Progress in Marine Science and Technology 10

Technology and Science for the Ships of the Future

Proceedings of the 21st International Conference on Ships and Maritime Research (NAV 2025), Messina, Italy, 18–20 June 2025

Edited by
Vincenzo Crupi and Vittorio Bucci

IOS Press

The oceans are a key resource for transportation, energy and material extraction, and food production, representing one of the most important environments on the planet. Technological developments enabling us to exploit marine resources in a sustainable way are therefore of the greatest importance.

This book presents the proceedings of the NAV 2025 conference, held in Messina, Italy, from 18 to 20 June 2025. The conference is held every 3 years, attracting specialists in marine technology from all over the world. NAV 2025 was the 21st edition of the conference, and covered a full spectrum of maritime technology themes, all related to the exploitation of sea resources. The book contains 125 scientific papers, covering subjects ranging from comfort on board; green and smart ships for sustainable navigation; hydrodynamics; marine renewable energies and resources; naval ships and submarines; offshore and underwater technologies; safety and security; ship and yacht design; ship digitalization and autonomous vehicles; ship propulsion, machinery and systems; ship structures and materials; Fincantieri workshop on digitalization and new edge-cloud technologies in the maritime sector.

Providing a comprehensive coverage of the latest scientific and technical maritime issues, the book will be of interest to all those involved in this vital global industry.

TECHNOLOGY AND SCIENCE FOR THE SHIPS OF THE FUTURE

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ISSN 2543-0955 (print)
ISSN 2543-0963 (online)

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Sage | IOS Press

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ISBN 978-1-64368-610-3 (online)
doi: 10.3233/PMST10

IOS Press

A Sage company
Nieuwe Hemweg 6B
1013 BG Amsterdam

Sage
1 Oliver's Yard
55 City Road
London EC1Y 1SP

Sage
2455 Teller Road
Thousand Oaks
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Preface

About NAV

The first Conference took place in 1974 as "Convegno Scientifico del Gruppo Automazione Navale e Problemi delle Grandi Navi" (Scientific Conference of Marine Automation Group and Large Vessels Issues), to be held every two years under the patronage of Technical Naval studies Centre (CETENA) and Italian National Research Council (CNR).

In 1984, the cooperation between CETENA and Marine Technical Association (ATENA) led to rename the conference as NAV spreading the topics also to purely technical field, originally covered by ATENA national conferences. Since 1994 the NAV conference is held every three years being the most important Italian forum for scientific and technical maritime community, attracting also specialists from all around the world.

The 21st Conference (NAV 2025) is finally back in Messina, after 15 years. An international scientific Committee, composed by members of international academic institutions and relevant industry sectors, ensures the scientific quality of the conference under the guidance of the chairman, Professor Vincenzo Crupi (University of Messina).

The previous editions: Rome (1974), Naples (1976), Trieste (1978), Genoa (1980), Naples (1982), Venice (1984), Palermo (1986), Trieste (1988), Ancona (1990), Genoa (1992), Rome (1994), Sorrento (1997), Venice (2000), Palermo (2003), Genoa (2006), Messina (2009), Naples (2012), Lecco (2015), Trieste (2018), Genoa (2022).

About ATENA

ATENA (Associazione Italaiana di Tecnica Navale) was established in Genoa in 1947 on the initiative of a group of Italian naval architects and marine engineers. Its principal aim was to extend the initiatives of the Collegio degli Ingegneri Navali e Meccanici in such a way as to incentivise the discussion of ship design and maritime industry between the Italian specialists in this sector.

The first Technical National Conference was held in February 1948, attracting contributions from the most representative personalities of the national maritime sector, including professional naval architects and marine engineers, professors, researchers, ship owners and insurers.

Since the foundation of ATENA, its members have been providing high-level contributions to research, ship design & construction, and the shipping industry. A primary focus is also given to other relevant topics such as maritime safety and environmental issues.

Because the maritime industry acts in a global market, ATENA also spreads this vision worldwide by opening its conferences and events to international professionals.

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- Ship Digitalization and Autonomous Vehicles
- Ship Propulsion, Machinery and Systems
- Ship Structures and Materials
- Yacht Design
- Fincantieri Workshop on Digitalization and New Edge-Cloud Technologies in the Maritime Sector

Peer Review Statement

Number of submitted articles: 142
Number of accepted articles: 125
Acceptance rate: 88%

Proceedings of the 21st International Conference on Ships and Maritime Research

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Patronages

With the support of

NAV 2025, the 21st International Conference on Ships and Maritime Research, was held in Messina (Italy) on June 18th–20th 2025 and organized by ATENA (Associazione Italiana di Tecnica Navale), with the collaboration of the University of Messina.

