Centrum Rzeczoznawstwa Budowlanego

Inżynieria Bezpieczeństwa
Obiektów Antropogenicznych 1 (2024) 67-82
https://inzynieriabezpieczenstwa.com.pl/

Inżynieria Bezpieczeństwa Obiektów Antropogenicznych

Proposed concept for the development of residential floating facilities

Emilia MISZEWSKA[*1], Maciej NIEDOSTATKIEWICZ[1], Radosław WIŚNIEWSKI[2]

[1] *Faculty of Civil and Environmental Engineering, Gdańsk University of Technology, Gdansk, Poland*
[2] *School of Business, University of Economics and Human Sciences in Warsaw, Warsaw, Poland*

Abstract

Currently, a dynamic growth of interest in residential buildings located on the water can be observed in Poland. However, the lack of legal regulations, the increase in society's affluence and overpopulation in city centers lead to reflection on the development strategy that should be implemented for maritime construction. The publication presents a proposal of four development strategy concepts: aggressive, conservative, competitive and defensive, developed for floating homes (FHs) based on the authors' own research. The strategy concept that, in the authors' opinion, should be implemented was indicated using the TOWS-SWOT analysis. A detailed analysis revealed that the strategy that obtained the highest result in the study was the aggressive strategy.

Keywords: TOWS-SWOT analysis, floating homes, SWOT matrix, strategic analysis, development strategies

1 Introduction

The culture of building residential structures on water has a long history in Europe, as well as in Asia and North America. In every latitude, construction on water was created for different causes and is constantly evolving to adapt to new realities. Despite the various factors behind this phenomenon, there are currently common features and problems faced by investors, city authorities and ordinary users of water reservoirs. The experience of countries such as the Netherlands, Great Britain and Germany should become the basis to strategize on the development of floating homes (FHs for short) for countries where housing on water is only gaining popularity. An example of a country where the phenomenon of housing on water is just developing but the number of FHs is already noticeable is Poland.

* **Corresponding author:** E-mail address: (emiurban@pg.edu.pl) Emilia MISZEWSKA

https://dx.doi.org/10.37105/iboa.207
Received 15 February 2024
Available online 31 March 2024
ISSN 2450-1859, eISSN 2450-8721
Published by Centrum Rzeczoznawstwa Budowlanego

Development strategies should include solutions to formal and legal [1-9], technical [5, 10-14], economic [1-3, 5, 7-8], environmental [15-24], demographic and socio-cultural [2, 25-26] issues.

When analyzing the development of construction on water and taking into account economic and technical aspects, the significant safety aspect must not be forgotten, of course. Relating to both the stage of design work, the state of implementation as well as the operation of the FHs themselves. In Poland, facilities such as FHs have not been defined or classified in legal regulations, which results in the lack of detailed technical regulations and rules for supervising design, construction and operation [27]. According to the current legal status, floating objects permanently moored to a quay on inland waters are defined as ships. The design of such facilities, taking into account compliance with ship regulations, raises many understatements, controversies and various interpretations due to the lack of specific requirements and procedures [27].

Therefore, the experience gained so far from the supervisions conducted has prompted the Polish Register of Shipping (PRS for short) to start working on developing its own set of regulations. PRS is an institution conducting independent appraisal activities on the international market, which - guided by the public interest - by formulating requirements, supervision and issuing appropriate documents assists state administrations, insurers and its clients to ensure the safety of people, floating and land objects, cargo and the natural environment [28]. On October 1, 2020, PRS published new "Regulations for the classification and construction of stationary floating objects" [29]. The problem is that these are internal regulations investors and owners of FHs do not have to comply with. For comparison, there are many legal provisions regarding the investment and construction process for residential buildings located on land, including laws and regulations, i.a.: [30-35] which can be read in [36-40].

2 Selection of the strategic analysis method

Strategic management is a complex process consisting of three stages: analysis, planning and management, understood as the implementation stage of the developed strategy. Strategic analysis is a set of methods and techniques that were created in response to the necessity to anticipate changes. Its main aim is to determine the factors that will influence the studied object in the future (in the publication on MOP) and to formulate future strategies. Factors subject to strategic analysis constantly change over time [41,42].

There are many typologies in the literature on strategic analysis methods. One of them divides strategic analysis methods according to their application, useful for: analysis of the macro-environment, analysis of the competitive environment, enterprise analysis and integrated methods [43,44]. The division of these methods is presented in Table 1 [41,45].

The methods listed in Table 1 are used, among others, in the construction industry, depending on the subject analyzed, the product life cycle method [46-48] and SWOT analysis [49-52] are particularly popular. To analyze the future of FHs in Poland, the most appropriate of the above-mentioned ones is the SWOT analysis, because it is a universal strategic reasoning tool used to collect and segregate data and systematize knowledge about the diagnosed facility - as a result of which it is possible to determine and adopt a strategic variant that will be subject to implementation and execution. [53]. Additionally, thanks to the transparent structure of the factor aggregation matrix, determinants can be easily analyzed in the appropriate groups: demographic, economic, formal and legal, socio-cultural, environmental and technical [41].

Table 1. *Division of strategic analysis methods [own study, based on: 41, 43-45]*

Methods	**analysis of the environment**		**enterprise analysis**	**integrated methods**
	macro environment	competitive		
Trend Extrapolation	X			
Delphi method	X			
Gap analysis	X			
Scenario methods	X			

Sector structural analysis (Porter's Five Forces)		X		
Analysis of the experience effect		X		
Assessment of the attractiveness of the sector		X		
Mapg of staregic groups		X		
Product life cycle			X	
Technology life cycle			X	
Product portfolio analysis			X	
Analysis of key success factors			X	
Enterprise value chain analysis			X	
SWOT analysis				X
SPACE analysis				X

SWOT analysis, the name of which is an acronym- Strenghts [S], Weakness [W], which are internal conditions and Opportunities [O], Threats [T]- as external conditions describing the environment (Figure 1). The assumptions of the SWOT analysis were developed in the 1950s, using the framework and procedures [53] of Kurt Lewin's force field analysis [41].

