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The Dreams and Challenges of Bangladesh's Shipbuilding Industry

Hossain K A[1*], Aminul Islam[2], Khandakar Anika Akhter[3] and Khandakar Adiba Akhter[3]

[*1]Vice Chancellor, Bangladesh Maritime University, Dhaka, Bangladesh
[2]Administrative Officer, Bangladesh Maritime University, Dhaka, Bangladesh
[3]Department of Accounting & Finance, North South University (NSU), Dhaka, Bangladesh

Corresponding author: Hossain K A, Vice Chancellor, Bangladesh Maritime University, Dhaka, Bangladesh.

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Abstract

Bangladesh possesses a long shipbuilding heritage and a young, low-cost workforce, yet its share of the USD 200 billion global shipbuilding market remains marginal. This study examines the potential and constraints of Bangladesh's shipbuilding industry using a mixed-method design that combines secondary market and technology analysis with primary qualitative evidence from 695 stakeholder engagements (structured and semi-structured interviews and focus group discussions) conducted between May 2022 and March 2026 across shipyard workers, owners/managers, engineers, government officials, NGO representatives, academics and foreign experts. Primary data were analysed through qualitative thematic synthesis of interview and FGD content, triangulated with secondary industry data (global shipbuilding trend and forecast reports) and a SWOT-based assessment of the local industry. The findings indicate that Bangladesh's principal advantages lie in low-cost skilled labour, a long coastline, and a growing pool of technical graduates, while its main constraints are weak backward-linkage industries, limited adoption of smart and digital shipbuilding technologies, inconsistent government policy support, and infrastructural limits such as shallow river draft. The study estimates that Bangladesh could realistically target a 2–5% share (approximately USD 10 billion) of the projected USD 500 billion global market by 2035, primarily in the small-to-medium vessel segment (1,000–30,000 DWT). The paper contributes an empirically grounded, stakeholder-informed assessment of the sector - an area where prior studies have relied largely on secondary data - and offers policy and industry recommendations for technology adoption, workforce development and export-oriented shipyard zoning.

Keywords: Ship, Smart shipyards, Smart port, Advanced technology, AI, ML, IoT, Shipbuilding market

Introduction

Despite Bangladesh's long shipbuilding heritage, low-cost skilled labour and its 2008 entry into the global ship-export market, the country retains only a marginal and inconsistent share of the global shipbuilding industry. Existing studies on the sector remain largely descriptive or based on secondary data, with limited systematic, stakeholder-informed analysis of its opportunities, constraints and technology-adoption gaps. This matters because policy and investment decisions are currently made without a clear, evidence-based picture of what workers, managers, regulators and international counterparts identify as the industry's real strengths and -

and barriers. This study addresses that gap by combining a review of global and local shipbuilding trends with primary stakeholder evidence to (i) assess the capacity and capability of the local industry, (ii) identify perceived opportunities and challenges, (iii) evaluate the sector against global technological trends such as smart and digital shipbuilding, and (iv) derive policy-relevant recommendations for sustainable growth.

Shipbuilding is a primitive yet technologically diverse industry that stimulates numerous backward and forward linkages, encompassing the design and construction of inland and ocean-going vessels [1]. Because shipyards employ large workforces and operate in a globally interconnected market, the sector has historically suffered from weak international oversight and over-investment, while also attracting significant government subsidies that make it appealing to emerging economies [2]. After World War II, Japan rebuilt its industrial base through shipbuilding in the 1950s–60s; South Korea followed in the 1970s, later overtaking Japan by 2003 due to lower wages, strong state support and a weaker currency; China then became the world's largest shipbuilder by 2009 through similarly strong government backing [3-4].

Shipbuilding remains an attractive industry for developing nations aspiring to the trajectories of Japan, South Korea and China. As Asia and Africa's middle classes expand and Chinese labour costs rise - shrinking China's share of tankers, multi-purpose, cargo and small/medium container ships - new opportunities are emerging for countries like Bangladesh, Brazil, India, Vietnam, the Philippines and Turkey [5]. Bengal has a rich indigenous shipbuilding heritage rooted in traditional boat construction [6]. Ibn Battuta brought back a ship built in Sonargoan, Dhaka, after his 14th-century visit; some of these vessels remain on display in European museums. European traveller Caesar Frederick [7] noted Chattogram as a major centre for ocean-going ship manufacture by the mid-15th century. Chattogram built vessels for the Sultan of Turkey in the 17th century and produced significant numbers of ships for Mughal naval forces, as well as wooden-hulled British Navy battleships later used at the Battle of Trafalgar in 1805. The German Navy also built the frigate Deutschland (1000 dwt) in Chattogram in 1818 [8, 3, 9].

Modern ports increasingly deploy smart technologies - AI, Machine Learning, Deep Learning, IoT, Artificial Neural Networks, Data Science, Big Data, Blockchain and Automation - to streamline operations and reduce environmental impact [10]. These tools optimise logistics using shipping and cargo data, automate operations to cut manual labour, and improve efficiency [11]. They also enhance design and construction, detect anomalies, and predict incidents, improving safety, security and compliance [12-13], while supporting sustainability through optimised energy use, waste management and environmental monitoring. Smart shipyards apply sensors, data analytics, augmented reality, digital twins and blockchain [12, 14] to improve production timelines, reduce waste and emissions, and better serve stakeholders - though economic gains depend heavily on supply chain collaboration with suppliers and logistics partners, alongside quality assurance and timely delivery.

The global shipbuilding industry currently faces inflation, geopolitical tension, overcapacity, low margins, trade distortions, subsidisation and war-related disruptions. Despite this, Asia - led by China, South Korea and Japan - dominates the sector due to favourable politics, economic stability, durable rules, strong state support, low labour costs and extensive linked industries [15], while Europe and America remain niche markets. As a capital-intensive industry producing high-value units rather than mass-market goods, shipbuilding demands consistent government policy, strategic management, political stability, and adherence to safety norms and global benchmarks [11]. The goals of smart shipbuilding and the Fourth Industrial Revolution are intelligent shipyards marked by close stakeholder cooperation, resource efficiency, ergonomic design and flexibility [16]. Realising growth in Bangladesh's shipbuilding sector requires balancing strategic investment, government support, technology adoption and workforce development. Drawing on primary stakeholder data and secondary literature, this paper examines local and global trends, potential, challenges and technology to chart the sector's future.

Literature Review, Research Gap and Methodology

Literature Review

Today, smart ports and shipyards are defined by the combination of automation, digitization and AI, enabling near-continuous operation with minimal human interaction [11, 17], which considerably boosts efficiency while lowering labour costs [14]. This dynamic optimizes production costs, improves operational efficiency and ensures optimal resource use, with timely, accurate data playing a central role.

Smart shipbuilding is also more environmentally beneficial, aiming to cut carbon emissions and protect marine habitats [18], as modern shipyards increasingly adopt renewable energy, sustainable methods and smart technologies to reduce environmental footprint while sustaining growth and revenue. Smarter shipbuilding and port systems are further designed for greater connectivity with logistics and industrial networks [19], enhancing supply chain efficiency and reducing shipping delays through advanced coordination of commodity transport, information exchange, workforce management and production. These industries also follow an open innovation model, continuously improving design, operations, construction, safety and efficiency by adopting new technologies and ideas. However, even minor disruptions in large shipyards can have severe consequences - for ports, this can mean empty shelves and fuel shortages within days, as zero-inventory, just-in-time global trade systems break down [14]; similarly, cyberattacks on energy or automated systems pose major risks to shipbuilding and the broader economy [12].

Shipbuilding is a capital-intensive, globally oriented, technology-centred heavy industry with extensive forward and backward linkages [1, 20, 2, 21], and export-oriented smart shipbuilding is inherently global [22]. Bangladesh, with its historic shipbuilding tradition and affordable, abundant young workforce, can build small and medium ships (up to 10,000 DWT) to international standards at 10–30% lower cost than Japan, Korea, China or Western countries [4]. Yet in the era of digitization and the Fourth Industrial Revolution (4IR) - which integrates AI, ML, DL, DS, IoT, blockchain, digital twins, big data, cloud computing, simulation, AR/VR, 3D printing, advanced materials and automation [12, 14] - shipbuilding 4.0 [3, 23] aims to create flexible, resource-efficient, profit-maximizing smart shipyards with tight integration across shipowners, builders, suppliers and stakeholders. Developing countries can no longer rely on cheap labour alone; productivity and technology-skilled personnel are now essential. Without building a technology-ready workforce, Bangladesh risks losing this critical opportunity for sustainable economic growth [11, 13].

Research Gap and Questions: There is a gap that exists in exploring the potential and capabilities of the local shipbuilding industry and demonstrating the opportunities and challenges of this sector. It is important to examine what resources and potential the local industry has and what it does not have. There are various different research questions as indicated below:

a. How can the shipbuilding industry contribute to the economy and sustainability of Bangladesh?
b. What are the best cost-effective investment techniques for local shipbuilding, including government incentives?
c. Estimate the global shipbuilding market and estimate the local opportunity in value?
d. What are the barriers (know-how, educational, skill, financial, knowledge, technology) to shipyard owners for adopting profitable, sustainable and safer practices?
e. What are the practical and appropriate shipbuilding or ship-construction processes (design and production) in the context of Bangladesh in the framework of smart shipbuilding?
f. How can local shipyards be orientated with and implement intelligent ship building techniques?
g. What is the job opportunity with sustainable economic growth by developing this promising sector?

Research Methodology: This analytical study evaluates local and global shipbuilding trends, the present and future capacity of Bangladesh's shipbuilding industry through detailed SWOT analysis, ongoing technological advancements, global market status, and future market predictions and appropriate segments. The research follows a mixed-method design combining qualitative, quantitative and policy analysis tools. Methodology includes secondary data collection, historical and regulatory research, focus group discussions, quantitative forecasting, comparative benchmarking, and expert validation - offering a comprehensive view of the industry's economic, environmental, regulatory and social dimensions. The study draws on both primary and secondary sources, including stakeholder insights, literature and academic publications. The lead researcher, a naval architect with over two decades of industry and executive-level experience in Bangladesh's shipbuilding and ship recycling sectors, enabled primary data access across administrative, technological and labour domains not typically available to academic researchers alone.

Data Analysis Approach

Primary data from FGDs and structured/semi-structured interviews were analysed using qualitative thematic -

synthesis: discussion notes and interview records were organised by respondent category (Table 1) and by topic theme, with recurring patterns identified across respondent groups informing the Opportunities and Challenges findings presented later. Consistent with the study's qualitative design, findings are reported as themes and illustrative stakeholder perspectives rather than statistical frequencies, since no standardised quantitative survey instrument was administered. Secondary quantitative data on global shipbuilding demand and market size (e.g., ITF, SAJ, Clarksons Research forecasts, cited in relevant sections) were drawn from published industry sources rather than primary respondents, and are presented and cited accordingly. SWOT analysis served as an organising framework to synthesise qualitative findings and secondary data into strengths, weaknesses, opportunities and threats for the local industry (see Opportunities and Challenges sections). This approach, along with its limitations, is discussed further in the Limitations subsection preceding the Conclusion.

