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Assessing the Acquisition Capacity of the Djiboutian Navy through its Defense Industrial Base

June 2024

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Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
DEPARTMENT OF DEFENSE MANAGEMENT
NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

The Republic of Djibouti is a small country located in East Africa. Its location, on the Horn of Africa, exposes it to threats of the Houthis on the sea line of communication throughout the Indian Ocean to the Red Sea passing through the Bab-el-Mandeb Strait. Therefore, the Republic of Djibouti needs to secure the Bab-el-Mandeb Strait to ensure a sea line of communication and support its national security. To accomplish this mission, Djibouti requires a strong and reliable defense industrial base (DIB) that can sustain the Djiboutian Navy to conduct effective maritime control and surveillance. The study uses the sector-by-sector/tier-by-tier (S2T2) and fragility and criticality (FaC) conceptual framework to examine the Djiboutian DIB that currently supports Djiboutian shipbuilding and which contributes to the operationality of the Djiboutian Navy (DJN). These concepts help identify risks associated with the DIB, particularly the shipbuilding domain, that could impact the defense budget and the Naval forces' operationality. The analysis in this study generates several recommendations to the Djiboutian government: (1) implement laws and regulations that support shipbuilding and local industries by mandating all procurement and repair shall be done in the territory and by local companies; (2) update infrastructure; (3) train shipbuilding personnel to become skilled laborers; (4) avoid supply chain disruption by diversifying sources and creating local distribution centers.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACB	Advanced Capability Build
ADF	Australian Defense Force
AIMSS	Agency Information Management and Software
DAF	Djiboutian Armed Forces
DIB	Defense Industrial Base
FaC	Fragility and Criticality
IB	Industrial Base
IT	Information Technology
JCS	Joint Chief of Staff
MDA	Missile Defense Agency
OEM	Original Equipment Manufacturer
ODASB	Office of the Deputy Assistant Secretary of Defense for
MIBP	Manufacturing and Industry Base Policy
PBL	Program-Based Logistics
R&D	Research and Development
S2T2	Sector-by-Sector/Tier-by-Tier
SCM	Supply Chain Management

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I. INTRODUCTION

The Djiboutian Navy (DJN) played a crucial role during Somalia's piracy attacks between 2008 and 2014 (EU Navfor., 2021). The DJN worked closely with all maritime international forces that were involved in combatting piracy such as European Union Naval Forces mission Operation ATALANTA by providing liaison officers. According to EU Navfor. (2021), the role of these liaison officers was to interpret any communication between pirates whether the communication came from the land to a small vessel or from the lead ship to a small vessel. Also, the liaison officers were allowed to board any Somalia's small vessel to have a conversation with the people on board and determine whether they were pirates or fishermen. Despite the DJN's crucial role in these events, the defense industrial base that supports the DJN and Djiboutian Army Forces (DAF) is not robust, and most of the spare parts for the defense forces are imported. The Republic of Djibouti, though reliant on other countries for many of its defense products, is located in a strategic position that enables it to provide services to merchants' vessels transiting through Bab-El-Mandeb Strait (see Figure 1). Therefore, the Republic of Djibouti needs to secure the sea line of communication throughout the Bab-El-Mandab Strait through continuous maritime surveillance.

Figure 1. Bab-El-Mandeb strait. Source: Barden (2019).

A. PROBLEM STATEMENT

The defense industry supporting Djiboutian's shipbuilding comprises of small businesses that import most of its raw materials. The Djiboutian Navy needs a reliable shipbuilding sector supported by the defense industry to be able to control effectively the territorial water and to protect the sea line of communication in the region. This research aims to assess the Djiboutian's shipbuilding capability through a comprehensive industrial base analysis, sector-by-sector/ tier-by-tier (S2T2), and fragility and criticality (FaC) analysis.

B. RESEARCH QUESTIONS

The primary question is:

1. What are the risks associated with the Djiboutian DIB with respect to organic shipbuilding?

The secondary research questions include the following:

2. What is a strategy that mitigates these IB risks?

3. What are the suppliers' abilities (especially the supply chain)?

C. RESEARCH METHODOLOGY

This research starts with a literature review focused on the concept of S2T2 assessment and FaC analysis, and how other international Navies have used similar concepts to assess their DIB. The analysis part (Chapter IV) delves deep into Djiboutian's shipbuilding sector to determine strengths and weaknesses throughout the S2T2 and FaC approaches. Finally, recommendations (Chapter V) are made to mitigate risks related to shipbuilding and to improve shipbuilding capability.

D. SCOPE

This research aims to identify the risk associated with the shipbuilding sector that supports the DJN in the accomplishment of its missions by maintaining all Navy ships operational. The S2T2 approach serves as a tool to evaluate the Djiboutian shipbuilding capability and capacity.

To sum up, given the regional instability in the Horn of Africa and the threats in the vicinity of Bal-el-Mandeb Strait, the DJN shall count on a reliable DIB and particularly a strong shipbuilding sector. The following chapter highlights the strategic position of the Republic of Djibouti and its socio-economical situation.

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II. BACKGROUND

The Republic of Djibouti is located at the horn of Africa with Ethiopia, Eritrea, Somalia, and Yemen as neighbors in the west, north, south, and east respectively. Djibouti and Yemen are separated by the Bab-El-Mandeb Strait which connects the Red Sea with the Gulf of Aden and the Arabian Sea (see Figure 1). According to Justine Barden (2019) in her article *The Bab-el-Mandeb Strait a Strategic Route for Oil and Natural Gas Shipments* in 2017 about 9% of the world's seaborne-traded petroleum transited through the Bab el-Mandeb Strait, some went north to Europe, while the rest reached South east Asia. Figure 2 shows the number of barrels per day transiting through the Bab el-Mandeb strait, highlighting the importance of this strait to global commerce.

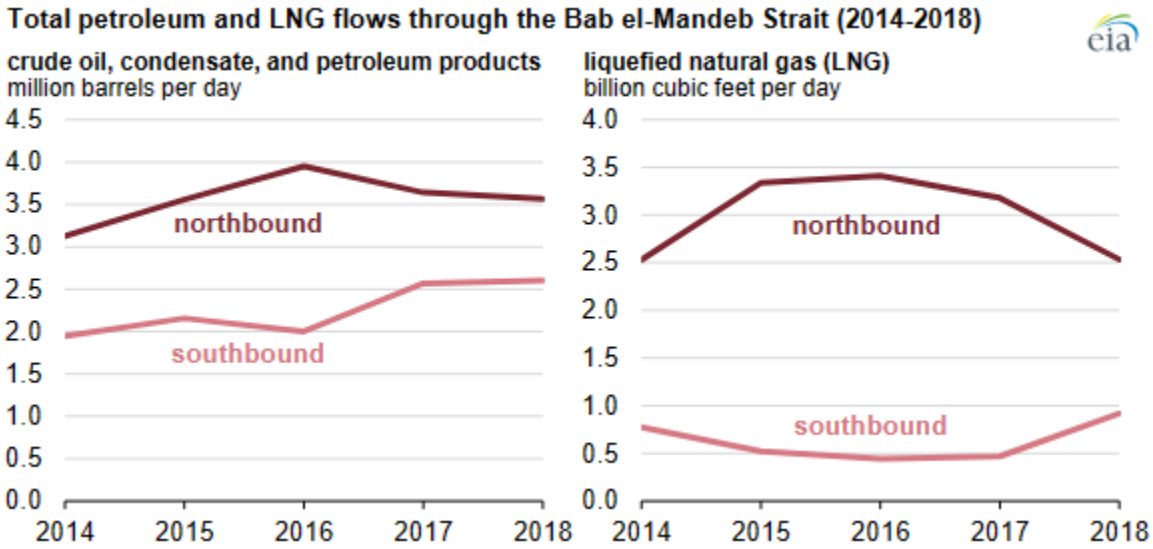

Figure 2. Total petroleum and natural gas transiting through the Bab el-Mandeb strait. Source: Barden (2019).