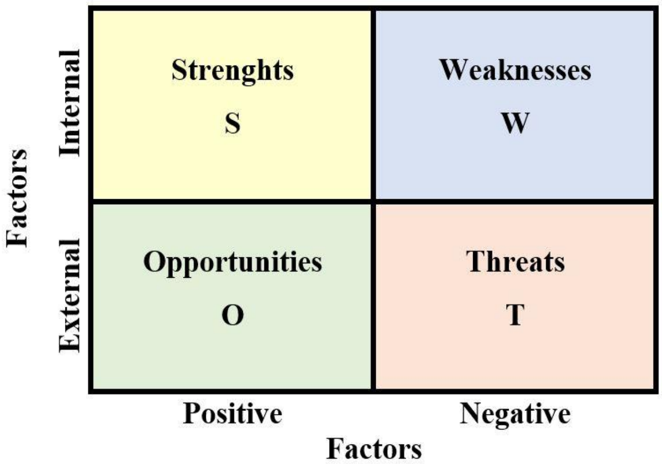

Figure 1. *Classification of factors in SWOT analysis [own study, based on: 41, 53]*

The subject features numerous modifications to the basic concept of SWOT analysis, which are a consequence of the differences in the authors' approaches regarding the essence, purpose and perspective of conducting research observations [41]. The most common modifications in practice include [53]:

- WOT's – up analysis. Arthur Sharplin in his book Strategic Management [54] is the first to use the concept of WOT's-up analysis. He emphasizes the importance of using Opportunities to minimize risk by identifying the organization's Weaknesses and Threats in its environment,

- TOWS analysis is a modification of the SWOT analysis proposed by Heinz Weihrich [55] and is mainly based on reversing the order of carrying out the analysis. According to him, in the process of formulating a company's strategy, one should first start with an analysis of the environment and then compare its results with the strengths and weaknesses of the organization,

- TOWS-SWOT analysis is the last of the mentioned types of SWOT analysis. It is a combination of TOWS analysis and SWOT analysis, i.e. conducting an analysis from the inside to the outside (SWOT) and from the outside to the inside (TOWS) [41,53].

The TOWS-SWOT analysis provides the opportunity not only to conduct a full assessment of the strengths and weaknesses of the examined facility (in the publication - the development of FHs) as well as the opportunities and threats occurring in the environment, which is also provided by the TOWS or SWOT analysis. It also allows one to examine how threats and opportunities occurring in the environment affect the strengths and weaknesses of the examined object (FHs), as well as whether the strengths and weaknesses of the research subject (FHs) allow one to take advantage of opportunities in the external environment and protect oneself against threats. The differences between SWOT, TOWS and TOWS-SWOT analysis are summarized in Table 2.

The two-way approach of the TOWS-SWOT analysis makes it more advantageous than the SWOT or TOWS analysis for examining issues where it is essential to consider the two-way impact, and such issues include the study [41] of the future of FHs in Poland.

Table 2. *List of differences between SWOT, TOWS and TOWS-SWOT analysis [own study, based on 41]*

Description of the feature	**SWOT**	**TOWS**	**TOWS-SWOT**
Relations			
Analysis of relationships between factors	One-way - from the inside to the outside	One-way - from outside to inside	Two-way - from inside to outside and from outside to inside
Calculations			
Number of cross plates	4	4	8
Summary table			
The number of data taken into account when selecting a scenario	8	8	16

3 Development of a FHs development strategy using the TOWS-SWOT method

The results of own research aimed at developing the concept of a strategy for the development of FHs in Poland using TOWS-SWOT analysis are presented below. A reverse order of analysis was proposed, involving first of all selecting factors for analysis using the scenario method and developing states of the surrounding scenarios (SSSs for short). Then, a strategy was developed for the most likely scenario using TOWS-SWOT analysis. A detailed methodological description of conducting the analysis using the reverse order scenario method and TOWS-SWOT analysis will be the subject of another publication.

3.1 Description of the research method – TOWS-SWOT

The general assumptions for conducting the TOWS-SWOT analysis can be characterized in 9 stages [41,43, 53,56-57]:

- stage 1 - characteristics of the facility subject to diagnosis and indication of the analysis purpose- in the case under consideration, proposing a concept of a strategy for the development of FHs in Poland,
- stage 2 - identifying as many factors as possible affecting the object and characterizing them,
- stage 3 – grouping factors into S/W/O/T sets – Figures 1-2,
- stage 4 – classification of factors into subgroups A, B, or C – Tables 5-8,
- stage 5 – development of strategic variants,
- stage 6 – assigning weights to factors,

- stage 7 – correlations between individual factors,
- stage 8 – carrying out calculations in cross tables,
- stage 9 – interpretation of the results and implementation of an appropriate action strategy.

3.2 Building a strategy – general assumptions

Based on the characteristics of the examined facility, its goals and identified conditions, possible strategic variants should be developed. Developing strategic variants, also known as building a strategy, is stage 5 of the TOWS-SWOT analysis. Preparing four possible strategies before starting the calculations (only based on the indicated factors) is intended to:

- eliminate the subconscious willingness to indicate the best strategy, which is a subjective assessment of the person preparing the analysis,
- eliminate the strong willingness to look for additional relations between unrelated factors by the assessment of the person preparing the analysis in order to indicate a specific strategy as appropriate.

The method of building four action strategies for TOWS-SWOT analysis is explained below [42, 57-58]:

- Aggressive/SO/maxi-maxi

Implemented if the strengths of the researched subject outweigh the weaknesses, and the related opportunities generated by the environment dominate over the threats. It involves maximizing the use of synergy between strengths and opportunities. It is a strategy of expansion and diversified development [43,58-59].

