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► Sectoral skills priorities for the shipbuilding industry



► **Sectoral skills priorities for the shipbuilding industry**

Skills demand and supply insights based on the ILO Skills for Trade and Economic Diversification (STED) methodology

Forward

The following summary reports are the outputs of a series of capacity building activities delivered in collaboration with the Coordinating Ministry of Maritime Affairs and Investment (Kemenko Marves) and the Coordinating Ministry of Human Development and Culture (Kemenko PMK) under the Skills for Prosperity Programme, which was delivered by the ILO and funded by UK government.

The Skills for Prosperity Programme 2020 - 2023, set out to improve skills development policies and systems to respond to Indonesia's growing maritime skills demands and job opportunities; taking targeted action to promote skills for employment for young women and men, including those from disadvantaged groups.

The implementation of the Skills for Prosperity programme is aligned with two important government priorities: The development of a sustainable Blue Economy Agenda and Roadmap, which was launched during Indonesia's presidency of the G20 in 2022; and the Revitalization of the National Skills System (Presidential Decree no 68/2022), which launched the technical vocational education and training (TVET) national strategy (Stranas Vokasi) in February 2023.

The development human capital lies at the centre of both priorities. Under the Blue Economy Agenda, this focuses on Indonesia's maritime economic potential, whilst addressing the imperatives to protect and improve the health of ocean and coastal ecosystems and improve the livelihood of coastal cities and communities. New skills are required to remain globally competitive in Indonesia's maritime sectors such as shipbuilding, food production and coastal tourism. Meanwhile innovation and research collaborations will be needed to drive forward Indonesia's potential in emerging sectors such as offshore renewable energy generation and deep-sea exploration.

In the case of the Revitalization of the National Skills System, the Presidential Decree marks a paradigm shift in transitioning from the current supply-driven skills system, led and influenced through several government ministries; to a demand-led skills system, which will establish an inter-ministerial steering committee to co-ordinate a skills system that responds to industry needs at the sectoral level. The national strategy is perceived as being critical in maximizing skilled employment opportunities for all, especially young people, as the nation approaches a peak in the ratio of working age population that can provide the anticipated demographic dividend.

The report that follows, directly address these national priorities, bringing forward the results of a series of structured dialogues on the skills demands, constraints and emerging priorities of shipbuilding sub-sector.

Senior stakeholders representing government, industry, and worker representatives, TVET providers and academic experts representing the three maritime sub-sectors of shipbuilding, maritime logistics and seafaring, were convened through the Skills for Prosperity programme on multiple occasions between January 2022 and May 2023. The objectives were to establish a constructive dialogue between these stakeholders, intended to establish an industry-informed mapping of skills demand and supply constraints in shipbuilding sub-sectors; and then to form consensus on skills priorities for inclusive and sustainable economic growth. Activities took place through single day focus groups, high level policy exchanges, reflection and validation meetings, and two capacity building workshops taking place over several days.

Contributors and participants included representatives of ten different government ministries and agencies; industry and worker representatives representing the shipbuilding subsector; maritime polytechnics and universities; as well as professional consultants and facilitators.

The ILO STED methodology was used as the guiding framework for the process. This industry foresight tool has been developed by ILO for international use and is designed to support diverse stakeholders representing an industry in articulating skills demands and supply constraints in their respective sector or sub-sectors.

The series of activities undertaken describes a journey for this diverse stakeholder group in shipbuilding sector. For most of the stakeholders present, these meetings were the first opportunity to discuss skills relating to the specific sector with ministry, industry, and academic partners present. This meant that the topics and challenges were thoroughly reviewed and debated through government, regulatory, industry, academic and skills development lenses. This process encouraged participants to refine their initial views and move towards consensus positions about the skills priorities and potential solutions within the shipbuilding sub-sectoral skills ecosystem.

Several common themes emerged from the process. Participants from all the shipbuilding sub-sector concluded that a dedicated national skills strategy was urgently needed to align skills supply and demand. In all cases this would require:

- Development of standardized and disaggregated data on skills demand and supply-side capacity, which would need to be collated from multiple sources
- A systematic review and update the competency standards, qualification frameworks and certification mechanisms in operation across each sub-sector
- Review and updating of curriculum content and assessment methods, alongside industrial upskilling for vocational teachers
- Consideration of the sub-sector workforce demographic, including measures to widen participation in study programmes relating to shipbuilding sub-sector, upskilling programmes for existing workers, and the proposal of new career transition pathways from industry to teaching for specific groups of experienced industry professionals
- Improvement of careers advice and guidance that is informed by labour market intelligence and regularly updated through inputs from relevant industry

Importantly, shipbuilding sub-sectoral representatives viewed themselves as being part of the solution process. All agreed that the skills dialogues added value and enhanced their strategic perspective on the role of human capital development in the maritime sector. A central component of the development of national skills strategies would be:

- The formation of sectoral skills committees, consisting of industry, workers, government, academic and TVET representatives

Although each of the above points are addressed to some extent within the Stranas Vokasi launched in February 2023; the important point here is that these priorities emerged organically through industry-led dialogue with government and academic partners - in each case as responses to the skills constraints directly experienced by Indonesia's maritime industries.

As such these dialogues have been effective in forming working groups of senior stakeholders that have coalesced around shared skills visions in these critical maritime sub-sectors. These sub-sectoral skills forums are now ready to formalize as part of the national skills infrastructure to be implemented under the Stranas Vokasi under the newly established TVET Steering Committee.

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The ILO thanks the coordinating ministries, Coordinating Ministry for Maritime Affairs and Investment and Coordinating Ministry for Human Development and Culture Affairs who collaborated with the Skills for Prosperity Programme on this work; as well as our partner polytechnic Batam State Polytechnic (Polibatam), Maritime State Polytechnic (Polimarin), and The Shipbuilding Institute of Polytechnic Surabaya (PPNS) and their associated Industry Advisory Boards who contributed to this work.

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Our sincere appreciation goes to all stakeholders who participated and generously gave their time and insights to the process. We aim that the development activities under the Skills for Prosperity programme have laid the foundations for the formalization of industry-led sectoral skills committees that will benefit the maritime industry and its workforce for years to come.

Finally, we offer our gratitude to the UK government as the programme donors, and the British Embassy Jakarta for their support and advocacy throughout our collaboration.



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Executive summary

The shipbuilding industry is **a strategic one for Indonesia**. As a result of the extensive value chain linkages, its growth can trigger positive economic developments for other relevant sectors and benefit the whole Indonesian economy. Acknowledging and pursuing the importance of industry's development, the President issued Presidential Instruction No. 5 of 2005 on the Empowerment of the Shipbuilding Industry in Indonesia to support the growth of cooperatives and businesses operating in the sector. The instruction calls for the implementation of several measures with the potential for job creation such as developing design and research centres, standardizing the dimensions of ship components, developing the industry of raw materials and ship components, and providing incentives to national shipping companies that build and/or repair ships domestically and/or procure ships from abroad.

In 2022, there were approximately 250 shipyards in the country with a production capacity of up to one million dead weight tonnage (dwt) per year for new ships and up to 12 million dwt per year for ship repairs. These shipyards can produce various types of vessels, including passenger, cargo, and special purpose ships, with the largest graving dock facilities capable of handling up to 150,000 dwt.

Industry representatives consider that the shipbuilding industry confronts several challenges ranging from import duty policy (for import of intermediate goods, components, and materials), taxation and access to capital, skills of human resources (managerial and technical competence along with core skills), lack of national planning, and weak governance and coordination. In addition, the sourcing of domestic products to support the development of the industry (as mandated by Presidential Instruction Number 2 of 2009) is only partially effective due to challenges in the access to supply chains.

Skills mismatches exist in various phases of the productive process, including: (1) technical skills related to the manufacturing process; (2) skills on occupational health and safety; (3) environmental awareness and climate literacy; (4) ICT-related skills such as those necessary to apply "internet of things" (IoT) and artificial intelligence (AI) processes concerning the automation of electrical processes (cable routing and installation, reading of electrical diagrams and drawings, planning for any electrical work) and, lastly, (5) skills and competencies of dock masters (responsible for overseeing all operations at a marina or dock). In addition, the sector requires more qualified engineers across the value chain.

A total of fifteen universities and ten polytechnics in Indonesia offer tertiary and technical education study programmes related to ship building and repair. For instance, the PAL Indonesia Training Centre in Surabaya (PUSDIKLAT PAL Indonesia) is the largest ship industry training institution in Southeast Asia. In addition, some non-specialized training institutions such as Kampuh Welding, Briktru Training Institution, and ALKON Training Institution also offer elements of ship building training.

Industry representatives raised their concern about the supply of skills from national academic institutions, which they argue do not match the demand of skills required by ship-building companies. The existing collaboration between universities/polytechnics and the shipping industry is yet unable to reduce the skills mismatches and it is impacting the growth and competitiveness of the industry.