Figure 3 provides an image of the geographic location of Djibouti in relation to the rest of the globe.

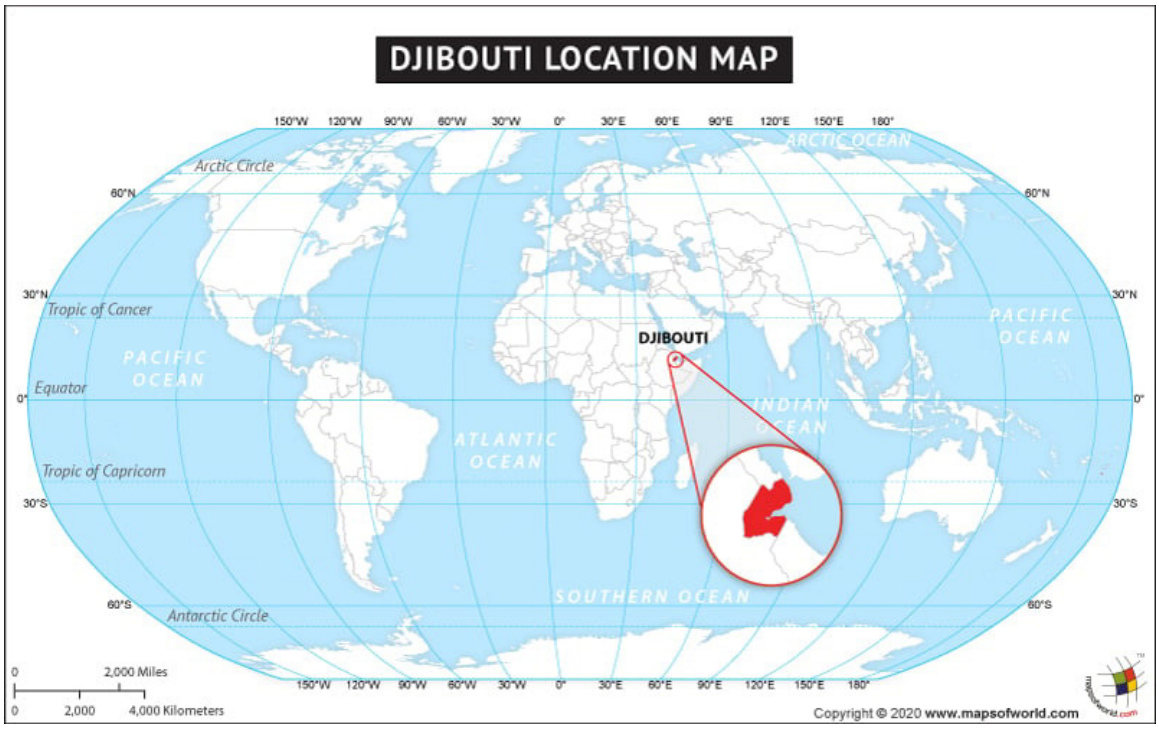

Figure 3. Republic of Djibouti in the world map. Source: Maps of World (n.d).

The Djibouti government shifted its economic policy from privatization to nationalization as stated by the president "to protect the fundamental interests of the nation and the legitimate interest of its partners" (Sow, 2018, p. 1). One of the biggest Middle East investors, Dubai Port World (DP World), was awarded a long-term contract to manage Djibouti's port (The Maritime Executive, 2018). The company invested in new ports equipped with world-class facilities and a large handling capacity to charge and discharge containers. However, Djibouti refused to extend the contract to the DP World's contract and instead chose to nationalize the port (Sow, 2018). Figure 4 shows the amount of containerized and non-containerized cargo transiting Djibouti's ports (shown in Figure 5) from 2012 to 2022 following nationalization of the ports.