- Conservative/ST/maxi-mini

A strategy chosen when the strengths of the analyzed object outweigh the weaknesses, but negative external factors are stronger than opportunities in the environment. The use of strengths in unfavorable external conditions allows the facility to function, but limits the possibility of its development,

- Competitive/WO/mini-maxi

A facility where the weaknesses outweigh the strengths, and opportunities appear more often than threats in the environment. This means that it is possible to eliminate weaknesses and build competitive strength by making maximum use of development-friendly opportunities [43, 58-59],

- Defensywna/WT/mini-mini

A situation in which there are more threats than opportunities in the external environment and weaknesses dominate over strengths. In its pessimistic version, the mini-mini strategy boils down to abandoning the project or liquidating the organization. In an optimistic, modifying the project assumptions or abandoning and postponing it, and for the organization, merging with another one with a better market situation.

3.3 Input data for developing the strategy

In the standard TOWS-SWOT analysis procedure, as many factors affecting the facility as possible should be identified and characterized. In the presented research, individual factors were identified at an earlier stage, when developing scenarios for the future development of FHs in Poland using the SSSs method. The research was presented in publications: [21, 23-24]. The determinants were selected based on a literature review, survey, interview and own observations. During the research, 46 factors were identified, which were aggregated into 6 spheres and presented in Table 3.

Table 3. *List of macroenvironmental factors aggregated in individual spheres [own elaboration]*

Spheres	Factors
1 Demograficzna	1.1 Overcrowding in city centers

	1.2 Metropolisation processes
	1.3 Generational changes
2 Economic	2.1 Rent costs (maintenance of the facility) FHs
	2.2 FHs insurance
	2.3 City centre real estate prices
	2.4 Mortgages for construction or purchase of FHs
	2.5 Technical inspection costs of FHs
	2.6 Increasing affluence of society
3 Formal and legal	3.1. Ownership of land covered by water
	3.2. Permanent residence and registration obligation
	3.3. There is no legal definition of habitable water features
	3.4. No categorization of habitable water features
	3.5. Loopholes in the legislative process
	3.6. Inability to obtain a mortgage loan
	3.7. Spatial development of water areas
	3.8. Formal issues of mobility and use of FHs
4. Socio-cultural	4.1. Contact with nature
	4.2. Fashion
	4.3. A way to spend free time
	4.4. Sense of freedom
	4.5. Convictions and beliefs
	4.6. The construction industry
	4.7. Sense of prestige
	4.8. Watercraft traditions
5 Environmental	5.1 Revitalization of urban areas
	5.2 Monitoring the aquatic environment
	5.3 Uncontrolled expansion FHs
	5.4 Eco-friendly solutionsFHs
	5.5 Alternatives to land drainage
	5.6 Rising sea and ocean levels
	5.7 Rapid change in water levels
	5.8 Hydrological drought
	5.9 Surface water resources

	5.10 Protecting the land by moving cities to the water
6 Technical	6.1 Systemic nature of FHs projects
	6.2 Modern FHs solutions
	6.3 Installations and connections
	6.4 No need to conduct the construction process
	6.5 Technological progress in the shipbuilding industry
	6.6 There are no studies on combining individual FHs into larger groups of floating objects
	6.7 There are no studies on FHs floating systems
	6.8 Renovation of the FHs
	6.9 Possibility of FHs' sinking
	6.10 FHs durability
	6.11 Load- bearing capacity and stability of FHs

In accordance with the procedure presented in point 2.1, the factors collected in Table 3 were grouped into S/W/O/T sets and classified into subgroups A, B, or C. The assignment of factors with the appropriate subgroup presents:

- strengths – Table 4,
- weaknesses – Table 5,
- opportunities – Table 6,
- threats – Table 7.

Table 4. *Classifying the strengths of the development of FHs in Poland [own study]*

Scenario elements	**Factor type**
6.2 Modern FHs solutions	A
4.3 A way to spend free time	A
5.4 Eco-friendly solutionsFHs	A
6.1 Systemic nature of FHs projects	A
4.1 Contact with nature	A
4.2 Fashion	B
4.7 Sense of prestige	B
2.1 Rent costs (maintenance of the facility) FHs	B
5.10 Protecting the land by moving cities to the water	C/B
5.2 Monitoring the aquatic environment	C/B
4.4 Sense of freedom	C
6.5 Technological progress in the shipbuilding industry	C

6.4 No need to conduct the construction process	C

Tabela 5. *Classifying the weaknesses of the development of FHs in Poland [own study]*

Scenario elements	Factor type
6.3 Installations and connections	B/A
2.5 Technical inspection costs of FHs	B/A
5.3 Uncontrolled expansion FHs	C/B

Table 6. *Classifying development opportunities for FHs in Poland [own study]*

Scenario elements	Factor type
2.6 Increasing affluence of society	A
2.3 City centre real estate prices	A
4.5 Convictionsand beliefs	C/B
6.11 Load capacity and stability of FHs	C/B
4.8 Watercraft traditions	C/B
5.5 Alternatives to land drainage	C/B
5.8 Hydrological drought	C/B
6.10 FHs durability	C/B
5.6 Rising sea and ocean levels	C/B
5.9 Surface water resources	C/B
1.2 Metropolisation processes	C
5.1 Revitalization of urban areas	C
4.6 The construction industry	C
1.1 Overcrowding in city centers	C
1.3 Generational changes	C

Table 7. *Classifying threats to the development of FHs in Poland [own study]*

Scenario elements	Factor type
3.3 There is no legal definition of habitable water features	B/A
6.6 There are no studies on combining individual FHs into larger groups of floating objects	C/B
6.7 There are no studies on FHs floating systems	C/B
3.2 Permanent residence and registration obligation	C/B
3.4 No categorization of habitable water features	C/B
6.9 Possibility of drawning FHs	C/B

6.8 Renovation of the FHs	C/B
2.4 Mortgages for construction or purchase of FHs	C/B
3.5 Gaps in the legislative process	C/B
3.8 Formal issues of mobility and use of FHs	C/B
3.7 Spatial development of water areas	C/B
2.2 FHs insurance	C
3.1 Ownership of land covered by water	C
5.7 Rapid change in groundwater levels	C
3.6 Inability to obtain a mortgage loan	C

