



THE BRAZILIAN NAVY SCIENCE, TECHNOLOGY AND INNOVATION STRATEGY

BRAZILIAN NAVY - NAVAL STAFF
2017



SCIENCE, TECHNOLOGY AND INNOVATION STRATEGY

BRAZILIAN NAVY

2017

EXPEDIENTE

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MESSAGE FROM THE COMMANDER OF THE BRAZILIAN NAVY

Since the beginning, the Brazilian Navy has acted with the firm purpose of contributing with the research towards the national scientific and technological development, aiming at fulfilling its Mission, according to its Vision.

Mission

To prepare and use the Naval Power, in order to contribute to the Country's Defense; to guarantee the constitutional powers, and, by initiative of any of these powers, the law and order; to fulfill the subsidiary attributes established by Law; and to support foreign affairs policy.

Vision

The Brazilian Navy will be a modern balanced Force, and will dispose of naval, naval air and marine assets compatible with the strategic-political insertion of our Country in the international scenario, and in accordance with the will of the Brazilian Society, will be permanently ready to act on the sea and interior waters, singularly or jointly, in order to meet the purposes established in its mission.

In the past, to adapt to an operational environment that was mostly fluvial, the Navy faced the necessary technological leap to use, maintain and operate steam powered ships. Nowadays, it aims at conquering the necessary technological leap to be part of the select and reduced group of countries that are able to project, build, maintain and operate submarines with nuclear propulsion, aware of the importance of participating in the national Academy and Industry to reach its goals.

The ST&I Strategy, object of this publication, aims at formalizing and publicizing to the members of the Triple Helix (Government, Academy and Industry) the challenges to be overcome, and how the Navy intends to meet the demands of research and technological development to fulfill its mission.



EDUARDO BACELLAR LEAL FERREIRA
Admiral
Commander of the Brazilian Navy

MESSAGE FROM THE CHIEF OF THE NAVAL STAFF



To fulfill its Mission and Vision, the Brazilian Navy, in its Organizational Structure, disposes of the Naval Staff (EMA), General Board which, among other tasks, assists the Commander of the Brazilian Navy in subjects regarding: maritime and environmental activities; legislation; organization; communications; science, technology and innovation; politics; doctrine; strategy; naval operations; intelligence; national defense; personal; and logistic.

EMA also is in charge of formulating the Strategic Plan, the Basic Doctrine, the Plan of Articulation and Equipment, the Program of Re-equipping and elaboration of documents with high level of interest for the Navy, among which, the Science, Technology, and Innovation Strategy (ST&I).

This Strategy, in accordance with other highest level documents, aims at balancing between the means and ends; between resources and goals; between demands and priorities of ST&I, concerning to the Navy of Tomorrow and of Future. To guide these activities, they are clustered in thematic fields and are correlated with the technologies to be used, according to objective criteria, which includes an evaluation of technological maturity.

LUIZ GUILHERME SÁ DE GUSMÃO
Admiral
Chief of the Naval Staff

MESSAGE FROM THE GENERAL DIRECTOR OF NUCLEAR AND TECHNOLOGICAL DEVELOPMENT OF THE NAVY

The Directorate General for Nuclear and Technological Development of the Navy (DGDNTM) is the Central Executive Institution of the Science and Technology System of the Force, which is in charge of coordinating the activities related to research management and development of Science, Technology and innovation (ST&I) in the Thematic Fields defined by this Strategy, addressed to Naval, Air Naval and Marine assets which will be part of the Navy of Tomorrow and of Future

To that end, the DGDNTM, aligned with the highest level documents of the Navy, among which, this Strategy, will work to meet the demands of infrastructure of the appropriate ST&I, the high level training of the Work Force, the Management of Knowledge, the continuous budgetary resources, the adequate prioritization in the use of these inputs, and the new information coming from an opportune global technological prospection.



BENTO COSTA LIMA LEITE DE ALBUQUERQUE JUNIOR

Admiral

General Director

B823e

BRASIL. Comando da Marinha. Estado-Maior da Armada

Estratégia de ciência, tecnologia e inovação da Marinha
do Brasil – Brasília, 2017.