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doi:10.3233/PMST250085

Luxury Cruise Ship Design: Evolution and New Perspectives

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Abstract. The luxury cruise industry has experienced significant changes driven by evolving social and cultural expectations of guests. This aspect has driven a rethinking of onboard experiences, leading to a redefinition of onboard urban planning and a comprehensive redefinition of decks functional layout. In this context, cruise ships are now expected to blend the best aspects of hospitality, technology and luxury living. This research aims to enhance passenger comfort and satisfaction by designing small vessels (100-150 meters) with a maximum capacity of 100 guests and a crew-to-passenger ratio of 1:1. Streamlined vertical connections and a well-organized distribution of technical and service spaces provide an even more efficient separation of crew and guest areas. The design convergence brings luxury ships close to mega yachts, with greater attention to privacy, accessibility and relative arrangement of common and private areas. Inspired by the luxury hospitality sector and fine dining, interiors spaces have been reshaped to provide high-quality, tailored experiences. The analysis includes a diachronic study of past cruise ships to illustrate design evolution and the changing passenger demographics over time. It explores how these transformations have affected management practices and redefined the travel experience, with a focus on the relationship between onboard layout, new itinerary strategies and event organization. The assessment of specific case studies highlights the practical implications of design choices and provides guidelines for optimizing the distribution and operational arrangements in future generations of luxury cruise ships.

Keywords. Luxury Cruise Ships, Cruise Ships, Interior Design, Space Optimisation, 1:1 crew-to-passenger ratio, Hospitality

1. Introduction

A significant and symbolic experience in 20th-century navigation is the story of ocean liners. First steamships and then ocean liners were designed to transport passengers across the Atlantic to the Americas. These vessels can be seen as fascinating phenomena within the realm of ships, representing a significant turning point in seafaring and symbols of luxury and prestige. From an engineering perspective, there is a transition from ships that could disappear without ever reaching the Americas to high-performance,

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cutting-edge vessels capable of achieving remarkable stability and impressive cruising speeds.

Architecturally, there is a shift from imitating the grand palaces and luxury hotels on the mainland. This trend incorporates decorative styles influenced by significant European interior design periods, including Hispano-Moorish, Florentine Quattrocento, from Pompeian to the 18th-century Baroque. This initial phase can be viewed as a rejection of the ship's geometry, transferring static terrestrial architecture into a marine design intended for movement. The Coppedè brothers and the Ducrot company of Palermo exemplify this style.

On the other hand, architect Gustavo Finali Pulitzer from Trieste and his studio Stuard offered a distinct perspective. Pulitzer is celebrated for his design philosophy which respects the connections among a ship's physical space, engineering components and intended function. He acknowledged the significance of bespoke designs for ocean liners and was a forerunner in merging art with maritime architecture. His approach was acknowledged and subsequently adopted by Milanese architect Gio Ponti, who lauded Pulitzer's work in the magazine Domus [1].

Gio Ponti's work on the ocean liner Andrea Doria embodies Pulitzer's philosophy. He not only honours the ship's curved geometry defined by its proportions but also enhances it through artistic expression. The wall becomes a piece of art, featuring a painting applied directly to its surface.

Figure 1. Transatlantic Andrea Doria (1951). Creative Commons License

Another perspective on the evolution of seafaring involves analysing the objectives behind the voyages. The ocean liner emerged from a genuine need: migration. Economic and social circumstances drove people to seek wealth in the New World. These journeys were primarily motivated by necessity, leaving little room for architectural or aesthetic considerations. It was only later that these voyages transformed from a necessity into a leisure activity. First-class travellers, part of the wealthy elite, shifted their focus from seeking fortune to enjoying trips to the Americas for pure pleasure. The ship became a crucial element of the journey, functioning not only as a means of transport but also as a sophisticated and elegant space for first-class passengers.

By the late 1950s, cruise ships began to replace ocean liners. This change was largely driven by the rise of air travel, enabling people to reach the Americas in considerably

less time. Cruise ships were designed to provide a completely different travel experience—a blend of entertainment, luxury, and comfort that offered passengers a unique holiday at sea. The shift from ocean liners to cruise ships represented a fundamental change in naval design and planning, prioritising passengers' experience and comfort in every aspect of the design process [2].

2. Methodology and Research Approach

This research employs a multidisciplinary framework to explore the progression of luxury cruise ship design, integrating architectural analysis, hospitality principles, and operational strategies. It is based on a diachronic examination of cruise vessels—from early ocean liners to modern ultra-luxury ships, highlighting significant shifts in spatial organisation and guest experience.