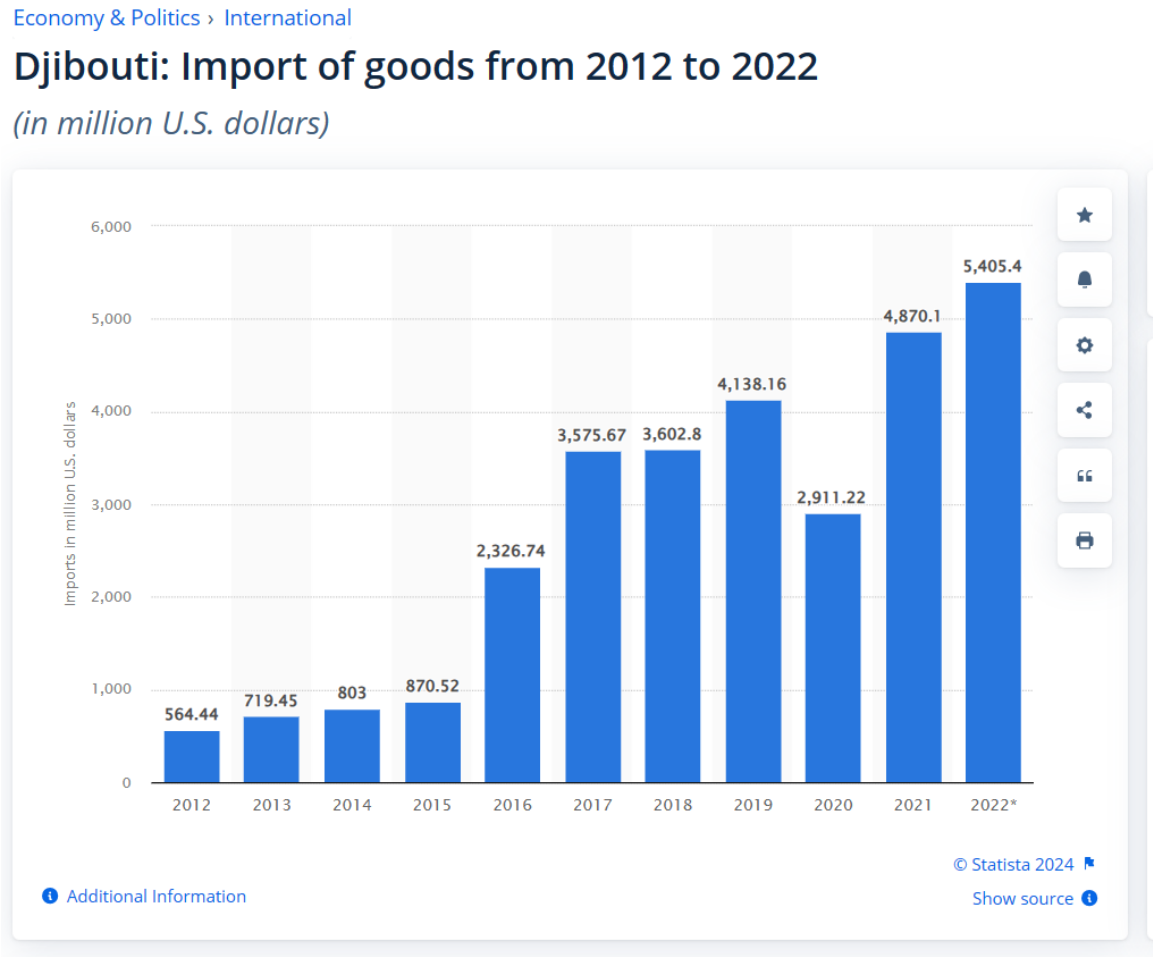

Figure 4. Djibouti's annual amount of imported goods (2012–2022) Source: O'Neill (2024).

Figure 5. Doraleh's port container. Source: Djibouti Ports & Free Zones Authority (n.d.).

To pursue economic growth, the Djibouti government decided to expand its ports to accommodate large container ships. In 2009, Doraleh's became the second port in Djibouti to be able to handle container vessels (Djibouti Port Free Zone Authority [DPFZA], n.d.). According to the DPFZA (n.d), "the quay side productivity of the terminal is 34 twenty-foot equivalent unit (TEU) movements per hour per crane- the highest rate in Africa. This reduces the time taken to handle cargo and enables efficient scheduling for shipping lines" (p.1).

Ethiopia, Djibouti's neighbor to the west, is a landlocked country with a current population of 129,272,104 inhabitants according to the latest United Nations estimation (World Population Review, n.d). Ethiopia has a fleet of merchant vessels that use Djibouti's port as a logistic base for exports and imports. The World Bank (2021) recently commented on Djibouti's fast-growing economy because of the increase in Ethiopian imports and exports, stating that "Djibouti's GDP growth is estimated to have reached

5.1% compared to 0.5% in 2020, driven by a rebound of transport and logistics services demand from Ethiopia" (p.1).

According to Djibouti's 2022 national defense strategy called " Le Livre Blanc de la Defense 2021–2026" [White Book of Defense 2021/2026], the Djiboutian government, in coordination with the Navy and Ports Authorities, solicited new offshore patrol boats for the Navy and a small fast boat for the Djiboutian Coast Guard as shown in Figure 6.

Figure 6. Djiboutian Navy's offshore patrol vessels and landing craft.
Source: Ministere de la Defense (2022)

In November of that same year, the Damen Shipyard, located in Cape Town (South Africa) was awarded a contract for three offshore ships and one landing craft (Janes, 2021). Currently, Djiboutian Navy Logistics is under the command of the Logistics Division of the D A F which does not have an acquisition department or office.

The Joint Chiefs of Staff (JCS), in reference to the JCS's (2022) directive and instruction (Office of the Joint Chiefs of Staff, 2022) held a series of meetings at the DAF's headquarters to discuss the government's interest in protecting foreign investments and

consolidating economic growth. As a result of the meetings, the JCS decided that all "maritime shipment users" (p.4) not just the government, should invest in Djiboutian's Navy and Coast Guard capabilities. In response to the JCS's demand, in 2022, the government, after the approval of an amendment to the financial year budget by the Minister of Finance and through a special funding offer by the Djiboutian Port Authority, issued a contract solicitation for four ships(Portail Internet du Ministère de l'Economie des Finances et de l'Industrie. 2014).

In summary, Djibouti expanded its port facilities to accommodate larger container ships. Djibouti also serves as a key logistics hub for Ethiopia, a landlocked country. This has significantly contributed to Djibouti's economic growth. Furthermore, Djibouti has invested in its naval capabilities by acquiring new ships to enhance maritime security and support economic activities. The following chapter explains the concept of S2T2 in the literature.

III. LITERATURE REVIEW

The objective of this literature review is to understand the concepts of S2T2, and FaC as they are used in contexts of different international Navies during procurement. These approaches serve to assess the Djiboutian Navy's overall DIB composed of multiple small businesses. Literature regarding supply chain, software management, and contracting are also parts of this literature review.

A. SECTOR-BY-SECTOR

In this 21st century, nations and countries strive to be leaders in technology research and development (R&D). Having cutting-edge technology allows countries to reinforce their economic growth, and healthcare system, and especially to "update" their defense systems. Defense industrial base planning required within acquisition programs use the S2T2 analysis concept to support the development amd procurement of warfighting capabilities for their army, air force, and navy forces. This methodology emphasizes operational and tactical decisions in naval shipbuilding and takes into consideration the broader objectives of national security, technological advancement, and economic sustainability. This literature reviews these approaches regarding naval ship acquisition, highlighting how they shape a nation's naval capabilities, through a detailed exploration of sector-specific demands, and analysis of the tiered structure of suppliers.

The Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industry Base Policy (ODASB [MIBP], 2016) implements a new framework that identifies opportunities and risks of each sector named S2T2. According to the (ODASB [MIBP], 2016) the sector-by-sector approach is a method for managing and understanding procurement by dividing it into distinct sectors. Each sector has its own design and structure and must have the necessary components available. This approach allows for a more specialized and focused analysis of each sector's unique requirements, challenges, and market dynamics. By focusing on one sector at a time, organizations can tailor their strategies to the specific needs and characteristics of that sector. This approach is relevant in the defense industries where the range of products and services is vast and varied.

Additionally, according to ODASB [MIBP] (2016) the sector-by-sector concept focuses on managing complex acquisition processes. It allows for a deep understanding of the unique challenges and risks associated with each sector such as the supplier landscape. The advantage of this approach is that it enables the development of strategies and policies that are specifically tailored to the needs and dynamics of each sector. It facilitates a more detailed risk assessment and management specific to each sector. This helps in identifying and focusing on key areas for innovation and (R&D) within each sector. Finally, this allows for a more effective allocation of resources as different sectors may have varying requirements and priorities. However, there are challenges as well such as ensuring integration and interoperability across different sectors, and balancing the needs and priorities across sectors, particularly when resources are limited.