[103] p.; 21 cm

1. Ciência, Tecnologia e Inovação. 2. Estratégia. 3. Gestão
estratégica. 4. Brasil. Marinha. I. Título.

CDD:355.07

APPROVAL

I approve the publication EMA-415 - THE BRAZILIAN NAVY SCIENCE, TECHNOLOGY AND INNOVATION STRATEGY to be used in the BN.

BRASÍLIA, DF.
On September 11, 2017

LUIZ GUILHERME SÁ DE GUSMÃO
Admiral
Chief of the Naval Staff

PURPOSE

This publication has the following purposes:

- a) to align the activities of Science, Technology and Innovation (ST&I) of the BN with the orientations issued by the highest level conditioning documents;
- b) to orient the coordination of research and development (R&D) of ST&I of the Force to meet the needs of the Navy of Tomorrow and of Future; and
- c) to present the BN ST&I strategic vision to decision makers, main actors, clients and executors.

DESCRIPTION

This publication is divided in five chapters and contains 4 appendix. Chapter 1 presents the Strategy of ST&I of the BN; Chapter 2 shows the Technological Challenges; Chapter 3, the Vision of the ST&I System of the BN. In chapter 4, we approached the Execution of the BN ST&I Strategy; and Chapter 5 shows the Strategic Resources and expected results from the execution of the ST&I Strategy of the BN. The appendix presents the Details of the Thematic Areas of the ST&I of the BN; the Organizational Structure of the System of Science, Technology and Innovation of the Navy (SCTMB); the Governance of ST&I of the BN; The detailed subareas and lines of research approached by the Thematic Fields of R&D of the ST&I.

RECOMMENDATIONS

The priority of this publication is to guide the activities of ST&I of the BN, and it should be revised every time there is a change in the Navy Strategic Plan (EMA-300).

CLASSIFICATION

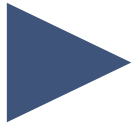
This publication is classified, according to EMA 411 - Navy Manual of Publications, as: uncontrolled, unrestricted, normative and political Publication of the Brazilian Navy (PMB).

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**PRESENTATION OF THE BN
ST&I STRATEGY**



CHAPTER I

PRESENTATION OF THE BN ST&I STRATEGY

The advances of science and its technological applications allow predicting the appearance of groundbreaking innovation in several sectors that affect the distribution of power in the international system, remarkably in the economic and military fields.

Major powers lead such a process, and try to maintain and increase the technological vanguard, continuously imposing challenges to emerging countries that seek better insertion in the decision-making processes of global governance.

In Brazil, a considerable normative effort has been made in order to lever the national scientific-technological capacity, including that of interest in the defense productive sector. In this sense, highest level documents, such as the National Defense Policy (PND), National Defense Strategy (END), National Defense White Paper (LBDN), Science, Technology and Innovation Policy for National Defense (PCTIDN), and the National Strategy of Science, Technology and Innovation (ENCTI), issue guidelines that value science, technology and innovation, which reflect on the strategic defense planning. Besides, laws, decrees and other public policies have tried to create conditions that stimulate the development of the Industrial National Defense Base.



The strategic orientation of the BN is in EMA-300 - Strategic Plan of the Navy (PEM), where the Naval Objectives are listed (OBNAV), as well as the resulting Naval Strategies (NS). For the performance of this study, two NS represent the lighthouse that guides all the rest: “development of technological competences of the Navy”; and “development of technological competences of the nuclear sector”. Besides the NS, related

Naval Strategic Actions (AEN) are indicated. This set composes a scenario of guiding macro-processes for the “how to do” basis, which is the focus of this Strategy.

The preparation for the BN future brings about huge technological challenges, not only to the Institution itself, but to several sectors of society, such as the industry and the academy. These challenges require orchestrated actions in order to generate synergies that are able to optimize the application of limited resources. This condition is not exactly new, once technologies are more and more intrinsic to the naval combat platforms. It is worth to mention the example of Admiral Álvaro Alberto. In the 1950s, he had already realized the importance of the domain of the nuclear fuel cycle for our Navy, and, consequently, for Brazil.

In this context, to face the complexity of the strategic projects that interest the Defense, and particularly, the Navy, it is important to gather efforts, trainings and knowledge from the several institutions that comprise the System of Science, Technology and Innovation of the Brazilian Navy (SCTMB), and its network of research and relationships.

