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RESEARCH ARTICLE

A modular boat concept as a response to marina berth scarcity: A two-phase qualitative consumer study

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ABSTRACT

Türkiye possesses extensive coastlines along the Aegean, Mediterranean, and Black Sea, yet recreational boat ownership among domestic users remains limited. Marina berth scarcity and high mooring costs constitute documented structural barriers to boat ownership, while storage and transportation constraints further suppress participation in recreational boating. This study aims to identify the product requirements of a portable, easily storable, affordable, and simple-to-build do-it-yourself (DIY) boat concept for potential recreational boaters in Türkiye. An iterative two-phase qualitative research design was employed: twelve semi-structured interviews were conducted prior to prototype construction (Phase 1), and six interviews were conducted following prototype exposure (Phase 2). Interview transcripts were analyzed using MAXQDA, yielding 551 coded segments across eight thematic codes. Co-occurrence analysis reveals that usage purpose alignment is the primary determinant of product acceptance, while portability, storability, and safety are unanimously positive attributes with no association with rejection. Price is predominantly a positive factor, and consumer heterogeneity in propulsion and configuration preferences provides empirical support for a modular design approach. The findings offer an empirical foundation for the development of a DIY boat concept as a practical response to the structural barriers constraining recreational boat ownership in Türkiye.

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Introduction

Türkiye is a maritime nation with approximately 8,333 km of coastline spanning the Aegean, Mediterranean, and Black Sea (Filimon, 2023). The country has historically positioned nautical tourism as a strategic sector, and its coastal waters attract both domestic and international recreational boaters. Despite this geographic endowment and the existence of established maritime education and training infrastructure, recreational boat ownership among ordinary Turkish citizens remains substantially lower than the country's maritime potential would suggest. Research on amateur boating interest in Türkiye indicates that while enthusiasm for maritime activities exists among the general public, actual boat ownership rates are constrained by a combination of structural, economic, and logistical factors (Mazmanoğlu & Altınağaç, 2020).

Two barriers stand out as particularly consequential. First, marina berth availability is limited relative to demand: reported marina counts in Türkiye range from 26 to 49 depending on source and classification criteria, and demand forecasting studies project that yacht berthing demand will continue to intensify through 2030 (Kovačić & Favro, 2014; Akar et al., 2022). This trajectory mirrors a broader Mediterranean pattern in which berth demand structurally exceeds supply in peak seasons and high-demand locations (Silveira et al., 2018). Fishermen in Turkish harbors have reported difficulties in securing mooring space (Çekiç et al., 2020), and discussions on amateur boating forums suggest that recreational boat owners experience similar challenges (Gezginkorsan, 2025). Second, the cost of mooring and marina services represents a significant financial burden. High and rising mooring fees have been documented in Turkish marinas (Gürbüz, 2024), and the recreational boating literature consistently identifies price as a central determinant of participation decisions (Marušić et al., 2020; Pintér et al., 2021).

For prospective boat owners who cannot secure or afford a permanent marina berth, the only practical alternative is to store and transport a small craft on land, a solution that in turn requires adequate storage space, a vehicle capable of towing or carrying the boat, and access to a launch ramp. These additional requirements further narrow the population for whom conventional boat ownership is feasible. A boat that can be disassembled, stored at home without dedicated facilities, transported on a standard passenger vehicle, and reassembled at any waterfront without a ramp would circumvent the marina berth dependency entirely, and if such a boat could also be built by the owner from affordable materials using accessible plans or a kit, it would address the cost barrier simultaneously.

DIY and self-build boat construction represents a globally practiced approach to recreational craft acquisition that can substantially reduce the financial barriers to boat ownership (Brahan et al., 2023). The growth of online communities, video-based instruction, and accessible plywood construction methods has lowered informational barriers to amateur boatbuilding, and several established designs, including the Chameleon Nesting Dinghy and the Tryst 10 trimaran, demonstrate the feasibility of portable, storable, self-built small craft. However, Türkiye-specific research on the consumer requirements for such a concept, what Turkish recreational boaters actually need from a portable, storable, affordable, and simple-to-build boat, has not previously been conducted.

This study aims to identify the product requirements of a portable, easily storable, affordable, and simple-to-build DIY boat concept for potential recreational boaters in Türkiye, where both the scarcity of marina berths and the high cost of mooring fees constitute significant barriers to boat ownership. To this end, an iterative two-phase qualitative research design was employed, combining semi-structured interviews with potential users prior to and following the construction of a physical prototype. Thematic coding and co-occurrence analysis of 551 coded segments from eighteen interviews provide an empirical picture of the consumer needs, product preferences, and acceptance determinants relevant to this concept in the Turkish context.

Literature Review

Previous research relevant to this study is examined below under four headings: recreational boating barriers in Türkiye, DIY boat construction, consumer-needs identification in NPD, and modular product design.

Recreational Boating in Türkiye: Infrastructure and Participation Barriers

Türkiye possesses a coastline of approximately 8,333 km spanning the Aegean, Mediterranean, and Black Sea coasts, providing substantial geographic potential for recreational boating and nautical tourism (Filimon, 2023). Despite this potential, the development of recreational boating as a mass leisure activity among domestic participants remains limited. Research on amateur boating interest in Türkiye indicates that while enthusiasm for maritime activities exists among the general public, actual boat ownership rates are constrained by a

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combination of structural, economic, and regulatory factors (Mazmanoğlu & Altınağaç, 2020).

Marina berth availability constitutes one of the most significant structural barriers to recreational boat ownership in Türkiye. Although the number of operational marinas has grown in recent decades, reported counts differ substantially across sources, ranging from 26 to 49 depending on the classification criteria and date of measurement, reflecting both the pace of development and the absence of a harmonized, longitudinal berth-capacity database in the peer-reviewed literature (Kovačić & Favro, 2014; Filimon, 2023). Demand forecasting studies project that yacht berthing demand in Türkiye will continue to intensify through 2030, suggesting that without proportionate capacity expansion, berth scarcity risk will become an increasingly binding constraint (Akar et al., 2022). This trajectory mirrors a broader Mediterranean pattern in which demand for marina berths structurally exceeds supply in peak seasons and high-demand locations (Oehmichen & Bourdais, 2007; Silveira et al., 2020).