3.4 Development of strategic variants for the development of FHs in Poland

Based on the factors and their categories presented in Tables 5-8, 4 action strategies for the development of FHs in Poland were developed:

- Aggressive / SO/ maxi-maxi

An aggressive strategy involves maximizing the use of synergy between strengths and opportunities [53]. The strengths of the development of FHs are modern technical solutions (factor 6.2.) and system designs (6.1.) used in their construction. This is the result of the progress that has occurred in the shipbuilding industry in recent years (6.5.). Pro-ecological solutions (5.4.) not only allow greater contact with nature (4.1.) or gaining a sense of freedom (4.4.) through a new way of spending free time (4.3.), but also monitoring the water environment (5.2.). This type of housing is also supported by financial issues related to the relatively low costs of living in FHs compared to life on land (2.1.), but also by fashion (4.2.) and the sense of prestige (4.7.) of living in the very center. Another futuristic vision is the fact that through water construction we can protect the land by moving cities to the water (5.10.), treating the existing areas as agricultural or forested. It is also worth noting that living on water does not require a tedious and expensive construction process (6.4.).

Factors intended to reinforce the impact of strengths include opportunities seen in the phenomenon of overcrowding in city centers (1.1.), which is the effect of current metropolisation processes (1.2.). The increase in society's affluence (2.6.) and the revitalization of urban areas (5.1.) result in a significant increase in real estate prices in city centers (2.3.), which increases the attractiveness of life on the water. However, the ongoing generational changes (1.3.) will force changes in trends in the construction industry (4.6.), thanks to which alternative solutions for land drainage will become more and more popular (5.5.). Surface water resources (5.9.) will be better rationalized to minimize the phenomenon of hydrological drought (5.8.). While in other areas, a noticeable rise in sea and ocean levels (5.6.) will force greater emphasis on durability (6.10.) and the load-bearing capacity and stability of FHs (6.11.). Regardless of the region, consciously or less consciously, people strive to live by and on the water, this is related to convictions and beliefs (4.5.) rooted in human nature and watercraft traditions (4.8.), which are also present in Poland.

- Conservative / ST/ maxi-mini

A conservative strategy will occur when the development potential of FHs will have to be used in the event of unfavorable external factors.

Such a situation is the combination of benefits resulting from relatively low maintenance costs (2.1.) and the lack of the need to conduct the construction process (6.4.), which should balance the problems related to insurance (2.2.) and a mortgage for the construction or purchase of FHs (2.4.) and its renovation (6.8.). Undoubtedly, the biggest drawback is the formal and legal aspects, which include the ownership of land covered by water (3.1.), issues of permanent residence and registration obligation (3.2.), lack of legal definition (3.3) and lack of categorization of habitable water features (3.4.), loopholes in the legislative process (3.5.), inability to obtain a mortgage loan (3.6.), spatial development of water areas (3.7.) and formal issues of mobility and use of FHs (3.8.). The mentioned threats should be offset by the strengths of the development of FHs in Poland, which include contact with nature (4.1.), fashion (4.2.), a way of spending free time (4.3.), a sense of freedom (4.4.) and prestige (4.7.). The environmental sphere brings more benefits than threats, apart from eco-friendly solutions (5.4.), environmental monitoring (5.2.), water housing is a form of land protection by moving cities to water. The environmental concern is the issue of rapid changes in water levels (5.7.) in river beds related to flood matters. The occurrence of FHs as single objects creates an increased impression of the possibility of the object sinking (6.9.), which is intensified by the lack of research on combining floating objects (6.6.) with each other and on large-size floating systems (6.7.). However, the continuous dynamic technological progress in the shipbuilding industry (6.5.) and the systemic nature of projects (6.1.) increase the impression that it is only a matter of time.

- Competitive/ WO/ mini-maxi

A competitive strategy will be implemented when the weaknesses outweigh the strengths and opportunities in the environment will appear more often than threats [51]. The relatively small number of weaknesses in the development of FHs in Poland will be compensated by emerging opportunities. The high costs of technical inspections of FHs (2.5.) are compensated by real estate prices in city centers (2.3.) and the level of society's affluence (2.6.). The significant fear of uncontrolled expansion of FHs (5.3.) will be neutralized by the benefits of urban revitalization (5.1.), alternatives to land drainage for construction investments (5.5.), the need to eliminate the threat of sea and ocean level rise (5.6), and potential hydrological drought (5.8.) and shrinking surface water resources (5.9.). However, the lack of properly equipped hydrotechnical infrastructure in the form of installations and connections (6.3.) is less important than the need for durability (6.10.) and the load-bearing capacity and stability of FHs (6.11.). Determinants of the socio-cultural sphere, i.e. convictions and beliefs (4.5.), changes in trends in the construction industry (4.6.) and watercraft traditions (4.8.) along with the entire demographic sphere (overcrowding in city centers (1.1.), metropolisation processes (1.2.) and generational changes (1.3.) should be treated as additional advantages that should be used in building a competitive strategy.

- Defensive/ WT/ mini-mini

The defensive strategy will be implemented when the weaknesses outweigh the benefits resulting from the strengths of FHs development in the existing unfavorable external environment.

The development of FHs will be slowed down or stopped when a defensive strategy occurs by, among others: costs of technical inspections (2.5.), which will additionally discourage potential investors due to the cost of a mortgage for the construction or purchase of FHs (2.4.) and the inability to insure it (2.2.), which will turn out to be unprofitable compared to an apartment on land. The existing deficit of appropriate installations and connections making it possible to fully use a water facility suitable for habitation inhibits the creation of floating settlements. This is intensified by the lack of research on combining single FHs into larger groups of floating objects (6.6.) and the lack of research on large-size floating systems for residential buildings (6.7.), the existing risk of sinking (6.9.) and problems related to renovation (6.8.) of an inhabitable floating object. The greatest threat to the development of FHs is primarily formal and legal issues related to the lack of definition of FHs (3.3.), the obligation to report permanent residence and registration, which is impossible to implement on a floating facility (3.2.). (3.2.).