It is important to emphasize that a system of science and technology demands the appropriate infrastructure, high-level training of people, continuous budgetary resources and, especially, an adequate priority in the direction of these elements. In this system is highlighted the importance of people management, aligned with a strategy of knowledge preservation.

Finally, besides all the characteristics previously mentioned, it is essential to define what the time frame expected is for the obtainment of results from the SCTMB. For that, the Strategy considered the following concepts, already used by the BN:

Present Navy (PN)

Operates and maintains the current naval, naval air and marine assets, as well as the respective systems and subsystems.

The aspects related with minor modernizations are also included.

Navy of Tomorrow (NT)

Refers to naval, naval air and marine assets, as well as the respective systems and subsystems, which are being built and/or obtained.

The aspects related with “opportunity purchases” are also included.

Navy of the Future (NF)

Gathers studies, research, technological development, analysis of the conjuncture at strategic level, technological prospection and the first steps for the conception of future naval, naval air and marine assets, as well as the respective systems, subsystem and supra-systems.

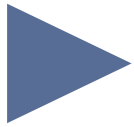
Here is the objective of this document, which balances the means and ends, the resources and goals, the demands and priorities, the Navy of Tomorrow and of the Future. It aims at guiding the ST&I activities of the BN, establishing its priorities, clustered in thematic areas, correlated with the technologies that will be employed to meet the needs to come, according to objective criteria, including the evaluation of technological maturity, in order to guide the distribution of financial resources for its execution. Therefore, it is essential to implement management mechanisms that facilitate the obtainment and use of financial resources coming from the public and private sectors, for the application in programs and projects of nuclear and technological development of the BN.

The Strategy is also an instrument of information for the actors, military and civilians, public and private, who participate, directly or indirectly, of the SCTMB. Therefore, it intends to obtain **three main effects**:

- a) **The coordinated direction of SCTMB, mainly for meeting the needs of the Navy of Tomorrow and of the Future;**
- b) **The presentation of the vision and strategy of the BN ST&I Sector to decision-makers, main actors, partners, clients and executors; and**
- c) **The optimization of the application of financial resources administered by the ST&I sector for the execution of the projects that are related with the strategic programs that interest the Force.**

TECHNOLOGICAL CHALLENGES





CHAPTER II

TECHNOLOGICAL CHALLENGES

The analysis of the highest level documents of the Navy is the base for the definition of the set of operational skills the Force must have available for the preparation and application of the Naval Power, in order to enable the fulfillment of the BN Mission¹, according to its respective Vision². Obtaining these operational skills leads to facing the technological challenges, which should be continuously identified by means of prospection activities and technological intelligence.

Therefore, the SCTMB must try to fulfill the technological gaps identified in the process of determining the necessary capacities for the naval, naval air and marine assets in the Navy of Tomorrow and of the Future.

¹BN Mission - “To prepare and use the Naval Power, in order to contribute to the Country’s Defense; to guarantee the constitutional powers, and, by initiative of any of these powers, the law and order; to fulfill the subsidiary attributes established by Law; and to support foreign affairs policy”.

²BN Vision - “The Brazilian Navy will be a modern balanced Force, and will dispose of naval, naval air and marine assets compatible with the strategic-political insertion of our Country in the international scenario, and in accordance with the will of the Brazilian Society, will be permanently ready to act on the sea and interior waters, singularly or jointly, in order to meet the purposes established in its mission”.

The first thing to consider, as a characteristic of the XXI century, is the high speed of the science progress, which enables or announces the appearance of innovative or groundbreaking technologies, of military or dual use. The consequence of that is the increasing risk for long and very-long term investments³, because of the possibility that developing strategic projects become obsolete before being concluded. It is worth to mention that major projects to obtain naval, naval air and marine platforms are included in this aspect.

Nonetheless, to assist the Navy of Tomorrow and of the Future, the SCTMB must face the great aforementioned challenge and others, resulting from the technological demands, such as:

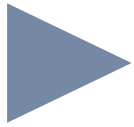
- a) The search for the scientific and technological domain in sensible or strategic areas of interest of the BN (detailed in Appendix A), especially the project, the construction and the operation of nuclear-powered submarines;**
- b) The monitoring and control of Brazilian jurisdictional waters and other areas of interest;**
- c) Cybernetic defense and Security;**

³Long term – between 3 and 5 Pluri-annual plans (PAP); and very long term – above 5 PAP.