Fishermen in Turkish harbors have similarly reported difficulties in securing mooring space, a problem that extends beyond professional use to affect amateur maritime participation more broadly (Çekiç et al., 2020). Risk assessments of local fishing ports similarly document structural and administrative deficiencies in Türkiye's small-craft shore infrastructure (Akar & Demirci, 2023). Amateur boating forums in Türkiye reflect ongoing public discussion of the same issue, suggesting that berth scarcity is perceived as a practical obstacle at the consumer level (Gezginkorsan, 2025).

Beyond physical scarcity, the cost of mooring and marina services represents a second major barrier. While comparative Mediterranean analyses suggest that Turkish marinas are relatively price-competitive internationally, particularly in terms of supplementary taxes on leisure craft in Turkish waters (Kovačić et al., 2013; Vukić et al., 2018), international price competitiveness does not preclude affordability constraints for domestic participants. Recreational boating is widely characterized in the nautical tourism literature as an inherently expensive leisure activity, and price along with berth availability consistently ranks among the primary determinants of marina choice (Marušić et al., 2020). High and rising mooring fees have been reported in Turkish marinas and represent a direct economic burden for potential boat owners (Gürbüz, 2024). Research further indicates that cost pressures can alter participation patterns, for instance, shifting demand from ownership toward charter models (Kaluđerović, 2019), and that high costs are associated with an aging participant base and reduced entry among younger cohorts in comparable boating markets (Pintér et al., 2021).

The storage of small recreational craft presents an additional challenge in the Turkish context. Trailering and road-launching arrangements require vehicle towing equipment and access to launch ramps, both of which impose additional costs and logistical burdens on prospective boat owners. In the absence of affordable and accessible berthing, portability and onshore storability emerge as functional prerequisites for a recreational boat concept targeting domestic participants.

Taken together, the literature identifies a clear structural problem: Türkiye has the geographic and cultural conditions for a larger recreational boating sector, yet berth scarcity, high mooring costs, and storage constraints combine to suppress boat ownership among the general population. Türkiye-specific peer-reviewed research that directly measures domestic participation barriers at the consumer level remains limited (Kovačić et al., 2013; Akar et al., 2022). Against this backdrop, the present study investigates the product requirements of a portable, storable DIY boat concept as a practical response to the berth scarcity and mooring cost constraints facing recreational boaters in Türkiye.

DIY and Self-Build Boat Construction

DIY and self-build boat construction represents a globally practiced approach to recreational craft acquisition that can substantially reduce the financial barriers to boat ownership. By building from plans or kits rather than purchasing a finished vessel, prospective boat owners can potentially obtain a functional craft at a fraction of the retail cost of comparable manufactured alternatives (Brahan et al., 2023).

The peer-reviewed literature on DIY boatbuilding as a consumer pathway is relatively sparse compared with broader nautical tourism scholarship. When it appears, it tends to emerge from adjacent domains, heritage and ethnographic studies of artisanal boatbuilding, maritime education research, and coastal sociology, rather than from a concentrated body of work on home boatbuilding as a participation mechanism (Rennu et al., 2018; Cooper et al., 2022). Studies in these areas identify social, educational, and community motivations as important drivers of participation in self-build craft activities alongside cost considerations, suggesting that DIY boatbuilding appeals to participants seeking experiential knowledge, craft engagement, and community connection as well as economic benefit (Rennu et al., 2018; Praça, 2021).

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The accessibility of self-build approaches depends critically on the availability of comprehensible plans, affordable materials, and supporting knowledge infrastructure such as tutorial videos, forums, and workshop facilities (Cooper et al., 2022; Brahan et al., 2023). The growth of online communities and video-based instruction has substantially lowered informational barriers to amateur boatbuilding in recent years, enabling geographically dispersed builders to access technical guidance and peer support. Several established DIY boat designs, including the Chameleon Nesting Dinghy and the Tryst 10 trimaran, are specifically designed for amateur construction from widely available sheet materials such as plywood, with construction processes documented through publicly accessible plans and video resources (Duo, 2016; Tryst 10 Trimaran, 2020; Chameleon Nesting Dinghy, 2024).

Despite these developments, Türkiye-specific peer-reviewed research on DIY boat construction as a participation pathway is essentially absent. The Turkish maritime literature addresses infrastructure planning, yacht tourism demand, and marina economics but does not examine self-build approaches as a strategy for expanding domestic recreational boating participation (Kovačić et al., 2013; Akar et al., 2022). Consumer perceptions of non-owners regarding yachts and small craft in Türkiye indicate high perceived cost barriers to conventional ownership (Aydın, 2023), suggesting potential interest in lower-cost alternatives, but empirical investigation of DIY boat preferences and requirements among Turkish consumers has not previously been conducted. The present study addresses this gap directly.

Identifying Consumer Needs in New Product Development

NPD scholarship consistently identifies the accurate identification of consumer needs as a primary determinant of product success. Research indicates that products which solve customer problems more effectively than competing alternatives demonstrate higher survival rates in the market, underscoring the strategic importance of need elicitation at the early stages of the development process (Kahn et al., 2013). The failure to adequately capture and translate consumer requirements into product design specifications is correspondingly associated with elevated new product failure rates (Altuğ, 2017).

The Voice of the Customer (VOC) framework provides the dominant conceptual structure for consumer needs elicitation in NPD. VOC refers to the set of customer needs and requirements that should drive design decisions, and its systematic collection and translation into engineering or product specifications, for instance through Quality Function Deployment (QFD), is treated as a foundational practice in the NPD literature (Veryzer & Borja de Mozota, 2005; Violante et al., 2015; Macnamara, 2020). The relationship between marketing and engineering functions in NPD has also been identified as a critical dimension of new product success, with effective cross-functional integration of consumer insight and technical capability associated with better development outcomes (Souder et al., 1998).