Focus Group Discussions (FGDs)

This study employs a mixed-method design, combining secondary data analysis (market predictions from various studies) with over 550 structured and informal stakeholder interviews - workers, engineers, regulators, NGOs, naval architects, professionals, managers, foreign experts, economists, consultants, and local and international shipyard owners - alongside focus group discussions (FGDs). Each FGD used a semi-structured questionnaire with 6–10 participants, covering themes such as perceptions of shipbuilding practice, production optimisation, digital and smart technology adoption, job satisfaction, labour and workplace safety, quality assurance, workmanship, process standardisation, compliance barriers, social livelihood implications, and views on modernisation and cutting-edge manufacturing needs. FGDs helped capture community-level opinions on local and international shipbuilding practices - insights typically absent from macro-level policy research.

To integrate stakeholder perspectives, FGDs were conducted with:

(a) skilled and unskilled shipyard workers;
(b) managers, architects, engineers and admin personnel;
(c) government officers and professionals;
(d) members of classification societies;
(e) quality control specialists;
(f) financial experts, economists and NGO representatives;
(g) domestic and foreign field experts;
(h) shipyard managers/owners; and environmental and labour rights campaigners.

FGDs and informal discussions/interviews were held over 100 times between May 2022 and March 2026, engaging more than 695 participants across various levels - from ministries and government bodies (MOS, MOE, MOD, MOI, MOF, MOFA, MOP, DoE, DoL, DoS, etc.), government organisations (CPA, MPA, PPA, EPZ, Army, Navy, Airforce, BGB, Coast Guard, etc.), shipyards (ASSL, WMSL, KSSL, KSY Ltd, DEW Ltd, CDDL, BN Dockyard, etc.), industries and associations (FBCCI, BGMC, BKMC, BTMC, Bashundhara Group, PHP Industry, Walton, RFL Group, etc.), and universities (DU, BUET, CUET, KUET, KU, NSU, SAU, BMU, BUP, MIST, IUT, Barisal University, BRAC University, Daffodil University, Marine Academies, etc.) - as well as international participants including organisations (IMO, UNDP, WB, JICA, ADB, EU, OECD, ABS, CCS, IRS, NKK, BV, Ardent Marine Singapore, Mitsubishi, etc.) and universities (WMU, Osaka University, University of Yokohama, University of Basel, University of Paris, etc.).

Interviews were conducted individually or in small groups, at varying times and locations based on participant availability. A total of 695 interviews were carried out from May 2022 to March 2026 to gather multi-perspective insights into Bangladesh's shipbuilding industry, spanning operational, technical, regulatory, environmental, professional and academic domains - reflecting experiences ranging from grassroots labourers to global policy advisors. Table 1 summarises the respondent profile.

All foreign experts were interviewed physically, virtually via structured digital questionnaires and Zoom sessions, or through standardised written response forms. Their perspectives were essential for assessing international perceptions of Bangladesh, identifying compliance gaps, and understanding what global ship-owners need to view Bangladesh as a viable long-term shipbuilding/recycling destination. The 35 foreign experts were selected based on active involvement in:

(a) classification societies (BV, CCS, DNV, LR, ClassNK, RINA, IRS, etc.);

(b) international funding agencies (IMO, UNDP, JICA, World Bank, ADB, environmental units);
(c) technical consultancy in global shipbuilding (Japan, China, South Korea);
(d) shipyards (China, Japan, South Korea, UK, USA, Canada, India, Pakistan, etc.); and
(e) foreign universities (WMU, Osaka University, University of Yokohama, etc.).

Respondent Type	No	Age Range	Gender (M/F)	Typical Role/Qualification	Location
Shipyard Workers	395	18–50	246/149	Semi-skilled/unskilled laborers	Dhaka, Khulna, Narayanganj, Barisal, Chattogram
Shipyard Owners/ Managers	55	35–65	55/0	Business owners, managing directors	Dhaka, Khulna, Narayanganj, Barisal, Chattogram
Engineers/Technicians	95	25–60	91/4	Mechanical/Marine/Naval Architects	Yard premises, BUET, CUET, Foreign
Government Officials	39	30–60	25/14	Ministry of Industries, DoE, BSRB, Customs	Dhaka, Narayanganj, Khulna, Chattogram
NGO/CSO Representatives	34	25–55	19/15	Environmental and labor-rights activists	Dhaka, Khulna, Chattogram
Academics, Researchers	42	30–70	22/20	Professors, policy researchers	Dhaka, BUET, CUET, BMU, DU, etc., Foreign
Foreign Experts	35	35–65	32/3	HKC/EU/IMO consultants, class surveyors	Dhaka, Chattogram, Remote, Online,
Total	**695**				

Table 1. Respondent Categories and Summary Profile

History and Trend Analysis of Global and Local Shipbuilding

The modern shipbuilding industry began in the 1860s with the shift to iron ships and steamships, which soon replaced sailing vessels due to their reliability and profitability for longer voyages. By the late 19th century, the United Kingdom led the world, building roughly 80% of global tonnage between 1892 and 1894. From 1900 to 1950, other European nations - Germany, France, and the Netherlands - captured 20–40% of the market. Lloyd's Register data show that a country's shipbuilding share tended to track the size of its national fleet, though the European sector declined sharply after 1986. UK dominance began fading during WWI, after which the United States rose to control about 55–60% of the market. US output peaked during WWII at 85–90% of global share, then collapsed to just 10% by 1950.

In the 1950s, Japan emerged as a highly competitive shipbuilder through integrated production and strong domestic demand, becoming the world leader by the 1960s with about half of global output. However, Lloyd's Register noted a mismatch between Japan's shipbuilding growth and its national fleet, which held only about 10% of world shipping by 1973 - despite Japan controlling nearly 73% of vessels registered under flags of convenience, a system recognized by the IMO and UNCTAD [24]. This open-registry system, which expanded in the 1970s, further boosted Japanese shipbuilding. Shipping expert Martin Stopford [22] attributed Japan's success to strong competitiveness and effective penetration of export markets, particularly for large tankers sold to independent owners. By the 1980s, Southeast Asia became the industry's center of gravity, with South Korea's rise described as remarkable. In the early 1980s, Japan held 46.5% of the market, Europe 33.5%, and South Korea under 4%. By the decade's end, Japan still led with about 43%, but South Korea had -

grown to 22%, and China had entered the market with a 2.3% share. By 1980, the three East Asian nations together held 70% of the market, while Europe's share fell by 10% [25]. By the late 1980s, the industry's center had fully shifted from the West to the East.

The sector has continued to shift since then. South Korea overtook Japan by 2003, aided by lower labor costs, greater efficiency, strong government support, and favorable currency rates [26]. China then rose to become the top shipbuilder from 2009 onward, during and after the global financial crisis, surpassing both South Korea and Japan using comparable strategies [4]. China capitalized on the crisis by initially focusing on mid- and small-sized vessels - cargo ships, tankers, and container ships. Historically, high labor costs have eroded market share for shipbuilding nations, especially once government subsidies are withdrawn, as seen in the decline of Britain, the US, and other European producers [20, 22]. American and European shares began falling in the 1960s, and these regions now mainly build military and specialty vessels like yachts and cruise ships. Today, China leads with over 45% of the global market, followed by South Korea (~25%) and Japan (~20%) [6, 27]. The industry remains slow-growing and vulnerable to unpredictable demand, along with disruptions such as COVID-19 and geopolitical tensions, including the Israel-Iran conflict and the Russia-Ukraine war [28].

Bangladesh's shipbuilding tradition dates back centuries, with early 19th-century facilities in Chottogram capable of producing vessels up to 1,000 dwt. public shipyards dominated during the Pakistani era, but private companies now lead domestic production. The country currently has over 100 shipyards building fishing, coastal, and inland vessels [2, 29]. In 1979, with FAO support, the Narayanganj-based High-speed Shipbuilding and Engineering Company (HSEC) Ltd built eight grain carriers for the Bangladesh Inland Water Transport Corporation (BIWTC), and later partnered with Japan's Mitsui Engineering and Shipbuilding Industry (MESI) to build four deep-sea trawlers. Two major firms - Western Marine Shipyard Ltd (WMSL) in Chottogram and Ananda Shipyard and Slipways Ltd (ASSL) in Dhaka - have since modernized and secured export contracts [25]. A milestone came in 2008, when ASSL exported Bangladesh's first ocean-going cargo vessel (3,500 dwt) to Denmark and Mozambique, alongside smaller ferries and boats [30].

Bangladesh has since transitioned from a ship-recycling nation to a shipbuilding one, leveraging low labor costs and native expertise to become a small but competitive global player. Despite this progress, the sector struggles to keep pace with global technological advances and faces persistent structural challenges [20, 12]. Success in securing a niche global market share - through the right vessel types and sizes - could support a sustainable domestic industry. Achieving status as a reliable ship-exporting nation will require aligning the sector with international standards, beyond simply meeting local demand. While general studies exist on both global and local shipbuilding, no research has specifically targeted this intersection, motivating this study's analysis of global trends and its recommendations for Bangladesh's sustainable development.

Bangladesh hosts around 100 indigenous dockyards and shipyards, mostly under private management, apart from three public yards operated by the Bangladesh Navy (BN). Private yards often source materials - plates, fittings, engines, and machinery - from the ship-recycling industry in Bhatiary, Chottogram [31-32]. In total, the country has over 200 shipbuilding and repair firms, ranging from small workshops to medium-sized yards, directly employing hundreds of thousands of skilled and semi-skilled workers, with roughly two million people connected to the industry overall. Local yards produce a wide range of vessels, with four shipyards capable of building ships over 10,000 dwt. Bangladesh has long ranked among the world's top three ship-recycling nations, while placing 10th to 15th globally in shipbuilding. Future growth will depend on identifying viable export markets and addressing existing challenges through improved efficiency, smart technology adoption, and workforce development [5].

Assessment of Future Vessel Requirements and Demand

As well as several other features, one of the key factors determining ship scrapping is the average service life of ships. Policy-related factors include environmental restrictions, bunker fuel costs, technical obsolescence, freight rates, new building prices, EOL, or secondhand ship prices, and demolition prices. [9] A ship will normally be scrapped after 25 to 30 years of service, although the timeframe can vary slightly depending on the type of ship and the locality. For example, the usual disposal age for tankers is 25 to 30 years, whereas the average age for container ships is between 17 and 26 years. Bulk carriers have a more diversified lifespan between 20 and 35 years. The share of ships demolished compared to the world fleet rose -

from 1% in 2006 to 3.5% in 2012, before declining to 2% in 2014. From country to country, the disposal rates differ a lot. But on average, disposal rates were low, in line with the growing average age of wrecked boats (Figure 1). The image below illustrates the survivability rates by ship type and age and is used to estimate future trends in vessel demolition. Research has found that tankers tend to survive better than cargo ships and bulk carriers. The survival rate for double-hull tankers is about 25% even after 40 years of service. IMO rules call for double hulls for safety reasons; hence, single-hull tankers are being phased out early. Figure 2 [33, 8, 34-35, 28] shows the patterns of global GDP, seaborne trade, and active fleet expansion.