- d) the continuous obtainment of knowledge about the different operational environments of the BN;**
- e) the improvement of the performance and the physical and psychological healthiness of the fighter before, during and after Naval Operations;**
- f) the preparedness for nuclear, biological chemical, radiological and explosive artifacts defense;**
- g) the overcome of barriers and limitations of access to Technologies, goods and services of interest for the Navy Strategic Projects;**
- h) the uncertainties inherent to the continuous provision of human and financial resources for long-term ST&I projects; and**
- i) the guarantee of a continuous and efficient Technological and knowledge Management.**

THE BN ST&I SYSTEM VISION

SHIPLIFT OF SUBMARINES NAVAL BASE SHIPYARD



CHAPTER III

THE BN ST&I SYSTEM VISION

3.1 - VISION

The SCTMB will be a ST&I system, with highly skilled **human resources and compatible infrastructure, focused on reducing the external dependence to meet the technological** demands of the Military Organizations in charge, mainly deriving from the system of strategic planning and forces related to the Navy of Tomorrow and of the Future; and those deriving from the Command of Naval Operations (ComOpNav), General Command of the Marines (CGCFN), General Board of Navigation (DGN), General Board of Navy Material (DGMM), General Board of Navy Personnel (DGPM), and the General Secretariat of the Navy (SGM) related to naval, naval air and marine assets, and the performance of the fighter, with management addressed to efficacy, efficiency and effectiveness.

3.2 - CHARACTERISTICS OF THE SYSTEM

The SCTMB will be a **dynamic, harmonic, integrated, synergetic, interdisciplinary and adaptive system:**

3.2.1 - A dynamic system, capable of accompanying and understanding the fast production of scientific knowledge and its technological applications of defense interest and maritime power, adjusting, when necessary, the focus on long-term projects that are viable from the political, social and economic point of view.



3.2.2 - A system that works harmonically with the institutions of the public and private sectors, in order to explore and optimize the stimulations coming from public policies addressed to ST&I.

3.2.3 - An integrated system that can gather the several capacities in the scope of the BN and partner institutions, with network action for

research and development, in order to generate synergy to increase the native powers, to face the challenges of the future.

3.2.4 - A system that is part of the strategic and force planning, from the first stages, providing information about the autochthonous capacities and the implications for the external dependence of the technological orders deriving from this process.

3.2.5 - An interdisciplinary system, capable of accompanying and receiving the contributions from the several cognitive domains in the XXI century, established or being formed, by stimulating the dialogue between the sciences of the nature and the applied social and human sciences, among others, to benefit the development of products and innovative processes of interest of the Navy.

3.2.6 - A system with high scientific and technological capacity, starting with the investment focused on human and research infrastructure resources, **valuing the intellectual capital**.

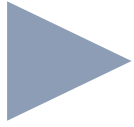
3.2.7 - A system aligned with the highest level documents, from the Federal Constitution (CF), National Defense Policy (PND), National Defense Strategy (END), National Defense White Paper (LBDN), Policy of Science, Technology, and Innovation for National Defense (PCTIDN), National Strategy of Science, Technology and Innovation (ENCTI), and the Systematic of High Level Planning (SPAN) of the Navy and its composing documents.

3.2.8 - An adaptive, resilient, and flexible system, which involves the political, social, and normative transformations, based on its systemic impacts, and is able to evolve in terms of structure and form, in order to outdo budgetary crises and political and economic adverse contexts, typical of developing countries.



**EXECUTION OF THE BN
ST&I STRATEGY**

DELIVERY OF THE STERN OF THE SUBMARINE MANUFACTURED BY NUCLEP AND ICN



CHAPTER IV

EXECUTION OF THE BN ST&I STRATEGY

4.1 - CHARACTERISTIC

The most important characteristic of the present Strategy is, as aforementioned, its alignment with the highest level documents shown in Chapter 1. Besides those documents, the Strategic Planning of the Navy (PEM) and the Naval Strategic Conception (CENAV) allow to infer, more specifically, the operational capacities the BN should have.