Within the range of available VOC elicitation methods, in-depth individual interviews have been consistently identified as particularly effective for uncovering latent and context-specific consumer needs. Individual interviews are argued to be superior to group methods such as focus groups for ideation and early-stage requirement generation, because they enable deeper exploration of individual experiences, preferences, and unarticulated needs without the conformity effects that can suppress divergent responses in group settings (Schirr, 2012). Semi-structured interviews are widely employed in NPD research to collect rich, contextually grounded VOC data that can be systematically analyzed and translated into product requirements (Vinayak & Kodali, 2014; Melander, 2019; Holub-Iwan et al., 2021). In the recreational craft context specifically, design methodology research emphasizes that user preferences determine vessel type and main dimensions from the earliest phases of design, alongside engineering requirements (Turan, 2023).

Qualitative methods more broadly, including ethnography, case studies, and grounded theory, are recognized as productive approaches for discovering latent needs and understanding use contexts in ways that are not accessible through purely quantitative techniques (Page & Schirr, 2008). The iterative use of qualitative methods across multiple stages of the NPD process, including prototype evaluation as well as initial need elicitation, supports progressive refinement of product requirements as design concepts become tangible (Driessen & Hillebrand, 2012).

The present study applies a two-stage qualitative interview design informed by these methodological principles. Initial interviews were conducted to elicit consumer needs prior to prototype development, and a second round of interviews was conducted following prototype construction to evaluate responses to a physical product and refine the understanding of consumer requirements. This iterative approach aligns with established VOC practice and enables both the identification of

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initial needs and the assessment of how physical realization shapes and deepens consumer articulation of requirements.

Modular Product Design and Consumer Heterogeneity

Modular product design refers to the development of products composed of independent, interchangeable components that can be configured, combined, or reconfigured to meet varying user needs (Bardakçı, 2004; Ayık, 2019). As a product architecture strategy, modularity has been examined in both engineering and marketing literatures as a mechanism for reconciling production efficiency with the demands of heterogeneous consumer populations.

The NPD and operations management literature identifies consumer heterogeneity, variation in user needs, use contexts, and preferences, as a primary condition under which modular architectures create market value. When users differ substantially in their requirements, a modular product that can be configured in multiple ways offers a means of serving diverse needs without the cost of producing entirely distinct products for each segment (Kamrad et al., 2017). Modular designs further enable postponement strategies in which variety is created closer to the point of use, reducing inventory exposure and improving responsiveness to demand variation (Appelqvist & Gubi, 2005). Research on mass customization approaches links higher modularity levels to positive demand responses when market sensitivity to configurability is sufficiently strong, while also noting that modularity can involve performance or cost tradeoffs that make integral architectures preferable in some contexts (Guo & Liu, 2019).

From a consumer acceptance perspective, modularity functions not only as an engineering property but as a perceived product attribute that can enhance value when it aligns with user expectations for customization and adaptability. Research on modular product platforms demonstrates that consumer perception of modularization value is positively associated with overall product value perception, and that this relationship can be mediated by platform service ecosystems (Tang & Inoue, 2021). Studies of modular design in circular economy contexts further indicate that willingness to adopt modular products is shaped by consumer values, awareness of product benefits, and normative considerations, with acceptance varying across cultural and national contexts (Gomes et al., 2022).

In the recreational boating context, modularity addresses a specific challenge identified in Turkish consumer research: potential users differ substantially in their preferences for propulsion (rowing, motor, sail), hull configuration (monohull versus trimaran), and boarding capacity, while sharing common constraints related to storage space and transportation. A modular boat design that can be assembled in multiple configurations, monohull or trimaran, with or without outriggers, with adjustable freeboard, enables a single core product to respond to this heterogeneity. Comparable approaches are already present in the international DIY boat market: the Tryst 10, for example, is designed to be built as either a solo monohull (Duo) or a trimaran depending on user preference (Tryst 10 Trimaran, 2020). The present study empirically examines the consumer need dimensions that motivate a modular approach in the Turkish context.

Taken together, these four bodies of literature define both the problem this study addresses and the approach it adopts. The first establishes the problem: berth scarcity, high mooring costs, and storage constraints suppress recreational boat ownership in Türkiye. The second identifies a candidate response, self-build, DIY construction, that can lower cost and storage barriers but whose consumer requirements have not been examined in the Turkish context. The third supplies the method for examining those requirements: NPD theory, and the Voice of the Customer tradition in particular, treats early, interview-based elicitation of consumer needs as a primary determinant of product success. The fourth provides the design principle for responding to the heterogeneous needs such elicitation typically reveals: modular architecture creates value precisely when users differ in their requirements. The present study connects these strands by using a two-phase, interview-based design to elicit potential Turkish users' requirements for a low-cost, storable, self-built boat, and by interpreting the resulting heterogeneity as the empirical justification for a modular concept.

Material and Methods

Research Design

This study employs a qualitative, exploratory research design to identify the product requirements of a portable, storable, DIY boat concept for potential recreational boaters in Türkiye. The research process began with a review of existing small boat models in order to map the solution space and contextualize the design challenge. Four principal categories of space-saving small craft were identified and reviewed: inflatable designs, compact designs, nesting designs, and collapsible designs. This review informed the subsequent consumer research by establishing the range of existing approaches to the portability and storage problem, and by providing reference

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models for discussion during participant interviews. The overall research process is illustrated in Figure 1.