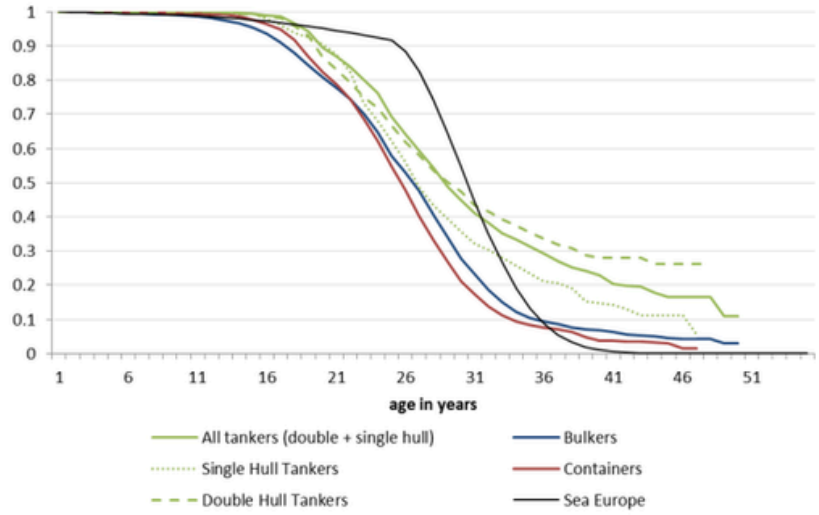
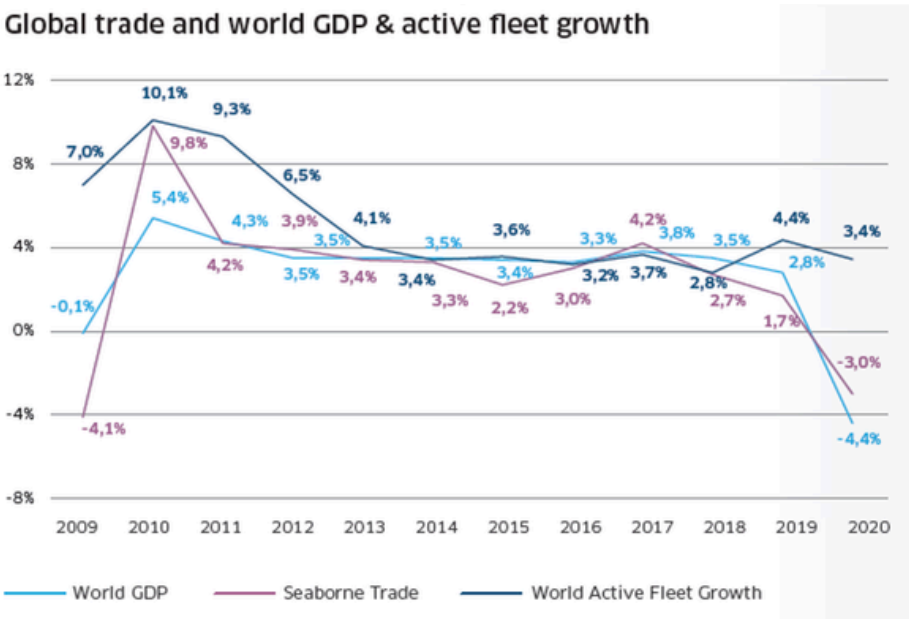


Figure 1: Survival rate by ship age (40, 53, 54)

Figure 2: World GDP, Global Seaborne Trade and Global Active Fleet Growth [6]



(ITF) and OECD have applied a network model [36] to predict international goods transport activity up to 2050 under three world trade scenarios, according to different levels of trade liberalization. They scrutinized extensively. ITF employed equilibrium-based OECD Economics Department international trade models [37]. Figure 3 shows ITF, Sea Europe and SAJ seaborne trade forecasts until 2035. The ITF's network model projects 20.8 billion tonnes of seaborne trade in 2035. By the same year, seaborne trade is expected to reach 16.2 billion tonnes [38-41, 36, 42] in Europe and SAJ. Figure 4 below shows the domestic investment in local shipbuilding in different nations from 2010 to 2015 [20].

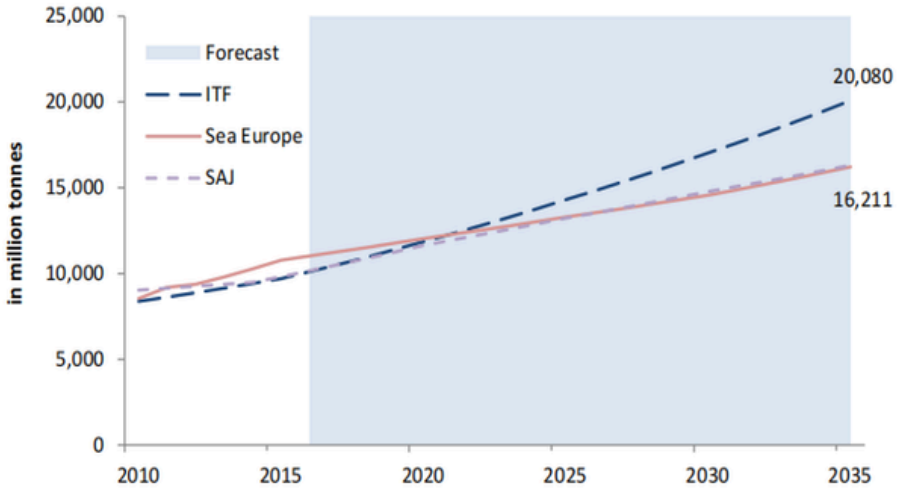


Figure 3: Forecast of seaborne trade from 2010-2035 by IFT, Sea Europe, SAJ, OECD [38-41, 36, 42].

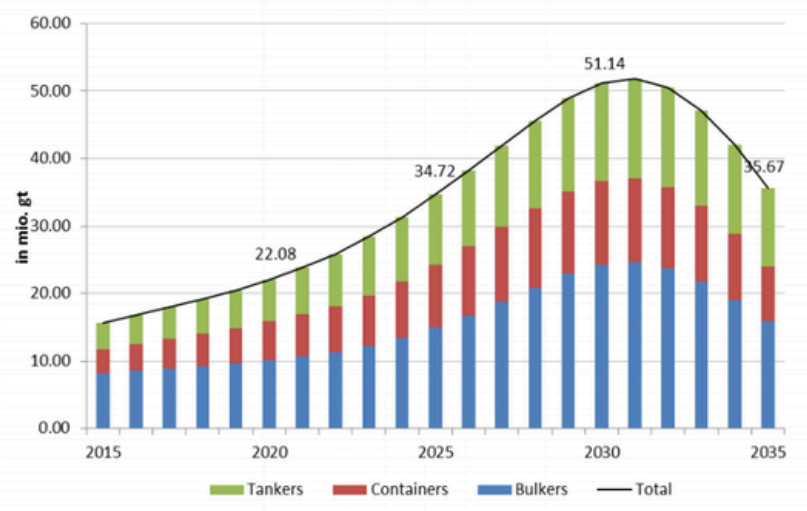


Figure 4: Trend of investment in local shipbuilding by own countries in 2010-2015 [20]

Ship disposals were used to predict future vessel requirements based on the destruction rate and historical data from 2016 to 2035 (see Figure 5). The demand for new vessels is estimated to be over 690 million GT, of which tankers account for 200 million, bulk carriers for 315 million, and container ships for 170 million. Disposal-related requirements will drop off from 2030 as activity declines after the economic crisis. As shown in Figure 6, the total new-building requirements from 2016 to 2035 are expected to be roughly 1500 million GT, which includes 460 million GT for tankers, 710 million GT for bulk carriers, and 335 million GT for containers. If plants do not close, the surplus capacity might remain for 15 years. In 2010, the global population was 6.83 billion, and it is projected to increase to 9.08 billion by 2050. The urban population is rising faster than the whole population, with more than half of the world's population living in cities, and by 2030, an estimated 70% of the total global population will be urban [21, 34]. A larger urban population means a healthy domestic market for goods and services, and it fuels economic growth and innovation, which should be excellent for seaborne trade. Urbanisation may also boost the middle class's consumption of goods and services.

Figure 5: Forecast of future ship requirements related to disposals up to 2035 (IHS Maritime & Trade) [21, 43, 42]

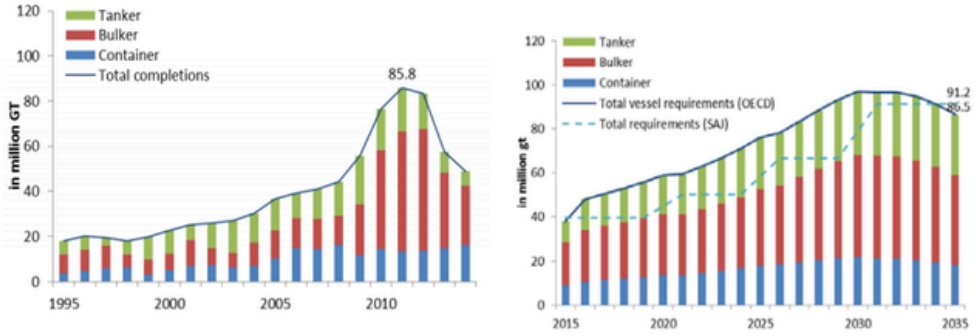


Figure 6: Completions (1995-2014) and forecast of future vessel requirements up to 2035) [34, 43, 44, 45,]

Forecast of Global Shipbuilding Market

The shipbuilding industry is considered one of the most profitable sectors in the world. Transportation is still dominated by ships, and shipbuilding is a key to the national growth of many countries. "R&D collaborations across business lines are generating innovative solutions and services that other units or groups can exploit" (Zakaria et al., 2012 [46]). Modern specialized vessel design and construction are highly technologically sophisticated processes. For instance, nuclear-powered aircraft carriers are essentially floating airports that can transport hundreds of planes and stay on the move across the world for decades at a time without needing to refuel. Similarly, nuclear submarines may stay underwater for up to 6 months and attack from deep beneath the sea unnoticed [5]. Modern cruise ships, oil tankers and bulk carriers are so big; they are like floating cities. The global shipbuilding market is influenced by GDP growth, economic growth, increasing global seaborne trade, increased demand for cargo transportation by sea, trade agreements, technological advancements, market trends related to end-of-life (EOL) ships, marine regulations and maritime transport sector automation [15]. However, considerations such as transportation and inventory costs, environmental concerns, and international crises, such as the COVID-19 pandemic, the Russia-Ukraine war, and the Israel-Iran conflict, may slow down market expansion [13]. The current major players of global shipbuilding are Hyundai Heavy Industries (KR), Daewoo Shipbuilding & Marine Engineering (KR), Samsung Heavy Industries (KR), China Shipbuilding Industry Corporation (CN), Fincantieri S.p.A. (IT), Mitsubishi Heavy Industries (JP), Navantia (ES), General Dynamics (US), Thyssenkrupp Marine Systems (DE), etc. [47]. Currently, shipbuilding stands out with more than 200 billion USD. The global shipbuilding market over the past five years is shown in Figure 7 [47-48]

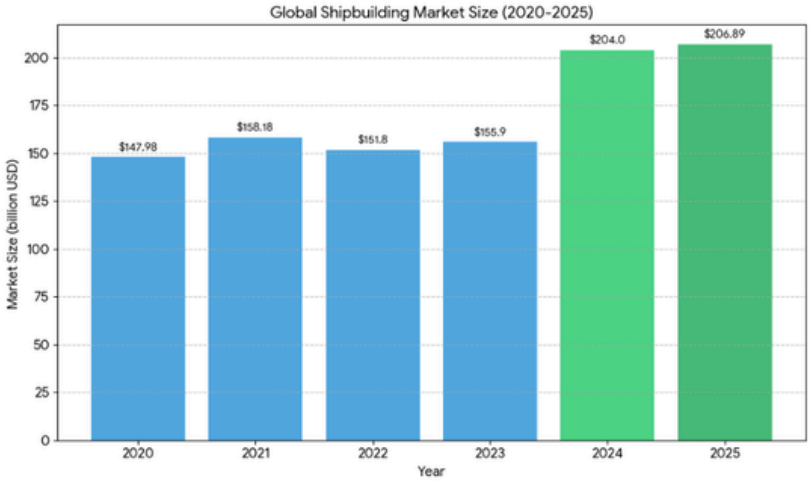


Figure 7: Global Shipbuilding Market by Hellenic Shipbuilding News [48]