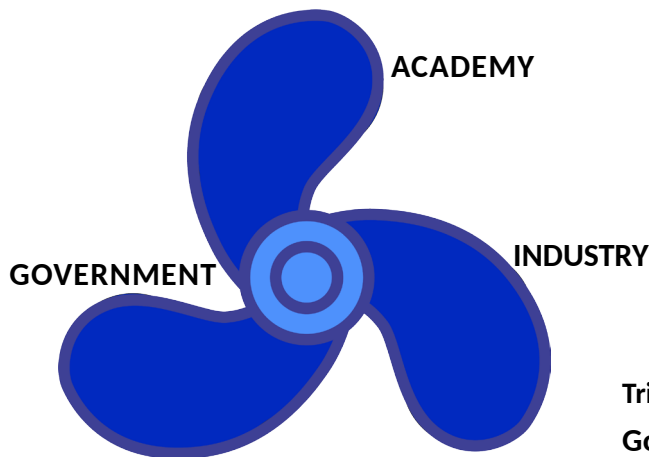
4.2 - EXECUTION

The execution of this strategy is constituted of a set of coordinated actions aiming at overcoming the technological challenges, identified by the SCTMB, and the consequent obtainment of the operational capacities planned.

4.3 - PHILOSOPHY

The philosophy around the planning and control of R&D of ST&I is the rationalization of the use of the BN resources, through a balanced management of the demands regarding the performance of the fighter and naval, naval air and marine assets, related to the Navy of Tomorrow and of the Future, using, when necessary, the other members of the “triple helix”⁴ composed by the Academy, the Government and the Industrial Defense Base (BID).

This approach is very flexible and has more strategic agility, in terms of the decision-making processes, since it adjusts the demands of basic and applied research to allow the obtainment of operational capacities of the Navy of Tomorrow and of the Future.



Triple Helix composed by the Academy, the Government and industry

⁴The Triple Helix Model was developed by Henry Etzkovitz in the 1990s, and is now one of the most popular and accepted metaphors to explain the capacity to transform scientific knowledge in innovation and technology.

4.4 - SCIENTIFIC, TECHNOLOGICAL AND INNOVATION DEVELOPMENT PLAN OF THE NAVY

Annually, the Scientific, Technological and Innovation Development Plan of the Navy (PDCTM) will establish and control the objectives related to the basic and applied research to be achieved, with detailed actions and guidelines that will be implemented, besides establishing indicators of efficacy, efficiency and effectiveness, to monitor the achieved results

4.4.1 - Actually, for any proposal that may compose the list of projects established by the SCTMB, the following analyses will be conducted previously: admissibility tests by the Governance of ST&I; and identification of the status of the technique, that is, the level of maturity of the technology or the set of technologies to be obtained.

4.4.2 - For the candidate projects to be admissible by the SCTMB, it is necessary that the demands come from ComOpNav, CGCFN, DGN, DGMM, DGPM or SGM; and that they be related to the performance of the fighter and the naval, naval air and marine assets regarding the Navy of Tomorrow or the Navy of the Future.

4.4.3 - As to the identification of the Technology Readiness Level (TRL)⁵, an increasing numerical reference will be used, based on the following diagram:

TRL	DESCRIPTION	ODS
9	Real and successful system employed in operational missions	ComOpNav CGCFN
8	Real, complete, qualified system in tests and demonstrations	DGN DGMM
7	Prototype of the system/subsystem demonstrated in the operational environment	D G D N T M
6	Prototype or model of the system/subsystem demonstrated in a representative environment	
5	Component or model validated in representative environment	
4	Component or model validated in the laboratory	
3	Characteristic or critical function of the concept that was analytically and experimentally proven	
2	Technological formulated concept and/or application	
1	Basic principles observed and/or described	