The sector-by-sector approach is highly relevant and beneficial for Naval ship acquisition due to the complexity and capabilities involved in maintaining Naval ships such as availability (operational readiness), maintainability, and sustainability (ODASB [MIBP], 2016). This approach helps the Navy to focus on specific areas and ensures that each sector's requirements and challenges are adequately addressed. For instance, sonar systems and electronic warfare necessitate a specialized approach to keep up with innovation and integration challenges in each sector. Moreover, the sector-by-sector concept enables tailored procurement strategies for each sector such as supply chains, and facilitates detailed risk assessment where vulnerabilities in many areas can have significant consequences.

In addition, this approach aids in allocating resources effectively by giving adequate attention and funding to critical sectors (ODASB [MIBP], 2016). Naval ship acquisition is typically a high-cost endeavor, and segmenting the acquisition into sectors allows for more precise budget allocation and cost control. Furthermore, as naval threats and technologies evolve, focusing on specific sectors allows for targeted R&D. However, effective coordination and a unified strategy are essential to ensure that the sector-by-sector approach aligns with the overall mission and capabilities of the naval fleet. Therefore, the sector-by-sector approach is not only relevant but also critically important in naval ship

acquisition in the sense that it allows for more focused expertise, better risk management, and strategic allocation of resources.

The sector-by-sector concept is crucial to assessing and evaluating the national defense industry due to the increasing complexity of new defense systems, limited resources, the uncertainty of the supply chain systems, and the increasing need for interoperability and joint capabilities (ODASB [MIBP], 2016). Similarly, the DAF can use this concept to identify any bottlenecks within the DIB that need investment or reform to sustain its forces. In their report "China's Defense Industry on the Path of Reform," Mulvenon and Tyroler-Cooper (2009) provided a comprehensive analysis of the Chinese defense industry's transformation and reforms since the late 1990s. They explain that "historically, China's defense industry has been plagued by a lack of capital, technology, and incentives. Redundant personnel, lack of R&D experts, limited know-how, and communist management practices impeded innovation and attempts to manufacture "leap-frog" technologies" (p 33). The researchers assessed China's defense-industrial sectors's infrastructure. They examined the evolution of the defense industry across various sectors, such as aviation, aerospace, ordnance, shipbuilding, and defense electronics, emphasizing the integration into the global production and R&D chain, the impact of foreign technology and capital, and the effectiveness of the reform initiated in 1998.

Small businesses, whether operating as subcontractors or primes reinforce technological innovation in defense organizations, and they also contribute to the national defense. In the DAF's case, small businesses ensure resiliency in maintaining and adapting defense technology and equipment. This support is vital for sustaining the military capabilities and operational readiness of the DAF. Wylie (2013) in his article "Defense Industry and Innovation Policy" outlined the strategic importance of a local DIB, emphasizing its role in enabling the Australian Defense Force to meet its strategic objectives. He highlighted the balance between supporting a competitive, efficient, and skilled local defense industry and managing economic constraints and reliance on overseas solutions.

According to Dillman (1992), the procurement processes for national defense needs require adaptability, effective collaboration, and strategic vision among the forces and the

defense industry. Threat identification and assessment must determine the operational requirements from which procurement strategies are drawn. Defense industries must possess technological advantages such as cyber resiliency, unmanned systems, and artificial intelligence (AI) to help defense forces to meet their operational requirements. Furthermore, building strong communication channels among defense stakeholders such as defense forces, the defense industry, and decision-makers is vital to improving processes, evaluating threats, and updating technologies.

Likewise, in times of conflict or war industries play important roles by ensuring the operational effectiveness and preparedness of the armed forces. Hellberg (2023), in his article "Swedish Public Procurement and the Defense Industry: Obstacles and Opportunities," explored the strategic importance of the national defense industry. He emphasized how public procurement acts can impact the defense industry's ability to deliver essential equipment and resources to the armed forces. He also examined the impact of globalization and privatization on the defense industry, through an important secure supply chain for national defense.

One example of a country that reformed its defense industry is Iran. The country's defense industry plays a crucial role in supporting its military needs, emphasizing adaptability and resourcefulness under challenging conditions. According to Czulda (2020) in his article "Defense Industry in Iran- Between Needs and Real Capabilities," Iran's defense industry has adopted international sanctions and technological constraints by focusing on self-reliance and indigenous capabilities. The industry has developed proficiency in maintaining older equipment, reverse engineering, and producing spare parts, essential for sustaining military capabilities. Iran's defense sector also shows some capacity in upgrading existing systems and developing certain types of military hardware like small arms, missiles, and unmanned aerial vehicles (UAVs). However, it faces challenges such as international sanctions and political isolation, financial constraints, and the lack of technological expertise in producing advanced and modern systems. The industry is also constrained by the lack of access to global markets and advanced foreign technologies.

The first challenge is balancing the country's limited economic resources with the Djiboutian government's desire to invest in the modernization of its ports and consequently its Naval capacities (International Monetary Fund, n.d.). In addition, the presence of foreign military bases (United States, China, Japan, European Union, France) in Djibouti requires that the government manages its international relationships carefully and align its security needs with the needs of these powerful nations. The Navy also lacks capacity building since it does not have the skilled personnel who are essential to operating advanced equipment such as sophisticated electronic charts and radars. Instead, most training and education are conducted by the international allies' forces present in the territory. Likewise, Matthews and Koh (2021) explained in their article "The Decline of South Africa's Defense Industry" the challenges faced by the South African defense industry post-apartheid. Their research detailed the transition from a focus on the military to a focus on human security and the resulting impact on defense funding and industry operations. Corruption and unethical practices have influenced industries and weakened the effectiveness of policies such as defense offsets, arms exports, and international partnerships sustaining the industry.

There are various international cases highlighting how the sector-by-sector approach operates. One example is Sweden's approach to naval procurement, particularly in renewing its submarine fleet as cited in the article "Saab Inks Upgrade Contract for Third Gotland-Class Submarine" (Naval News, 2022). Specifically, the program for modernizing and constructing new submarines (A26 Blekinge class) and upgrading the existing A19 Gotland class highlights a sector-by-sector approach. This strategy involved significant investment in both the upgrade of existing assets and the development of new technologies, with contracts spanning several years The approach focused on addressing each sector's specific needs from the modernization of current submarines to the development of new classes. These efforts included substantial technological investments and collaborations with industry leaders like Saab, demonstrating a balance between innovation, modernization, and maintaining current capabilities.

Similarly, Norway's naval procurement, particularly the renewal of its submarine flotilla in conjunction with the German Navy, showcases a sector-specific focus. The

procurement of Type 212 CD submarines as discussed in the article "Kongsberg to Provide Sonar and Navigation Systems for Type 212 CD Submarines" (Naval News, 2021), which occurred under a substantial contract, involved collaboration with and benefits to local industry, such as Kongsberg sonar systems and combat management system development for the new submarines. This approach not only addresses specific fleet renewal needs but also integrates local industry expertise, demonstrating a strategic balance in naval acquisitions.