Today the global shipbuilding market is undergoing a transformative phase driven by sustainability and technological advancements. North America remains the largest market for shipbuilding, driven by robust commercial shipping activities. However, technological advancements and rising demand for energy-efficient vessels are key drivers shaping the market landscape. Currently, the commercial shipping section continues to govern, while the defense section is perceiving rapid growth due to geopolitical tensions. As per MRFR investigation and forecast, the shipbuilding market Size was estimated at USD 201.4 Billion in 2024. The shipbuilding industry is projected to grow from USD 226.3 Billion in 2025 to USD 500.63 Billion by 2035, reflecting a compound annual growth rate (CAGR) of 8.26% during the forecast period 2025 to 2035 [49], as shown in Figure 8 below. The shipbuilding market is progressively concentrating on sustainability initiatives, with shipbuilders adopting eco-friendly materials and advanced technologies to minimize environmental impact. As a result, this trend reflects a broader commitment to reducing carbon footprints and complying with stringent regulations [47, 50]. In the global shipbuilding market, the application segment is primarily dominated by commercial shipping, which continues to represent the largest share compared to other segments such as defense, leisure, fishing, and research. Additionally, the commercial shipping sector benefits from increasing global trade and the need for efficient transport solutions, driving substantial investment in larger, more advanced and eco-friendly vessels. Meanwhile, the defense segment is gaining traction as nations prioritize maritime security and increase defense budgets, creating extensive demand for naval vessels; the global shipbuilding market forecast up to 2035 is shown in Figure 8 below [49].

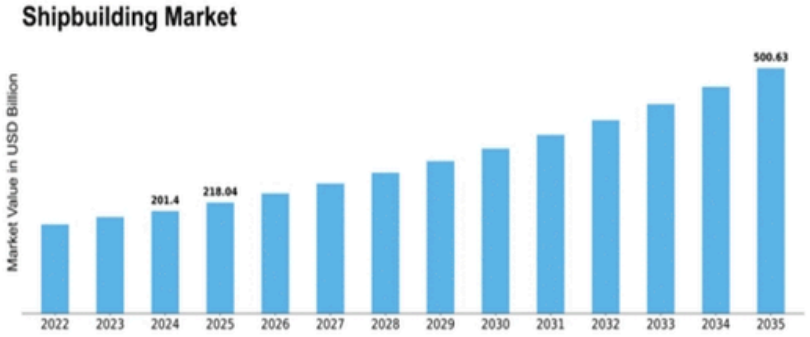


Figure 8: Global shipbuilding market size and prediction up to 2035 by growth and application [49]

Suitable Market for Local Shipbuilding

The middle classes in Asia and Africa are expanding quickly in the 21st century. In the near future, China's market share in small and medium-sized container ships, cargo boats, tankers, and multipurpose vessels may decline due to increasing shipbuilding labour costs [4, 2]. This has created openings for countries like Vietnam, the Philippines, India, Bangladesh, Myanmar, Australia, Turkey and others in commercial shipbuilding. This area has a proud shipbuilding heritage. An empirical study has been made using quantitative and qualitative data-gathering methodologies like Focus Group Discussions (FGDs) with multinational merchant ship seafarers and shipping company staff in Bangladesh to determine acceptable target markets for Bangladesh. Experts say Bangladesh is ideally placed to cater to the niche market for 3,000–10,000 DWT small container ships, tankers, cargo vessels, multifunctional ships and special-purpose ships. Large international shipyards often overlook this location, enabling Bangladesh to compete with lower pricing.

Moreover, other analysts say Bangladesh can also aim for the small- and medium-sized ship market, especially boats in the 3,000–10,000 DWT and 12,000–20,000 DWT ranges, including multipurpose, container, tanker, and cargo ships. Analysts project that these niche markets will remain viable in the coming years. Another potential domestic market is that of building the country’s own merchant fleet to keep the export and import activities of Bangladesh in cargo, energy and other items. The strategic importance of the coastal area of Bangladesh is significant since it is the only direct link to the rest of the world in times of regional crises (about 118,813 sq km) [25]. To safeguard marine corridors, national rights, and economic benefits, the Navy and Coast Guard must be present at all times. The Bangladesh Navy (BN) and Bangladesh Coast Guard (BCG) should send ships to sea to counter both traditional and non-traditional security threats.

Troops moving in coastal areas require the use of both navy and army landing boats. Hence, the requirement for military vessels for peacetime and conflict operational readiness. This scenario provides an interesting niche for the BN-run private shipyards and the huge local interior and coastal commercial fleet. The worldwide shipbuilding market is estimated at over USD 200 billion, and the small shipbuilding segment accounts for around USD 20 billion. International demand for cargo ships of all sizes is large and growing. Reports by UNCTAD, the World Bank, the WTO and the OECD show that the need for container ships is expected to grow continuously in the years to come. The small niche market in shipbuilding is well suited for indigenous shipbuilders in nations like Bangladesh. In the foreseeable future, the globe will need several thousand new ships, primarily small and mid-sized. Furthermore, the existing worldwide fleet of older single-hull tankers must be immediately and in full replaced under IMO rules, creating further demand for new builds in this segment. Thanks to its low prices, China used to be at the top of the shipbuilding industry. However, as living standards grow and labour wages climb in China, the competitive edge has changed. Bangladesh presently enjoys a favourable position with its relatively low labour costs and rising technological capabilities. Analysts expect China to progressively surrender some of its dominance in the small- and medium-scale shipbuilding sector, offering new chances for countries like Bangladesh. The shipbuilding industry of Bangladesh has been exporting small and medium-sized ships and boats to over a dozen other nations since 2009. Based on its present potential and capability, it is predicted that Bangladesh will take at least 2% of the world's shipbuilding industry by 2030 with an annual export value of about USD 10 billion [11]. With the development of a trained workforce, deliberate government investment & precise planning, Bangladesh can produce USD 5 to 10 billion annually from this attractive sector.

There are around 100 indigenous shipyards in Bangladesh. More than 150,000 skilled, semi-skilled and unskilled/casual workers are employed in this labor-intensive industry, and a further few thousand naval architects, marine engineers and skilled shipbuilding workers are employed internationally. About five local shipyards are capable of building ocean-going ships of around 20,000 DWT. A few shipyards are developing facilities and capacity, aiming to enter the export market. The size of the global shipbuilding market is around USD 500 billion, of which the small-ship segment accounts for around USD 50 billion. The small niche shipbuilding market is suitable for local shipbuilders. Bangladesh has the potential to capture 2 to 5% of global shipbuilding market within 2035. Technological breakthroughs such as digitization, robotics, IoT, AI, ML, DL and data science have considerably improved productivity and operational efficiency in shipbuilding. Hence, the increase in labour productivity and the highly skilled workforce are the main factors in the maintenance and growth of this business [5]. Furthermore, maintaining safety standards and ensuring global compliance are still essential for competitiveness in foreign markets [12]. Strategic investments, strong government support, and the ongoing development of qualified human resources are necessary for substantial growth in the 21st century to ensure Bangladesh’s shipbuilding sector confronts emerging challenges and takes its due place in the global market.

Smart Port and Smart Shipping

The notion of smart cities is gaining traction, powered by the expansion of cities and the quick pace of technology. In this context, smart ports are developing into technologically advanced seaports that use data-driven technologies, automation, and digitalization to boost operational efficiency, optimize logistics, increase security, and reduce environmental impact [51]. Smart ports are necessary for the sustainable and integrated development of metropolitan systems and for enabling global trade. Some ports are using advanced digital tools to optimize resource utilization, reduce ecological impacts, and streamline port operations. Port operations are integrating technological advances such as blockchain, AI, ML, DL, DS, IoT, and big data sensors [11]. Automated ports use digital technology such as data analytics and smart sensors to improve their infrastructure and daily operations. These include coordination of vessel movements, monitoring of port facilities and real-time tracking of cargo. These efforts can include, for example, interoperability solutions, digital twin technology, predictive analytics, communication systems, cybersecurity tools, supply chain integration, and augmented and virtual reality applications [14]. AI is a general-purpose and adaptable technical advance in this digital shift. The applications are vast and include automation, robotics, language translation, image processing, decision-making, online banking, digital healthcare, credit evaluation, web-based commerce, innovative farming and many others [52]. Artificial intelligence and smart technology will strongly drive the future of the shipping and shipbuilding industries [12].

Figure 9: AI transforming shipping sector and future port operation [53, 16]

AI enables machines to sense, interpret, act and research scientific subjects. The term 'machine learning' (ML) was coined by Arthur Samuel in 1959. ML algorithms learn from data to enhance AI accuracy and performance. ML is an algorithm which improves an AI system [12]. It fights spam, scams, and phishing [54]. AI algorithms can reduce transit time and fuel consumption by optimizing routes and schedules based on real-time traffic, weather, and vessel data. DL is a multi-layered neural network. The neurons in the brain [38] constitute a neural network. Causal factors are connected through strong prediction tools, specifically artificial neural networks (ANNs). ANNs process large datasets of observations of natural phenomena and possible impacts. DL and ML are subdomains of AI and ML, respectively. Lastly, DS needs all the attention. Data science is an interdisciplinary field that uses all the methods to analyze and extract knowledge from data. Today, autonomous ships are monitoring the ocean; AI-based satellite data processing [55], passive acoustics, remote sensing and other environmental monitoring applications use ML or DL [22]. In modern port operations, ML, DL, ANNs or DS are used to improve efficiency, reduce expenses and improve performance. These technologies enhance port administration through data-driven decision-making, predictive analytics, and automation [17].

Artificial intelligence, in its most general sense, is the ability of machines, especially computers, to behave intelligently [56]. AI is currently widely used in both industry and academia, similar to the steam engine, internal combustion engine, electricity, or computers [12]. The application of artificial intelligence and related technology in modern port development is also leading to the emergence of smart or automated berths, which are fitted with automatic mooring systems, shore power connections to cut emissions, and clever, energy-efficient lighting systems. These upgrades are part of a broader trend to modernise port facilities to match contemporary demands better. Smart ports also spend a lot of time on security, not just in building and maintenance. One important part is reviewing and upgrading port management software, including yard management, berth scheduling, and terminal operating systems (TOS). Port facilities are a whole range of infrastructure and services that need to be maintained and operated efficiently to guarantee a smooth flow of goods as well as safety, security and environmental sustainability. The way in which port facilities are managed is changing due to digitalisation. Innovations such as collaborative platforms for stakeholder collaboration and Port Community Systems (PCS) are examples of the implementation of smart technologies. Smart ports use digital tools, including automation, sensors, data analytics, and the Internet of Things (IoT) to improve port operations. The technologies allow for real-time monitoring of cargo loading and unloading, infrastructure status, and ship movements, leading to enhanced efficiency and fewer delays.