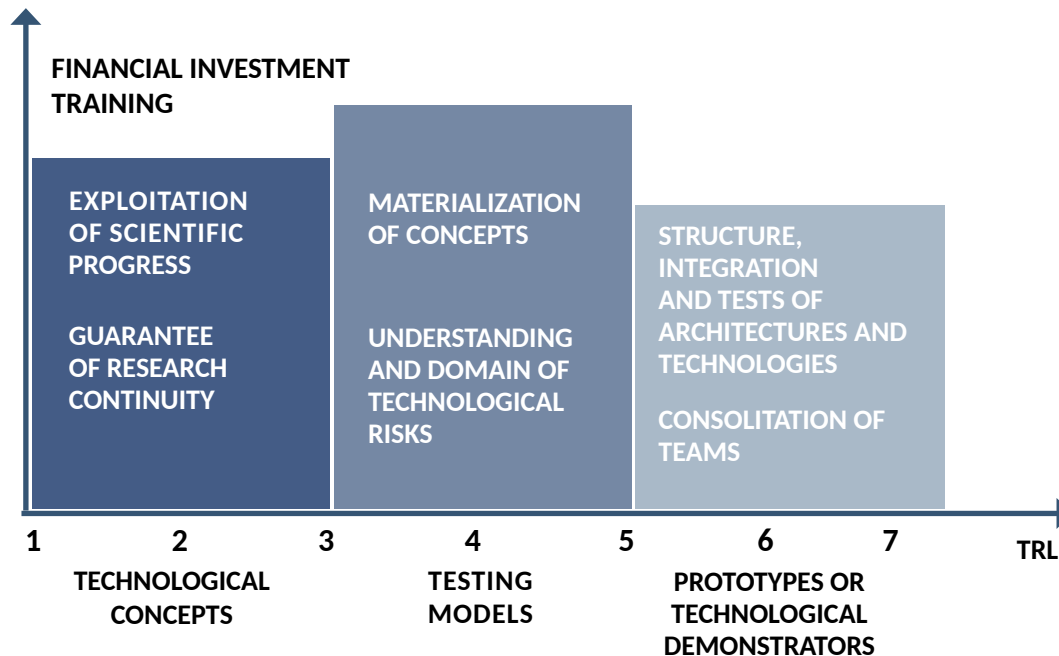
⁵The TRL scale considered here is based on that defined by the US Department of Defense.

4.4.4 - It is observed that the involvement of the ST&I Governance occurs until the level of maturity 7 (TRL-7), when the project can be transferred to the Operational and Material Sectors.

4.4.5 - The importance of the strict identification of the level of technological maturity lies on the fact that projects in the early stage of the scale (TRL-1), characterized by higher risk and higher time of maturation, have a radically different management dynamics than those which begin at a stage that is close to that of the prototypes and technological demonstrators (TRL-6 and 7).

4.4.6 - Therefore, the ST&I Governance must be able to promote the transition of those technologies considered as a priority for the BN (higher risk) to higher levels of maturity, mainly using the Academy and sources of financial resources that last for longer.

4.4.7 - Regarding to the projects that are close to the stage of transfer to the Operational and Material Sectors (TRL-6 and 7), the allocation of structures and personnel of the ICT of the BN, together with the obtainment of financial resources to be used immediately must be prevalent. This balance can be illustrated by the following graph:



4.4.8 - After the preliminary analysis of admissibility and the identification of the level of technological maturity, the technological demands must be forwarded, as projects, for the analysis of the Technical Commission of Science, Technology and Innovation of the Navy (ComTecCTM), and further approval by the deliberation of the Council of Science and Technology of the Navy (CONCITEM), except for those projects of lower complexity, which may be approved by ComTecCTM.

4.4.9 - Based on the clear identification of the technological demand in terms of deadline and necessity of



financial resources, **all management and execution activities of the ST&I, of interest of the BN, including the management of knowledge, are subordinated to the Directorate General for Nuclear and Technological Development (DGDNTM), main executive Governance institution of the SCTMB, with purposes of follow-up, supervision and control.**

‘DGDNTM - The beginning of the third cycle of evolution in the ST&I field is marked by Decree n. 8900, from November 10, 2016, which formalizes the alteration in the name of the Secretariat of Science, Technology and Innovation of the Navy to Directorate General for Nuclear and Technological Development (DGDNTM), and the incorporation of the activities of the Program of Submarine Development (PROSUB) and the Nuclear Program of the Navy (PNM), including the Organizational Management Structures of ST&I of the Navy, and Management of PROSUB and PNM.