Therefore, to allow the shipbuilding industry to realize its full employment potential, national stakeholders agreed on a number of priority interventions, including: (1) focused study programmes in universities and polytechnics on developing or strengthening competencies for employment in occupations such as Ship Senior Designer (Naval Architects), AI/IoT Engineer, Dock Master, Health and Safety Engineer, Automation Engineer, and Project Manager; (2) Upskilling of teachers to meet the upcoming new standards and curricula development; (3) Production and dissemination of complete labour market information, notably concerning career opportunities and job requirements, possibly via a dedicated Career Information Centre; (4) increased collaboration and cooperation between the government, private companies, education and training providers, and; (5) improved governance and institutional arrangements for the shipbuilding industry, which could be addressed through the formalization of the Shipbuilding Sectoral Skills Committee.

I. Introduction and background

Indonesia comprises more than 17,500 islands and possesses abundant natural and marine resources. The government has recognized the central role of the country's maritime resources via several recent strategies and regulations including Indonesia's long-term national strategy for maritime development (2020-2045) and the blue economy development framework for economic transformation directed at accelerating while also nurturing ocean-based economic activities. (*Bappenas, 2021*).

The shipbuilding industry is one of the industries considered most strategic for the country and its maritime development. Its expansion can spur the growth of other maritime (and non) sectors.¹ At the same time, the industry plays a vital role to supply quality fleet needed for current passenger transportation and logistics distribution needs. The latter are instrumental to address, amongst other, the long-term national strategy for maritime development (2020-2045) and the interventions therein planned.

The present study will inform activities of the soon-to-be-established sectoral skills council for the Indonesian shipbuilding industry and in the meantime provides analysis and actionable interventions to address future skills needs. The study begins with identifying the main challenges for business development with an emphasis on human resources, followed by a presentation of policy options and a tentative plan for implementation of interventions by relevant stakeholders.

Throughout the study, the shipbuilding industry is identified as overlapping with the International Standard of Industry Classification of all Economic Activities (ISIC rev 4)² sector code 301 – Building of Ships and Boats, a sector including the building of ships, boats and other floating structures for transport and other commercial purposes as well as for sport and recreational purposes. In addition, where relevant and with due caveats, information about the ISIC sector 3830 which includes ship scaling, dismantling (but also dismantling of other items) and ISIC 3315 Repair of transport equipment, except motor vehicles which includes repair of ship and boats (but also of other items) is presented

The study includes six sections. Following the introduction, the first section introduces the methodology. Sector profile, human resource profile, and the analysis of the educational offer to address human resources needs in the shipbuilding sub sector follow next. Sections on policy options to address present challenges and a draft human resource strategy complete the presentation.

II. Methodology

The ILO STED, is a sector-focused methodology that assists in the **formulation of skills development policies/strategies** intended to enhance countries' competitiveness and economic diversification. With focus on the skills and human resources aspects of sectoral development, the methodology combines research (diagnostic), policy analysis and consultation via social dialogue towards defining a concerted strategy ready for implementation.

In the case of Indonesia's shipbuilding sector, STED was implemented in stages. A first workshop was held in August 2022 with the goal of highlighting the main barriers to sectoral development in regard to skills whether specific or systemic; a further aim was agreeing on an initial set of proposed actions to address the barriers.³ Following the first workshop, a dedicated desk review was drafted to structure the available information and provide a profile of the national shipbuilding sector, addressing its business operations and associated occupations in the matter of skill demand. The desk review matched proposed future interventions against available data and structured proposed actions accordingly. A final workshop held in March 2023 allowed participants to review the ensemble of gathered data and, after considering the latest developments, to agree on proposed actions to address existing gaps. Based on findings of a second workshop, the report was finalized.

1 The main supplier/users of shipbuilding industry products include the oil and gas, port, power, defence, fisheries, transportation, and tourism industries (users) as well as design centres, research and development institutions, banking and financial services (suppliers). The maximization of the linkages between the shipbuilding industry and the rest of the economy is consistent with the application of Presidential Instruction Number 2 of 2009 concerning Increasing the Use of Domestic Products (P3DN) in the Procurement of Government Goods/Services.

2 United Nations. Statistical Division (2008).

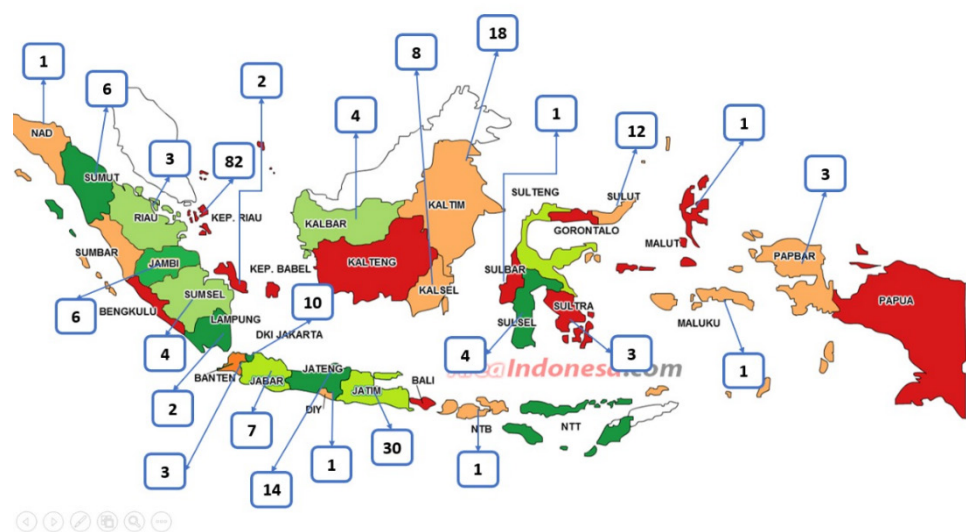
3 In detail, the first workshop aimed at producing: (a) a SWOT analysis of the shipbuilding industry, (b) a profile of major occupations and key skills needed in the shipbuilding industry, and (c) an overview of labour supply challenges and constraints including relevance of curricula and qualifications, financial constraints, government policy-related shipbuilding industry concerns, a vision for the future of the shipbuilding industry, and a summary of gaps in the capabilities and skills needed to achieve the vision along with recommendations.

It is important to highlight that in addition to the drafting of a common strategy, applying STED methodology to the shipbuilding sector conduces to reaching a series of broader and longer-lasting objectives, such as: developing a common understanding of the sector's vision and challenges, facilitating social dialogue among stakeholders, and building a sense of ownership concerning sector development to foster a commitment to implementing the strategy.

III. Indonesia shipbuilding industry: sector profile and stakeholder vision

Overview. The shipbuilding industry in Indonesia handles the construction and repair of various types of ships including passenger, cargo, and special-purpose vessels.⁴ In 2013 the number of shipyards in Indonesia was 240 with a total production capacity of about 750,000 dwt for the construction of new ships and about 10 million dwt for ship repair. The maximum infrastructure capacity (graving dock facility) for individual shipyards was 50,000 dwt for shipbuilding and 150,000 dwt for ship repair. By 2022, the number of shipyards had reached 250 with production capacity around 1 million dwt per year for new ships and up to 12 million dwt per year for ship reparation. The distribution of shipbuilding companies across provinces in Indonesia is shown in Figure 1.

Figure 1 Ship building companies' distribution in Indonesia 2022



Source: Ministry of Industry, 2022a

According to the main materials handled, shipyards are classified into two groups according to the main materials handled, namely steel and non-steel. Each category can be further subcategorized according to capacity. Large shipyards have a capacity of more than 10,000 tons; medium shipyards capacity between 500 and 10,000 tons and small shipyards capacity below 500 tons. While the total number of shipyards is 250, most can build and repair only small vessels of less than 10,000 dwt with relatively old engine and equipment (Suryadi, 2012). Table 1 summarizes the distribution of shipyards according to size.

⁴ See Appendix 3 for a visual representation of the different stages of the shipbuilding process.

Table 1. Number and type of shipyards, Indonesia, 2022

Steel shipyard		Non-steel shipyard	
Classification	Number of companies	Classification	Number of companies
Large (>10,000 tons)	40	Large (>10,000 tons)	10
Medium (500–10,000 tons)	80	Medium (500–10,000 tons)	20
Small (500 tons)	60	Small (500 tons)	40

Source: IPERINDO, 2022

Employment. National stakeholders engaged in the exercise agreed that in Indonesia, the shipbuilding industry generally operates through a labour-intensive process due to obsolescence of technology and overall low investment.

Data from industry sources (IPERINDO, 2022) estimate the total number of workers in the shipbuilding industry in Indonesia at 164,900, of which **142,400** are directly employed in shipyards and **22,500** function as “support” workers in companies providing accessory services (ship hull material, ship machinery, ship outfitting and electrics) for a total of **164,900** workers. Tables 3 and 4 present the breakdown of employment by type of shipyard and indicate steel-based shipyards’ reliance on a large workforce.