B. TIER-BY-TIER

The Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industry Base Policy (ODASB [MIBP], 2011) defines the S2T2 approach as a fundamental framework for understanding and managing supply chains in industries where the product is the culmination of many layers of supplied components and materials. This approach segments the supply chain into distinct levels or "tiers," each representing a different stage in the production and supply process. Furthermore, this method focuses on the relationship between different tiers of suppliers, from those providing raw materials to those involved in the final assembly of the product.

The structure of the tier-by-tier approach is often as follows (ODASB [MIBP], 2011):

- Tier 1. These are direct suppliers to the original equipment manufacturer (OEM), and they typically provide finished components or systems that are ready to be integrated into the final product. For instance, the Tier 1 supplier might provide the entire propulsion system or the combat system to the warship.

- Tier 2. These suppliers provide parts or components to Tier 1 suppliers. These components are less complex than those provided by Tier 1 and often require further assembly or integration. For example, Tier 2 suppliers provide engine parts or electronic modules for the propulsion system.

- Tier 3: These suppliers usually provide raw materials or basic components to Tier 2 suppliers. An example is companies that are supplying essential minerals to the Tier 2 supplier that is manufacturing basic electronic components.

- Tier 4: These suppliers provide basic goods and services that feed into higher-tier components, including suppliers of raw materials, basic parts, and indirect services.

This approach provides clarity and visibility into the supply chain, allowing OEMs to trace components back to their origins. It enables strategic decision-making regarding sourcing and supplier relationships, including decisions about diversification. (ODASB [MIBP], 2011). Also, it helps in identifying cost-saving opportunities and efficiency improvements at different supply chain levels. Finally, by understanding the different tiers, companies can identify and manage risks at each level, such as supply disruptions or quality. (ODASB [MIBP], 2016).

Based on its size, Djibouti's national defense capabilities could be compared to other relatively small navies and their respective challenges. One obvious example is the Malaysian Navy and how it overcame its challenges. Bing (2019) in his article "Building Malaysia's Defense Industry" explored the significance of developing national defense capabilities in Malaysia. He emphasized reducing reliance on foreign suppliers and contributing to national economic growth. He discussed the strategic need for Malaysia to establish a self-reliant defense sector, highlighting the benefits of decreased foreign dependency and the economic advantages of a thriving defense industry. He also acknowledged the challenges Malaysia faced such as capital investment, technological expertise, and maintaining high-quality production. Bing (2019) suggested strategic partnerships and targeted development in specific areas to overcome these challenges, underscoring the importance of a well-planned approach to strengthen Malaysia's defense capabilities and economic position.

In addition, a supplier-led approach facilitates a two-way learning process, ensuring that sustainability knowledge is not only distributed but also effectively implemented,

thereby fostering a more sustainable supply chain. Silva et al. (2023) in their article "Bridging Sustainability Knowledge Management and Supply Chain Learning: Evidence Through Buyer Selection" emphasized the crucial role of suppliers in enhancing supply chain sustainability. They highlighted how suppliers are key to disseminating sustainability knowledge across the supply chain. Through their interactions and strategies, such as careful buyer selection, suppliers can significantly influence sustainability understanding and practices among their buyers.

Implementing a tier-by-tier approach in naval acquisition presents several challenges, particularly in managing complex supplier networks and integrating advanced technologies across different tiers. Managing supplier networks in naval acquisition is complicated due to the multiple tiers involved. Each tier of suppliers may have different capabilities, standards, and timelines, making coordination and communication a significant challenge. For instance, the U.S. shipbuilding industry, which includes both public and private shipyards, faces challenges like limited dry docks that contribute to delays in construction and maintenance further complicating the acquisition process. Furthermore, Navy warships need to be adaptable to allow regular upgrades or changes throughout their life cycle to take advantage of the latest technologies. This is often complicated by long acquisition cycles and inflexible contracting, which can limit opportunities for innovation. Navies should balance the need for new capabilities with the constraints of existing ship designs and infrastructure.

C. FRAGILITY AND CRITICALITY

According to the International Council on Systems Engineering (2020), the concepts of FaC are fundamental in acquisition planning and risk management, guiding decision-makers in prioritizing resources and strategies to ensure robustness and reliability in their operations. In the acquisition domain, fragility refers to the susceptibility of a system, process, or supply chain to disruptions or failures due to various internal or external factors (International Council on Systems Engineering, 2020). It involves considerations like complexity, dependency on specific suppliers, or vulnerability to market fluctuations. Criticality, on the other hand, pertains to the importance or essentiality of certain elements,

systems, or processes within the acquisition framework (International Council on Systems Engineering, 2020). This includes aspects that are crucial for successful operations, such as strategic supplier relationships, or core components whose failure or unavailability could have significant adverse effects on the overall system or project.

Historically, these concepts were primarily focused on the reliability and importance of physical components in manufacturing and military contexts. However, with globalization and technological advancement, the scope has broadened significantly. Modern acquisition strategies now consider FaC in the context of global supply chains because they involve analyzing and mitigating risks associated with supplier dependencies and the critical nature of certain components. For instance, the Navy might rely heavily on a single supplier in a geopolitically unstable region for a critical component. Recognizing this fragility, the Navy might develop strategies such as diversifying its supplier base or stockpiling essential components. In the same context, in the case of criticality, the Navy might identify a critical component that significantly influences operationality. Thus, the Navy might prioritize securing multiple reliable sources for this component or invest in R&D to reduce dependency on external suppliers.

Additionnally, according to the International Council on Systems Engineering (2020) the FaC is a comprehensive concept that helps inform budget decisions and identify segments of the industry that are vital yet potentially vulnerable. Mishory (2013) in his article "Pentagon Examining Criticality, Fragility of Nuclear Industrial Base" outlined the Pentagon's approach to identifying critical and fragile areas in the nuclear industrial base. The assessment integrated data from various sources, including the Pentagon's 2011 S2T2, and missile FaC assessment. Furthermore, according to Mishory (2013), the process involved examining different programs to pinpoint critical and fragile sectors within the industrial base.

Similarly, there is an imperative for a comprehensive industrial strategy to sustain critical defense sectors amid fiscal austerity and complex security challenges. "DOD Needs Industrial Strategy To Preserve 'Critical' Sectors" (Sherman, 2011) discussed the Pentagon's need for an industrial strategy to maintain vital sectors of the defense industry.

It emphasized the importance of identifying and preserving critical sectors essential for future threats, suggesting redirecting funding from less crucial weapons programs. The study highlighted challenges in a constrained budget environment and the unique nature of the defense industry, which does not operate as a normal free-market entity.

D. SUPPLY CHAIN

According to NAVSUP (n.d), the main goal of the supply chain management (SCM) is to increase the operationality of the new by managing effectively all logistics activities. It is a conscious effort run by the Navy logistics department to develop supply chains in the most effective and efficient ways possible. There are several key components to SCM such as identifying the most valuable strategy for the supply chain, selecting suppliers that provide the best quality value and are reliable for goods and services, efficiently producing goods and services to meet demand, ensuring that products are delivered to the right place at the right time, using IT systems to monitor and control processes, and identifying, assessing and mitigating risks throughout the supply chain to minimize vulnerabilities.

