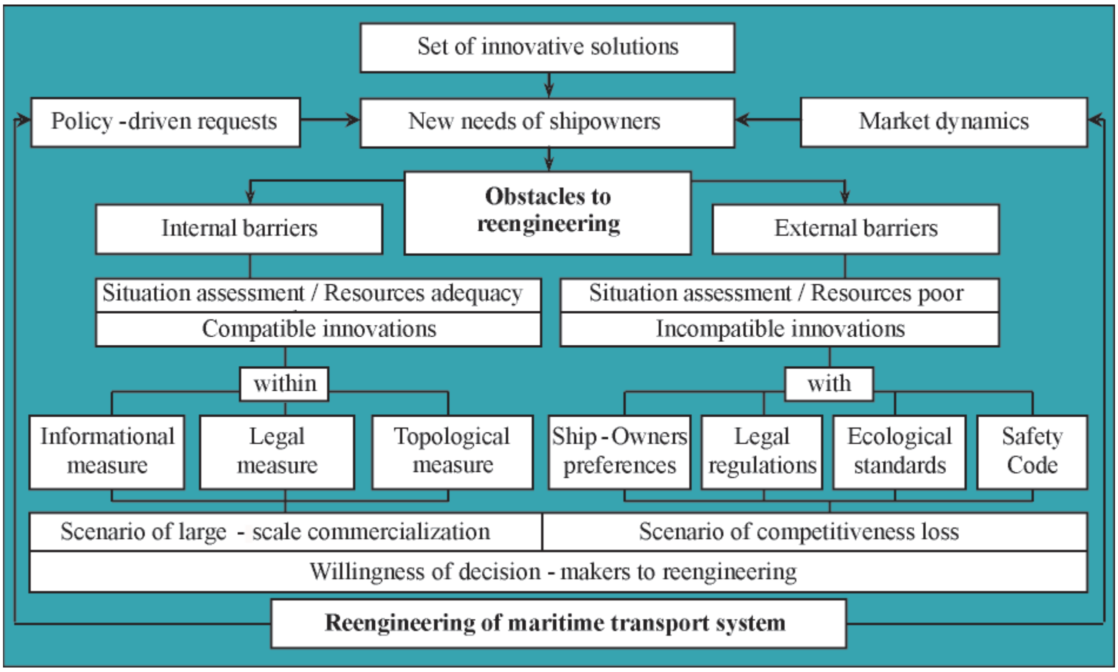

Fig. 4. *Two-Dimensional Approach (D2SR) to choice of investment strategy*

The three initial stages represent the pre-commercial period. Decision-makers identify the targeted transport system, as well as choose, correct, test and develop appropriate technologies and techniques within the context of the innovative problem. At the same time, they develop quantitative and qualitative measures for close estimation of innovative solutions' potential influence on intra-system compatibility. The goal of these stages is to support innovative transformations using necessary resources, strategies and tools, as and timely decision making to overcoming of various barriers. Therefore, the outcomes of third stage will help decision-makers identify shortcomings, evaluate risks, and invest in the best combination of innovative strategies, minimizing influence of eventual barriers, and as result, to increase competitiveness for improved transport system, as well as help to estimate the resulting benefit from the innovative idea.

The fourth and fifth stages represent the commercialization's period. At the fourth stage, decision-makers correct the plan of activity, considering the obtained results of estimation at the third stage. The market penetration strategy develops, taking into account marketing research, the regional market condition and the competitors' profiles. The goal of this stage is to evaluate the potential of the innovation and ability of its adaptation to changeable wishes of consumers. At the fifth stage, decision-makers take steps to the complete standardization of the novelties. The main goal of this stage is large-scale market expansion.

Barriers to innovative activity within the EU marine industry

The RDI activities are keys to renewing economic growth, strengthening competitiveness and boosting employment. Successful implementation of innovative knowledge-based products with enhanced utility and profitability may help for the EU shipping companies, on the one hand, raise both service quality and environment safety, and as result to achieve a domestic promotion, and on the other hand strengthen their competitive position in global market through overcoming various barriers [11, 17, 29]. Author offered new classification of barriers to innovative activity, shown in Tab. 3.