The methodology involves a comparative analysis of selected case studies, both historical and modern, to assess design evolution and strategic patterns. These cases were chosen for their significance in innovation, market positioning and impact on the cruise sector. The study analyses technical factors like spatial ratios, service flow layouts and material use, alongside demographic changes and evolving experiential expectations.

This layered analysis seeks to establish design guidelines for future luxury cruise ships, focusing on comfort, privacy, and personalization. Combining qualitative and quantitative data offers a thorough understanding of the intersection between architecture and experience at sea.

The interior design considerations presented in this study, particularly regarding spatial standards, circulation logic, and service organisation, are the result of original research conducted by the team based on comparative analysis and operational criteria.

3. From Mass-Market Cruise Ships To Luxury Cruise Liners

Mass-market cruise ships are notable for their large size, designed to host thousands of passengers, typically ranging from 2,000 to 6,000. These cruises often focus on shorter trips to popular destinations like the Mediterranean, Caribbean, and Northern Europe. Guests enjoy various onboard services, including entertainment, dining and swimming pools. Cabin options vary from basic and budget-friendly interior cabins to more spacious and luxurious choices, complete with balconies and ocean views, catering to the diverse preferences of a wide range of travellers.

Mass-market cruise ships have transformed the concept of seaborne holidays. Companies such as Carnival, Norwegian Cruise Line, and Royal Caribbean have made this travel experience more accessible to a broader segment of the global population by offering all-inclusive packages.

However, an increasing number of passengers began to seek more refined and custom-tailored travel experiences. These changing expectations presented valuable design opportunities, providing architects and designers new parameters and inspirations. From this demand for more exclusive cruises, the luxury cruise sector emerged. This niche began to take shape in the 1990s and has continued to grow through the early decades of the 21st century [3].

Luxury cruise ships distinguish themselves from their mass-market counterparts primarily in vessel size and passenger capacity. In the most exclusive segment, maximum capacity typically ranges from 600 to 700 guests, for whom service is tailored to meet individual needs and preferences. Notable luxury cruise lines include Seabourn, Silversea, and Regent Seven Seas Cruises.

Figure 2. Wonder Of The Seas Cruise Ship**,** Royal Caribbean (2020). Creative Commons License

4. From Luxury Cruise Ships To Ultra-Luxury Cruise Ships

Since the 2000s, the final evolution of this trend has resulted in the emergence of ultra-luxury cruise ships, boasting a crew-to-passenger ratio of 1:1. The service provided on board these vessels is so tailored that each guest has a dedicated crew member at their disposal. In contrast, traditional cruise ships typically have a crew-to-passenger ratio ranging from 1:3 to 1:5. This ratio on ultra-luxury ships enables a customised experience for guests.

The ships within this market segment have a maximum capacity of 100 to 150 passengers. The targeted customer for this market comprises highly influent individuals, entrepreneurs, professionals, celebrities and aristocrats, who seek not just a trip, but a unique and unparalleled experience. Requests from this clientele include highly personal services with custom activities, such as private excursions and in-suite dining. Privacy and discretion are crucial elements. The cabins guarantee maximum confidentiality and discretion, while the common areas are minimised to create exclusive spaces catering to every need.

Figure 3. Le Bouganville Cruise Ship (2019), Ponant. Creative Commons License

Modern cruise ships have evolved into outstanding examples of engineering and design over the years, drawing inspiration from mega yachts and luxury hotels, while also responding to new social and cultural expectations. Consequently, the cruise industry has frequently intersected with and drawn influence from the yacht market. This trend originated with the rise of the private mega yacht sector during the 1980s and 1990s, when very wealthy individuals began to prefer exclusive, tailor-made trips.

The evolution of yacht-style luxury cruise ships marked a significant change in the cruise industry, blending private yachting experience with traditional cruising. As a result, companies began designing vessels that accommodate fewer passengers, achieving a 1:1 ratio of guests to crew members. This trend signifies a shift in travel perception, viewing the journey as a unique event that emphasises personalization and exclusivity, aligning with the guest's social status. In this context, ultra-luxury cruises represent more than just leisure; they provide an experience that fully immerses travellers in luxury and social distinction [4].

An important factor is the advancement of maritime technologies and the emphasis on sustainability, which have reduced operating costs and the construction of smaller yet more efficient ships regarding the services offered to the guests.

5. Post-Pandemic Evolution Of The Luxury Cruise Sector

In recent years, the luxury cruise sector has grown significantly, greatly impacting the maritime industry and ship design. This change has primarily resulted from shifts in consumer preferences following the pandemic. A growing number of individuals are choosing remote and exclusive destinations over large crowds, a demand that Small Luxury Cruises successfully meets by providing comfort, privacy, luxury, and access to areas unreachable by larger ships.