In addition, the lack of categorization of habitable water features (3.4.), loopholes in the legislative process (3.5.), issues related to the mobility and use of such facilities (3.8.), land ownership rights and the inability to obtain a mortgage loan (3.6.) may result in that not only will development be suspended, but the occurrence of such facilities in Polish water areas will even be banned. The last mentioned weakness is the fear of uncontrolled expansion (5.3.), which may happen in the near future if the situation is not regulated in any way, especially with the threat resulting from a rapid change in water levels in river beds (5.7.).

3.5 SWOT matrix

All information collected during the analysis should be placed in the SWOT matrix (Figure 2). For each of the fields of the S/W/O/T matrix, the factors were placed according to their weight, giving them an individual code, which consists of a letter denoting a specific field of the SWOT matrix and a number in order from the highest value of weight to the lowest. In the case of the same weight values, the order of factors was determined based on the probability of their occurrence. (The details of this procedure will be described in detail elsewhere in the authors' publication).

Code	Internal factors		Code	External factors	
	Weight	**Strengths**		**Weight**	**Opportunities**
S1	16.67	6.2 Modern FHs solutions	O1	26.64	2.6 Increasing affluence of society
S2	12.50	4.3 A way to spend free time	O2	20.00	2.3 City centre real estate prices
S3	12.50	5.4 Eco-friendly solutions FHs	O3	6.67	4.5 Convictions and beliefs
S4	12.50	6.1 Systemic nature of FHs projects	O4	6.67	6.11 Load- bearing capacity
S5	12.50	4.1 Contact with nature	O5	6.67	4.8 Watercraft traditions
S6	8.33	4.2 Fashion	O6	6.67	5.5 Alternatives to land drainage
S7	8.33	4.7 Sense of prestige	O7	6.67	5.8 Hydrological drought
S8	8.33	2.1 Rent costs (maintenance of the facility) FHs	O8	6.67	6.10 FHs durability
S9	4.17	5.10 Protecting the land by moving cities to the water	O9	6.67	5.6 Rising sea and ocean levels
S10	4.17	5.2 Monitoring the aquatic environment	O10	6.67	5.9 Surface water resources
Sum	**100%**		**Sum**	**100%**	

Code	Internal factors		Code	External factors	
	Weight	**Weaknesses**		**Weight**	**Threats**
W1	33.34	6.3. Installations and connections	T1	16.70	3.3 There is no legal definition of habitable water features
W2	33.33	2.5. Technical inspection costs of FHs	T2	8.33	6.6 There are no studies on combining individual FHs into larger groups of floating objects
W3	33.33	5.3. Uncontrolled expansion FHs	T3	8.33	6.7 There are no studies on FHs floating systems
			T4	8.33	3.2 Permanent residence and registration obligation
			T5	8.33	3.4 No categorization of habitable water features
			T6	8.33	6.9 Possibility of FHs' sinking
			T7	8.33	6.8 Renovation of the FHs
			T8	8.33	2.4 Mortgages for construction or purchase of FHs
			T9	8.33	3.5 Loopholes in the legislative process
			T10	8.33	3.8 Formal issues of mobility and use of FHs
			T11	8.33	3.7 Spatial development of water areas
Sum	**100%**		**Sum**	**100%**	

Figure 2. *SWOT analysis matrix for the development of FHs in Poland [own study]*

3.6 Indication of the development strategy for FHs in Poland

The last computational stage of the analysis is collecting individual sums of interactions and sums of products into Table 8. Summary of the results of the TOWS-SWOT analysis of the development of FHs on water in Poland. Then, read the appropriate items from the list to construct a matrix containing numerical data (Table 9). The highest value of the sums of products and sums of interactions indicates which of the four previously developed strategies should be implemented.

Table 8. *Summary of the results of the TOWS-SWOT analysis of the development of FHs on water in Poland [own study, based on 58]*

Combination	TOWS analysis results		Combination	SWOT analysis results		SWOT/TOWS summary	
	The sum of interactions	T he sum of products		The sum of interactions	The sum of products	The sum of interactions	The sum of products
O/S	**164**	**1793.96**	**S/O**	**258**	**2731.49**	**422**	**4525.45**
T/S	126	1170.85	S/T	122	1099.95	248	2270.80
O/W	28	666.61	W/O	18	380.00	46	1046.61
T/W	76	1599.94	W/T	35	243.80	111	1843.74

Table 9. *Selection of a strategy based on the results of the TOWS-SWOT analysis of the development of FHs on water in Poland [own study, based on 59]*

	Opportunities [O]	**Threats [T]**	
Strengths [S]	**Aggressive strategy**	Conservative strategy	
	422	248	The sum of numerous interactions
	4525.45	2270.80	The sum of the weighted number of interactions
Weaknesses [W]	Competitive strategy	Defensive strategy	
	46	111	The sum of numerous interactions
	1046.61	1843.74	The sum of the weighted number of interactions

4 Final conclusions

Based on the results obtained in preparing a strategy for the development of FHs in Poland, it can be concluded that the ultimate solution is to implement an aggressive strategy.

FHs should be promoted as system/modular modern houses that do not require any construction process. It is worth emphasizing a number of pro-ecological solutions being introduced that are used to monitor the condition of the water environment. In the era of society striving for work-life balance and the possibility of remote work, a Residential Floating Facility is not only a fuller contact with nature without leaving home, enhancing the sense of freedom and being a new form of spending free time, while also providing a fashionable and quite prestigious way of living in the very center of the city without having to incur high maintenance costs. Construction on water is a symbol of the reviving shipbuilding industry and an opportunity for a new form of urbanization.