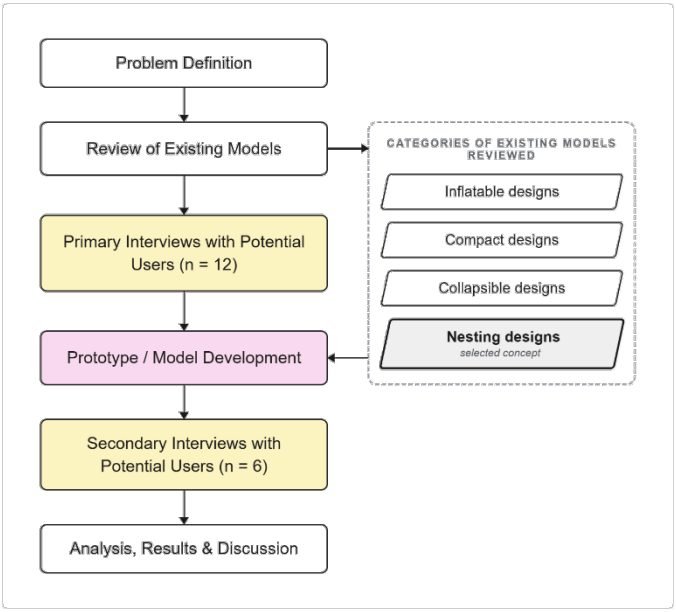


Figure 1. Research process flowchart

Following the existing model review, the study is structured in two sequential phases of face-to-face semi-structured interviews with potential users. This iterative design reflects established practice in Voice of the Customer (VOC) research, in which consumer needs are elicited both prior to and following the development of a physical prototype, enabling progressive refinement of product requirements as the concept becomes tangible (Schirr, 2012; Melander, 2019). A summary of the two interview phases is provided in Table 1.

Participant Selection

Participants were selected through purposive sampling. Eligibility criteria required that participants be potential consumers of a small recreational boat, defined as individuals who currently own a coastal fishing vessel, previously owned a boat, or have expressed an interest in recreational sea activities. This criterion was applied to ensure that participants possessed sufficient experiential context to meaningfully evaluate the product concept and articulate relevant needs. All interviews were conducted face-to-face.

A total of eighteen participants were interviewed across the two phases (Phase 1: n = 12; Phase 2: n = 6). Participants were recruited from the coastal region of İzmir, Türkiye, an area with an active recreational boating culture and direct relevance to the marina berth scarcity problem motivating the study. Participants varied in age and occupational background, and all met the eligibility criteria of prior boat ownership or active interest in recreational sea activities. All participants provided verbal informed consent for audio recording, transcription, and analysis of their responses prior to the commencement of each interview.

Data Collection

Data were collected using a semi-structured interview protocol consisting of twelve questions (Table 2). The protocol was designed to cover key dimensions relevant to product requirements: overall product evaluation, perceived need satisfaction, ease of use, purchase intention, price willingness, safety perceptions, and suggestions for improvement. Questions 9 and 10 addressed specifically the trimaran configuration, allowing the research team to assess consumer response to the stability-enhancing design option.

In Phase 1, participants were interviewed without prior exposure to a physical prototype. In Phase 2, participants were shown the physical first prototype and, where applicable, a 1:10 scale cardboard model of the revised design along with prototype construction videos, providing concrete referents for evaluation. This approach enabled assessment of how physical realization shapes consumer articulation of needs and preferences.

All interviews were audio-recorded with participant consent and subsequently transcribed verbatim. To support the interview process, a training video demonstrating the boat construction process and an example online forum were prepared and shared with Phase 2 participants, reflecting the envisaged customer support infrastructure for the proposed product concept.

Table 1. Overview of interview phases

Interview Phase	n	Timing	Purpose
Phase 1 — Primary Interviews	12	Prior to prototype construction	Elicit initial consumer needs and product requirements
Phase 2 — Secondary Interviews	6	Following prototype construction	Evaluate prototype; refine and deepen requirements
Total	18		551 coded segments across 8 codes

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Monetary amounts are reported in Turkish Lira (TRY) as stated by participants and, for international comparability, also in US dollars (USD), converted at the July 2025 exchange rate (1 USD ≈ 40.2 TRY).

Table 2. Semi-structured interview questions

No.	Interview Question
1	What do you think about this product?
2	Do you think this product meets your needs?
3	Do you think this product would be easy to use?
4	Do you have any suggestions for making this product easier to use?
5	Would you prefer to purchase this product?
6	Do you think training videos and forum-based customer support would be sufficient to build this product?
7	How much would you pay for this product?
8	What factors would be important in your purchase decision?
9	Did you know that trimarans are among the most stable boat types?
10	If this product were a trimaran usable with both motor and sail, would you consider purchasing it?
11	Do you have any other suggestions regarding the product?
12	Would you recommend this product to others?

Data Analysis

Interview transcripts were analyzed using MAXQDA Analytics Pro (Version 26.1.0), a dedicated qualitative data analysis software package. A thematic coding approach was applied, in which segments of participant speech were assigned one or more codes from a codebook developed iteratively during the initial review of transcripts. The final codebook comprised eight codes: Usage Purpose, Price, Buildability, Portability, Storage, Safety, Favored, and Against. Coding was applied across both phases of data collection, enabling frequency comparison between Phase 1 and Phase 2 segments. All coding was performed by a single researcher (the second author). Consistency was promoted through the iterative development of the codebook during the initial review of transcripts and its uniform application across both phases; as coding was not conducted independently by multiple researchers, inter-coder reliability statistics such as Cohen's kappa are not applicable, and this is acknowledged as a limitation in this study.

A total of 551 coded segments were identified across all transcripts (Phase 1: 151 segments; Phase 2: 400 segments). Co-occurrence analysis, an established MAXQDA procedure for examining how codes relate within coded segments (Kuckartz & Rädiker, 2019), was conducted to examine relationships between codes within individual segments, identifying which themes frequently appeared together and the directionality of those associations relative to product acceptance (Favored) or rejection (Against).

The research was conducted in accordance with the ethical procedures applicable to studies involving human participants at Dokuz Eylül University. All participants provided informed consent prior to data collection.