Luxury cruises strive to deliver an experience that overcomes basic expectations, emphasising quality, exclusivity and heightened status. Although the luxury cruise model resembles that of mega yachts, it also complies with SOLAS maritime regulations

regarding ship safety. Luxury hospitality heavily influences these vessels, drawing inspiration from renowned brands such as Fairmont Hotels & Resorts, Hilton Hotels & Resorts, Mandarin Oriental, and Four Seasons. The luxury yacht industry has more than doubled in size over the past decade [5].

Demand notably increased after the COVID-19 pandemic disrupted global tourism in March 2020, leading to a rise in advertisements for upscale yacht vacations and small luxury cruises [6]. This trend highlights their growing appeal as an alternative to traditional mass-market cruises, which host large numbers of guests on one ship. The mega yacht and luxury cruise markets are closely intertwined.

5.1 Market Size and Global Trends

The luxury cruise industry represents a significant sector, generating $ 154 billion in 2019, prior to the COVID-19 pandemic (CLIA, 2021). By 2021, revenues from luxury cruises came from 323 active small cruise ships worldwide, owned by over 70 ocean and river cruise companies (2021 data, Cruise Market Watch). In 2020, the luxury nautical sector was valued at $64.1 billion [7] with forecasts predicting it will exceed $83.2 billion by the end of 2025, bolstered by an annual growth rate of 4.1% from 2020 to 2027 [7].

At the beginning of the last decade, Europe was the preferred luxury travel destination, with 41% of participants selecting the continent, particularly noting France (14%) and Italy (9%). However, today luxury cruise routes have greatly diversified, with emerging locations such as the Americas, the Arab world, and Asia gaining traction, offering a broader spectrum of distinctive global experiences.

In 2018, a Chinese government report titled "Some Opinions and Suggestions on Promoting the Development of the Cruise Industry in China" acknowledged the immense potential of the Chinese cruise tourism market. The government aims to establish one of the world's most vibrant cruise markets by 2035, underscoring its commitment to develop further the cruise sector in China, which is increasingly recognised as a significant player in luxury cruise destinations.

The Luxury Cruise sector features ships that differ greatly in size and capacity. For example, the Crystal Esprit measures 82 meters in length, has a gross tonnage of 3,300 GT, and accommodates up to 62 passengers[8]. In contrast, Windstar vessels typically carry between 250 and 350 guests and boast a gross tonnage of around 10,000 tons[9]. Another key operator, Seabourn, usually hosts 450 passengers, measures 198 meters long, and weighs 32,346 GT [10].

Notable brands in the small luxury cruise market include Oceania Cruises, Emerald Cruises, Silversea Cruises, Ponant, and Scenic Eclipse, each with a unique focus. Global tourism experienced severe disruptions due to the COVID-19 pandemic, exacerbated by media reports that inflated contagion risks on cruise ships, which heightened traveller anxiety. As the health crisis unfolded, cruise ships came under extensive scrutiny, significantly impeding the industry's recovery. This situation led to a surge in demand for luxury experiences aboard yachts and smaller vessels, which offered a more exclusive and secure environment, fulfilling travellers' desires for serenity and control during their journeys. While luxury mega yachts are generally more compact, some can surpass the size of specific luxury cruise ships.

Luxury cruises typically maintain a guest-to-crew ratio of 1:1[11], whereas certain luxury yachts achieve a 1:2 ratio and can even drop to 1:0.5, ensuring highly personalised service. Although larger luxury cruise ships tend to be more economical, their interior

design combines elegance with durability, allowing them to withstand extensive use by numerous passengers while providing comfort and longevity.

Figure 4. Symbiosis (AY 2024-25) – Riccardo Etai, Gianluca Ferrante, Niccolò Marini, Paolo Spanu, Daniele Versace, Luca Gagliano.

5.2 Demographics and Traveller Preferences

Recognising the target audience in the luxury cruise market has proven more complex than anticipated. Traditionally, cruise lines attracted primarily older demographics, but this is changing rapidly. Nowadays, various companies provide customised experiences for distinct demographic groups, categorising their offerings by age. Insights from Karen Warrel and Tatiana Gladkikh, as detailed in Luxury Yachting versus Luxury Cruising: Differences, Similarities, and Customer Choices, suggest that older travellers, particularly those over 65, often prefer brands like Cunard and Silversea. Conversely, couples aged 40 to 65 typically choose lines such as Seabourn, Regent Seven Seas, and Viking. Nonetheless, a significant transformation is occurring: luxury travellers are becoming increasingly younger. As Baby Boomers hand over to Generation X, individuals in their forties are gaining the purchasing power previously held by those in their fifties. Indeed, a notable segment of affluent luxury travellers is now in their thirties and forties [12].