This allows for a more efficient overall operation and less downtime; advanced technologies are being developed to integrate all aspects of port operations, including cargo handling, customs clearance, and ship scheduling. Port authorities, shipping companies, terminal operators, customs agencies and logistics providers use PCS to communicate and exchange information. PCS improves transparency, optimizes procedures and supports the smooth flow of commodities through the port. This transition is enabled by smart asset management technologies that track cranes, cars, containers and infrastructure via sensors, RFID tags and -

GPS tracking [14]. These solutions assist in prolonging the life of key equipment, allow for preventive maintenance and increase overall asset utilization. Predictive maintenance approaches are also being embraced, where algorithms analyze sensor data, maintenance histories and operational performance to predict probable equipment faults and arrange repairs ahead of time. This method not only boosts the dependability and safety of port operations but also decreases downtime and maintenance costs. Big data analytics, AI and IoT sensors allow for real-time monitoring of port infrastructure and equipment. ML and DL algorithms can also estimate cargo demand based on prior trends, which helps ports manage inventories, labour, and resources [10].

Figure 10: An automated port [57] and their smart activities [58]

As AI and other smart technologies continue to evolve, the maritime industry will witness more autonomous vessels crossing the high seas. These smart ships will contribute to enhanced safety, reduced operational costs, improved management and increased overall efficiency. The future of AI integration in the shipping sector will be shaped heavily by digital technologies and the IoT. IoT devices will generate real-time data on vessel performance, cargo status and environmental factors that AI algorithms can process to optimise operations [11]. AI will enable the maritime industry to reach sustainability by optimising fuel consumption, reducing pollution, and improving supply chain efficiency. AI-driven solutions will help shipping companies satisfy environmental regulations and sustainability goals. AI should assist in creating more advanced predictive analytics solutions. These technologies will enable industry players to make data-driven decisions and stay ahead of the market dynamics. However, AI, ML, DL, DS, blockchain, and other smart technologies demand large expenditures on hardware, software, and expert labour. Such large upfront costs might be a burden for small- and medium-sized shipping companies. Technology use entails the gathering and handling of massive data, and this exposes the technology to privacy, cybersecurity, and safety hazards.

Smart Ship and Shipbuilding

A ship's average lifespan is thirty years, so shipowners and operators focus on keeping fleets safe, efficient, and operational as long as possible - balancing compliance with current standards and preparation for future ones [59]. Smart ships offer benefits like improved operating efficiency, increased safety, and environmental sustainability. While not all smart ships are autonomous, autonomous vessels are a subset of smart ships. They use digitized alarm monitoring, power management, dynamic positioning, integrated navigation, and electronic engines to optimize onboard and onshore operations, generating higher volumes and frequencies of data [60]. Making ships "smart" requires deliberate study and action: data must be gathered, analyzed, and delivered to the right person at the right time. This involves collecting data, identifying patterns and trends, and contextualizing it for decision-making. Dashboards then translate this into insights, notifications, and alerts, while also predicting and simulating optimal scenarios to improve understanding of ship performance and support operational decisions [61].

Figure 11: Smart Shipyards and their activities [62-63]

Retrofitting current technology onto existing ships to build "smart" ships is one way to address industry challenges. Advanced technologies and digital tools can increase efficiency, save cost, meet regulatory criteria, and enhance safety measures for shipowners [64]. The marine sector is increasingly adopting smart ship technology, revolutionizing operations through improved efficiency, safety, and sustainability. Smart ship technology involves integrating IoT, AI, DL, ML, big data, and blockchain into ship systems, using intelligent sensors and data analytics tools to monitor and optimize operations in real-time [65], enabling predictive maintenance that prevents unexpected breakdowns and costly repairs.

Smart ships use algorithms and data analytics to optimize fuel economy, route planning, and cargo handling, drawing on sources like weather forecasts and traffic patterns to make cost-effective, environmentally conscious decisions [66]. Automation, advanced navigation, real-time monitoring, and predictive maintenance improve situational awareness, reduce human error, and prevent equipment failure, while easing crew burden and improving safety. AI-powered analysis helps predict equipment faults and schedule preventive maintenance, and smart systems can send early warning alerts for potential threats. Smart ships adopt cybersecurity measures to prevent cyberattacks [67] and monitor pollutants in real time to meet environmental guidelines, increasingly incorporating sustainable energy solutions like hybrid propulsion and renewables [68]. Smart ships generate detailed performance and emissions reports supporting regulatory compliance, with emissions closely monitored against strict standards. Safety is paramount in maritime operations, and smart technology enhances it through real-time monitoring and AI analytics that detect risks, predict malfunctions, and issue early warnings [69], improving navigational safety while lowering operational hazards. As the maritime industry matures, integration of IoT, AI, ML, DL, blockchain, and big data is expected to increase, unlocking new capabilities [70], transforming the industry's efficiency, safety, performance, and sustainability [71]. Modern smart ships will feature digital certificates, supercomputer code, and advanced technological infrastructure promoting innovation and sustainable supply chains. Smart contracts - code executed by computers - could transform many global business contracts [72]. In 2017, several IMO member states proposed amending the Maritime Safety Committee's agenda for a scoping study on safely integrating Marine Autonomous Surface Ships (MASS) into IMO standards [73]. Amid competitive pressure to reduce crew sizes and costs, growing focus on efficiency and carbon reduction is driving demand for AI, automation, and smarter navigation, central to the 4th industrial revolution and autonomous ship development [74], with public-private partnerships in China, the EU, Korea, and Japan driving eco-friendly autonomous vessels.

Smart ships are reshaping ship design and operation, affecting shipbuilders, shipping businesses, owners, and system providers [75]. Real-time remote vessel monitoring worldwide will boost safety, efficiency, confidence, and supply chain integration. AI will improve vessel autonomy and crew environmental awareness [76], reducing human error and accidents through stronger decision-making algorithms and management systems.

- Smart contracts combined with blockchain and IoT enable transparent shipment tracking across the shipping value chain, automating procedures and boosting security [77-78]. A decentralized blockchain with smart contracts creates an immutable, transparent shipment record from origin to destination, letting stakeholders track shipments in real time. Cryptography and consensus methods ensure data integrity and prevent fraud [79], though scalability, integration, and regulatory challenges remain for wider adoption.

- Augmented reality combined with big data analytics offers an immersive navigation experience, overlaying computer-generated images, video, and GPS data onto the physical environment [80]. Sensors and connected systems generate vast data volumes to improve ship and fleet efficiency, with integrated onboard-onshore networks using satellite communication to analyze condition data in real time [81], including position, speed, wind speed, fuel flow, shaft torque, RPM, and pollution data [82]. Mandated ECDIS use, the new EU MRV law, and demand for transparency will drive greater reliance on data transmission this decade [83], boosting output while reducing man-hours through automation.
- Cloud technology simplifies managing off-site and on-site workforces, making cloud computing a major part of the 4th industrial revolution [84], delivering on-demand resources, software, and knowledge over the internet [85] and helping shipowners establish centralized data systems. Cloud services are classified as public, private, or hybrid [86]; public services constrain sensitive data sharing through private policies disclosing only essential information [87].
- IoT connectivity enables real-time collection of shipment condition and location data, automatically processed through smart contracts [88] to optimize routing. Blockchain enables real-time tracking, enhanced security, and automated smart contracts, reducing fraud and ensuring data integrity [89] while streamlining compliance inspections and giving all supply chain participants equal visibility [90].

The IMO has established a legally binding framework to cut global shipping greenhouse gas emissions to net-zero by roughly 2050 [91], with carbon intensity projected to fall at least 40% by 2030, reducing CO_2 emissions per unit of transport effort from 2008 levels [92]. Seaborne trade is expected to grow around 35% by 2050; a shift toward a circular economy will reduce coal and oil transport, while container ships, gas carriers, and offshore wind vessels are projected to grow, with sustainability and digitalization shaping the industry's future [93]. Shipping is the most energy-efficient way to move large cargo volumes, yet international shipping contributes about 3% of total greenhouse gas emissions, comparable to aviation but with higher sulfur and particulate contributions [94].

The shipping industry is undergoing a major technical revolution, with terms like "smart ship," "autonomous ship," and "electric ship" representing distinct concepts and levels of technological development [95]. China's CSIC launched an unmanned freighter, and Japan launched a Smart Ship Application Platform project [96]. Europe's Munin project targets an unmanned vessel by 2035; Yara Birkeland and Kongsberg pursue automated deliveries to eliminate 40,000 trucks; Hyundai develops maritime ICT systems; Finland is establishing AAWA with Inmarsat and DNV-GL [97], with Maersk and IBM investing. The IMO considers current automation Level 2, suggesting fully autonomous ships could arrive within five years, though target Level 4 automation may be 10-30 years away [98].

Smart ships are designed and built using AI, ML, DL, blockchain, and big data across propulsion, internal systems, and manufacturing. Hull plating uses advanced materials like glass fiber, carbon fiber, and reinforced polymers (GFRP), alongside adaptive damping systems and composite sandwich panels with phase-changing material (PCM) for insulation on refrigerated cargo ships [99]. PCMs absorb and release thermal energy through phase changes, useful for thermal storage and temperature control [100]. Digital twins enable concurrent development with physical products, supporting continual lifespan optimization [101]. Automation - robotic welding, assembly, and integrated power management, navigation, and alarm systems - generates more data and boosts efficiency [102], optimizing performance across varied conditions while reducing maintenance costs and increasing cargo capacity through lightweight composites [103]. Not all smart ships are fully autonomous [104].

Shipping companies have shown renewed interest in high-speed craft (HSCs) for short-haul transport, with technological developments making previously overlooked hydrofoils competitive again [105-107], aided by lightweight materials like fiber metal laminates and composite sandwich materials [108-111]. Modern C-drive arrangements use a two-stage reduction system with an aluminum alloy upper gearbox and a contoured lower gearbox with contrarotating propeller shafts, providing propulsive thrust and azimuth rotation for maneuverability and speed control across monohulls and catamarans.

Two double-acting hydraulic actuators achieve thruster azimuth rotation, simplifying construction and reducing weight and cost [112]. The vessel's PODs rotate in azimuth, eliminating rudders and enabling high-precision steering. The lower gearbox's contra-rotating shafts and propellers use interference fit, a technique long used reliably for transmitting torsional stresses [113]. Oil grooves and spiral conduits minimize friction between tapered surfaces, reducing extraction force by up to 90 percent. The hull's drive shaft may use composite materials (epoxy resin and carbon fiber) or cast aluminum alloy [114], while the lower gearbox may be cast in EN 43300 T6 aluminum to boost production speed and cut costs [115], with bearing seats CNC-machined and contra-rotating components made from high-strength steel.

Smart shipbuilding improves efficiency, cost savings, safety, and sustainability across design, construction, and maintenance through AI, automation, and data analytics. Digital twins and simulation tools improve design and speed development [116]. Robotics and automation increase manufacturing speed while cutting labor costs; intelligent systems improve material flow and inventory control. Smart shipyards use pre-fitted components and modular construction to save assembly time [117], reducing physical labor on dull or dangerous tasks. Data-driven predictive maintenance identifies problems early, minimizing waste and improving resource efficiency. Since human error is a major accident contributor in traditional shipbuilding, automated systems and AI-based navigation help reduce errors and detect early equipment failure signs [118]. AI-enhanced solutions improve emergency response, while automation improves manufacturing precision [119]. Smart technologies enhance vessel quality by catching flaws early, maintaining high standards throughout the shipbuilding lifecycle [120]. Smart shipyards can also adopt green technologies like alternative fuels to reduce emissions [118].