Prototype Development

Following Phase 1 data collection, the research team designed and constructed a physical prototype of the proposed boat concept. The prototype was developed as an amateur concept design drawing on the construction principles of established small DIY boats, including the Portuguese Style Fishing Dinghy (Vartiala, 2003), the Chameleon Nesting Dinghy (Chameleon Nesting Dinghy, 2024), and the Tryst 10 trimaran (Tryst 10 Trimaran, 2020). The prototype incorporated a flat-bottom hull form to maximize initial stability and was constructed primarily from 8 mm plywood using epoxy resin and mechanical fasteners. The completed first prototype was water-tested, during which stability limitations were identified.

A revised concept design was subsequently developed incorporating two outriggers to enable trimaran configuration, a reduced freeboard, and a modular assembly system allowing the vessel to be configured as either a monohull or trimaran according to user preference. The revised design also incorporated detachable wheel supports for shore transport and was sized to fit on a standard passenger car roof rack, directly addressing the portability and storage requirements identified in Phase 1. Photographs of the prototype in its assembled and disassembled states are presented in the Results section (Figures 3–6).

It must be emphasized that the prototype and revised design presented in this study constitute an amateur concept design intended to give physical form to the product requirements

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identified through consumer research. The design has not been subject to formal naval architectural analysis or certification. Any further development of this concept into a commercially or publicly available product would require review and redesign by a qualified naval architect or marine engineer to ensure structural integrity, stability, and compliance with applicable safety regulations.

Results

Overview of Coded Data

A total of 551 coded segments were identified across all eighteen interview transcripts. Phase 1 (n=12, prior to prototype construction) yielded 151 coded segments, while Phase 2 (n=6, following prototype exposure) yielded 400 coded segments. The higher segment count in Phase 2 reflects the richer and more detailed nature of participant responses when evaluating a physical product. The distribution of coded segments across the eight codes is presented in Table 3.

Usage Purpose was the most frequently occurring code across both phases, accounting for 213 segments (38.7% of all coded content). This dominant frequency indicates that participants consistently framed their evaluations of the product concept in terms of intended use scenarios, contexts, and purposes. Price ranked second (87 segments, 15.8%), followed by Buildability (78 segments, 14.2%) and Portability (58 segments, 10.5%). Storage (48 segments, 8.7%) and Safety (28 segments, 5.1%) were also recurring themes. The Favored code (31 segments, 5.6%) substantially outnumbered the Against code (8 segments, 1.5%), indicating that overall participant orientation toward the product concept was strongly positive.

Phase 1 and Phase 2 Comparison

Comparison of code frequencies between Phase 1 and Phase 2 reveals notable shifts in the nature of consumer concerns following prototype exposure. The most striking change was observed in the Storage code, which increased from 2 segments in Phase 1 to 46 segments in Phase 2. This finding suggests that storage considerations, though central to the product concept, were not spontaneously foregrounded by participants prior to seeing a physical product. Once confronted with the actual dimensions and assembly logic of the prototype, participants actively reflected on storage implications and articulated specific requirements.

Safety similarly showed a marked increase from 5 segments in Phase 1 to 23 segments in Phase 2. This pattern suggests that the physical reality of the prototype prompted participants to engage more concretely with safety considerations, including stability, freeboard height, and use in adverse conditions. Conversely, the Against code decreased from 5 segments in Phase 1 to 3 segments in Phase 2, indicating that exposure to the physical prototype reduced, rather than increased, participant reservations about the concept. Usage Purpose showed the largest absolute increase (46 to 167 segments), reflecting the richer elaboration of use scenarios that the prototype enabled. These patterns confirm the value of the two-phase iterative design: prototype exposure substantially deepened and diversified the consumer needs data collected.

Table 3. Code frequency distribution across interview phases

Code	Total (n)	Phase 1 (n=12)	Phase 2 (n=6)	% of Total Segments
Usage Purpose	213	46	167	38.7%
Price	87	30	57	15.8%
Buildability	78	32	46	14.2%
Portability	58	16	42	10.5%
Storage	48	2	46	8.7%
Favored	31	15	16	5.6%
Safety	28	5	23	5.1%
Against	8	5	3	1.5%
Total	551	151	400	100%

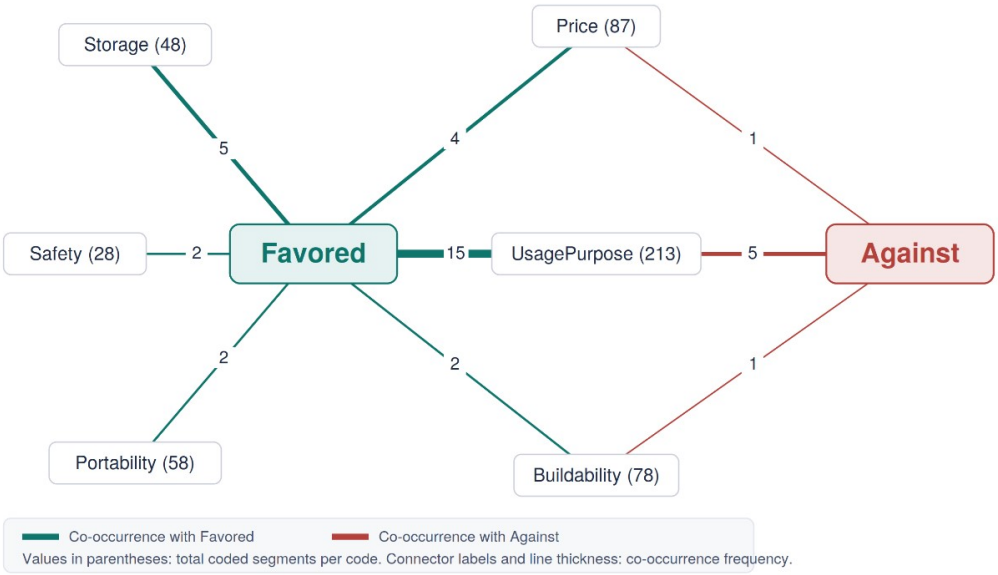


Figure 2. Co-occurrence model of thematic codes with Favored and Against (segment frequencies in parentheses)