Although this trend may vary by country, the general pattern shows that luxury cruise travellers can no longer be limited to a specific age group or nationality. The one universal trait among luxury travellers is their financial capability, which allows them to engage in these premium experiences.

While the previous sections focused on market trends and user profiles based on external sources and industry reports, the following part of the study presents original design reflections developed by the research team. These include considerations related to interior layouts, functional zoning, and space planning for small luxury cruise ships.

Although some ultra-luxury cruise ships in the current market offer a 1:1 crew-to-passenger ratio, they typically accommodate between 500 and 700 guests. This research instead focuses on a different scale: small vessels hosting a maximum of 100 passengers. In this context, the 1:1 ratio is not simply a service metric but a structural design principle that informs spatial organisation, circulation flows, and the overall onboard experience.

6. Design and Interior Layouts

Luxury cruise ships offer numerous opportunities for onboard exclusivity, primarily in three main areas that constitute over 60% of guest space: cabins, dining areas, and lounges.

The cabins vary in size depending on their type, primarily featuring suites with stunning sea views. A notable recent addition is the Emerald Sakara from Emerald Cruise, launched in 2023. Its cabins are classified as follows: Owner's Suite: 109-111 m², Yacht Suite: 65-67 m², Deluxe Balcony Suite: 36-38 m², Balcony Suite: 27-29 m², Terrace Suite: 60-62 m², and Oceanview Stateroom: 17-20 m². Additionally, certain ships from Oceania Cruise and Regent Seven Seas offer suites exceeding 1,000 m², delivering an exceptionally exclusive luxury experience.

According to the Neufert design standards, the kitchen must cover at least 20 m² to serve up to 50 covers, including the washing area. The space should increase by 0.5 m² for each extra cover to accommodate additional meals. If the number of covers is over 100, a separate dishwashing area will be required, although smaller kitchens may have exceptions based on structural, equipment, and operational needs. For example, pizzerias require a minimum of 12 m², excluding the space for the oven.

On luxury cruise ships, inspired by high hotel standards, kitchen space is designed to allocate from 7 to 12 m² for every 10 passengers. This ratio varies due to multiple factors: the luxury level (fine dining demands more space for food preparation and presentation), the number of dining venues that rely on the central kitchen, and the complexity of the menu (more complex dishes necessitate additional workstations and equipment). Typically, for 100 passengers, the kitchen on luxury ships should range from 70 m² to 120 m², as they are designed to serve guests over multiple shifts (breakfast, lunch, dinner), thereby distributing the workload efficiently.

However, the available space must still guarantee high-quality service and elegant plating. Specifically:

- Food storage space: approximately 20-25% of the kitchen area;
- Equipment and cleaning: 15-20% of the kitchen area;
- Active preparation and cooking zones: 50-60% of the kitchen area.

When calculating the overall size of restaurant areas, several sections are taken into account:

- Dining area (Front of House): includes seating, aisles, and furnishings;
- Kitchen (Back of House): encompasses cooking, preparation, cleaning, and storage areas;

- Support areas: consist of restrooms, staff relaxation rooms, office spaces, and service areas.

In fine dining, the recommended space per customer is 1.8-2.7 m² per seat. Thus, for a dining capacity of 100 people, the restaurant area should span approximately 200-300 m². On luxury cruise ships, lounge areas typically provide 1.5-2.5 m² per passenger, varying by type.

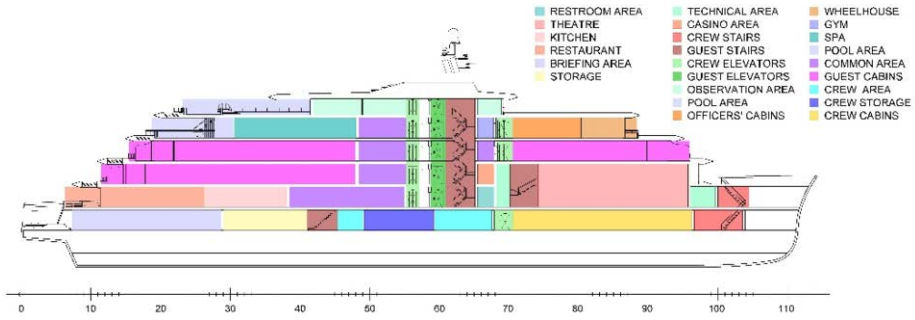

Figure 5. Rimor: hypothesis of internal subdivisions (AY 2024-25): Marco Claudio Cavallo, Adriano Publio Elio Panizzi, Elio Tublio, Edoardo Tommasi , Leonardo Camatta, Agnese Fanti, Nicola La Commare.