Table 2. Number of Shipyard Workers

No.	Shipyard classification	Number of companies	Workforce per company	Total
A.	Steel shipyard			
	Large (>10,000 tons)	40	2,000	80,000
	Medium (500–10,000 tons)	80	600	48,000
	Small (500 tons)	60	200	12,000
B	Non-steel shipyard			
	Large (>10,000 tons)	10	80	800
	Medium (500–10,000 tons)	20	40	800
	Small (500 tons)	40	20	800
	Total	250		142,400

Source: IPERINDO, 2022

Table 3. Size of supporting industry (non shipyards) manpower

No.	Type of industry	Number of companies	Total workforce
A	Hull material industry	16	11,000
B	Ship engineering industry	30	7,500
C	Ship outfitting industry	18	2,400
D	Electrical and electronics industry	14	1,600
	Total	78	22,500

Source: IPERINDO, 2022

The data presented above are roughly consistent with that gathered by the national labour force survey (SAKERNAS)⁵ presented in Table 2 below:

Table 4. Employment in shipbuilding industry (point estimates, August 2022)

Total employment ISIC 301 (<i>building of ships and boats</i>)	Total	93,797
	Total Men	91,258
	Total Women	2,539 (unreliable)
As % of employed workforce	Total	0.069
	Men	0.110
	Women	0.005 (unreliable)
Total employment ISIC 301 (<i>building of ships and boats</i>), ISIC 3315 (<i>repair of transport equipment including routine maintenance of ships and pleasure boats, motor vehicles excluded</i>), ISIC 3830 (<i>materials recovery including ship breaking</i>)	Total	177,055
	Total Men	164,186
	Total Women	12,869
As % of employed workforce	Total	0.13
	Men	0.20
	Women	0.02

Source: Own elaboration on the basis of Sakernas data 8/2022

Notwithstanding discrepancies between industry- and survey-based data, the above-presented employment data and their similar order of magnitude allow for the conclusion that employment in the shipbuilding industry is numerically very limited (although more sizable if repair activities are included), and male-dominated. With respect to the latter, stakeholder consultations highlighted that work in the shipbuilding/repair industry is still widely considered apt for men only.

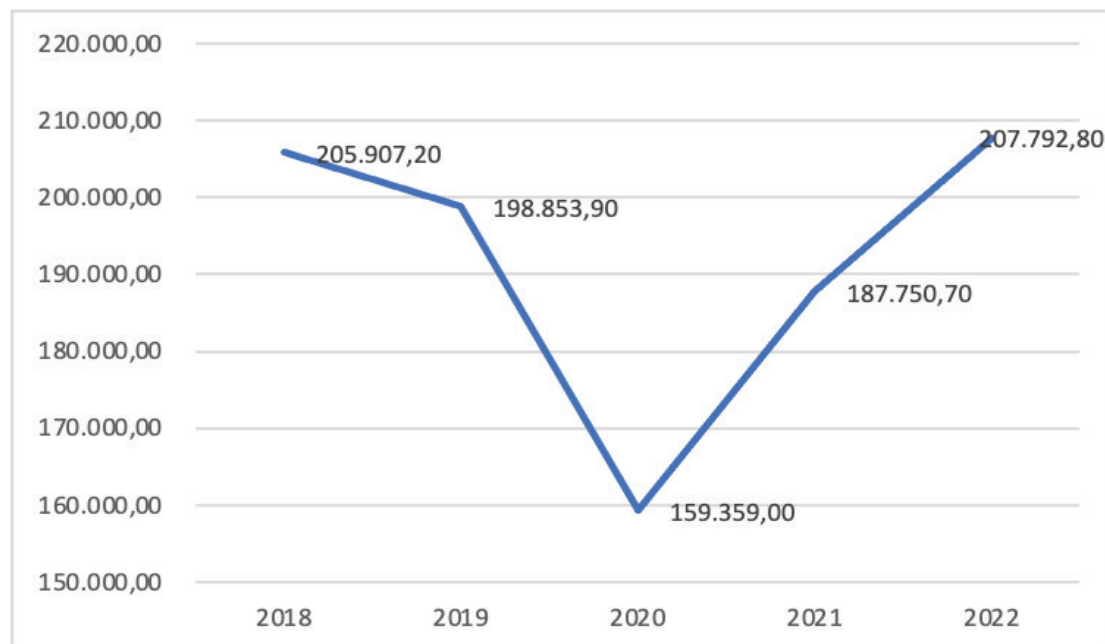
GDP Contribution. The shipbuilding industry is part of the transportation equipment manufacturing industry which is itself part of the broader manufacturing industry. Manufacturing contributed to 21.40% of Indonesia's GDP in 2022 or 2,396,603 billion rupiahs while the transportation equipment manufacturing industry contributed 207,792.80 billion rupiahs or 4.54% of the manufacturing sector (see can be seen in Figure 2).

⁵ Data are derived from answers relevant to "employment by industry, ISIC sector". According to the international classification of economic activities (ISIC Rev 4), shipbuilding belongs within the manufacturing section (Section C – Manufacturing), division 30 "Manufacture of other transport equipment" and group 301 which includes "Building of ships and boats". While the above covers scope of the shipbuilding industry, there are other activities performed in shipyards such as repair and dismantling of ships that cannot be captured by looking at only the 301 code; any attempt must also include scrutiny of employment in sectors ISIC 3315 and ISIC 3830 as above, both of which include the

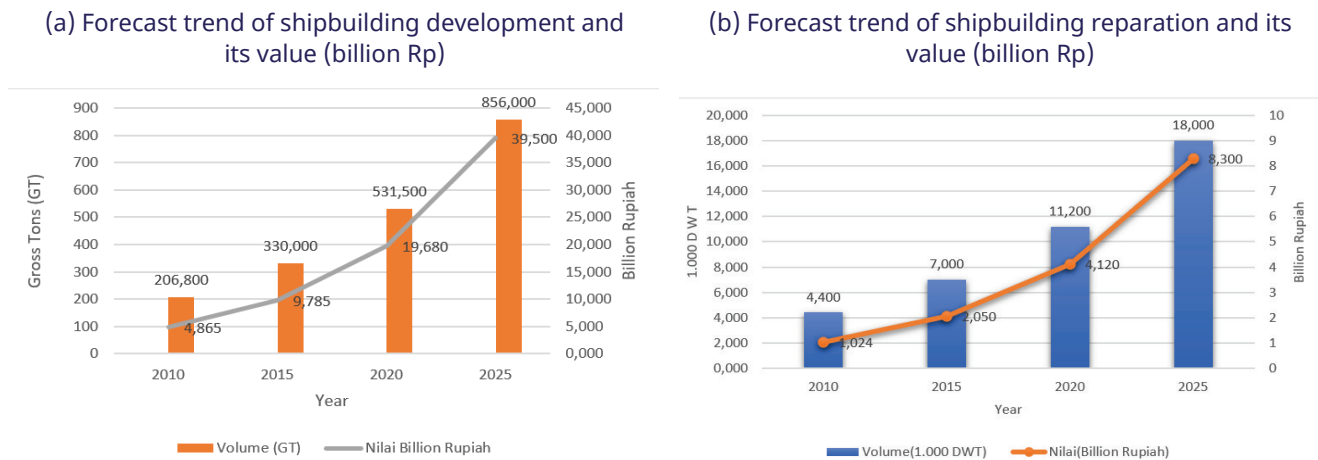
Figure 2. GDP of the transportation equipment industry as part of manufacturing (2022)

Source: visualized from data [Series 2010] GDP Series 2010 (billion Rupiah), BPS Indonesia, 2023

Manufacturing of transportation equipment experienced a significant decline in 2020 due to COVID-19. However, in the following year the industry grew and in 2022 the resulting GDP value was greater than in 2018.

Figure 3. Evolution of GDP of the equipment transportation manufacturing sector (2018-2022), millions of rupiah constant PRICES)

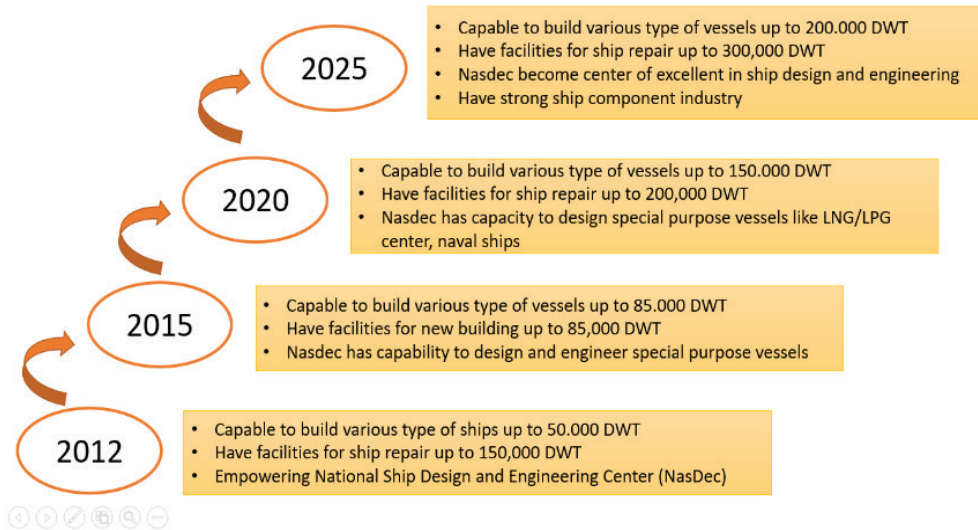
Source: Visualized from data [Series 2010] GDP Series 2010 (billion Rupiah), BPS Indonesia, 2023

Figure 4. Forecast for Shipbuilding and Ship Repair (2025)

Source: IPERINDO, 2015

Projected demand. The national shipbuilding association IPERINDO projects increased demand for new ships between 2020 and 2025 of up to 325 GT and up to 6,800 GT for ship repairs (Figure 4), largely due to increased shipping activity throughout Indonesia.