Shipyard production, materials, and machinery are now closely integrated with new technologies, with AI becoming as pervasive as steam engines, internal combustion engines, electricity, and computers once were [38, 12]. Ship and port operations utilize ML, DL, ANN, data science, and blockchain to enhance efficiency and performance, enabling data-driven decision-making and automation that advance port administration [17, 121]. Digitalization is transforming shipyard facility management through collaborative platforms ensuring safety, profitability, and timely delivery, with smart shipyards using automation, sensors, IoT, and AI/DL to improve operations and revenue. Smart asset and logistics management systems monitor the location, condition, and performance of essential shipyard assets like cranes, trucks, machinery, and infrastructure [14], improving equipment lifespan and enabling predictive maintenance. Predictive maintenance algorithms analyze sensor data and operational performance to detect probable breakdowns early, increasing safety and reliability while reducing downtime and costs. ML and DL algorithms analyze historical data to forecast future ship demand, supporting better decisions on inventory, manpower, logistics, and resource allocation [10].

AI will become essential to the maritime business, with IoT/AI devices monitoring markets and operations in real time and algorithms improving production, operations, and management [11]. AI will help the sector meet environmental targets through improved fuel economy and reduced emissions, and enhance predictive analytics to offer market pattern insights for competitive decision-making. However, adopting AI, ML, DL, blockchain, and data science requires substantial investment in equipment, software, and skilled staff - high initial costs can be a major barrier for small and medium companies, while extensive data collection and processing raise concerns around data privacy, cybersecurity, and overall security.

Figure 12: Future smart ship and smart shipyard [122]

The shipbuilding industry is about to witness a technological revolution, driven by research and development activities carried out by top organizations in the field. Organizations have taken steps towards making engines efficient and building intelligent ships, which will be faster and more environmentally sustainable than traditional ships. It is crucial to incorporate environmentally friendly shipbuilding practices due to the harmful effects caused by the maritime industry [123]. There are various ways in which the maritime industry can minimize the ecological damage caused through environmentally friendly shipbuilding. Sustainable design, innovative material use, sustainable construction practices, and digitalization and green technology can help achieve environmentally friendly shipbuilding [124].

- Hyundai Heavy Industries (HHI) illustrates how a traditional shipbuilder can reposition itself as a technology company. HHI has been shifting from a conventional shipbuilding model towards becoming a broader maritime-technology provider, investing in intelligent and secure engine-control systems, eco-friendly propulsion and autonomous shipping. The company has developed smart ships fitted with AI-powered navigation systems to improve safety and efficiency, and is exploring ammonia and hydrogen as alternative fuels to cut carbon emissions in line with IMO guidelines. HHI has also partnered with Lloyd's Register to pilot blockchain-enabled class registers, making shipping documentation more transparent and secure [114].
- Shipbuilders are increasingly prioritising fuel-efficient propulsion, since lower fuel consumption reduces harmful emissions and operating costs alike [115]. HHI, for example, is developing LNG- and ammonia-fuelled vessels together with next-generation propulsion systems aimed at cutting carbon output.
- A growing number of shipbuilders are adopting lighter, stronger materials that improve speed and fuel efficiency while reducing wear, maintenance costs and lifecycle expenditure. HHI is developing next-generation materials and propulsion systems in pursuit of faster, more fuel-efficient ships.
- Systems that allow vessels to operate with minimal human intervention are steadily maturing, improving safety and reliability while reducing crewing costs. HHI has run autonomous-shipping demonstrations and continues to invest in digital design tools that shorten development time and cut waste; blockchain can add supply-chain transparency, while IoT sensors improve monitoring and control of onboard systems and reduce energy use.
- Digital design and production tools make it easier to design, build and coordinate ships across the supply chain, improving communication between yards, suppliers and classification societies and catching errors earlier - saving both time and cost, while supporting the design of more energy-efficient vessels.
- Shipyards are increasingly using environmentally friendly materials and construction techniques that reduce harm to marine ecosystems; such practices can also lower long-term costs and ease regulatory compliance [118]. Hybrid and electric propulsion, together with energy-efficient systems such as LED lighting and efficient HVAC, are helping cut both emissions and running costs.
- Lean principles reduce waste and improve production efficiency, while green shipyard practices - renewable energy use and reduced water consumption - lower a yard's environmental footprint. Damen Shipyards has adopted modular assembly and energy-efficient facilities [116], and Fincantieri has introduced solar energy and energy-efficient lighting [117]. 3D printing and digital-twin simulation further cut waste by allowing testing without physical prototyping, while automation improves overall production efficiency.
- Adopting green technology can carry higher upfront costs than conventional processes, and regulatory uncertainty or limited awareness can also slow uptake. Even so, major shipbuilders are moving ahead: Hyundai Heavy Industries, for instance, has adopted solar power and efficient lighting systems to reduce its environmental footprint [120].
- Reducing shipbuilding's environmental impact requires engagement from every stakeholder, from designers to shipyard operators. Clear sustainability targets, workforce training, and closer collaboration with suppliers and customers all help embed a lasting culture of sustainability across the industry.

Capacity and Capability of Local Shipyards

Bangladesh has hundreds of private indigenous shipyards nationwide building and maintaining nearly all inland and coastal vessels, many with long-standing reputations - High-Speed Shipyard Ltd (HSSL) has operated for nearly 60 years. Several private shipyards now meet international standards, exporting small and medium-sized ships, with some building merchant vessels up to 10,000 DWT. Notable yards - Ananda Shipyard and Slipway Ltd (ASSL), Western Marine Shipyard Ltd (WMSL), Khulna Shipyard Ltd (KSYL), and Karnaphuli Shipyards -

and Slipway Ltd (KSSL) - have secured orders from foreign owners in Germany, Japan, Denmark, the Netherlands, the EU, Mozambique, India, and Nigeria, delivering dozens of ships worldwide. Ongoing improvements are opening new avenues for foreign direct investment (FDI) in Bangladeshi shipbuilding [3, 25].

Bangladesh's rich shipbuilding heritage continues attracting local and foreign investors. The country operates about 40,000 inland/coastal vessels and 100,000 mechanized country boats, carrying roughly 85% of oil products, 65% of cargo, and 25% of passengers domestically - all built and maintained by local shipyards. Bangladesh has over 100 indigenous shipyards, including four capable of building certified export-standard vessels up to 10,000 DWT, with others upgrading for export markets. The industry employs about 200,000 skilled, semi-skilled, and temporary workers directly, and nearly two million people directly or indirectly.

As shown in Table 2 and Figure 13, labor productivity in Bangladeshi shipbuilding was 11.43 in 2009, with average hourly pay of just USD 1.00 and a relative labour pay index of only 0.45 - the world's lowest (Table 3, Figure 14). Though wages rose by 2021, they remain among the lowest globally, keeping Bangladesh attractive for cheap labor. However, productivity and shipyard safety remain challenges. Adopting smart technology - modular construction, digitization, robotics, AI, ML, DL, and DS - has become essential to address these issues and stay competitive [12, 10].

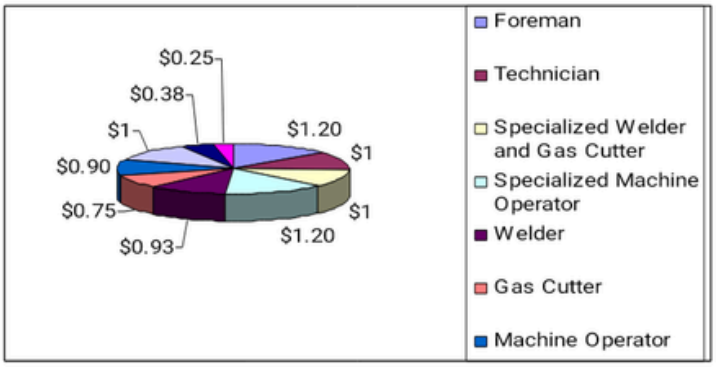


Figure 13: Average labor wage for class ship builds in local shipyards in 2009 [3, 125]

Country	Formula for Labor Productivity = Man-Years/Unit Output (in CGT)	Productivity
Japan	Using basic formula	1
European countries	Same	2
United States	Same	4
China	Same	6
India	Same	10
Bangladesh	Same	11.43

Table 2: Shipbuilding labor productivity of different nations in 2009 (MSC Thesis 2010)

Country	Relative Labor Wage	Country	Relative Labor Wage
Bangladesh	0.45	Canada	11
India	1	Japan	12
China	1 to 2	Italy	13
Singapore	3	France	13
Hong Kong	3	Denmark	13
Taiwan	3	Norway	14
South Korea	6	Sweden	14
U.K.	10	Finland	15
USA	10	Germany	15

Table 3: Relative labor wage for different nations around the globe in 2009 [7]

Many types of boats and ships are built in the local shipyards of Bangladesh. Types of vessels built include multi-purpose vessels, coasters, dry cargo vessels, cargo coasters, passenger vessels or ferries of the lunch type, double decker passenger vessels, tankers, container vessels, landing crafts, tugs, dump barges, supply barges, deck loading barges, self-propelled barges, dredging barges, research vessels, survey ships, hospital ships, tourist ships, inspection vessels, pleasure crafts, yachts, Ro-Ro ferries, crane boats, speed boats, hydrographic survey boats, work boats, pilot boats, water taxis, pontoons, catamaran vessels, sand carriers, troop carrying vessels, fast patrol boats, offshore patrol vessels (OPVs), patrol crafts (PCs), light patrol crafts (LPCs), landing crafts vehicle (LCVs), landing craft tanks (LCTs), deep sea trawlers and other vessels. Currently, the Department of Shipping (DOS) registers close to half of the 40,000 inland vessels operating in the country's rivers and along its sea shore. In addition, more than 100,000 country boats, both manually and mechanically powered, are not formally registered or statistically structured. The Mercantile Marine Department (MMD) keeps a registry of more over 500 coastal vessels. The actual number of ships built by local shipyards is thus significantly higher than the number registered with DOS or MMD. Table 4 [7, 125] gives main data on the most common types and sizes of ships developed for inland and coastal operations in the region including their length (L), width (B), draft (d), deadweight tonnage (DWT) and other specifications.