Tab. 3 *Barriers classification to innovative activity on the European-wide scale*

Barriers to innovative activity					
Positive barriers		**Negative barriers**			
		Bi-criterion classification		**Multi-criterion classification**	
		Subjective	**Objective**		
Individual barriers:	• Threat of economic collapse • Individual ethical code	*Labor obstacles:* • Skills shortages of a staff • A high level of intra-staff conflicts • Staff passivity to innovative changes • Workers unwilling-ness to retraining	*Business environment obstacles*: • Economical cycles (economic recession) • Market uncertainty • Limited potential of domestic market • The peculiar regional environment	*By source localization*	Internal
					External
Social barriers:	• Public moral code • Multi- aspect liability to future generations: - ecological - living conditions - architecture & historic protection - landscape preservation -safety etc.	*Individual obstacles:* • Lack of entrepreneurial spirit • Lack of intelligence & creativity • Lack of task awareness • Prejudice against innovative changes • Undisciplined behaviour • High level of informational uncertainty, as result of lack of firsthand knowledge	*Regulative obstacles:* • Restrictive laws and government regulations • Long certification procedures • Universal service obligation	*By number sources*	Single
					Multi
			Administrative obstacles: • High level of bureaucracy • Long external decision -making processes • Strong requirements to novelty submission • Disconnect between science and business • Unawareness of support importance of new initiative	*By ability to overcoming*	Surmountable
					Partial surmountable
					Insuperable
Regulative barriers:	• Antitrust rules • Obligatory ecological assessment • Obligatory safety testing; • Intellectual property rights	*Organizational obstacles:* • Corporate culture does not encourage innovativeness • Lack of innovator - decision maker contact • Undue centralization • Formalism, long inte-rnal decision-making processes • A low level of imple-menttation control; • Incorrect business-plan / master-plan	*Industrial obstacles barriers:* •Three-dimensional complexity of innovative changes • Conflict for resources; • Bundling (high interdependency) of technology	*By mechanism*	Cumulative
			Financial obstacles: • Lack of funds • High innovation costs • Inflation risk • Exchange rate risk • High credit rate		Synergetic

This necessitates efforts to bring new and more profitable products into the consumer market. Experience shows, that identification and research of critical barriers to an innovation are important, but creation of strategies and tools to overcoming barriers to innovative process has even more values. The most investigations of innovative process are focused on two types of barriers to converting of new ideas into new products. First of all, it is internal and external barriers to innovative transformations. Secondly, ones are so-called business environment barriers forming under of market fluctuations [3, 5, 7].

In author's opinion such classification of eventual barriers is adequate, if an innovative process is described for structurally linear systems. On basis of many investigations [18, 20], and author's researches, we can contend that for structurally nonlinear systems main obstacles to rapid achievement of total success are connected with poor encouraging motivations for innovative actions, as and lack of systemic approach to leveling or removing of various barriers to implementing novelties. Properly, the dominant barriers to European innovative activity can be divided into ten groups: financial, labour, administrative, industrial, regulative, business environment, organizational, operational, individual and natural barriers. Fig. 5 and 6 shows the importance degree of barriers to innovative activity in the EU, on basis [4, 8, 9, 15, 16, 22, 23].

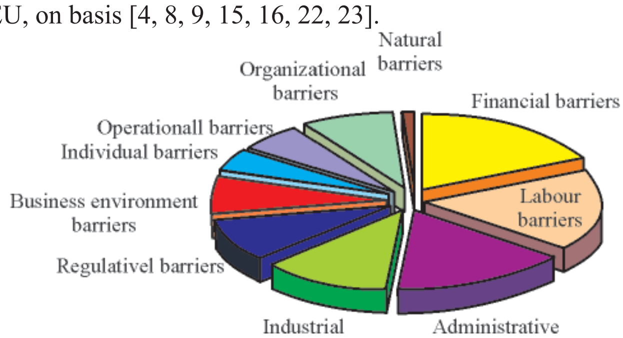

Fig. 5. Main obstacles to the European innovative activity

Otherwise additional classification of such barriers is required, considering the sources forming mechanisms, a surmountableness level, etc. Also the author classifies barriers to innovative activity by one more criterion, namely by predictability:

⇨ The predictable cumulative barriers. These barriers foresee at the early design stages of any engineering systems. These are divided into predictable positive barriers including external and internal, as well as, predictable negative barriers.
The nature of the predictable positive external barriers lays in aspiration for the support of public and ecological safety as well as in liability to future generations. The predictable positive internal barriers, i.e. barriers within the organization, focuses on identification and development of promising innovations through demand to the innovator to give a detailed suggestion of the innovative changes or a business plan which shows the way to commercialization. The nature of these barriers lays in aspiration for the avoidance of additional expenditure. The high moral standards and professional ethics of personnel are the positive internal barriers too, e.g., refusal to novelties use without intellectual property rights.