6.1 Operational Management and Service Logistics

The layout and design of small luxury cruise ships directly impact onboard operational efficiency. In vessels with a 1:1 crew-to-passenger ratio, service flows must be optimised to maintain discretion while delivering premium hospitality. The spatial organisation must, therefore, facilitate smooth logistical operations without compromising the guest experience.

Crew movement is managed through separate corridors, stairways, and technical shafts, allowing for behind-the-scenes operations such as housekeeping, catering, and maintenance. Service elevators are located away from guest routes to ensure uninterrupted workflows and reduce visible staff presence in public areas. Galley and pantry positioning is also critical: they are often placed centrally relative to dining venues to minimise travel distance and maintain food quality and timing.

Small luxury vessels require highly tailored workflows compared to larger cruise ships, where standardised processes serve thousands of guests. This includes personalised in-suite services, just-in-time restocking of amenities and flexible scheduling for dining and wellness experiences. Staff must operate efficiently across multiple functions while maintaining the tailor-made approach expected by high-end travellers.

The overall spatial configuration thus supports a hotel-like operational logic, where back-of-house and front-of-house functions are distinctly planned. The close coordination between architectural design and service management systems ensures that luxury standards are consistently met without visible strain on operations.

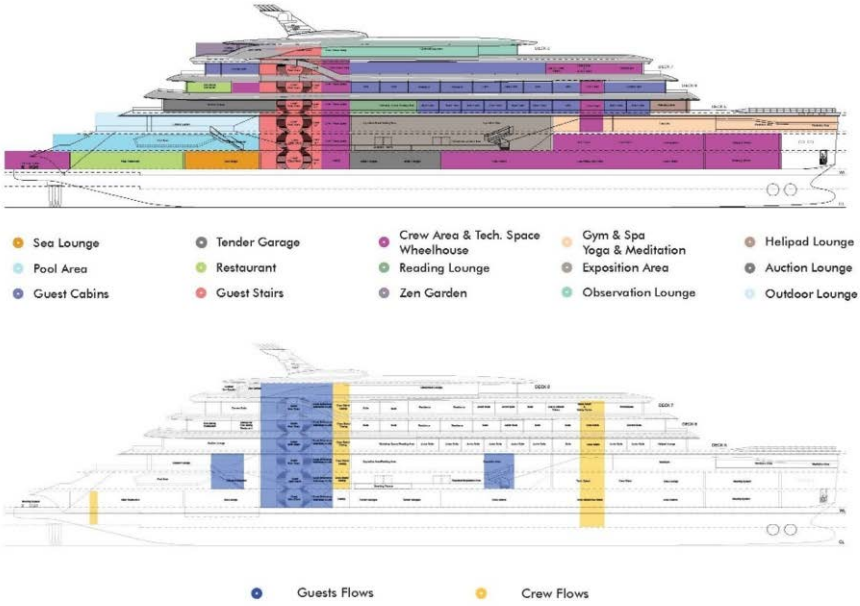

Figure 6. Symbiosis: hypothesis of zoning (AY 2024-25): Riccardo Etai Ahari, Gianluca Ferrante, Niccolò Marini, Paolo Spanu, Daniele Versace, Luca Gagliano

The primary types of lounges available on these ships include:

- Main Lounge (80-120 m²): This acts as the social hub of the ship, often hosting live performances, dancing, or group activities, featuring a stage, versatile seating, and a small bar area;
- Observation Lounge (40-60 m²): Usually found at the bow or upper deck, it boasts breathtaking panoramic views and a serene atmosphere, with comfortable seating perfect for enjoying the scenery in tranquillity;
- Bar or Cocktail Lounge (50-70 m²): This area is designed for entertainment and social interaction. It features a prominent bar and surrounding seating that encourages guest engagement;
- Specialty Lounge (30-50 m²): These smaller, unique spaces are dedicated to peaceful pursuits or niche entertainment, such as a library or a game room.

6.2 Functional Deck Layouts and Vertical Circulation

The redefinition of functional layouts plays a crucial role in enhancing passenger comfort and operational efficiency in the design of small luxury cruise ships. The internal organization of decks aims to ensure a seamless separation between guest and crew pathways, a concept derived from luxury hospitality arrangements. This spatial separation helps preserve privacy for guests while optimizing logistical operations for staff.