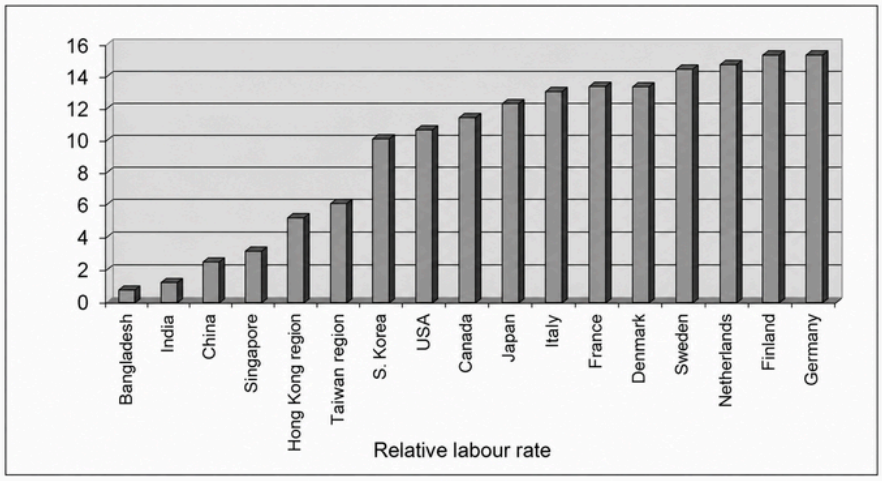


Figure 14: Relative labor rate or wage for different nations around the world [125]

Types of Vessels	dwt or no of passenger	Length in Meter	Breadth in Meter	Draught in Meter	Usually, Ply
Multipurpose ship or Coaster	1500- 4000	60- 120	10- 16	3.5- 6.0	Coastal
Cargo	1000- 3500	50- 100	10- 15	3.0- 5.0	Inland &Coastal
Passenger ship or Launch	300- 1500 Passenger	60- 110	10- 20	3.0- 4.0	Inland
Tanker	1000- 4000	50- 120	10- 16	3.0- 6.0	Inland & Coastal
Sand Carrier	200- 500	20- 40	5- 10	2.0- 3.0	Inland
Barge	200- 1000	20- 60	6- 14	2.5- 3.5	Inland
Dredger	30-100	10-30	4-8	2.0-3.0	Inland

Table 4: Principal data of common types and sizes of ships built locally for inland water

Analysis of Opportunities of Local Shipbuilding Industry

The opportunities below are qualitative themes synthesised from the FGDs and interviews described in the Methodology (Data Analysis Approach), triangulated with secondary industry data; they reflect recurring views expressed by the stakeholder groups in Table 1 rather than statistically weighted survey results.

The Bangladesh shipbuilding industry has the potential to grow dramatically to capture just a small portion of the global market. Bangladesh has the potential to become an important shipbuilding country in the world -

its young and cheap workforce, rich maritime history and abundance of materials. Local shipbuilding industry has indigenous shipyards, a strong tradition of shipbuilding, and a large pool of young workers, all of which generate a fantastic potential for the sector to grow. But it has some specific challenges to overcome and convert into potential to enable sustainable growth. Bangladesh can develop labor-intensive heavy industries like shipbuilding, vehicle manufacture, food manufacturing and mass production with its large and young population. The following definitions give the main potential and potential:

- Bangladesh has the substantial benefit of low-cost shipbuilding labor. Compared to other nations, the country has a large pool of youthful, cheap labour, and its manual welding quality and qualified welders are often better than in countries like China, Vietnam and the Philippines. Bangladeshi marine workers have proved their discipline, sweat, effort, obedience and fast learning power in the international labor market, especially in South Korea, the Middle East, Malaysia and Japan.
- The local shipyards are not well supported by the backup and backward linkage industries that supply materials and components at competitive prices. In Bangladesh, re-rolling manufacturers use the scrap metal from the Bhatiary ship recycling yards to produce a variety of shipbuilding accessories, providing an easily accessible and cheap source of raw materials. Many of the SMEs are playing an active and vital role as backward and forward linkage industries in heavy industries such as shipbuilding.
- Bangladesh is a maritime country and has a long history of ship building. It is very natural that both local and foreign corporate houses are interested to participate in this area. Moreover, the geographical location of Bangladesh with its long coastline and riverbank areas is especially suitable to the development of shipbuilding and other maritime enterprises.
- There is a huge availability of semi-skilled white-collar and blue-collar workers, like naval architects, marine engineers, electronics and IT engineers, management experts, welders, grinders, cutters, mechanics, carpenters, painters and helpers. This workforce can be quickly converted to productive human resources for ship building sector with little training and skill development programs.
- There are more and more vocational training institutes and technical institutions providing trained labor for heavy industry. Shipyards like Khulna Shipyard (KSY), BN Dockyard, Western Marine Shipyard Ltd (WMSL), Karnaphuli Shipyard and Slipway Ltd (KSSL) and Annada Shipyard and Slipway Ltd (ASSL) produce thousands of skilled shipbuilding workers every year who are employed in various trades like welding, cutting, painting, carpentry, blacksmithing, mechanics and electrical works.
- Classification societies are providing strong assistance for quality class-certified shipbuilding and certification of material lists for export-oriented ship construction. Well-known societies such as Germanischer Lloyd (GL), Bureau Veritas (BV) and Nippon KaijiKyokai (NKK) are assisting in the growth of Bangladesh's export shipbuilding capacity.
- The cost of shipbuilding in China has skyrocketed along with the country’s rising level of living. Bangladesh will get opportunities as China will soon lose a part of its market share in the small and medium-sized shipbuilding sector.
- Policy incentives like tax-free activities for export-oriented shipyards, simplified regulations, import taxes on foreign-built ships, strategic development plans for the local industry, river dredging, and coordinated efforts with related sectors will further boost the growth and competitiveness of Bangladesh’s shipbuilding industry.
- The current global financial crisis and geopolitical environment may increase the demand for cost effective ships which can be a good opportunity for the ship manufacturing sector of Bangladesh. The local shipbuilding sector has the ability to earn significant foreign cash and acquire a piece of the global market by producing and exporting high-quality ships. This sector provides a good number of job prospects. There is no shortage of youthful and trainable labor in Bangladesh. This workforce can be trained and developed skills programs to make it meet the worldwide requirements. Additionally, there is a vast pool of semi-skilled white-collar personnel accessible across numerous disciplines who can become highly competent assets for the sector with sufficient training and mentoring.
- Local shipyards are capable of building quality ships at competitive prices. Furthermore, there is a wonderful potential to establish backward and forward linkage industries through overseas partnership and to increase supporting backup industries to boost the local shipbuilding ecosystem. The prospects of the shipbuilding industry to become a major foreign exchange earner for Bangladesh are bright in the next years.

- Considering the imbalance in export-import and the current export deficit of Bangladesh, it is necessary to look for new sectors to reduce this gap. Shipbuilding is a sustainable option that provides major employment opportunities and access to duty-free markets in industrialized countries.
- The shipbuilding sector has significant potential for Foreign Direct Investment (FDI), with China, Turkey, the Netherlands, and Australia showing great interest. Geopolitics is still tense, and many international purchasers, particularly from Europe and North America, are looking elsewhere than China. They typically demand conditions for the employment of their own devices in the vessels ordered, opening up chances for Least Developed Countries (LDCs) and developing countries such as Bangladesh.
- The government and other stakeholders, investors, shipbuilders, ship owners and other associated entities are considering the shipbuilding as a viable sector and it may become an alternative to the Ready-Made Garments (RMG) business very soon.
- Focus group discussions suggest that Bangladesh is particularly well-suited for small and medium-sized shipbuilding. "The country has a chance to take a big share of the global market of multipurpose, container, tanker and cargo ships of 1,000-30,000 DWT", experts claim. These specialty markets for small and medium sized vessels are projected to be strong in the next years.
- Special shipbuilding zone can establish at Matar-Bari, Chattogram area to construct over 50000 DWT vessels.

Analysis of Challenges of Local Shipbuilding Industry

The challenges below are similarly derived from thematic analysis of the FGDs and interviews (Methodology, Data Analysis Approach) and from the SWOT-based synthesis of secondary industry data; they are reported as recurring qualitative themes rather than statistically ranked findings.

The shipbuilding industry of Bangladesh could not be developed timely and consistently due to absence of coordinated initiatives from government, stakeholders coupled with common initiative both in public and in private sector This has led to delayed progress and an inability to effectively break into the global shipbuilding market. The following are the main challenges:

- Bangladesh has a proud tradition of shipbuilding, but has not been able to match the pace and consistency with technological improvements of the world. Availability of inexpensive labour has made many ship-yard operators reluctant to employ modern technologies. Local shipyards are lagging far behind in the application of smart and sophisticated technologies for ship design and construction. Hence their quality assurance systems and product standards are generally below international ones.
- The needs of the industry are far from the curricula of the mainstream educational institutions. The gap can be bridged by more focus on technical and vocational education. Universities and technical institutes have largely missed the development of a trained work force and sustainable human resources due to poor training facilities, outdated curricula, inadequate research infrastructure and attitudinal impediments.
- Policy planners, bureaucrats, bankers and other important players often ignore the potential of the shipbuilding sector. This industry needs the same kind of nurturing support as the Ready-Made Garments (RMG) sector to make real progress.
- The primary local shipyards are situated in and around Dhaka far from the coastal belts, preventing them from building bigger ships. A further key impediment to the development of the shipbuilding sector is the high interest rates on bank loans and service charges. Moreover, international buyers sometimes need bank guarantees, while local banks seek counter-guarantees from foreign banks, which adds expenses and reduces competitiveness.
- Bangladesh does not manufacture class authorized mild steel plates, frames, girders, stiffeners, longitudinal, machinery, fittings and other vital shipbuilding materials and equipment required for the growth of export-oriented shipbuilding. * Weak backward connectivity to support the industry. The shipbuilding sector in Bangladesh is primarily reliant on imported raw materials, resulting in higher production costs and susceptibility to global market volatilities.
- Deterrence of Foreign Direct Investment (FDI) due to sector’s image crisis and Ease of Doing Business (EODB) issues. There is little promotion of company and proactive transmission of information to possible foreign customers. Bangladeshi diplomats abroad should play a proactive role in promoting the sector. Attitudes inside the shipbuilding community need to change too.

- a.The government's financial assistance is not enough to enable local shipyards to adapt to the Fourth Industrial Revolution (4IR) and integrate smart technology because modern technologies are beyond their reach. This technology gap still represents a major obstacle for the sustainable development of the sector [10].
- b.One major drawback is the existence of unethical actions in the industry like dishonesty and attempts to earn illicit gains. Such behaviour engenders mistrust and hinders the growth of goodwill in international markets.
- c.The private shipyards frequently do not have a professional corporate culture and management and key appointments are often dominated by family members. The result is a toxic work atmosphere, characterized by mistrust and lack of confidence that erodes employees' sense of belonging to the firm. Besides, the family industrial legacies which are crucial in the capitalist society are still scarce in Bangladesh.
- d.The technology available at local shipyards remains primitive, contributing to inefficiencies and low production. There is acute lack of advanced shipbuilding equipment, machinery and trained operators especially those with digital and AI-enabled systems skills (34, 35). Bangladesh's ship design still largely relies on foreign expertise.
- e.The industry also suffers from the lack of government support in terms of generating capital and handling financial emergencies which are both crucial for growth and sustainability of heavy industries in any nation. Import LC commissions, counter bank guarantees and other bank mark-ups add to the expenses and reduce the competitiveness of Bangladesh's export-oriented ship building vis-à-vis China, South Korea, Japan, Vietnam, Philippines, India and Brazil.
- f.Countries like Vietnam, the Philippines, Indonesia, India, Brazil and others are aggressively trying to grab the excess and niche shipbuilding markets. This is a serious threat and problem for Bangladesh's shipbuilding sector. Opportunities do not wait forever, local industry needs the guts, clear vision, strategic direction, timely action and political stability to be fulfilled.
- g.Market assessments indicate the global demand for new ships (measured by the Compound Annual Growth Rate or CAGR) is at about 4% currently. While this growth presents opportunities, it also entails considerable risks and increased competition for new entrants and local investors.
- h.Bangladesh's shipbuilding industry is constrained by lack of infrastructure, inconsistent electricity supply, inadequate industrial land and poor Ease of Doing Business (EODB) environment. Besides, image problem, integrity concerns, bureaucratic issues and attitudes of some local investors are dangers to the general credibility of shipbuilding sector of Bangladesh. This harms the ability to sustain the goodwill and establish the confidence of international customers.
- i.Low motivation and job satisfaction of employees due to ineffective management techniques in local shipyards. Common issues facing the sector are indiscipline, frequent absenteeism, and poor retention rates of competent manpower. Besides, there is a continuous brain drain (like naval architects and engineers, managers etc) and trained personnel loss from Bangladesh's shipbuilding industry to international companies, depleting the local talent pool.
- j.The post-COVID-19 global economic recession and severe geopolitical crises such as Russia-Ukraine war and Israel-Iran tensions have negatively impacted the global shipping and shipbuilding markets, leading to order cancellations and a general slowdown in business.
- k.The shallow draft of Bangladeshi rivers (max ~4 metres) limits the size of ships which can be built and launched from local shipyards. Heavy siltation also hinders the maintenance of navigable depths. Moreover, the construction of bridges and overhead cables places constraints on air draughts, requiring a minimum clearance of 22 metres above high-water levels (monsoon) for major rivers, thereby further curtailing ship size and design.
- a.The shipbuilding sector lacks comprehensive and supporting government policies and strategic frameworks. The lack of efficient conception, execution, monitoring and periodic updating of export-oriented shipbuilding policies and plans still hinders sustainable expansion of this industry.