⇨ Unpredictable synergetic barriers. Generally, the nature of these barriers is closely connected with resonance phenomenon induced by multidimensional innovative changes. In most cases this phenomenon generating structural, information and evolutionary complexities, and as result critical obstacles to end-to-end innovative process. According to numerous investigations [6, 29]:

- structural complexity is a measure of topological features produced by differentiation and integration in the spatial dimension of the improving system. It is determined by extent of structural compatibility through mapping intra-coalitional level, inter-coalitional level, and inter-system. Structural compatibility within inter-coalitional level implies spatial compatibility between both innovative and standard coalitions embedded into improved system. Structural compatibility within inter-system level implies spatial compatibility between updated maritime transport and business distinguished by administrative, regulative and/or market barriers
- information complexity is a measure of conceptual features of targeted system and its conformity extent to market's expectations. It is described both by basic characteristics and distinguishing features of the updated system, as well as by groups of conformity between these descriptions. Information complexity is determined by informational compatibility which means an opportunity of legal, language, and/or knowledge barriers, and
- evolutionary complexity is a measure of transformations features carried out within the system's modernization. It is determined by integration of all changes in the temporal dimension through three aforementioned systems levels. Evolutionary complexity within intra-coalitional level implies age-related barrier between all elements embedded into each coalition. Evolutionary complexity within inter-coalitional level implies operational barrier between coalitions embedded into renovated system, which is determined by timeliness of replacement of outdated coalitions by innovative coalitions. Evolutionary complexity within inter-system level implies advancement barrier between consumers' demands and supply, which is determined by maturity and readiness of a business to implantation of new solutions.

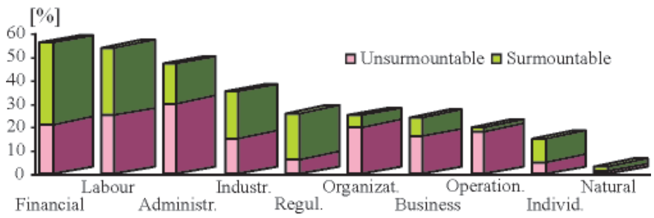

Fig. 6. *Percentage composition of main barriers to reengineering of the European marine industry*

All barriers should be divided by positive barriers and negative barriers. Positive barriers play a vital part in an attempt both to the environmental protection and the maintenance of operational safety. Negative barriers are obstacles in development. Such barriers are the responses of obsolete systems to innovative solutions. Some reasons for this opposition are unwillingness of top management to changes, lack of creativity, a low level of motivation, aspiration for the avoidance of high economic risks as consequence of market uncertainty high level and lack of pressure from customers.

The multilevel contradictions between innovative activity obstacles generate the so-called Domains of Incompatibility (DoIs). The mini-level contradictions lead to forming the intra-coalitional DoIs and to the drop in competitiveness of separate shipping company. The middle-level contradictions lead to forming the inter-coalitional DoIs and to the reduction of regional economic activity. The meta-level contradictions lead to recession in the marine industry and to the drastic growth of market uncertainty, and as result, to the pressing need of various tools and resources to overcoming predictable and unpredictable barriers, forming into various the European Regions. The marine industry is very important part of the EU economy. Let's discuss some facts. First of all, in 2006 years, the European shipbuilding was characterized by [10, 13, 15]:

- approx 9 000 production and supply enterprises, with more than 350 000 workforce
- an annual turnover of more than € 35 billion, more than half of it through exports
- stable positions on global market in sophisticated shipbuilding production, particularly fast ferries, chemical tankers, cruise ships, megayachts, FPSO
- nearly 10% of turnover spent on Research, Development and Innovation (RDI) activities.

At the same time, the European maritime transport plays major role in the international and internal trade of the EU. In 2005/2006 years, key data of this sector of marine industry were:

- almost 90 % of the European Union's external trade (imports and exports combined) is transported by seaways, in particular that relating to bulky and low value goods
- more 40 % of the internal trade between the EU Member States is realized by the maritime transport and inland waterways
- more 4,000 mln tones of a freight loaded/unloaded in the European Union harbours.

The level of risk factor plays an essential part in acceptance of new technique or technology by any shipping company or shipyard. Quite enough one tragic event, so that the freighters or shipowners' preferences have been radical changed, and their DoIs are extended.