For reference, the national ship industry roadmap elaborated by the Ministry of Industry in Indonesia targets 200,000 dwt for construction of new ships by 2025 and 300,000 dwt in 2025.⁶ (*Ministry of Industry, 2022b*)

Figure 5. National Ship Building Road map

Source : Ministry of Industry, 2022b

In a 2022 statement the Ministry of Industry noted that the national ship industry made some progress including increasing the number of shipyards to more than 250 companies with a production capacity of around 1 million dwt per year for new buildings and up to 12 million dwt per year for ship repairs.⁷

Relevant regulatory framework. Following up on the Presidential Regulation No. 28 of 2008 on the National Industrial Policy and Regulation, the Minister of Industry issued regulation No. 124/M-IND/PER/10/2009 concerning Shipbuilding Industry Cluster Development. Such regulation defines the scope of the ship building industry as including

⁶ In addition, the roadmap includes specific targets for enhancing the performance of the National Ship Design and Engineering Centre (NasDec) concerning the design of special purpose vessels, liquified natural gas/UPS (spell) carriers, and naval ships. The concrete goal is for NasDec to become the centre of excellence in ship design and engineering by the year 2025 and contribute to Indonesia ship component industry.

⁷ Ministry of Industry (2020) "Industri Galangan Kapal Perlu Dukungan Pembiayaan. [Online]. Available: <https://kemenperin.go.id/artikel/21504/Industri-Galangan-Kapal-Perlu-Dukungan-Pembiayaan>. [Accessed 9 September 2022].

shipbuilding, ship repair, ship breaking and offshore ship building while being supported by ship equipment and supplies industry. The same regulation also states that the shipbuilding industry '*cluster*' includes core, supporting and related industries, i.e. building of new ships (on and offshore), ship repair, design centres, research, and development centres.

Presidential Instruction No. 5 of 2005 concerning the Empowerment of the Ship Industry in Indonesia aims to bolster the industry's growth and development, including its human resources in large, medium, and small businesses as well as cooperatives. Specific provisions refer to the development of (a) design capabilities through research and development centres for the ship industry; (b) standard measures for ship components; (c) industry supply capabilities regarding raw materials and ship components; and (d) incentives for national shipping companies that build and/or repair ships domestically and/or those that procure ships from abroad.

SWOT analysis, policy developments. As part of the dialogue undertaken to assess present and future skills needs, national stakeholders were called to consolidate their views via a **strength, weakness, opportunities, and threats (SWOT)** analysis. Figure 6 below summarizes the findings.

Figure 6. SWOT analysis of Indonesia shipbuilding sector (August 2022).

STRENGTH	WEAKNESS
1. As an archipelago country, the need for sea transportation in Indonesia is very high 2. Number of shipyards: 250 3. Size of workforce: 150,000 workers 4. Among educational institutions, 17 universities, 10 polytechnics and various vocational schools provide degree programmes relevant to the shipbuilding industry 5. Dedicated Professional Certification Bodies (LSP) created by IPERINDO (Third Party LSP) and by Surabaya Polytechnic in 2018 (Marine Polytechnic LSP) exist to support the ship industry	1. Ship imports policies, taxes and repairs hindering shipbuilding industry development 2. Financial difficulties owing to high interest rates and lack of industry-specific funding offers by banks 3. Insufficiently skilled human resources at most shipyards 4. Skill Competency Standard (SKKNI) in shipbuilding industry either not adequately developed and updated or specific enough 5. Professional Certification Body (LSP) number still limited (only two certification bodies, BKI and BNSP) 6. National ship industry supply chain limited in size and scope 7. Lack of orders and unpredictable demand 8. Technology in use mostly outdated 9. Sub-optimal application of quality control and assurance for ships being built
STRENGTH	WEAKNESS
1. High demand for ships for various purposes, especially for the mining sector (tug, barge) and oil and gas 2. High demand for refurbishment of ferries, commercial and fishing vessels 3. Existence of regulations regarding docking obligations 4. Acknowledgment by government of maritime sector importance (Blue Economy Strategy) 5. Government support in form of ship procurement and ship maintenance programmes with APBN/APBD funds	1. High demand for ships by mining sector may benefit foreign suppliers who can compete on quality, time of delivery and price 2. Price competition from abroad 3. Import ease of used ships 4. Preference of well-skilled workers to work abroad

8 National stakeholders highlighted how lack of national planning and/or reliable demand forecast tools can limit the capacity of local producers to efficiently plan for ship production. It was also mentioned that the matter could be addressed via a forecasting tool to be provided by relevant government institutions and reflecting the needs of the industry for at least the next five to ten years.

Seen as the main **strengths** for the sector are national geography; the already high number of shipyards and workers; and the availability of vocational, higher education and certification institutions. **Weaknesses** are diverse and include obstacles linked to import duties⁹ and access to capital¹⁰ together with the generally low adoption of modern technology and integration of shipbuilding within the national value chain. Moreover, contributing to the relatively low level of qualifications among the workforce is a lack of adequately developed and updated as well as sufficiently specific competency standards, in addition to the low number of certification bodies. These factors further conduce to sub-optimal application of quality control for ships being built. Considered main **opportunities** are high demand for new and refurbished ships together with priority having been assigned by the government to the maritime sector as a whole, this in addition to direct procurement of ships together with the existence of regulations regarding docking obligations. Perceived as **threats** for the sector are competition from foreign providers, the ease of importing price-competitive used ships, and emigration of qualified workers.

IV. Human Resources Profile

Profile of major occupations and key skills in the shipbuilding industry

Building and repairing ships is a complex engineering process, based on inputs by professionals spanning a wide range of specializations (see appendix 3 and 4).

Concerning relevant competencies, the Decree of the Minister of Manpower of the Republic of Indonesia Number 437 of 2015 presents the National Working Competency Standards (SKKNI) for shipbuilding (see Appendix 6) and the SKKNI in the field of Ship Maintenance and Repair (the SKKNI No. 91 of 2021 (see Appendix 7)

Future needs and skills gaps

National stakeholders involved in STED consultations identified the 12 most common occupations in the shipbuilding and ship repair industry, and of those singled out six expected to be most critical for the coming years. Occupations were categorized as: Managerial Roles (project manager and health, safety, and environment engineers), Production Supervisor Roles (senior design engineers and dock masters), and Experts in Technological Adaptation Roles (AI and IoT) in addition to electrical automation). Role profiles are presented below.

Managerial roles

a. Production management and planning

As the diagram in Appendix 5 shows, project managers, project engineers and administrative engineer positions require experienced professionals with a minimum education level of Diploma IV (bachelor's degree) in naval engineering. Position holders are expected to manage and supervise teams of up to 100 workers, thus the combined need of relevant academic qualifications with longstanding work experience. (Ridwan and Julianto 2010).

National stakeholders assess that at present available managerial competencies are not internationally competitive, with a lack of expertise in planning, production, and procurement capabilities. They also acknowledge that part of the shortcomings is linked to the fact that shipbuilding project management skills can only be gained through longstanding practical experience.

⁹ Import and export regulations including import duties limit acquisition of capital and equipment needed to upgrade production. Specifically, it was estimated that with 70 per cent of components for shipbuilding being internationally sourced and subject to import duties, production costs are high, thus orienting demand towards imported and/or used vessels. Demand for the latter is still considered high despite a government-issued regulation to tighten the importation of used vessels (Ministry of Trade Regulation No. 20 of 2021 concerning Import Policies and Regulations).

¹⁰ Shipbuilding operators relying on commercial loans do not enjoy any special regime, despite the nature of their business (high fixed initial cost of investment, mid-term returns). Specifically, bank interest is high and applied over a short span. In turn, this leads to under-investment in technology and skills enhancement. By the same token, national operators expressed scepticism about the efficacy of tax decreases as they don't necessarily reflect the business cycle and cash flow.

b. Health, safety and environmental (HSE) management

The HSE engineering degree is obtained at universities/TVET in D4 or S1 programmes, but it is mostly in the field of occupational safety and health. Currently, both polytechnics and universities do not have HSE-specific programmes for shipbuilding, although in principle a fully-fledged professional¹¹ responsible for supporting health, safety and environment matters in accordance with organization policies and procedures is required by the industry.