A clear distinction is made between service areas (such as kitchens, laundries, technical rooms, and crew quarters) and guest areas (cabins, lounges, wellness spaces, restaurants). Separate vertical circulation systems often serve these zones. Dedicated crew-only stairwells and elevators are positioned to avoid overlap with guest routes, ensuring discretion and reducing potential disturbances. Similarly, guest vertical circulation is streamlined and centralised around visually open and accessible spaces, such as atria or panoramic lift shafts, often connected directly to common areas.

The deck layout typically follows a tiered organization, where lower decks accommodate technical and crew facilities, middle decks are assigned to guest cabins, and upper decks host public and recreational areas. This hierarchy supports both efficient service workflows and intuitive guest navigation. The positioning of shared spaces, such as lounges or observation areas, on higher decks provides panoramic views and reinforces the sense of exclusivity and escape.

Incorporating these strategies brings luxury cruise ship design closer to that of mega yachts, where the architectural hierarchy emphasises comfort, intimacy, and functional clarity. This convergence of spatial logic ultimately elevates the overall cruise experience by supporting refined hospitality standards at sea.

6.3 Exclusive Destinations and Shore Experiences

A key feature of luxury cruises is their docking locations. Traditional cruise ships are often too large to access all ports, limiting their choices. In comparison, luxury cruise ships are smaller and can dock at lesser-known ports that larger vessels cannot reach, providing guests the opportunity to discover more remote and tranquil destinations. Typically, a port is not required for docking unless it is at capacity; in these cases, tender landings can be used to reach the mainland, even during peak traffic. This strategy can also reduce docking costs.

Some companies specifically design ships for luxury river cruises. The onshore experiences offered to guests on both yachts and luxury cruises are generally similar, although yachts deliver a more intimate maritime experience thanks to their smaller size. For example, some small luxury cruise ships come equipped with actual beach clubs that enhance the connection to the sea and surrounding nature. While shore excursions vary based on local options, luxury cruises often present exclusive tours for an additional charge, featuring different levels of luxury and customization. These excursions allow guests to partake in unique and privileged experiences, such as private tours or trips to secluded locations.

One particularly attractive aspect of luxury cruises is the opportunity to meet new people while enjoying a private and exclusive environment. Although privacy is a key element, diversifying social entertainment options aboard luxury cruise ships increases

the chances of meeting other passengers with similar interests, creating connections in a sophisticated setting.

Cruise ship entertainment typically falls under the category of "activities." This includes water sports toys such as jet skis, kayaks, paddleboards, and snorkelling equipment, all supplied by the crew, along with helicopter tours. Guests can enjoy cocktails in lounges with various live music performances and participate in interactive events like game shows. Many vessels also feature a mid-sized theatre that presents a nightly main show, highlighting international talents such as singers, comedians, musicians, and illusionists. Depending on the ship's itinerary, amenities like casinos or spas may also be available. Cultural entertainment is becoming an essential aspect of luxury cruises, which cruise companies increasingly recognise as an important part of the guest experience. This trend is especially true for smaller luxury and exploration vessels that weave cultural programming into their entertainment offerings, enhancing the overall traveller experience. People choosing these cruises often look for educational opportunities to engage with their destinations' local culture, history, cuisine, and wildlife. Guests typically prioritise eco-consciousness and aspire to understand and connect with local practices and the environment [13]. To strengthen the educational aspect, luxury cruise lines are increasingly hiring educators, experts, and presenters to give lectures and classes onboard. For example, on Alaskan cruises, naturalists share their insights about the wildlife encountered along the way [14].

Passengers on Hawaii or the South Pacific trips may also participate in hula dance lessons or learn to play the ukulele, often led by Polynesian ambassadors.

Scholars are invited to present lectures in various locations on distinct historical and cultural subjects, such as the Moai's history on Easter Island or presentations by marine biologists on marine biodiversity during cruises in Australia. This increasing emphasis on educational entertainment enriches the luxury cruise experience, evolving it from simple leisure to a source of cultural and intellectual depth [15].

Figure 7. Contempla (AY 2024-25): C. Ardenghi, M.E. Carbone, F. Raggi, A. De Angelis, M. Migliorini, C.Perrone

Figure 8. Rimor (AY 2024-25):Marco Claudio Cavallo, Adriano Publio Elio Panizzi, Elio Tublio, Edoardo Tommasi , Leonardo Camatta, Agnese Fanti, Nicola La Commare.

6.4 Itinerary Strategies and Onboard Experience Planning

The design of small luxury cruise ships is closely tied to their itinerary strategies and onboard programming. Small ships can access exclusive destinations with limited port infrastructure than larger vessels that follow high-capacity commercial routes. This capability directly influences ship design, particularly regarding draft, manoeuvrability and deck layout flexibility.