For the Navy to implement an SCM system there are several specialized steps (NAVSUP, n.d):

- Administer a needs assessment to understand mission requirements,
- Expected environments, and longevity of service,
- Conduct thorough market research to identify potential suppliers for materials, components, and technologies,
- Work closely with suppliers, engineers, and naval architects to design ships that meet specific operational requirements while being cost-effective and easy to maintain,
- Use strategies like bulk purchasing and long-term contracts to achieve cost savings,

- Regularly audit suppliers and conduct inspections,
- Plan and coordinate the logistics of delivering materials,
- Invest in the latest technologies and practices to improve SCM efficiency,
- Train military and civilian personnel in SCM best practices and specific systems used in naval acquisitions,
- Ensure that all aspects of the supply chain comply with government regulations and ethical standards, and
- Identify potential risks to the supply chain from geopolitical issues to supplier bankruptcy, and develop contingency plans.

Regnier et al. (2013) emphasize the importance of reassigning combat assets for force protection and ideal depot location in supply chains. This concept is stressed in their report "Estimating Supply-Chain Burdens in Support of Acquisition Decisions," which provided a detailed and analytical look at how acquisition decisions impact supply-chain burdens, particularly focusing on the cost and logistics of energy and fuel in military operations. Furthermore, according to Regnier et al. (2013), the study assessed the impact of consuming multiple supply commodities through logistics activities. Additionally, it identified three primary cost categories associated with delivering fuel to the warfighter: resource expenditure, capability reductions, and increased vulnerability

Another system, the program-based logistics (PBL) portfolio is a first step and a useful tool for practitioners, but further empirical testing and development are required, most notably in the areas of cost and performance control, supply security, and risk-sharing approaches. Glas et al. (2013) provided a detailed exploration of the PBL concept in the context of military logistics, offering a strategic framework for decision-making and emphasizing the need for further R&D in this area. The methodology, as described by Glas et al. (2013), involved qualitative interviews and examples from different European countries.

According to Regnier et al. (2013), it is important to have robust and flexible systems in place to manage unforeseen challenges, such as the COVID-19 pandemic, and ensure continued operational readiness. The pandemic's disruption has been felt across supply chains. One of the primary issues has been the effect on operations and supply chains globally, posing a critical and unknown risk to military readiness. To find the best possible solution to these issues, defense suppliers have been proactive in enhancing cooperation with supply bases to assess and mitigate these risks, ensuring uninterrupted services (Regnier et al., 2013). Advanced analytical tools have helped provide an end-to-end view of inventory levels and the overall health of spare and repair parts supply (Regnier et al., 2013). For instance, to address these challenges, large companies like Airbus and Boeing had to temporarily suspend production and assembly activities in locations affected by lockdowns, although key support services continued to be provided.

In summary, this literature review aimed to give a comprehensive understanding of the concept of S2T2, and FaC and how they are beneficial for assessing the defense sectors. However, as technology is evolving at a rapid pace, these concepts shall not be put aside but instead, applied as an agile concept for continuous improvements. Furthermore, the explanation of the concepts of S2T2 and FaC and how they are used serve as primary steps before delving deeper into the next chapter (Chapter IV).

IV. ANALYSIS

To answer the primary research objective, that of evaluating risks associated with Djibouti's DIB risks in shipbuilding, the study uses a qualitative research approach. This assessment prioritizes risk mitigation strategies based on the severity and impact of potential disruptions. In addition, integrating findings from the qualitative research into broader strategic insights can improve informed decision-making processes within the DJN and Djiboutian government, and propose tailored recommendations that could strengthen the DIB, enhance the DJN's self-reliance, and improve the country's overall national security posture.

The goal is to provide an understanding of Djiboutian's shipbuilding structure and functionality. This involves dissecting each sector and tier to assess their contributions to the shipbuilding capabilities and identify specific vulnerabilities or inefficiencies. The Republic of Djibouti's strategic maritime position facilitates significant international shipping, including along one of the international choke points, the Bab-el-Mandeb Strait. These geographical advantages emphasize the importance of having shipbuilding to contribute to regional security and economic stability.

The defense industrial base supporting the shipbuilding predominantly consists of small businesses with limited capabilities, relying heavily on imports for raw materials and spare parts. The previous chapters highlighted the need for a detailed S2T2 concept, and also pointed out the necessity of improving software management, supply chain logistics, and contracting processes to bolster operational effectiveness and strategic readiness. The S2T2 involves understanding each sector's specific challenges and dependencies, as well as how tiers of suppliers contribute to the overall readiness and sustainability of shipbuilding. Similarly, the need to evaluate the shipbuilding's fragility (vulnerability to disruptions) and criticality (importance of specific sectors or elements) has been established as a foundational aspect of this research.

According to the Congressional Research Service (O'Rourke, 2024) for U.S. shipbuilding, there are companies in various sectors that contribute to the design, construction, maintenance, and repair of naval and commercial ships:

- **Shipbuilding and repair yards**: primary sector where ships' actual construction and repair occur. It includes major shipyards that build naval ships, submarines, large commercial vessels, and smaller yards for other types of vessels.
- **Marine engineering and naval architecture**: this sector includes engineering services that specialize in the unique requirements of marine structures and systems.
- **Propulsion and power generation:** this sector provides the engines, turbines, and other power systems that drive ships. Both design and manufacturing are critical components.
- **Electronics and navigation systems:** companies that supply the navigation, communication, and other electronic systems vital for modern ship operation.
- **Weapons systems: manufacturer of weapons systems,** such as missiles, guns, and other defensive and offensive systems integrated into military vessels.
- **Steel and special metals production**: a sector that includes the mills and foundries that produce steel and other alloys used in hulls and other ship structures.
- **Parts and components suppliers:** manufacturer of pumps and valves to electrical cables and lighting systems

- **Research and development**: R&D efforts aimed to advance shipbuilding technology, improve materials, and develop new ship construction and maintenance methods.

This research uses these sectors to assess Djibouti's DIB risks in shipbuilding.

In the same context, the O'Rourke (2024) highlights that in the Navy shipbuilding, the supply chain is structured in tiers.

- **Prime contractors (Tier 1):** these are the major shipyards that contract directly with the government or ship operators to deliver complete ships. They manage the overall project and integrate systems from various suppliers.

- **Major subcontractors (Tier 2):** these companies provide substantial subsystems or major components directly to the prime contractors. This might include major engine assemblies, large sections of the ship's superstructure, or complex electronic systems.

- **Subcontractors (Tier 3:):** tier 3 suppliers provide specialized components and materials to the Tier 2 subcontractors. These can include smaller machined parts, specialized electronics, and materials like piping and wiring.

- **Material and component suppliers (Tier 4):** these suppliers provide raw materials and basic components used in the manufacturing processes at higher tiers. This includes the provision of steel, alloys, fasteners, and basic electronic components.