Production roles

a. Senior design engineer¹²

Stakeholders gauge that, in general, mastery of technologies related to ship design remains very limited. Two roles in particular play a decisive role in the production process and will be pivotal in coming years:

- ▶ Senior design engineer – responsible for designing and engineering activities, technology investment and testing of prototypes. The engineer should have the technical knowledge and skills related to the design of various ships and rig components, systems, and equipment. In addition, ship design requires competent architects and interior design specialists.
- ▶ Marine estimator – manages the analysis of bids and completes estimates for assigned projects, creating detailed cost estimates for ship repair and other marine projects. The position requires a strong background in skills, knowledge and experience related to naval design and engineering and likewise must have knowledge of materials used in ship construction. The estimator also must be able to develop detailed cost specifications and estimates.

In Indonesia, the pool of senior design engineers is usually drawn from those with practical experience at the workplace yet without any dedicated degree. Some university programmes provide the knowledge and skills for basic design; however, that is deemed insufficient.

b. Dock masters

Dock masters are responsible for overseeing all operations at a marina or dock. They are the face of the facility and often the primary contact for anyone who uses the docks or services provided. Dock masters may be tasked with everything from ensuring that boats are properly tied up to managing the flow of traffic in and out of the marina. They may also be responsible for handling any emergency situations such as responding to boat accidents or other incidents that require urgent medical attention.

The number of dock masters in Indonesia is very limited. Their skills are obtained from the workplace, as no universities or polytechnics have these competencies as part of any curricula.

Technology adaptation roles

a. IoT and AI

IoT applications in the shipbuilding industry are revolutionizing the way shipowners and logistics operators do business. AI, referring to machines or computers behaving in ways that we previously believed required human intelligence, uses data to constantly refine processes and reduce decision-making time. In the shipbuilding industry, this is done by constantly collecting voyage-impacting data so that AI predictive analysis can ensure vessels are always sailing the best route at the best speed, avoiding port delays and bad weather (Sinay, 2021). The sectoral stakeholders identified that there are still gaps in use of AI within the shipbuilding sector.

b. Automation Electrical/Electrician or Automation Engineer

The automation electrician must be able to carry out cable routing and installation; to read electrical diagrams and drawings; to plan for any electrical work requirement on board; and to perform duties in the workshop, on board a vessel and overseas. He or she also must be able to work independently and as part of a team, prepare service reports upon completion of jobs, and be capable of and willing to work extended hours when job completion is urgent.

¹¹ Singapore Government Agency (2022)

¹² See Singapore Government Agency (2022) for a broader description.

V. Educational Offer to Address Human Resources Needs

Polytechnics and universities

There are 15 universities and ten polytechnics providing degrees related to shipbuilding and repair in Indonesia (see Appendix 2). The offer consists of diploma, bachelor, and master programmes. Four universities have accreditation A (top level), seven universities have accreditation B (mid-level), while three universities and two polytechnics have accreditation C (lowest level).

Note that many universities provide customized training programmes for companies by request.

Other training providers

Government-funded

- ▶ Some vocational training centres (BLKs) funded by the Ministry of Manpower focus specifically on maritime sectors: BBPVP Serang, BBPVP Medan and BBPVP Makasar on welding and electricity related components.
- ▶ In addition, the government sponsors targeted training programmes (such as for construction of submarines and traditional boats) in collaboration with universities/polytechnics and training institutions. An example here is training for construction of traditional boats made of fibre in Papua communities under the aegis of the Ministry of Social Affairs and implemented in collaboration with the Department of Engineering ITS Shipbuilding (Surabaya).

Private sector-funded training centres

- ▶ PUSDIKLAT PAL Indonesia is one of the largest ship-industry training institutions in South-East Asia. Established in 2001, it implements competency-based training by following the SKKNI. In addition, it holds accreditation by the Accreditation Institute for Job Training (LA-LPK), allowing it to operate not only as a training provider but also as a certification body.
- ▶ Kampuh Welding is a welding training institution that also provides welding training related to ships.
- ▶ Briktru Training Institution is a project management training institution also providing shipbuilding project training.
- ▶ ALKON Training institution provides OSH/HSE training, some of which focuses on shipyards.

Mixed-funded training

The Ministry of Industry cooperates with the Japan International Cooperation Agency (JICA) and the Indonesian Shipbuilding and Offshore Industry Company Association (IPERINDO) to foster the Indonesian shipbuilding industry through the programme “The Indonesian Shipbuilding Industry Modernization Project” which, among other functions, provides workforce training for IPERINDO members.

Professional certification institutions (LSPs: Lembaga Sertifikasi Profesi)

There are only three shipbuilding LSPs industry providers, namely:

- 1) the currently inactive LSP that was formed by IPERINDO (third party of LSP) in 2018 and located in Surabaya;
- 2) the Marine Polytechnic LSP, formed by Surabaya Polytechnic in 2019; and
- 3) the PT PAL Professional Certification Institute (LSP PAL), an LSP holding the authority to organize work competency certification for workers among business partners of PT PAL Indonesia. It provides certification services in collaboration with various certification bodies (see figure 7)

In addition to the three private LSPs, there are Polytechnics and Universities LSPs on Shipbuilding as listed in Appendix 2.

Figure 7. Certification Bodies collaborating with LSP PAL



Current gaps/challenges regarding educational offer

Gaps in the supply of relevant degrees

Some of the skills needed by shipbuilding companies are not acquired during the education process at universities or polytechnics. For example, degrees aimed at providing qualifications for dock masters are not taught at universities/polytechnics. Similarly, national stakeholders highlighted gaps regarding degree programmes offering qualifications for senior design engineers and degrees applying AI to shipbuilding.

Such gaps are perceived to be particularly limiting for the small-boat industry which has less capital available and thus is less competitive regarding accessing qualified human resources, a circumstance particularly threatening for suppliers of ships for the mining sector as the lack of qualified human resources means that during times of high demand they may miss out on opportunities to foreign providers.

Mismatch between teaching and industry needs

Subjects related to ship management projects, HSE and automation are taught in polytechnics and universities. Nonetheless, industry stakeholders perceive a gap between their needs and the knowledge and skills acquired by students. Reasons behind the gap include:

- ▶ outdated equipment/technology used in training programmes;
- ▶ limited supply of degree programmes imparting the required knowledge for workers to utilize the latest technological developments regarding, in particular, shipbuilding machinery, automation engineering, application of AI, and *naval architecture including design software*;
- ▶ *lack of collaboration between universities, polytechnics, and the shipbuilding industry.*

Standard of technical skill

The SKKNI for shipbuilding no. 437/2015 is outdated and need to update based on the current situation. Not all key competences in the shipbuilding industry have been standardized via the SKKNI. Such a gap is particularly harmful for occupations having to deal with or master new technologies pertaining to design, automation engineering and electrical automation.

Certification (lack of, cost)

Although there are at least two operational certification bodies in Indonesia, some competencies cannot be certified owing to an absence not only of competency standards but also of certification standards.

While acknowledging the importance of certification of competencies towards efficient operation of the labour market, stakeholders noted how the cost of certification may hinder any decision to pursue upskilling as a company or individual must bear such cost entirely.

Occupational needs relating to continuing education and lifelong learning for existing workers

Continuing education and lifelong learning are goals to be pursued across the sector. However, it was noted that a lack of clearly identified occupational needs adversely affects the demand and supply of relevant training.

Inclusion of people with disabilities

Industry-led support for the inclusion of people with disabilities focuses on making fully known all job openings and providing possible matches for job seekers and employers, notably at the community level. However, access to *technical education for students with disabilities is extremely limited due to occupational hazard concerns.*

Dissimilarity of existing incentives to foster collaboration between training and industry

Existing incentives to foster collaboration between industry and training institutions such as the Ministry of Education's "link and match" programme are perceived as not functioning uniformly across educational institutions. Some providers have strong links with industries while others have none. For instance:

- ▶ some polytechnics have very strong relationships with employers in terms of (a) apprenticeships and other work-based learning programmes, (b) on-the-job experience for trainers and educators, and (c) curricula development;
- ▶ similarly, both public and private universities have strong partnerships in terms of curricula development, career development and recruitment, for instance ITS with PT PAL;
- ▶ however, other training providers have limited cooperation in the areas of curricula development.

General policy framework reference for vocational training and the shipbuilding industry

The recent Presidential Decree No. 68/2022 on the Revitalization of National TVET in Indonesia, and subsequent Regulations 5 and 6 by the Coordinating Ministry of Human Development and Culture (2022), call for industry stakeholders to engage more actively in vocational education and training.