Onboard spaces are designed as multifunctional environments to support curated programming for each destination. Lounges can serve as lecture halls for cultural briefings during Arctic expeditions or be transformed into tasting rooms for local cuisine in the Mediterranean. Wellness decks, outdoor terraces, and panoramic lounges enhance the connection with the surroundings, adapting their function to the cruise context.

These ships follow seasonal itineraries, visiting regions during peak cultural or environmental times. This enables planning event-based experiences like art exhibitions, music performances, or culinary weeks aligned with local traditions. The adaptable interior configuration allows event planners to host immersive high-value activities without major structural changes.

The synergy between itinerary design and onboard layout thus becomes a strategic tool for delivering meaningful, immersive, and luxurious experiences, reflecting a shift from passive tourism to curated, event-driven exploration.

7. Innovation, Sustainability and Future Visions

The ships' design and configuration increasingly reflect their destinations' cultural identity. According to Verified Market Reports, the small luxury cruise market is expected to grow significantly in the coming years, with a remarkable compound annual growth rate (CAGR). This expansion is accompanied by an industry-wide shift toward sustainable practices, including adopting alternative fuels and partnerships with local communities to mitigate environmental and social impacts.

At the same time, growing demand for personalised experiences, such as themed cruises focused on wellness, gastronomy, or the arts, is helping to redefine the role of

small luxury cruises within the broader luxury tourism landscape. These trends point to a future in which innovation and sustainability converge to shape a more responsible and dynamic cruise offering.

In this context, future-oriented design concepts have begun to emerge, inspired by luxury vessels' distinctive aesthetic and functional features. Some scenarios envision annual itineraries aligned with natural seasonal cycles, visiting warm and culturally rich destinations throughout the year. These itineraries combine relaxation, exploration, and cultural immersion, offering guests season-specific experiences that foster a deeper connection with nature and local traditions.

The onboard spatial organisation promotes calmness, flexibility, and personalisation. Expansive outdoor areas facilitate wellness, creative activities, and social interaction. A central theme is integrating local culture and promoting artistic expression via events, exhibitions, and curated art auctions.

The envisioned amenities are panoramic lounges, wellness decks, meditation areas, art galleries, and multifunctional lounges designed for relaxation and creative programming. Complementary spaces may include fully equipped gyms, spas, reading lounges, and co-working environments, all conceived to blend comfort, productivity, and immersion in the voyage's natural and cultural context.

These emerging visions represent a synthesis of technical innovation, environmental responsibility, and experiential design, pointing toward new paradigms in the evolution of luxury cruising.

8. Conclusion

This research outlines a conceptual and design-oriented framework for next-generation small luxury cruise ships. By combining historical analysis, market trends, and original design investigation, it positions vessels of 100 to 150 meters in length, with a maximum of 100 passengers and a 1:1 crew-to-passenger ratio, as a distinct typology within the broader cruise sector.

The study demonstrates how this scale enables new levels of spatial quality, operational efficiency, and personalized experience, redefining the relationship between ship architecture and guest expectations. Unlike larger ultra-luxury vessels currently on the market, the proposed design principles are not merely responses to service standards but form the basis of the entire onboard spatial organization.

Through this lens, the paper contributes to expanding the discourse on luxury hospitality at sea, highlighting the potential of architectural design to shape future travel experiences where intimacy, flexibility, and cultural immersion become central.

Author Contributions

The authors wish to clarify that Chapters 1, 2, and 7 were edited by Mario Ivan Zignego; Chapters 3 and 4 by Elisabetta Proia and Chapters 5 and 6 by Davide Nicolini.

Acknowledgments

This study was developed within a broader academic research initiative that also includes the paper "An Innovative Approach to Sustainable Luxury Cruise Ship Design", submitted for NAV 2025. Although the two papers are presented separately for clarity in the articulation of concepts, they originate from a unified research activity carried out collaboratively by all contributors.

The authors of this paper are the teaching staff of the Yacht Design Studio Workshop B, a design studio course offered within the Master's Degree Programs in Naval Engineering (DITEN) and Naval and Nautical Design (DAD). The research group also includes Massimo Musio-Sale, Angela Denise Peri, Lei Gao, Massimiliano Cavallin and Vito Zaccaro, affiliated with the University of Genoa, Department of Architecture and Design (DAD).

Within the workshop framework, students developed independent conceptual projects related to the themes explored in this study. While these student projects are not included in this publication, the studio served as a valuable space for reflection, experimentation, and the testing of design hypotheses.

Special thanks go to Architect Vittorio De Jorio and Engineer Giangiacomo Zino for their consultancy and passionate support during the development of the workshop activities.

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Technology and Science for the Ships of the Future
V. Crupi and V. Bucci (Eds.)
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