Enlargements of an individual dissatisfactions of permanent participants of innovative process (e.g. eventual freighter/shipowner) takes place as a consequence of the enduring increase of the various requirements to a risk level of investments, to the transportation quality etc. Best tool for investigation of DoIs is risk-mapping techniques (Fig. 7). Therefore, critical goal of each innovative process is choice of high-quality strategy for rapid growth of the European economy (Tab. 4).

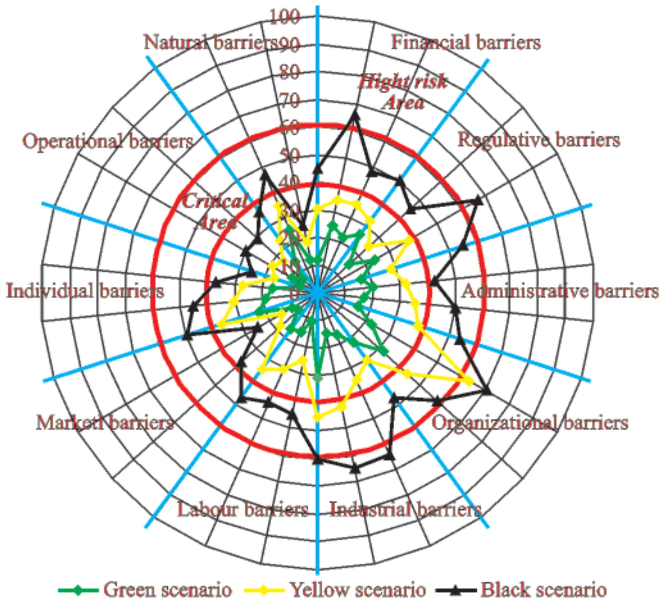

Fig. 7. *Risk-mapping of the barriers' impacts to the innovative activity within the EU maritime industry*

Forecast of the barriers impacts to the innovative activity through creation of various scenarios are necessary before the beginning of innovative changes with the purpose of the negative results' minimization. This problem is very important for the Polish maritime industry too. Therefore Part II of this paper will be devoted to the multi-objective analysis of the obstacles in the Polish maritime industry development.

Table 4. *The basic strategies for European Regions development through overcoming barriers to innovations*

Key strategy	Convergence Regions	Phasing – in Regions	Competitive Regions
The policy of main Regional barriers overcoming	Upgrading of regional economy through use of world experiences of innovative development	Intensification of regional economy through incremental innovations	Strengthening position of regional economy in global knowledge economy
The strategy of Regional barriers in marine industry overcoming	– increase co-operation between inventors and sea-port authorities – increase innovative – capabilities of shipping companies – implant of "catching up learning" techniques	– wide innovative activity – new sectors of marine industry – implant new ideas in sea transportation systems – establish of joint-ventures companies	– enlargement of bases of knowledge – embedded of radical innovative solutions – enhance interaction of regional industry and decision-makers on new market shares
The strategy of Regional barriers in education systems overcoming	– build up medium level skills – co-operation increase between shipowners and High Schools, Maritime Academies	– build up new skills required – inter-regional mobility schemes through co-operation shipowners and Universities	– set up both Universities and High Schools for growth specialized abilities – increase attraction of new skills
The strategy of Regional barriers in knowledge networks overcoming	– creation of a permanent links between innovative firms for transfer knowledge inside the Region – preference to the demand-led approach to development of Regional knowledge networks	– stimulation of activity of knowledge networks – support to new technologies on National and International horizons – encourage interfaces between researchers and marine industry	– all possible assistance of creation and development of knowledge networks – promote Regional networks among shipping companies

CONCLUSIONS

- The innovative activity is required to be designed on the basis of assessment results of their expediency and opportuneness, i.e. research of real market demands, as well as utility of planned changes and resources necessary for its execution.
- Early identification of cumulative barriers, as and the forecast of synergetic barriers to required innovative changes are very important.
- Creation of effective strategies, helpful resources and instruments for overcoming barriers before beginning of improvement process plays a key role to the innovative project's success as whole.
- The more carefully innovative project is elaborated, the barriers to successive modernization of maritime transport are less, and at last the risk of a misfortune is lower.
- It is necessary to remember that the increase of uncertainty in free resources raises the probability of the unpredictable barriers' evolvement to the modernization process of maritime transport.
- Simulation of innovative process is required to be executed under condition that the black scenario of shaping of negative effects during barriers overcoming takes place.
- It is recommended to choose decisions to overcoming barriers to the modernization process using risk-mapping techniques.