In addition, Presidential Regulation No. 74 of 2022 concerning National Industrial Policy for 2020-2024, provides a framework to work on strengthening human resources for the shipbuilding and ship components industry. As part of the former, the Ministry of Industry is implementing a dedicated programme named "The Indonesian Shipbuilding Industry Modernization Project" based on development of standard competency (SKKNI), of standard of qualification (KKNI), actual training provision and actual certification. Such programme could have concrete implications for the shipbuilding industry especially on the standard definition issue.¹³

¹³ For example, by q2 2023, BPSDMI (Human Resources Development Unit) in Ministry of Industry is facilitating the preparation of seven draft SKKNI documents and three draft KKNI (Indonesia Qualification Framework) documents. (Ministry of Industry, 2023)

VI. Strategy to Address Human Resources Challenges in the Shipbuilding Industry

National stakeholders agreed on a common vision for the sector at the beginning of consultations, consisting of:

- ▶ making the Indonesian shipbuilding industry technology based;
- ▶ adding value from competitive products and services across national and international markets by building a business and work culture enhanced by competent and qualified human resources; and
- ▶ increasing productivity, sustainability, and inclusivity.

To realize the above and address the sectoral skills needed, national stakeholders agreed on a series of intervention strategies to be led by the forthcoming sector skills council. Notwithstanding interlinkages, the strategy focuses on challenges for the shipbuilding industry intrinsically linked to human resources/educational offer. Other challenges, meanwhile, are more systemic in nature and bear on the profitability of companies (and thus capacity to hire/train staff); other systemic issues such as trade policy, red tape, wages; and the general capacity of the system to ensure coordination between actors.¹⁴

The strategy – presented in Table 5 – proposes interventions for the short-, medium- and long-term identifying lead agencies/institutions.

Challenges linked to human resources/educational offer and proposed interventions

Table 5. Challenges Linked to Human Resources/Educational Offer and Interventions

Priority Skills Challenges	Proposed Intervention	Responsibility (ies)
1. Competency standards for shipbuilding require updating in traditional occupations and do not respond to the competencies required for new occupations.	Updated a comprehensive SKKNI specifically for the shipbuilding competence, in collaboration with industry experts, educational institutions, and government agencies. This standard should outline the skills and competencies required for various roles within the industry and serve as a benchmark for design of training programmes and certifications. The current competency certification schemes in the shipbuilding industry are still based on the construction sector. Having a clear and comprehensive SKKNI will provide guidance on the development of demand driven training programmes and certifications and reduce skills mismatches.	Regulatory bodies, government agencies, education institutions and shipbuilding companies

¹⁴ During consultations stakeholders often referred to issues such as: (a) increasing competition from lower-cost shipbuilders in other countries; (b) fluctuating demand for ships due to economic conditions, in addition to rising materials and labour costs; (c) weakness of the value chain stemming from/resulting in lack of communication and collaboration between shipyards, suppliers and subcontractors (d) difficulty in aligning the interests and priorities of different actors in the industry, such as ship owners, shipbuilders and regulatory bodies; (e) lack of standardization (dimensions) across the industry, which can make it difficult to achieve economies of scale and reduce cost; and (f) current public procurement system hindering access for small producers.

Priority Skills Challenges	Proposed Intervention	Responsibility (ies)
2. Limited number of Professional Certification Agencies (LSP - P3). (Note that data on LSP – P1 and P2 was difficult to ascertain)	2a. Develop the capacity of the Professional Certification Agencies (PCAs) to provide more options for workers to get certification and recognize their skills. This requires greater specialization of the existing PCAs to certify skills for occupations in the shipbuilding industry. In addition, it is necessary to improve the coordination with the objective to avoid overlaps between the roles and responsibilities of certification agencies under different ministries.	Government agencies, education and training institutions, and shipbuilding companies
3. There is a lack of inter-ministerial coordination between ministries regarding certification.	3. Establish a task force or working group comprising key public and private stakeholders to coordinate efforts and ensure alignment in certification standards and requirements. Additionally, the government could consider incentivizing training, upskilling and certification through skills development funding, which could be to be co-managed by industry and government.	Government agencies, education and training institutions, and shipbuilding companies
4. The adoption of innovative technology by employers is limited due to the workforce lack of relevant skills	4. Investment required in innovative collaborations, technology, and equipment to improve efficiency and productivity in the shipbuilding industry. This requires collaboration between the skills system and equipment manufacturers to develop training programmes for workers and providing access to new technologies through partnerships.	Government agencies, education institutions
5. Not all skills needed by shipbuilding companies are available due to mismatch between education curricula and needs of the shipbuilding industry.	5. Strengthen the collaboration between universities and Technical and TVET institutions with the shipbuilding industry to ensure that the curricula and learning processes are aligned with the industry's needs. This could involve: ► The creation of dedicated industry-led advisory boards to provide guidance on curriculum development based on industry	Government agencies, education institutions and shipbuilding companies

Priority Skills Challenges	Proposed Intervention	Responsibility (ies)
	skills needs along with regular industry lectures for students to better understand industry requirements. ▶ The increase/creation of work-based learning in the form of structured apprenticeships for students and trainees, and capacity development of teachers through industry attachments. ▶ The promotion of enterprise-based training for the existing workforce with the objective to support career development whilst improving enterprises' productivity. The enterprise-based training programme require a process of assessment and certification to ensure this adds value to both the individual and the industry.	
6. Workers and companies in the shipbuilding industry may not be aware of the training programmes and resources available to them. This can lead to a lack of investment in training and career development support and limit opportunities for career advancement.	6a. A centralised training and resource hub may be developed, hosting information about available training programmes and resources, specific to the shipbuilding sector 6b. Employers' organizations and labour unions to collaborate in the design dissemination of information about available training programmes and resources for their members. 6c. Provide incentives for employers and workers to boost attendance in the training programmes offered. 6d. Build monitoring mechanisms into training programmes, tracking the impact on productivity to help improve these programmes over time; and enabling industries to make data-driven decisions about future training investments.	Government agencies, education institutions, and shipbuilding companies

Priority Skills Challenges	Proposed Intervention	Responsibility (ies)
7. Lack of coordination between government, industry and workers' representatives and TVET stakeholders.	7a. Strong case for the establishment of a Sectoral Skills Committee for the shipbuilding sector mandated to implement the proposed strategy as well as (i) reduce gaps on demand and supply in shipbuilding both in terms of quantity and quality; (ii) strengthen cooperation between industry and universities/TVET in various fields including human resource development and technology development, (iii) review and update the existing National Shipbuilding Industry Roadmap 2012 to 2025, to support longer-term employment and productivity growth.	Government agencies, education institutions, and shipbuilding companies
8. Gender equity and inclusion of people with disabilities remains a challenge. The current shipbuilding workforce is male dominated and the employment of people with disabilities is limited.	8a. Develop micro credentials (shorter learning) focusing on skills needed for specific roles within the shipbuilding industry that help under-represented groups access employment opportunities where the skills need is most acutely experienced by industry. 8b. Design and implement targeted outreach and recruitment strategies to reach underrepresented groups, including women and girls, people with disabilities, and people from lower-income backgrounds in collaboration with TVET and community organisations.	Training institutions, shipbuilding companies, employment centres and industry associations
9. Lack of sector specific career information and advice.	9a. A dedicated career information centre serving students, teachers and workers who want to continue their education or undertake RPL (Recognition of Prior Learning). Such centres can also become matching platforms allowing industry to look for qualified human resources.	Training institutions, shipbuilding companies, employment centres and industry associations

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Appendices

Appendix 1. Participants of shipbuilding consultation workshop, August 2022 and May 2023

The initial shipbuilding workshops were facilitated by I Putu Arta Wibawa ST., MT., PhD (PPNS) and Tauvik Muhammad, MPA (ILO). Dr. Agnes Tuti Rumiati, MSc. provided the preparatory sectoral research and the final report.

Participants and Contributors

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- ▶ Directorate of Manpower
- ▶ Bappenas
- ▶ Pusat Pasar Kerja Indonesia (Pasker.Id)
- ▶ Coordinating Ministry of Economic Affairs
- ▶ Coordinating Ministry of Human Development and Cultures Affairs

Industries Association, Professional Associations and Industries:

- ▶ Ikatan Perusahaan Industri Kapal dan Lepas Pantai Indonesia (IPERINDO)
- ▶ Indonesian Association of Maritime Technology Engineers (IATMARIN)
- ▶ PT PAL Indonesia
- ▶ PT Adiluhung Saranasegara
- ▶ DOK Bahari Nusantara
- ▶ PT DUMAS Tanjung Perak Shipyard
- ▶ Batam Shipyard and Offshore Associations (BSOA)

Trade Union Representatives:

- ▶ Konfederasi Serikat Buruh Seluruh Indonesia (KSBSI)
- ▶ Kesatuan Serikat Pekerja Nasional (KSPN)
- ▶ Dok Bahari Union

TVET Institutions Representatives:

- ▶ Program Studi Kapal, Politeknik Negeri Batam
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Total: 21

Gender:

Male: 15

Female: 6

Representatives

Government: 5

Industry: 9

Trade union: 2

University: 5

Appendix 2. List of universities, polytechnics, and certification bodies relevant to the shipbuilding industry