Introducing FHs into the urban fabric will minimize the current metropolisation processes, i.e. gentrification of city centers and their overpopulation, resulting from the increase in society's affluence and the simultaneous increase in real estate prices in the very center. The ongoing generational changes force the construction industry to use solutions that move away from land drying and increase surface water resources and minimize hydrological drought.

The revitalization of urban water areas and the noticeable increase in sea and ocean levels will force greater emphasis on the durability, load-bearing capacity and stability of FHs. This is intensified by beliefs and convictions rooted in human nature and waterman traditions, which are also present in Poland.

At the same time, it should be emphasized that the above conclusions are formulated on the basis of the conducted analyses. We must always bear in mind that in Poland the culturally dominant type of housing construction is civil engineering, which has many years of tradition. Changing these habits is very difficult. Moreover, it should be remembered that the development of housing on the water may be difficult due to the unstable geopolitical situation, which may additionally generate difficulties in changing the approach to choosing the type of housing.

The main direction in the development of housing on water is the use of this type of facilities as private residential units. However, in the light of dynamic geopolitical changes, it is necessary to consider the possibility of using FHs, even to a limited extent (e.g. as floating hospitals [60-61]), as critical infrastructure facilities in the event of war [62-68].

Bibliography

[1] Zaremba, K. (2006, 27 kwietnia). *Co to jest Dom Na Wodzie?*. DomyNaWodzie.pl. http://www.domynawodzie.pl/dnw_co.html

[2] Gołębiewski, J. I. (2013). Rozwój idei zamieszkiwania w domu na wodzie w Polsce na tle doświadczeń wybranych państw europejskich. Czy mieszkanie na wodzie stanowi realną alternatywę dla tradycyjnych form zamieszkania w Polsce?. *Środowisko Mieszkaniowe*, *11*, 130-136.

[3] Kaźmierczak, I., i Zaremba, K. (2013). Paradoks budynków pływających. *Warunki Techniczne*, *2*, 57-61.

[4] Miszewska, E. (2013). Analiza możliwości lokalizacji DNW na przykładzie Gminy Miasta Gdańska. W M. Kuczera (Red.), *Młodzi Naukowcy dla Polskiej Nauki* (75-83). CREATIVETIME.

[5] Miszewska, E. (2014). Identyfikacja systemów cumowniczych MJP i konsekwencje wynikające z ich zastosowania. W M. Kuczera i K. Piech (Red.), *Dokonania Młodych Naukowców*, (579 – 582). CREATIVETIME.

[6] Miszewska, E. (2016). Modern Management Challenges of Floating Housing Development. *Real Estate Management and Valuation*, *24*(1), 31-40. https://doi.org/10.1515/remav-2016-0003

[7] Kuryłek, A. (2017). Aspekty prawne realizacji oraz rejestracji obiektów sytuowanych na wodzie. *Inżynieria Morska i Geotechnika*, *1*, 3-7.

[8] Miszewska, E. i Niedostatkiewicz, M. (2019a). Formalno-prawne uwarunkowania rozwoju mieszkalnictwa na wodzie w aspekcie mieszkalnych jednostek pływających. W N. Książek (Red.), *Materiałach konferencyjnych Ogólnopolskiej Konferencji – Problemy Techniczno-prawne utrzymania obiektów budowlanych*, (129-139). Główny Urząd Nadzoru Budowlanego.

[9] Miszewska, E. i Niedostatkiewicz, M. (2019b). Application of multi-criteria method to assess the usefulness of a hydrotechnical object for floating housing. *IOP Conf. Ser.: Mater. Sci. Eng.*, *660*, 1-9. https://dx.doi.org/10.1088/1757-899X/660/1/012015

[10] Ostrowska-Wawryniuk, K. i Piątek, Ł. (2020). Lightweight prefabricated floating buildings for shallow inland waters. Design and construction of the floating hotel apartment in Poland. *Journal of Water and Land Development*, *44*, 118-125. https://doi.org/10.24425/jwld.2019.127052

[11] Karczewski, A. i Piątek, Ł. (2020). The Influence of the Cuboid Float's Parameters on the Stability of a Floating Building. *Polish Maritime Research*, *27*(3), 16-21. https://doi.org/10.2478/pomr-2020-0042

[12] Karczewski, A. (2021). Towards an Understanding of the Stability Assessment of Floating Buildings. W Ł. Piątek, S. H. Lim, Ch. M. Wang, R. de Graaf-van Dinther (Red.), *WCFS2020*, (297-308). Springer. https://doi.org/10.1007/978-981-16-2256-4_18

[13] Nakajima, T., Saito, Y. i Umeyama, M. (2021). A Study on Stability of Floating Architecture and Its Design Methodology. W Ł. Piątek, S. H. Lim, Ch. M. Wang, R. de Graaf-van Dinther (Red.), *WCFS2020*, (273-296). Springer. https://doi.org/10.1007/978-981-16-2256-4_17

[14] Miszewska, E, Niedostatkiewicz M. i Wiśniewski, R. (2020a). The Selection of Anchoring System for Floating Houses by Means of AHP Method. *Buildings*, *10*(4), 1-17. https://doi.org/10.3390/buildings10040075

[15] Cole, V. J., Glasby, T.M. i Holloway, M.G. (2005). Extending the generality of ecological models to artificial floating habitats. *Marine Environmental Research*, *60*(2), 195-210. https://doi.org/10.1016/j.marenvres.2004.10.004

[16] English, E. C. (2009, 25-27 listopada). Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing. W UNESCOIHP and COST Action C22 (sponsored by) *Road Map Towards a Flood Resilient Urban Environment*. International Conference on Urban Flood Management, Paris.