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BIBLIOGRAPHY

1. Bertalanffy, L. *The theory of Open Systems in Physics and Biology*. Science, 111, 1950
2. Borg J. *Role of the future EU maritime policy in shaping new standards of maritime education and employment*. Inter. Consultation Conf. from Education to Employment - How to create a Successful Image of Seafaring in Europe. Sopot, 22 February, 2007
3. Bharadwaj, S.; Menon, A.: *Making Innovation Happen in Organizations: Individual Creativity Mechanisms, Organizational Creativity Mechanisms or Both*? Journal of Product Innovation Management, Volume17, issue 6, 2000
4. Birla M. FedEx: *How the World's leading Shipping Company keeps innovating and Outperforming the Competition*, Wiley, John & Sons, 2005
5. Boutellier, R., Gassmann, O., and von Zedtwitz, M.: *Managing Global Innovation: Uncovering the Secrets of Future Competitiveness*, 2[end] ed., Springer, Berlin, 2000
6. Braha, D., Maimon, O. *The Measurement of a Design Structural and Functional Complexity*. IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans, Volume 28, issue 4, 1998
7. Dougherty, D.; Hardy, C.: *Sustained product innovation in large, mature organizations: Overcoming innovation-to-organization problems*, Academy of Management Journal, Volume 39, No. 5, 1996
8. EC: *Observatory of European SMEs: Analytical report*, Eurobarometer, №196, The Gallup Organization, 2007
9. EC: *Observatory of European SMEs: Technical and Evaluation report,* Eurobarometer, №196, The Gallup Organization, 2007
10. EC: *Attitudes on issues related to EU Transport Policy: Analytical report,* Eurobarometer, №206b, The Gallup Organization, 2007
11. EC: Commission staff working document: *European maritime transport space without barriers reinforcing the internal market for intra-European maritime transport*. Brussels, SEC 2007
12. EC: *Defining the future of the shipbuilding of the European shipbuilding and shiprepair industry*, 2003
13. EC: *Europe in figures*. *Eurostat yearbook 2006-07*, Luxembourg: Office for Official Publications of the European Communities, 2007
14. EC: *Improving the competitiveness, safety and security of European shipping*, Directorate-General for Energy and Transport, Brussels, 2006
15. EC: *Key figures on Europe. Statistical Pocketbook*, Luxembourg: Office for Official Publications of the European Communities, 2006
16. EC: *Panorama Transport EU*. *Statistical book*, Luxembourg: Office for Official Publications of the European Communities, 2007
17. Freel, M. (2000): *Barriers to product innovation in small manufacturing firms*, in: International Small Business Journal, Volume18, № 2, Jan. 2000
18. Galende, J.; de la Fuente, J.M.: *Internal factors determining a firm's innovative behaviour*, Research Policy, Volume 32, issue 5, pp. 715-736, 2003
19. Gallin C. *Synergy in ship propulsion- a CODMAE plant for efficient, flexible, and redundant operation*. The Naval Architect, UK, March, 2003
20. Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S., and Smits, R.E.N.M. *Function of innovation systems: A new approach for analyzing technological change*. Technological Forecasting and Social Change, Volume 74, issue 4, 2007
21. Hulfactor M. *Overcoming Barriers to Market Understanding: Achieving Innovative Technology Product and Service Success*. Decision Trend Research LLC, Feb., 2006
22. *Knowledge for growth: Role and Dynamics of Corporate R&D*. Proc. of the 1[st] European Conf., Seville, 2007
23. Pearce R.: *Globalization of R&D: key features and the role of TNCs,* Proceedings of the Expert Meeting *Globalization of R&D and Developing Countries*, United Nations Conference on Trade and Development, Geneva, 2005
24. Robinson, J.E. *Waves of Change*. Published by The Nautical Institute, London. 2007
25. Schumpeter, J. *Business Cycles: A Theoretical, Historical and Statistical Analysis of Capitalist Process.* McGraw-Hill, New-York. 1939
26. Semenov, I., N: *The multivariable co-evolutionary approach to modeling innovative vehicles.* Part I and Part II., PAS, Marine Technology Transactions, Vol.16, 2005
27. *UNCTAD survey on the internationalization of R&D: Current patterns and prospects on the internationalization of R&D*, Occasional Note, United Nations Conference on Trade and Development, Geneva, 2005
28. U.S. Department of Transportation. *US Marine Transportation System: A Vision for the 21st Century*, Washington, November, 2007
29. Zaltman, G.; Duncan, R.; Holbek, J. (1973): *Innovations and Organizations*, Wiley & Sons, 1973.

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