Table 4. Summary of co-occurrence relationships with favored and against

Code	Co-occurrences with Favored	Co-occurrences with Against	Interpretation
Usage Purpose (213)	15	5	Primary driver of both acceptance and rejection; product fit with intended use context is decisive
Price (87)	4	1	Predominantly associated with acceptance; affordability perceived as positive attribute
Buildability (78)	2	1	Predominantly associated with acceptance; ease of construction seen as enabling factor
Portability (58)	2	0	Exclusively associated with acceptance; no rejection association
Storage (48)	5	0	Exclusively associated with acceptance; no rejection association
Safety (28)	2	0	Exclusively associated with acceptance; no rejection association

Co-occurrence Analysis: Factors Influencing Product Acceptance

Co-occurrence analysis examining the relationship between thematic codes and the Favored and Against codes constitutes the central analytical finding of this study. Figure 2 presents the co-occurrence model, in which the thickness and numeric weight of connecting lines indicate the frequency of co-occurrence between codes within the same segment.

The co-occurrence model reveals a clear and interpretable structure of product acceptance determinants. Usage Purpose is the only code connected to both Favored (15 co-occurrences) and Against (5 co-occurrences), establishing it as the pivotal factor in product acceptance decisions. This bidirectional relationship indicates that whether a participant endorsed or rejected the product concept was primarily determined by the alignment, or misalignment, between the product's capabilities and the participant's intended use context. Participants who envisioned using the boat for coastal recreation, leisure fishing, or short-distance excursions in sheltered waters consistently expressed acceptance. Those who had expectations incompatible with the product's capabilities, such as open-sea use, high-capacity transport, or high-speed performance, tended toward rejection.

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Price co-occurred with Favored 4 times and with Against only once, indicating that the product's perceived affordability was predominantly a positive driver. Participants expressed that the low estimated cost of a DIY kit or self-build plan relative to manufactured alternatives was an attractive feature, and willingness-to-pay estimates ranged from approximately 10,000 to 100,000 Turkish Lira (≈ USD 250–2,500), with the lower end of this range described by participants as highly reasonable for a self-built craft. Buildability co-occurred with Favored twice and against once, suggesting that while participants generally viewed the construction process as manageable, particularly with video-based guidance and forum support, concerns about construction complexity constituted a minor reservation for some.

Portability, Storage, and Safety each co-occurred exclusively with Favored and showed no co-occurrence with Against. This is a substantively important finding: none of these three attributes, which are central to the product concept's rationale, generated any participant rejection. The portability of the design (transportable on a standard car roof rack), its storable nature (demountable into parts that can be kept in a garage or apartment), and its perceived safety characteristics were uniformly received as positive attributes. The exclusive association of Storage with Favored is particularly notable given that the concept was specifically developed to address the storage and berthing constraints documented in the Turkish recreational boating context.

A summary of co-occurrence frequencies and their interpretations is provided in Table 4.

Taken together, the co-occurrence analysis identifies Usage Purpose alignment as the primary determinant of product acceptance, with Portability, Storage, and Safety functioning as uniformly positive attributes that strengthen acceptance when present in a participant's evaluation. The overwhelmingly low frequency of Against responses (8 total segments, 1.5% of all coded content) across both interview phases indicates that the product concept was received positively by the vast majority of participants, with reservations confined to specific use-context mismatches rather than fundamental objections to the concept.

Prototype Development

The physical prototype was developed in two iterations, with the second iteration informed directly by findings from Phase 1 interviews and first prototype water testing. Photographs of the prototype in key configurations are presented in Figures 3 through 6.



Figure 3. First prototype fitted with detachable wheel supports shore transport



Figure 4. First prototype transported on a standard passenger vehicle roof rack



Figure 5. First prototype during water trial, configured for rowing

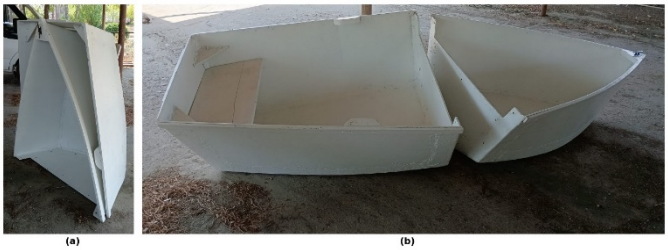


Figure 6. Prototype on land

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The first prototype was constructed from 8 mm plywood with epoxy resin bonding and demonstrated the core nesting and assembly concept. Water trials confirmed the feasibility of the monohull configuration but revealed stability limitations at larger heel angles. In response, the revised design incorporated a flat-bottom hull form, reduced freeboard, and two detachable outriggers enabling trimaran configuration. The detachable wheel supports visible in Figure 3 were incorporated in response to participant suggestions from Phase 1 regarding ease of shore handling and transport. The prototype demonstrated that the assembled vessel could be transported on a standard compact car roof rack (Figure 4) without requiring a trailer, directly addressing the storage and portability requirements that dominated the co-occurrence analysis.

Table 5. Principal particulars of the prototype (as built)

Parameter	Symbol	Unit	Value
Length overall	LOA	m	2.97
Beam (maximum)	B	m	1.27
Moulded depth	D	m	~0.48
Light draft	T	m	~0.10
Light displacement (empty boat weight)	Δ	kg	~62
Maximum carrying capacity (payload)	—	kg	~150

Note: Indicative figures measured from the as-built amateur prototype; not certified naval-architectural values.

The draft and payload values in Table 5 are included solely to provide an indicative description of the physical scale and envisaged use of the amateur prototype. The indicative light draft was estimated through comparison with similar small craft, namely the Compass Skiff (Chase Small Craft, n.d.), 11' Dinghy Vee (Olesen, 2025), and Flats River Skiff (Salt Boatworks, n.d.), for which reported drafts range from 7.62 to 13.3 cm. The preliminary payload reference was likewise derived from comparison with small craft of broadly comparable dimensions and intended use; it does not represent a verified maximum carrying capacity.