- **Small Businesses (Tier 5 and Below**): many small businesses play critical roles in the shipbuilding supply chain, supplying highly specialized services and components that contribute to the construction and outfitting of ships. These businesses often provide products and innovative solutions that larger companies cannot supply economically.

This research uses these tiers to assess Djibouti's DIB risks in shipbuilding.

Table 1 shows an assessement of the capability of companies involved in shipbuilding across various tiers of the supply chain. The table presents companies categorized based on their ability to meet the needs of the shipbuilding sector, marking their status with different colors to indicate their level of capability and capacity:

- **Red:** Indicates that Djibouti lacks organic companies with the capability or capacity to meet specific shipbuilding needs. This highlights a gap in the local industrial base where Djibouti is dependent on foreign suppliers or needs to develop these capabilities domestically.
- **Green**: shows that Djibouti has organic companies with both the capability and capacity to fulfill these roles. This suggests a level of self-sufficiency and development within the local shipbuilding sector.
- **Yellow**: signifies that Djibouti has organic companies, but their competencies are immature. These companies may require further development, support, or investment to fully meet the demands of the shipbuilding sector.

Table 1. Supplier contractor in tiers across shipbuilding sectors

	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Shipbuilding and repair yard					
Marine engineering and naval architecture					
Propulsion and power generation					
Electronics and navigation systems					
Weapons systems					
Steel and special metal production					
Parts and components suppliers					
Research and Development					

To be competitive in the region, the Djibouti government decided on November 26, 2020 to lead the foundation for the first Djibouti shipyard. The Dutch company Damen Shipyard was awarded the construction of the shipyard. Besides, the Ports' personnel, the Dutch company has to train Djiboutian engineers and manual personnel. The economic

impact of the construction of this shipyard will represent 300 direct jobs and 1,500 indirect jobs. According to Nemeth (2020) in his article the shipyard provides service for the supply of propellers, rudders, pumps, and valves. One dry dock that lifts and holds out any vessel 217 m long, 37 m wide, and 10 m high constitutes the major equipment of the shipyard. Furthermore, applying the concepts of FaC to Djibouti's shipyard (see Table 3, below) shows that skilled labor, navigation systems, and engines, and the dry docks are critical to the shipyard activities.

Table 2 shows the factors that help determine if a company is critical to the shipbuilding sector by identifying how the company has a unique capability to the sector and how often the service or the capability of this company is used by the sector. Furthermore, fragility factors are how a company depends on the government's support to be in the market and how many companies offer the same capacity for shipbuilding.

Table 2. Fragility and criticality factors

Factor type	**Factor description**	
Criticality	Shipbuilding unique capability	How unique the capability is to the Navy shipbuilding
	Relevant to the Shipbuilding	How often the capability is used for shipbuilding
Fragility	Financial Outlook	Risk the provider is going out of business.
	Defense dependence	Provider dependence on defense contracts
	Firms in sector	Number of firms in the market that can provide this capability

Table 3 shows categories of shipbuilding capabilities into different levels of fragility and criticality, each with specific impacts on operations if disrupted. The categories are defined as fellow:

- High Criticaity, High Fragility (**Category I**): Capabilities are both critical and vulnerable, with disruptions potentially having a significant operational impact

- High Criticality, Medium Fragility (**Category II**): These capabilities are critical but more stable, where disruptions are likely but the impact remains significant.

- Medium Criticality, Medium Fragility (**Category III**): These are less critical and depend on the government, which disruptions likely not critically impacting operations but still causing concerns.

- *Low Criticality, High Fragility (**Category IV**): These are vulnerable and less critical, with disruptions primarily having an economic impact.

- Low Criticality, Medium Fragility (**Category V**): These are less critical and depend on government support, with minimal impact from disruptions.

- *Low Criticality, Low Fragility (**Category VI**): These are the least critical and independent from government support, with disruptions having negligible impacts.

Table 3. Fragility and criticality matrix

Category I	High criticality, high fragility
Category II	High criticality, Medium fragility
Category III	Medium criticality, Medium fragility
Category IV	Low criticality, High fragility
Category V	Low criticality, Medium fragility
Category VI	Low criticality, Low fragility

Table 4 below, applies the fragility and criticality framework to Djibouti's shipbuilding sector. It shows the assessement of the critical and fragile nature of various components like repair yards and weapon systems within the Djiboutian shipbuilding industry. This table shows how shipbuilding companies such as shipyard repair and weapons systems, are both crucial (high criticality) and fragile (high fragility). Furthermore, it details the presence and capability of companies in Djibouti (marked with

colors such as green for present and capable, and red for crucial but not locally producible), demonstrating the reliance on defense contracts and the strategic need to foster local manufacturing to reduce foreign dependency and enhance economic stability.

Table 4. Fragility and criticality applied to Djibouti's shipyard capabilities

	Criticality	Fragility	**Category**
Shipbuilding and repair	High	High	**I**
Marine engineering and naval construction	High	Med	**II**
Propulsion and power generation	Med	Med	**III**
Electronics and navigation systems	Med	Med	**III**
Weapons systems	High	High	**I**
Steel and special metal production	Low	Low	**VI**
Parts and components suppliers	Low	Low	**VI**
Research and Development	High	High	**I**

The findings from applying the FaC framework to analyze the Djiboutian shipbuilding show that reinforcing the DIB and maintaining and expanding these companies related to shipbuilding encourages the growth of local manufacturing sectors create jobs for locals, and reduces the unemployment rate. By reducing dependency on foreign suppliers, Djibouti can retain a larger share of its defense expenditure within the local economy, promoting economic stability.

In addition, having a robust shipbuilding sector where the Navy could maintain its assets operational can lead to collaborations on defense projects with other countries. This kind of partnership can include joint development of naval technologies or shared defense manufacturing facilities, boosting the local defense. Thus, having a strong navy will contribute to international security, especially in strategic maritime regions like the Bab-el-Mandeb Strait.

On the other hand, from an environmental point of view, the construction of new naval facilities or expansion of existing ones could affect local flora and fauna, particularly

marine species that depend on coastal habitats. Furthermore, increased naval activities can lead to more instances of oil spills, and contamination from ship maintenance activities. These pollutants can have detrimental effects on marine life, impacting food chains and ecosystem health. For instance, anti-fouling paints and other chemicals used in shipbuilding and maintenance thrown into the water could have toxic effects on marine organisms.

In summary, the FaC approach highlights vital sectors and components that are crucial for shipbuilding. Still, there is a risk of over-reliance on single suppliers, which could decrease operational capacity if disrupted. Furthermore, although, dependency on imported materials introduces vulnerability and political, economic, and logistical challenges diversifying the suppliers and supporting local businesses are beneficial. Finally, all these findings contribute to a comprehensive understanding of the imperative and vulnerabilities within DIB, and the need for a balanced, well-coordinated approach to optimize resources and to have a resilient industry. In the next chapter (Chapter V), solutions (recommendations) from the government and the private sectors explain how to improve the shipbuilding sector.