Universities with degrees related to shipbuilding

No.	University	Degree	Level of accreditation
1	Universitas Diponegoro	D-III	B
2	Politeknik Negeri Bengkalis	D-III	B
3	Politeknik Batulicin	D-III	Baik
4	Universitas Indonesia	S1	A
5	Institut Teknologi Sepuluh Nopember	S1	A
6	Universitas Hasanuddin	S1	A
7	Universitas Diponegoro	S1	A
8	Universitas Darma Persada	S1	B
9	Universitas Pattimura	S1	B
10	Universitas Muhammadiyah Surabaya	S1	B
11	Institut Teknologi Adhi Tama Surabaya	S1	B
12	Universitas Hang Tuah	S1	B
13	Sekolah Tinggi Ilmu Maritim Mutiara Jaya	S1	B
14	Universitas Pembangunan Nasional Veteran Jakarta	S1	C
15	Universitas Karimun	S1	C
16	Institut Teknologi Kalimantan	S1	C
17	Universitas Hasanuddin	S2	B

Source: summarized from Directory of Study Program Accreditation Results by BAN-PT (banpt.or.id)

Polytechnics with degrees related to shipbuilding

	Polytechnic	Province	Field	Degree
1	Politeknik Perkapalan Surabaya	East Java	Shipbuilding engineering	D3
			Welding engineering	D4
			PC engineering and ship construction	D4
			Ship mechanical engineering	D3, D4
			Ship electrical engineering	D3, D4
2	Politeknik Batulicin	South Kalimantan	Marine engineering	D3
3	Politeknik Negeri Bengkalis	Riau	Naval engineering	D3
4	Politeknik Pelayaran Sulawesi Utara	North Sulawesi	Shipping engineering	D3
5	Politeknik Madura	East Java	Shipbuilding engineering	D3
6	Politeknik Pelayaran Sorong	West Papua	Shipping engineering	D3
7	PoliytekNIK Pelayaran Barombong	South Sulawesi	Shipping engineering	D3
8	Politeknik Malahayati		Shipping engineering	D3
9	Politeknik Negeri Banyuwangi	East Java	Ship manufacturing engineering	
10	Politeknik Negeri Batam		Marine construction engineering technology	

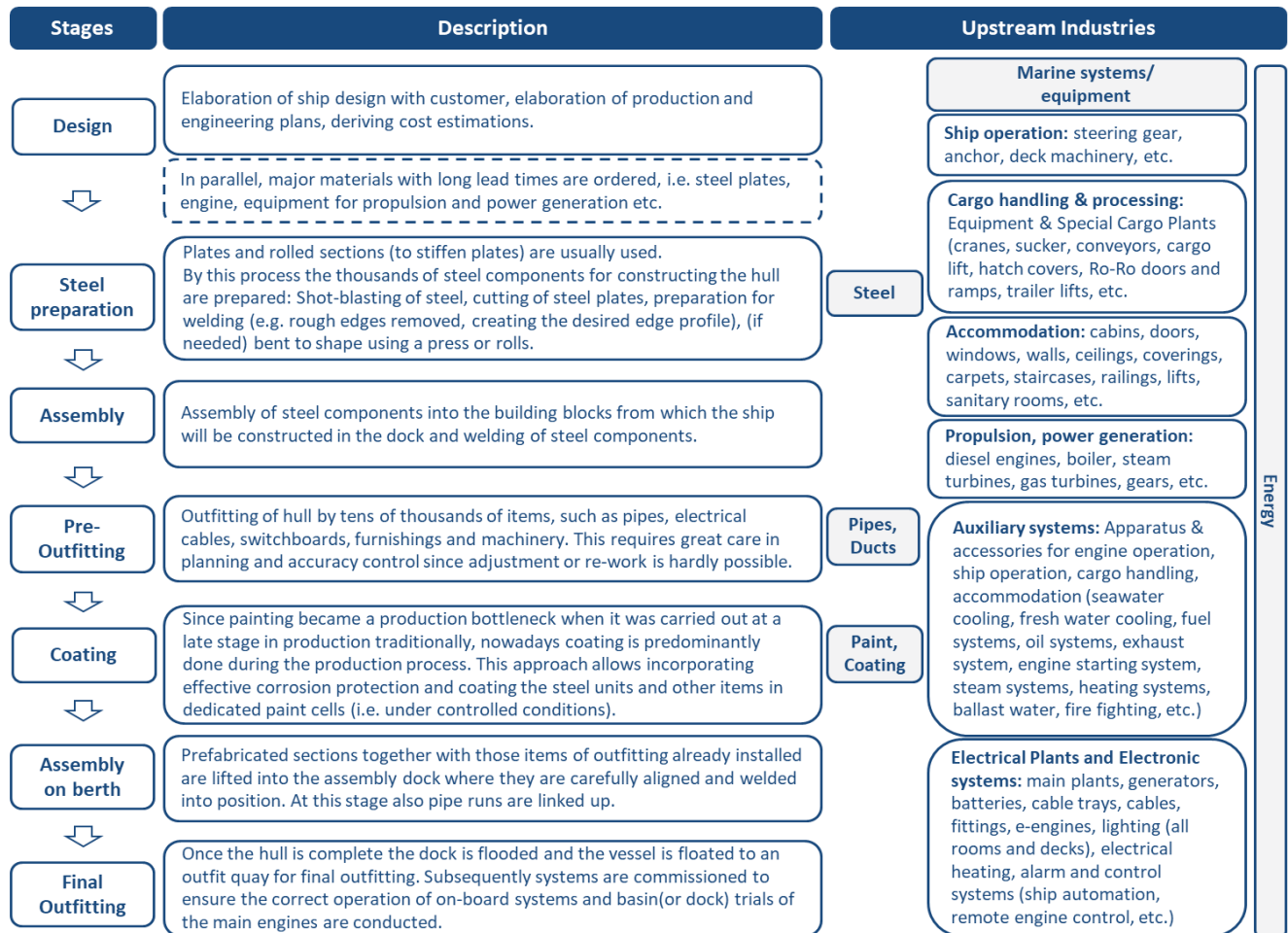
Source: summarized from Directory of Study Program Accreditation Results by BANPT (banpt.or.id)

List of certification scheme at polytechnics and universities

	Polytechnic	Code of Certification Scheme	Title of Certification Scheme
1	Shipping LSP	SKM/1175/00003/2/2017/2	SMAW I Welder Certification Scheme
2	Shipping LSP	SKM/1175/00003/2/2018/3	SMAW III Welder Certification Scheme
3	Shipping LSP	SKM/1175/00003/2/2018/4	FCAW II Welder Certification Scheme
4	Shipping LSP	SKM/1175/00003/2/2018/4	GMAW Welder Certification Scheme
5	Shipping LSP	SKM/1175/00003/2/2018/5	FCAW I Welder Certification Scheme
6	Shipping LSP	SKM/1175/00003/2/2018/6	SMAW II Welder Certification Scheme
7	Shipping LSP	SKM/1175/00003/2/2018/I	GMAW II Welder Certification Scheme
8			
9	Marine polytechnic LSP	SKM/0197/00003/3/2019/14	Intermediate naval architecture
10	Marine polytechnic LSP	SKM/0197/00003/3/2019/15	Advanced naval architecture
11	Marine polytechnic LSP	SKM/0197/00003/3/2019/8	CNC machine programmer
12	Marine polytechnic LSP	SKM/0197/00004/3/2019/11	Electric and electronic outfitting inspector
13	Marine polytechnic LSP	SKM/0197/00008/3/2019/9	Machine outfitting MO
14	Marine polytechnic LSP	SKM/0197/00003/2/2019/1	Welding inspector
15	Marine polytechnic LSP	SKM/0197/00003/2/2019/17	Welding supervisor
16	Marine polytechnic LSP	SKM/0197/00003/2/2019/5	Hull construction (HC) inspector
17	Marine polytechnic LSP	SKM/0197/00008/2/2019/10	Marine engineer

Source : Summarized from PT PAL Data "The National Board of Professional Certification, 2022"

Appendix 3: Steps of shipbuilding production



Source: K. Gourdon and C. Steidl (2019).

Appendix 4: Brief description of main jobs in a shipyard & shipbuilding industry

Source: Chakraborty, 2021 on Different Jobs in a Shipyard & Shipbuilding Industry

Welders and solderers

Welders are responsible for welding all metal structures that make up a ship, which includes the ship's hull plates, frames, girders, tanks, foundations, pipes, etc. Soldering is a minor job in the entire workflow, with most soldering jobs passed on to subcontractors.

Structural fabricators

A majority of the labour force in shipbuilding yards comprises structural fabricators. They rely on technical drawings to fabricate all structures forming a part of the lightship hull. The two most important skills necessary for structural fabricators are reading engineering drawings and fabricating metal for jobs. After fabrication of each structure, they then install the material on the hull. Most shipyards recruit fabricators after they have completed a certified apprenticeship programme along with a related theory course.

Plumbers

Plumbers are important because the water fittings and supply in a ship must conform to exacting specifications. Plumbers are workmen who specialize in the installation of all pipelines inside a ship, along with assorted pipe fittings such as valves and flanges. In all modern shipyards, plumbers are deemed qualified only after undergoing a certified apprenticeship programme within the shipyard, following which they appear for a final exam testing their theoretical knowledge and practical know-how.