No hydrostatic, intact-stability, structural, or load-capacity analysis was undertaken for the amateur prototype. Accordingly, the draft and payload values should not be interpreted as safe operating limits. Any future development of the concept would require a qualified naval architect or marine engineer to determine the design draft, permissible payload, stability characteristics, structural adequacy, and regulatory compliance through formal calculation, testing, and certification procedures.

It is emphasized that the prototype and revised concept design presented here represent an amateur construction intended to give physical form to consumer-derived product requirements. The design has not undergone formal naval architectural review or safety certification, and any further development toward a publicly available product would require redesign by a qualified naval architect or marine engineer.

Discussion

This study set out to identify the product requirements of a portable, storable DIY boat concept for potential recreational boaters in Türkiye, a context in which marina berth scarcity and high mooring costs constitute documented structural barriers to boat ownership (Çekiç et al., 2020; Akar et al., 2022; Gürbüz, 2024). The findings from eighteen semi-structured interviews, analyzed through thematic coding and co-occurrence analysis, provide both a substantive picture of consumer requirements and a methodological demonstration of how iterative qualitative research, combining need elicitation with prototype evaluation, can deepen the understanding of product requirements in an NPD context (Schirr, 2012; Melander, 2019).

The concept's regulatory position reinforces its accessibility rationale. Under Türkiye's Recreational Craft and Personal Watercraft Regulation (Gezi Tekneleri ve Kişisel Deniz Taşıtları Yönetmeliği, 2017), which transposes EU Directive 2013/53/EU (EU Directive, 2013), craft built for personal use are exempt from CE conformity assessment for five years provided they are not placed on the market, and human-powered craft fall outside its scope entirely. No operator's licence (*Amatör Denizci Belgesi in Turkish*) is required for oar propelled or sub-10 HP craft, and mooring-registry (*Bağlama Kütüğü in Turkish*) registration is mandatory only for craft exceeding 2.5 m in length (Bağlama Kütüğü Uygulama Yönetmeliği, 2014). A small, self-built, oar- or low-power craft for personal use can therefore be lawfully built, owned, and operated without formal certification, although any intention to market it, or to exceed these thresholds, would trigger full conformity-assessment obligations, reinforcing the need for professional redesign and certification before any public release.

As a concept, the design targets short-range use in sheltered, fair-weather waters, for example, leisure outings or rod-and-line fishing, and its modular architecture allows adaptation to other purposes and conditions through future configurations,

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such as a short sailing rig with a retractable centreboard or a low-power outboard.

The dominant finding of the co-occurrence analysis, that Usage Purpose is the primary determinant of both product acceptance and rejection, aligns with the VOC literature's emphasis on use context as the central axis of consumer need (Veryzer & Borja de Mozota, 2005; Macnamara, 2020). Participants who envisioned the product within familiar, personally meaningful use contexts, coastal leisure, recreational fishing, short-distance excursions in sheltered waters, consistently expressed acceptance. This finding is consistent with research showing that matching product capabilities to intended use contexts is a primary condition for new product survival in competitive markets (Kahn et al., 2013; Altuğ, 2017). The pattern also resonates with nautical tourism research documenting those recreational boaters in Türkiye and comparable Mediterranean contexts are predominantly oriented toward near-shore, protected-water use rather than open-sea navigation (Çakıroğlu, 2019; Mazmanoğlu & Altınağaç, 2020), suggesting that the product concept's capabilities are well-matched to the dominant use profile of the target population.

The finding that Portability, Storage, and Safety co-occurred exclusively with Favored and showed no association with Against is particularly significant. These three attributes constitute the core value proposition of the concept: a boat that can be stored at home, transported without a trailer, and used without marina berthing. Their unanimous positive reception confirms that the product concept is addressing genuine, felt needs rather than presumed ones, a distinction that the NPD literature identifies as critical to new product success (Kahn et al., 2013). The storage finding is especially noteworthy: the dramatic increase in Storage-coded segments from Phase 1 (2 segments) to Phase 2 (46 segments) suggests that participants did not spontaneously articulate storage as a need until confronted with a physical product, at which point it became a salient and uniformly positive evaluation criterion. This pattern illustrates the well-documented limitation of purely verbal VOC methods in surfacing latent needs, and supports the value of prototype-based elicitation as a complement to initial interviews (Driessen & Hillebrand, 2012).

The predominantly positive orientation of Price toward Favored is consistent with the literature's characterization of cost as a central participation barrier in recreational boating (Marušić et al., 2020; Pintér et al., 2021). Participants' willingness-to-pay estimates, ranging from approximately 10,000 to 100,000 Turkish Lira (≈ USD 250–2,500), generally exceeded the estimated material cost of a self-built craft, indicating that the DIY route offers a financially viable path to boat ownership for a meaningful segment of the Turkish recreational boating population. This finding supports the broader argument that self-build approaches can mitigate the cost barriers to recreational boating participation that are documented in both Turkish and international contexts (Kaluđerović, 2019; Aydın, 2023).

The consumer heterogeneity evident in the interview data, with participants differing substantially in their propulsion preferences (rowing, motor, sail), desired hull configuration (monohull versus trimaran), and capacity expectations, provides direct empirical support for the modular design approach adopted in the revised prototype. The NPD and operations management literature identifies user heterogeneity as the primary condition under which modular architectures create market value, by enabling a single core product to be configured differently for different users without the cost of producing entirely distinct products (Bardakçı, 2004; Kamrad et al., 2017; Ayık, 2019). The present findings instantiate this principle concretely: a modular boat that can be assembled as a monohull or trimaran, with or without a sail rig, and with adjustable freeboard, is capable of addressing the divergent preferences documented across the participant sample while maintaining a shared core structure.