V. RECOMMENDATIONS AND CONCLUSION

Given its critical location, near the Bab-el-Mandeb Strait which connects the Indian Ocean to the Red Sea, the Republic of Djibouti needs to ensure a strong and reliable DIB that can support the Djiboutian's Navy accomplishing effective maritime control and surveillance in the the Bab-el-Mandeb Strait. Using the sector-by-sector/tier-by-tier (S2T2) and fragility and criticality (FaC) conceptual frameworks, this study examined the Djiboutian DIB on how it can support the Djiboutian shipbuilding to contribute to the operationality of the Djiboutian Navy (DJN). The DJN faces several challenges ranging from an underdeveloped DIB to relying on imported technologies and components. To address the DIB's challenges and increase the country's naval capabilities, new strategies regarding procurement processes, infrastructure development, and training opportunities are needed. Furthermore, the DJN requires the government's support through policy and law to bolster Djiboutian's shipbuilding. The primary research question is what are the risks associated with the Djiboutian DIB with respect to organic shipbuilding, and the secondary research questions are what is a strategy that mitigates these IB risks and what are the supplier's abilities? Strengthening the DIB and supporting the development of business related to shipbuilding not only boosts local manufacturing sectors but also generates employment opportunities and lowers the unemployment rate. By implementing laws and regulations, and lessening reliance on foreign suppliers, the Republic of Djibouti can keep more of its defense spending within the local economy and the Navy keeps its assets operational.

A. PROCUREMENT PROCESS IMPROVEMENTS

1. Implementation of an S2T2 and FaC

The first action to improve the procurement process is to apply an S2T2 conceptual approach for procurement that tailors the acquisition strategies to meet the unique needs of different naval sectors such as weaponry, marine engineering, and naval architecture. This strategy should focus on identifying and mitigating risks associated with each sector and fostering innovation through R&D investments.

2. Enhanced Supplier Diversification

The next step is to reduce the risk associated with supplier dependencies by diversifying the supplier base. This involves not only identifying multiple suppliers for critical components such as parts and components of the shipbuilding (colored in green in Table 2 above) but also developing local suppliers to reduce overseas dependencies and improve the resilience of the naval supply chain.

B. INFRASTRUCTURE UPGRADES

1. Development of Local Shipbuilding Facilities

Expanding the shipyard (repair yard) in Djibouti should be one of the government's priorities because this facility would be capable of building new naval vessels and repairing and maintaining the existing fleet. Thus, this would reduce dependency on foreign shipyards. Likewise, it would improve turnaround times for repairs, and boost the development of local expertise in naval engineering and construction.

2. Modernization of Port Facilities

Besides building a shipyard, port facilities should be modernized to enhance the logistical capabilities. This includes expanding dry dock facilities and improving the technological infrastructure at ports to handle advanced naval systems and bigger fleets. Furthermore, the ports would handle larger technologically advanced vessels such as the 3 to 5 Marchant's vessel category. At the same time, acquiring this capability will increase the Navy's operational range. Therefore, by planning for and investing in naval infrastructure, the Navy will enhance its operational readiness and capacity, ensuring it can meet future demands efficiently.

3. Establishing a Naval Logistics Hub

The other solution to improve infrastructure is to create a centralized logistics management center such as a distribution center for resource pooling, equipped with advanced inventory tracking and fleet management software. This hub would oversee the logistics across all naval bases and shipyards, ensuring efficient resource allocation, maintenance schedules, and readiness of all naval assets.

4. Training and Development

It is also necessary to implement ongoing training and certification programs for all naval personnel regarding contract management and supply chain management to keep pace with the latest technological developments to foster relationships and collaborate with local industries. This would in the long run benefit Djiboutian's shipbuilding and increase its operational capabilities.

To support the strategic and operational changes necessary for Djiboutian's shipbuilding development, a series of policy adjustments and new policies are essential. These recommendations should focus on ensuring long-term sustainability and aligning with the broader national security and economic goals for Djibouti. Furthermore, increased government support through funding and legislation will provide the necessary resources to implement the recommended strategies effectively.

C. POLICY ADJUSTMENTS

1. Investment in Local Defense Industries

The Djiboutian government should implement policies that stimulate the growth of local defense industries. This could include tax incentives, start-up grants, and subsidies for (R&D) aimed at encouraging local production of military equipment and reducing reliance on foreign suppliers. Furthermore, by revising procurement policies and stimulating local defense industries. Djiboutian's shipbuilding can reduce its reliance on foreign suppliers, enhance its operational independence, and foster domestic economic growth.

2. Strategic Resource Allocation

The government should develop a policy framework for strategic resource allocation that prioritizes critical areas within the shipbuilding domain such as weaponry, marine engineering, and naval architecture (in red in Table 2). This should include detailed budgeting rules that ensure adequate funding for maintenance, training, and acquisition of new technology. Moreover, strategic resource allocation and a dedicated policy for technology upgrades will ensure that the shipbuilding remains at the technological

forefront, enhancing its operational capabilities and supporting the DJN against maritime challenges.

3. Environmental Protection

The government should implement strict controls on pollution and require the use of environmentally friendly materials and technologies for shipbuilding and maintenance. Furthermore, the government must establish marine protected areas where for flora and fauna habitat conservation and collaborate with environmental research institutions to study impacts and develop strategies for sustainable naval operations.

4. Naval R&D initiatives

The government should encourages and funds R&D initiatives to foster innovation in naval shipbuilding. This can be facilitated through collaborations with universities, international naval forces, and private sector entities specialized in maritime technologies.

These policy adjustments aim to create a robust framework within which Djiboutian's shipbuilding can operate effectively, fostering an environment conducive to security and development. Implementing these changes will require strong leadership, clear strategic direction, and consistent governmental support.

D. CONCLUSION

In conclusion, the recommendations outlined for Djiboutian's shipbuilding are designed to bolster its operational capabilities and strategic readiness, ensuring it remains a robust industry capable of addressing current and future challenges, capable of supporting the DJN, the Republic of Dibouti's strategic interests, and indirectly contributing more effectively to regional stability and security. These recommendations encompass policy adjustments, and specific government interventions, all aimed at enhancing Djibouti's shipbuilding. Implementing these recommendations is expected to significantly enhance the Djiboutian'shipbuilding operational readiness and strategic responsibilities. As a result, the Navy will be better equipped to handle maritime security threats, protect national interests, and engage in international maritime operations. Furthermore, upgraded

infrastructure and technology, along with a skilled workforce will enable Djiboutian's shipbuilding to respond effectively to a variety of maritime scenarios such as cyber attacks.

A committed effort from governmental bodies, local industry representatives, and the defense department, especially the Navy's command structure is essential. Continuous investment and legislative support are crucial for the sustained modernization of Djiboutian's shipbuilding and as a result the capability enhancement of the Navy. Further research should be conducted in areas such as sustainable maritime practices, and effective human resource strategies. This will ensure that the Republic of Djibouti not only keeps pace with global naval trends but also innovates in ways that are uniquely suited to its strategic context.

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