Electricians

Electricians are responsible for installation of all electric cables on board a ship, based on cable routing plans. They also install all electrical and electronic equipment, navigational equipment in the bridge and radar, lighting, control panels, main electrical control room panels and other items. Electricians must be adept in reading equipment positioning drawings and, most importantly, equipment end drawings (those that represent where cables are attached to equipment).

Carpenters

Even though shipbuilding has advanced from the days when wood was used to build ships, carpenters are still required at shipyards and have an important role to play. In shipyards where hydraulic bending of plates are not equipped with 3D laser dimensional checks, the carpentry department prepares wooden templates for the ship's hull, which are used for bending of straight plates to the required geometry. They also prepare templates for sea pipes (that are conical sections used in any hull opening).

Riggers

At shipbuilding yards, the scope of work for a rigger includes lifting and shifting of heavy structures, erecting scaffolding, and moving structures of moderate weight within the shipyard. They are also trained to operate various types of cranes employed in the yard, and their certification is renewed every year. Use of hand symbols to communicate among themselves and the crane operator during lifting and shifting operations in high noise conditions is a major part of their training programme. Riggers also undergo a certified apprenticeship programme before being employed at a shipyard.

Quality control inspectors

Most called QC inspectors, they are among the most skilled and experienced members of a shipyard workforce. They are responsible for carrying out non-destructive tests on weld joints and carrying out dimensional control inspections of every major structure after its installation. As design drawings are used as reference for checks on dimensions, QC inspectors must be adept at reading complex production drawings.

Supervisors

Construction supervisors oversee the entire ship construction process at a shipyard. Every workshop-level department will have a supervisor of its own. For example, a hull supervisor would look after all aspects of a ship's structural outfitting. If multiple ships are being built by the yard at one time, there will be multiple hull supervisors. In larger shipyards that build longer ships in blocks, each block is assigned a separate hull supervisor. Similarly, there are supervisors for each department – for example, piping supervisor, electrical supervisor, rigging supervisor, maintenance supervisor and drydock supervisor. Usually, the most skilled and experienced among fabricators, fitters, electricians, plumbers and so on are promoted to a supervisor role.

Marine surveyors

Though not directly employed in shipyards, they play a pivotal role in the entire process of ship construction. The owner of the ship hires a classification agency to certify the design and construction of the ship. The classification society, in turn, appoints a team of surveyors who are posted in the shipyard and are responsible for certifying every stage of construction including every weld joint. They refer to the approved production drawings to ensure that the dimensions are as per design. A surveyor is well-remunerated with experience, and one of the most important advantages of this career is an exposure to the latest marine construction technologies. Engineers (mechanical, electrical, civil) and naval architects are recruited as marine surveyors by classification societies.

Engineers

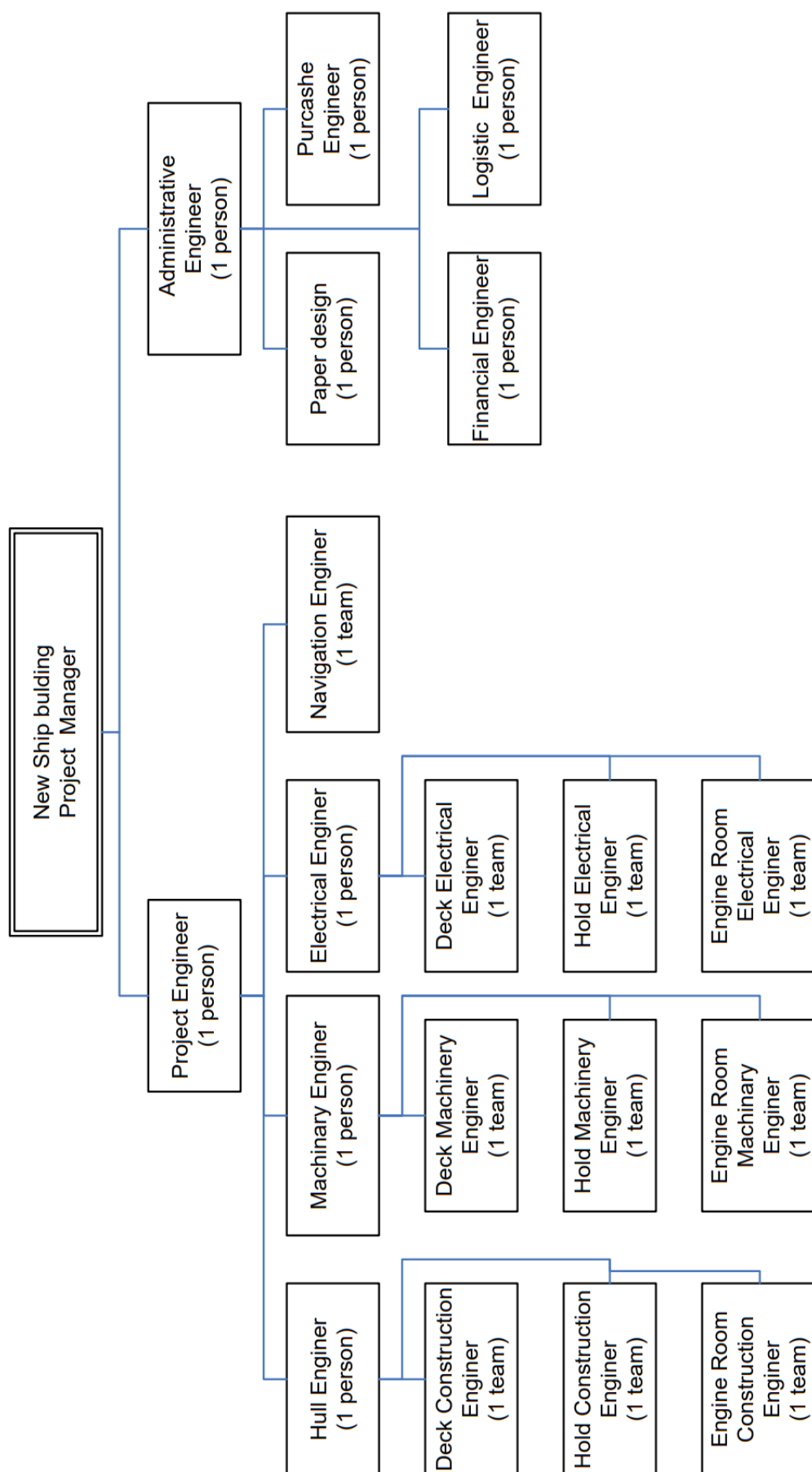
Shipbuilding calls for involvement of engineers from a wide range of fields. For example, mechanical engineers carry out all the structural fabrication, outfitting and welding in a ship. Electrical engineers are responsible for procurement and installation of electrical equipment and electrical cables and panels. For example, the wiring and installation of navigational equipment and its operation is undertaken jointly under supervision of electrical and electronic engineers.

Major shipyards now employ specialist piping engineers to undertake all work related to fabrication and installation of piping and pipe fittings in a ship. However, some jobs like installation of major machinery (main diesel engine, auxiliary engine, propellers, shafts, etc.) are carried out under supervision of engineers from multiple fields of expertise. An undergraduate degree in engineering is a necessity for this profile.

Naval architects or designers

Naval architects play a major role in the shipbuilding industry. In shipyards, they are mainly responsible for designing the ship, which includes concept design, stability calculations, resistance estimations, preparation of 3D production model and 2D production drawings. They also carry out inclining experiment calculations, prepare docking and undocking plans, and carry out docking calculations whenever a ship is to be drydocked in the yard. Naval architects are solely responsible for launching calculations, the accuracy of which is crucial for one of the most critical operations carried out by a shipyard.

Appendix 5: Shipbuilding process and organization



Source: Ridwan & Yulianto, 2010

Appendix 6: General national competency standards (SKKNI) for shipbuilding (Ministry of Manpower of the Republic of Indonesia Decree No. 437 of 2015)

Worker/employee must be able to:

- 1) Identify market opportunities to plan new ship marketing strategies
- 2) Calculate shipbuilding costs
- 3) Read, interpret, and apply technical drawings
- 4) Perform simple construction stress calculations
- 5) Operate CAD system to make production drawing hull construction
- 6) Determine assembly method to achieve optimum production process
- 7) Plan production capacity
- 8) Purchase local/domestic and imported procurement materials
- 9) Cut with portable gas cutting machine
- 10) Prepare and place pipe materials

Appendix 7: General national competency standards (SKKNI) for ship maintenance and repair (SKKNI No. 91 of 2021)

Worker/employee must be able to:

- 1) Estimate maintenance and repair service costs for ships, boats, and floating buildings
- 2) Perform ship maintenance and repair
- 3) Check ship construction
- 4) Check main engine area
- 5) Check auxiliary engine
- 6) Check electrical and electronics components
- 7) Check deck machinery
- 8) Check propulsion systems
- 9) Check piping systems and valves
- 10) Check navigation and communication systems



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