Analysis of Outlook of Local Shipbuilding and Future Perspective

Present State of Local Shipbuilding. Ship building has always been a labor intensive, low tech, heavy enterprise. However, the ship construction has been changed since 1950s with the introduction of high tensile and strong steel with increased physical and chemical properties. [22]. Modern shipbuilding has outstanding -

aesthetic finishing and work precision. Now included are automation and innovative technologies, line production manufacturing methods and a competent workforce. Nowadays block or module construction is often used in shipyards. Large multi-deck parts are built at other locations and transported to the building dock or slipway to be assembled and finish fabrication [20, 25]. The modules are equipped with the equipment, piping, electrical cables and other systems to minimize installation requirements after assembly. Ship design and naval architecture is further aided by model testing in towing tanks or basins. The upcoming 4IR will significantly revolutionize the maritime sector, including shipbuilding.

- Bangladesh has a long and glorious history of shipbuilding and nautical business which has acted as an incentive for the local entrepreneurs as well as foreign investors. In this way the country has gained large foreign currency in this area.
- Over 85 percent of oil products, 75 percent of cargo and 25 percent of people are transported by 40,000 inland and coastal ships and 100,000 mechanized country boats and trawlers. These ships are built and maintained by local shipyards.
- About 100 indigenous shipyards with more than 2 lakhs trained and unskilled workers in their fold.
- Shipbuilding activities directly and indirectly employ around 2 million persons.
- Four local shipyards can build small to medium-size export quality ships (up to 10,000 dwt) and numerous others are upgrading to reach the export market.
- Small ship building accounts for USD 20 billion of the USD 200 billion global ship building business. Demand for container ships and compliance with IMO requirements to replace single-hull tankers will require thousands of small to medium-sized vessels in the next years.
- Government spends less than 5 per cent of its Annual Development Programme (ADP) for canals and water transport and over 70 per cent for roads;
- Local shipyards usually oppose QHSE reforms. Internationalization of these principles requires government pressure, foreign buyer requirements and awareness and training programmes.
- Corporate management culture is usually not a feature of private shipyards. The management is still family-oriented and does not allow professionalism to flourish. The example of ASSL, which failed to maintain its export success because of the family-oriented management.
- The attitude of “getting rich quick” is dominant and is an obstacle to sustained progress. For example, WMSL could not continue its performance in exports due to diversions of investment concentration.
- There is general dissatisfaction with shipyard jobs. Workers are not eligible for industrial advantages such as production bonus, fringe benefits and welfare amenities (medical, pension, travel allowance and compensation). There is lots of cheap labour and owners don’t care about the welfare of employees. This leads to skilled graduates and trained hands migrating for jobs elsewhere.
- Local shipbuilding expenses are 10-20% more than competitors such as China, Korea, Japan, India and Vietnam.
- Industries are not allowed to develop smoothly due to high pricing, poor supply of energy and gas, and poor infrastructure.
- Weak state diplomacy, poor country branding and lack of promotional activities are hindering growth of export shipbuilding.
- The sector is still susceptible and needs considerable interventions to achieve sustainable development and international standards. “Given facilities like the RMG sector, shipbuilding has the potential to generate more net benefits.”
- The workforce has the lowest relative labour pay in the world, yet the productivity is low because of the inexpensive hourly rates.
- The government has a shipbuilding policy to encourage industry. But in its implementation, it must ensure proper appraisal and uniform prioritization to the end that public and private shipyards may gain alike.
- Increasing living standards and rising labour wages in China are projected to push some small and medium shipbuilding market share from China, creating an opportunity for Bangladesh.
- New FDI opportunities have recently arisen with nations such as China, Turkey and the Netherlands showing interest. It could be good for the economy to establish export shipyard zones.
- Bangladesh is suitable for building small to medium sized container ships, tankers, cargo boats, multifunctional ships and specialist ships (1000-30000 dwt) and has the ability to conquer this niche market affordably.

- aSpecial shipbuilding zone can establish at Matar-Bari, Chattogram area to construct over 50000 DWT vessels.
- The report states that Bangladesh can get 2% of the global shipbuilding market share of roughly USD 10 billion by 2030.

Critical Analysis and Future Perspective

Cheap labor alone cannot sustain the shipbuilding sector's growth. While low labor costs have been Bangladesh's competitive edge, modern technology is increasingly essential for cost and global competitiveness. Over-reliance on cheap labor risks weakening Bangladesh's market position as other shipbuilding nations adopt automation and smart technologies. Bangladesh's rich nautical history, advantageous location, and large workforce give entrepreneurs confidence in export-oriented shipbuilding's promising future - ships built to international standards are 10–30% cheaper than equivalents from Japan, Korea, China, Vietnam, or India [4, 20]. However, sustaining this advantage requires technological adaptation. The Fourth Industrial Revolution (4IR) is reshaping the maritime and industrial sectors. Where the first industrial revolution relied on water and steam, the second on electricity, and the third on electronics and IT-driven automation, 4IR digitalizes physical production through AI, ML, DL, DS, IoT, blockchain, digital twins, big data analytics, cloud computing, virtual/augmented reality, simulation, human-machine interaction, 3D printing, and advanced materials [12, 14]. Cheap labor and a young population are no longer sufficient drivers of industrial progress - productivity and skilled labor are now paramount. If Bangladesh fails to develop a trained workforce from its youth, it risks missing this critical economic opportunity and falling behind globally. The industry is approaching 6th Generation Ports (6GP) capable of handling megaships up to 50,000 TEUs with 20-meter drafts, advanced automation, and strong hinterland connectivity - signaling a broader transformation across shipping and shipbuilding. The core aim of 4IR in shipbuilding is creating intelligent, adaptive, resource-efficient shipyards that closely integrate shipowners, builders, suppliers, and stakeholders across the value chain [12, 23]. Without smart technologies and innovative design and construction methods, Bangladesh will struggle to produce globally competitive, safe, quality ships that satisfy customers. The sector needs a balanced, strategic approach - viable planning, sustained government support, adequate financing, operational discipline, workforce development, and smart technology integration [13, 11]. With the global shipbuilding market exceeding USD 200 billion (small ships: USD 20 billion), Bangladesh could capture USD 4 billion through coordinated investment, technology upgrades, and human resource development.

Limitations

This study has several limitations. First, primary findings are based on qualitative thematic synthesis of FGDs and interviews rather than a structured quantitative survey instrument; consequently, the opportunities and challenges identified reflect recurring stakeholder perspectives rather than statistically weighted rankings, and formal inferential analysis (e.g., significance testing across respondent categories) was not possible. Second, market size and forecast figures are drawn from secondary industry sources rather than derived from primary data and should be interpreted as such. Third, as the lead researcher's professional background provided access to respondents, some selection bias toward industry-connected stakeholders cannot be ruled out. Future research employing a structured quantitative survey instrument alongside qualitative methods would allow statistical validation of the themes identified here.

Conclusion

The shipbuilding industry involves numerous entities - shipyards, equipment manufacturers, technical manpower, knowledge networks, and service providers. Historically, the UK built about 80% of the world's ships by gross tonnage in 1892, driven by its global trade dominance and colonial demands for large merchant vessels, but the sector declined after WWI. The US then became the shipbuilding center, peaking at 85-90% market share during WWII's wartime demand before collapsing afterward. Japan led in the 1950s-60s, followed by South Korea's rapid rise in the 1970s-80s, and China's emergence as the current global leader in the 2010s through large state-funded investments. Bengal's shipbuilding heritage spans centuries. Ibn Battuta visited Bengal in the 14th century and returned home on a wooden ship built at Sonargaon, Dhaka - now housed in European museums. Chattogram was a renowned shipbuilding center noted by European visitor Caesar Frederick in the 15th century, later building a fleet for the Sultan of Turkey in the 17th century -

and numerous Mughal warships. In 1805, Chattogram-built wooden vessels served the Royal Navy at the Battle of Trafalgar, and in 1818 the German Navy acquired the frigate Deutschland from Chittagong.
Bangladesh's promising outlook is supported by growing export interest and foreign investment from China, South Korea, Japan, Turkey, and the Netherlands, making specialized export shipyard zones and effective strategies essential. Globally, shipbuilding faces overinvestment, inflation, overcapacity, thin margins, trade distortions, subsidies, financial crises, COVID-19 impacts, and shifting geopolitics - reflecting its slow-moving, market-sensitive nature. The current global shipbuilding market is worth approximately USD 200 billion (small ships: USD 20 billion), projected to reach USD 500 billion by 2035 (small ships: USD 50 billion). Bangladesh could capture 2-5% of this global share, equivalent to USD 10 billion. This study recommends government support, sustainable policy, advanced technology adoption, modern manufacturing processes, workforce skill development, foreign direct investment (FDI), and comprehensive effort as essential for sustainable growth. Bangladesh's strategic location, maritime heritage, and competitive pricing in small-to-medium ship segments (1,000-30,000 DWT) position it to capture this niche market, with a special shipbuilding zone proposed at Matarbari, Chattogram for vessels exceeding 50,000 DWT.

The government has introduced a basic shipbuilding policy, but proper analysis and prioritization are needed to ensure equitable benefits for public and private shipbuilders before implementation, alongside sufficient capital and strategic support. Smart technologies - including fifth- and sixth-generation ports and smart shipping systems - are increasingly vital for effective, sustainable, market-driven shipbuilding. The sector should develop viable policies and effective strategies to target the right market segments and optimize production capacity, helping revive Bangladesh's shipbuilding tradition. Advanced technologies like digitalization, robotics, IoT, AI, machine learning, deep learning, and data science have transformed the global shipbuilding landscape, demanding improved labor productivity and a skilled workforce alongside safety and international compliance standards. A balanced approach combining smart investment, sustained government support, and targeted human resource development is essential to address future challenges. If Bangladesh can tackle productivity, technology adoption, and safety standards, its shipbuilding sector can become globally competitive and significantly contribute to national development and economic prosperity.

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