[17] Liao, K. H., Le, T. A. i Nguyen, K. V. (2016). Urban Design Principles for Flood Resilience: Learning from the Ecological Wisdom of Living with Floods in the Vietnamese Mekong Delta. *Landscape and Urban Planning*, *155*: 69–78. https://doi.org/10.1016/j.landurbplan.2016.01.014

[18] English, E. C., Friedland, C. J. i Orooji, F. (2017). Combined Flood and Wind Mitigation for Hurricane Damage Prevention: Case for Amphibious Construction. *Journal of Structural Engineering*, *143*(6). https://doi.org/10.1061/(ASCE)ST.1943-541X.0001750

[19] de Lima, R., Boogaard, F. C. i Sazanow, W. (2020). Assessing the Influence of Floating Constructions on Water Quality and Ecology. W Ł. Piątek, S.H. Lim, Ch. M. Wang i R. de Graaf-van Dinther (Red.), *WCFS2020*, (397-406). Springer. https://doi.org/10.1007/978-981-16-2256-4_24

[20] de Lima, R., Paxinou, K., Boogaard, F. C. i Akkerman, O., Lin, F-Y. (2021). In-Situ Water Quality Observations under a Large-Scale Floating Solar Farm Using Sensors and Underwater Drones. *Sustainability*, *13*(11), 1-18. https://doi.org/10.3390/su13116421

[21] Miszewska, E, Niedostatkiewicz M. i Wiśniewski, R. (2021). Enviromental factors as the elements determing the development of floating homes. *Inżynieria Bezpieczeństwa Obiektów Antropogenicznych*, *4*, 41-51. https://doi.org/10.37105/iboa.124

[22] de Lima, de Graaf-van Dinther, R. E., Boogaard, F. C. (2022). Impacts of floating urbanization on water quality and aquatic ecosystems: a study based on in situ data and observations. Journal of Water and Climate Change, *13*(3), 1185–1203. https://doi.org/10.2166/wcc.2022.325

[23] Miszewska, E., Niedostatkiewicz, M., Wiśniewski, R. (2022). Analiza możliwości rozwoju Mieszkalnych Obiektów Pływających (MOP) w aspekcie czynników środowiskowych. *Przegląd Budowlany*, *1*, 50-55.

[24] Miszewska, E.; Niedostatkiewicz, M.; Wiśniewski, R. (2023). Sustainable Development of Water Housing Using the Example of Poland: An Analysis of Scenarios. *Sustainability*, *15*, 11368. https://doi.org/10.3390/su151411368

[25] Flesche, F. i Burchard, C. (2005). *Water house*. Prestel.

[26] Pasternack, R. (2009, 8 maja). *Aquatecture: Water-based Architecture in the Netherlands.* Yumpu.com. https://www.yumpu.com/en/document/read/4620941/1-aquatecture-water-based-architecture-in-the-netherlands-

[27] Bogdanowicz, M. (2022). Bezpieczna budowa obiektów pływających. *Pomorski Inżynier*, (6-7)

[28] PRS. (n.d.). Charakterystyka i zakres działalności PRS. https://www.prs.pl/o-nas/charakter-i-zakres-dzialalnosci-prs

[29] PRS. (2020, 1 października) *Przepisy klasyfikacji i budowy stacjonarnych obiektów pływajacych*. https://www.prs.pl/uploads/sop.pdf

[30] Ustawa z dnia 7 lipca 1994 r. - Prawo budowlane (Dz.U. 1994 Nr 89 poz. 414.)

[31] Ustawa z dnia 24 sierpnia 1991 r. o ochronie przecipożarowej (Dz.U. 1991 Nr 81 poz.351)

[32] Ustawa z dnia 21 grudnia 2000 r. o dozorze technicznym (Dz.U. 2000 Nr 122 poz. 1321)

[33] Ustawa z dnia 23 lipca 2003 r. o ochronie zabytków i opiece nad zabytakami (Dz.U. 2003 Nr 162 poz. 1568)

[34] Ustawa z dnia 27 kwietnia 2001 r. - Prawo ochrony środowiska (Dz.U. 2001 Nr 62 poz. 627)

[35] Rozporządzenie Ministra Infrastruktury z dnia 12 kwietnia 2002 r. w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie Warunki jakim powinny odpowiadać budynki i ich usytuowanie (Dz.U. 2002 nr 75 poz. 690)

[36] Baryłka, A. (2016). Wymagania techniczno-prawne w zakresie eksploatacyjnego procesu budowlanego. *Chłodnictwo*, *11*. https://doi.org/10.15199/8.2016.11.5

[37] Baryłka A. (20016). Zagadnienie oddawania obiektów budowlanych do użytkowania. *Inżynieria Bezpieczeństwa Obiektów Antropogenicznych*, *3*, 24-28.

[38] Baryłka, J. i Baryłka, A. (2016). *Eksploatacja obiektów budowlanych. Poradnik dla właścicieli i zarządców nieruchomości*. Wydawnictwo CRB.

[39] Substyk, M. (2012). *Utrzymanie i kontrola okresowa obiektów budowlanych*. Wydawnictwo ODDK.

[40] Baranowski, W. (2000). *Zużycie obiektów budowlanych*. Wydawnictwo Warszawskiego Centrum Postępu Techniczno - Organizacyjnego Budownictwa, Ośrodek Szkolenia WACETOB sp. z o.o..

[41] Miszewska, E. i Niedostatkiewicz, M. (2020b). Dobór analizy strategicznej przedsięwzięć budowlanych w aspekcie zrównoważonego rozwoju. *Przegląd Budowlany*, *91*(6), 21-25.

[42] Pierścionek, Z. (2012). *Zarządzanie strategiczne w przedsiębiorstwie*. Wydawnictwo Naukowe PWN.

[43] Gierszewska, G. i Romanowska M. (2009). *Analiza strategiczna przedsiębiorstwa. Wydanie IV zmienione*. Polskie Wydawnictwo Ekonomiczne.

[44] Kałkowska, J., Pawłowski, E., Trzcielińska, J., Trzcieliński S. i Włodarkiewicz-Klimek H. (2010). *Zarządzanie strategiczne. Metody analizy strategicznej z przykładami*. Wydawnictwo Politechniki Poznańskiej.