The Safety increase observed in Phase 2 warrants specific discussion. The heightened salience of safety concerns following prototype exposure reflects a rational response to seeing an actual small craft rather than an abstract concept: participants became more concrete in their safety requirements, including freeboard height, stability in adverse conditions, and use range limitations. This pattern is consistent with the broader safety concerns documented in the Turkish recreational boating context, where participants in this study consistently linked safety to use in sheltered, near-shore waters rather than open-sea conditions. The Safety findings reinforce the importance of the recommendation made in this study that the amateur concept design be reviewed and redesigned by a qualified naval architect before any public dissemination of construction plans.

Conclusion

This study identified the product requirements of a portable, storable DIY boat concept for potential recreational boaters in Türkiye through an iterative two-phase qualitative

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interview design involving eighteen participants and 551 coded segments. The principal findings are as follows.

Usage purpose alignment is the primary determinant of product acceptance. Participants who could situate the product within their personal use context, coastal leisure, recreational fishing, near-shore excursions, expressed clear acceptance, while the small number of rejections were driven by use-context mismatch rather than fundamental objections to the concept.

Portability, storability, and safety are unanimously positive attributes. None of these three core value dimensions generated any consumer rejection across either interview phase, confirming that the product concept addresses genuine consumer needs in a context where marina berth scarcity and storage constraints limit recreational boat ownership.

Price is predominantly a positive factor. Participants' willingness-to-pay estimates indicate that the DIY route offers a financially accessible path to boat ownership for a meaningful segment of the target population, with the estimated self-build cost received as highly reasonable.

Consumer heterogeneity justifies a modular design approach. The diversity of propulsion preferences, hull configuration expectations, and capacity requirements documented across participants supports a modular product architecture capable of serving multiple user profiles from a shared core design.

Prototype exposure deepens consumer need articulation. The two-phase design revealed that storage and safety requirements, though central to the product concept, were substantially more salient and richly articulated in Phase 2 than in Phase 1, demonstrating the value of prototype-based elicitation as a complement to initial verbal VOC methods.

These findings contribute to the limited body of Türkiye-specific consumer research on recreational boating participation and provide an empirical foundation for the further development of the DIY boat concept as a practical response to the structural barriers, berth scarcity, high mooring costs, and storage constraints, that currently suppress recreational boat ownership in Türkiye. Future research directions include formal naval architectural development of the concept design, quantitative survey-based validation of the requirement priorities identified here, and investigation of the self-build boat market's potential scale across different Turkish coastal regions.

For policymakers and marina operators, these findings suggest that consumer interest in low-cost, demountable, self-built craft represents a latent segment of recreational demand that conventional berth-centred provision does not serve. Supporting this segment need not require additional deep-water berths: measures such as dry-stack and rack storage for small demountable craft, accessible public slipways and launch points, designated low-cost moorings for small boats, and streamlined registration pathways for small self-built vessels could expand participation at modest cost while easing pressure on scarce marina capacity. Recognising self-build and modular small craft within local maritime-tourism and coastal-recreation planning could therefore widen access to recreational boating among segments currently priced out of conventional ownership.

Several limitations of this study should be acknowledged. First, the total sample of eighteen participants, while appropriate for exploratory qualitative research, limits the generalizability of the findings. Future research employing larger samples or mixed-method designs could provide more representative quantification of consumer requirement priorities across the Turkish recreational boating population.

Second, participants were recruited from the İzmir coastal region, which, while relevant to the study's context, may not capture the full diversity of potential users across Türkiye's Aegean, Mediterranean, and Black Sea coasts. Regional variation in boating culture, infrastructure availability, and use patterns may produce different requirement profiles in other coastal areas. In addition, although all participants met the eligibility criterion of prior boat ownership or an expressed interest in recreational sea activities, the duration of participants' boating experience was not systematically recorded, and its potential influence on concept evaluations could therefore not be examined.

Third, the prototype evaluated in Phase 2 is an amateur concept design that has not undergone formal naval architectural analysis. Participant responses to the prototype therefore reflect reactions to a proof-of-concept rather than a fully engineered product, and some requirements articulated by participants (particularly regarding stability and safety) may be addressed differently in a professionally designed version of the concept. Two observed behaviors of the prototype merit specific acknowledgement in this respect. First, its directional stability was not formally evaluated: flat-bottomed hulls without a keel, skeg, or comparable tracking appendage typically exhibit reduced course-keeping under oars, tending to yaw after each rowing stroke. Second, the prototype exhibited noticeable roll during boarding and disembarkation, as is characteristic of light flat-bottomed craft. Neither behavior prevented completion of the water trial, but both should be addressed in future engineering development, for example,

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through the addition of a skeg or comparable appendage and through formal hydrostatic and hydrodynamic analysis; recent hull-form evaluation and refinement studies on traditional Turkish small craft illustrate the type of analysis such development would entail (Bulut, 2024).

Fourth, the co-occurrence analysis reflects associations between codes within segments as coded by a single researcher. While the codebook was applied consistently across all transcripts, inter-rater reliability was not formally assessed, which is a common limitation of single-coder qualitative research. Finally, this study did not undertake a systematic comparison between the proposed concept and commercial portable alternatives such as inflatable boats, folding boats, or rigid inflatable boats; a structured comparison of acquisition cost, durability, storage footprint, and user engagement across these categories represents a natural direction for future research.

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Compliance With Ethical Standards

Authors' Contributions

SP: Project Administration, Methodology, Resources, Formal Analysis, Supervision, and Writing – original draft.

AT: Project Administration, Conceptualization, Methodology, Investigation, Data Curation.

All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

The study has been approved by the Dokuz Eylül University Social and Human Sciences Scientific Research and Publication Ethics Committee (E-87347630-659-299893) and has been conducted in accordance with accepted ethical standards.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

AI Disclosure

Generative AI (Claud Opus 4.7) was used for grammatical review of the introduction and discussion sections. The authors validated all outputs and assume full responsibility for the content.

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