[45] Trzcielińska, J. (2013). Metody analizy strategicznej jako narzędzie identyfikacji okazji. W Trzcieliński, S. (Red.), *Wybrane problemy zarządzania. Teraźniejszość i przyszłość.* (189 – 202). Wydawnictwo Politechniki Poznańskiej.

[46] Plebankiewicz, E., Zima, K., Wieczorek, D. (2019). Original Model for Estimating the Whole Life Costs of Buildings and its Verification. *Archives of Civil Engineering*, *LXV*(2), (165–179). https://doi.org/10.2478/ace2019-0026

[47] Grzyl, B., Miszewska, E., Apollo M. (2017). The life cycle cost of a building from the point of view of environmental criteria of selecting the most beneficial offer in the area of competitive tendering. *E3S Web of Conferences*, *17*(28), (1–8), https://doi.org/10.1051/e3sconf/20171700028

[48] Rogalska, M., Szewczak, D. (2019). Analysis of the Cost of a Building's Life Cycle in a Probabilistic Approach. *Open Engineering*, *9*(1), (129–133), https://doi.org/10.1515/eng-2019-0015

[49] Isikdag, U., Zlatanova, S. (2009). A SWOT analysis on the implementation of Buil ding Information Models with in the Geospatial Environment. W Krek A., Rumor M., Zlatanova S., Fendel E. M. (Red.), *Urban and Regional Data Management*. (15-30). Taylor & Fran cis Group.

[50] Zima, K., Plebankiewicz, E., Wieczorek, D. (2020). A SWOT Analysis of the Use of BIM Technology in the Polish Construction Industry. *Buildings*, *10*(1), (1–13). https://doi.org/10.3390/buildings10010016

[51] Miszewska, E., Bolt, A., Apollo, M. (2018). A role of an Enterprise Identifica tion Card in a building process of water tourist investments. *E3S Web of Conferences*, *63*(1), (1–6). https://doi.org/10.1051/e3sconf/20186300001

[52] Larsen, I. L., Terjesen, O., Thorstensen, R. T., Kanstad, T. (2019). Use of Concrete for Road Infrastructure: A SWOT Analysis Related to the three Catchwords Sustainability, Industrialisation and Digitalisation. *Nordic Concrete Research*, 60(1), (31–50), https://doi.org/10.2478/ncr-2019-0007

[53] Nowicki, M. (2015). SWOT. W Szymańska, K. (Red.), *Kompendium metod i technik zarządzania. Teoria i ćwiczenia.* (325-354). Oficyna a Wolters Kluwer business.

[54] Sharplin, A. D. (1985). *Strategic Management*. McGraw Hill Higher Education.

[55] Weihrich, H. (1982). The TOWS matrix-A tool for situational analysis. *Long Range Planning*, *15*(2), 54-66. https://doi.org/10.1016/0024-6301(82)90120-0

[56] Homa, S., Piatkowski, Z., Wójcik-Kośla, D. (2005). W Duchniewicz, S. (Red.), *Metody organizacji i zarządzania; teoria i praktyka* (93). Wydawnictwo Menadżerskie PTM.

[57] Analiza SWOT, (n.d.). Zasady analizy. analiza-swot.pl. http://analiza-swot.pl/dowedz-się-o-swot/zasady-analizy

[58] Klasik, A. (1993) Studia prospektywne i analiza strategiczna. W Klasik, A. (Red.), *Planowanie strategiczne* (111-112). Polskie Wydawnictwo Ekonomiczne.

[59] Obłój, K. (2007). *Strategia organizacji*. Polskie Wydawnictwo Ekonomiczne.

[60] Kiszniewski, A. (2020, 17 października). Okręty typu Mercy - pływające szpitale z tysiącem łóżek. Komputerswiat.pl. https://www.onet.pl/?utm_source=r.search.yahoo.com_viasg_komputerswiat&utm_medium=referal&utm_campaign=leo_automatic&pid=51b4b25d-2b5d-5546-9911-cafa27fd8d4a&sid=07372b08-f780-4b33-9df9-1b765bfb7d0f&utm_v=2

[61] Geekweek (2020, 31 marca). Zobaczcie, jak wyglądają latające i pływające szpitale do walki z CoVID-19 (film). Medycyna. https://geekweek.interia.pl/medycyna/news-zobaczcie-jak-wygladaja-latajace-i-plywajace-szpitale-do-wal,nId,5545505#utm_source=paste&utm_medium=paste&utm_campaign=chrome

[62] Lidawa, W., Krzeszowski, W., Więcek, W., Kamiński, P. (2012). *Ochrona infrastruktury krytycznej*. Wydawnictwo Akademi Obrony Narodowej.

[63] Radziejewski, R. (2013). Infrastruktura a bezpieczeństwo. *Zeszyty Naukowe AON*, *3*(92), (249-267).

[64] Baryłka, A. (2016). Obiekty budowlane niezbędne na cele bezpieczeństwa i obronności państwa (cz. 1). *Przegląd Techniczny: Gazeta Inżynierska*, *22-23*, (23-26).

[65] Baryłka, A. (2016). Obiekty budowlane niezbędne na cele bezpieczeństwa i obronności państwa (cz. II). *Przegląd Techniczny: Gazeta Inżynierska*, *25-26*, (24-26).

[66] Milewski, J. (2016). Identyfikacja infrastruktury krytycznej i jej zagrożeń. *Zeszyty Naukowe AON*, *4*(105), (99-115).

[67] Baryłka, A. (2017). Zagadnienie obiektów budowlanych niezbędnych na cele bezpieczeństwa i obronności państwa w przepisach prawa budowlanego. *Przegląd Techniczny: Gazeta Inżynierska*, *2-3*, (32-34).

[68] Baryłka, A., Kulesa, A., Obolewicz, J. (2023). Introduction to the issues of engineering of anthropogenic objects of state security infrastructure. *Inżynieria Bezpieczeństwa Obiektów Antropogenicznych, 3,* (15-29). https://doi.org/10.37105/iboa.178