4.4.10 - Therefore, by identifying a technological demand and its specific service, the DGDNTM will establish which Scientific, Technological and Innovation Institution of the Brazilian Navy will be responsible for developing the project, which should look for the necessary partnerships, when necessary, in order to complement its ability to execute it and allow the efficient and effective project management.

4.4.11 - - It is also important to mention that **the execution of such strategy must be carried out also by means of partnerships with civilian and military scientific and technological institutions, besides the Industry and the Academy.** It is also important to obtain the cooperation and coordination with other Singular Forces and other fields of the Government, especially the Ministry of Science, Technology, Innovation and Communications.

4.4.12 - With the aforementioned partnerships and cooperation, the intention is to work on the technological border, always **looking for the dual utility (both military and civilian) of the technology.**



**SIGNATURE OF THE PROTOCOL OF
MUTUAL INTENTIONS NAVY, ARMY
AND AIR FORCE**

4.4.13 - It is worth to mention that, for the projects involving sensible technologies, safety and secrecy must be a priority regarding the treatment of the knowledge produced and used. In case it is mandatory to carry out partnerships, these must be primarily performed with military ICT, transferring to each institution of the Industry or the Academy, if that is the case, only the necessary fractions of knowledge to carry out the research by that institution. The DGDNTM will be in charge of integrating the fractions to obtain the complete sensible technology expected.

4.5 - ICT-MB IN CHARGE

The ICT-MB in charge, according to the best practices of project management, should be oriented for prospecting, with the purpose of obtaining the mapping of the technological training existing in Brazil and abroad, and to keep track of the evolution of the technology, especially regarding its level of maturity, in order to guide the research and subsidize DGDNTM in any possible way.

4.5.1 - Technological Innovation Cells (CIT) related technically and functionally to the Technological Innovation Nucleus (NIT) of the DGDNTM

These are the sectors in charge of managing the intellectual property (IP) subjects, in terms of organizational structure of the ICT-MB, and must orient their respective ICT-MB as to the prospection.

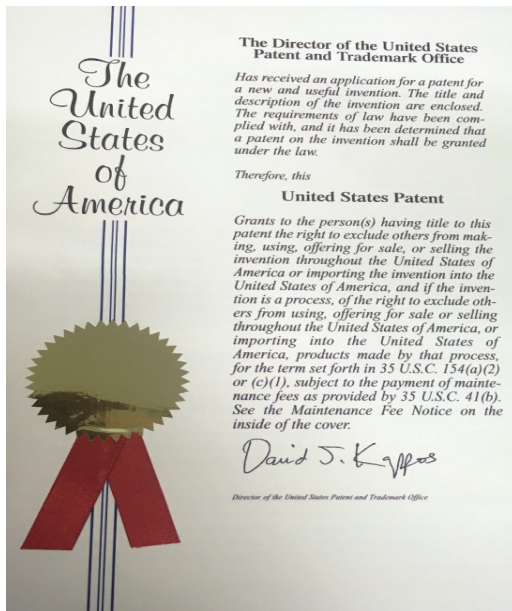
In this context, it is worth to mention the partnership between the BN and the National Institute of Industrial Property (INPI), which allows the elaboration of Technological Mapping studies in the fields of interest of the BN, especially the more complex projects.

In accordance with the orientation of the END, the search for autonomy for the domain of critical technologies is admitted, including international partnerships, with the goal of “capacitate the national industry of defense material so that it can conquer its autonomy in technologies that are indispensable to the Defense”, so that the State Defense material sector can operate in the technological threshold, developing technologies that do not present with commercial viability for the private companies, in the short and mid-terms.

In this context, the BN, through the DGDNTM, will try to encourage the Industrial Defense Base, using joint actions that can enable the transition of the developing technology to the private initiative, using, for that, the different mechanisms of taxes exemption in the Brazilian legislation, to

reduce the costs of production of the companies properly classified as strategic defense companies.

Appendix B and C expand and demonstrate the Organizational Structure of the SCTMB and the Governance of the ST&I of the BN.



LETTER OF PATENT “FERRUGEM PROTETORA” (PROTECTIVE RUST)

FINAL DISPOSITIONS



RESEARCHER FROM IEAPM

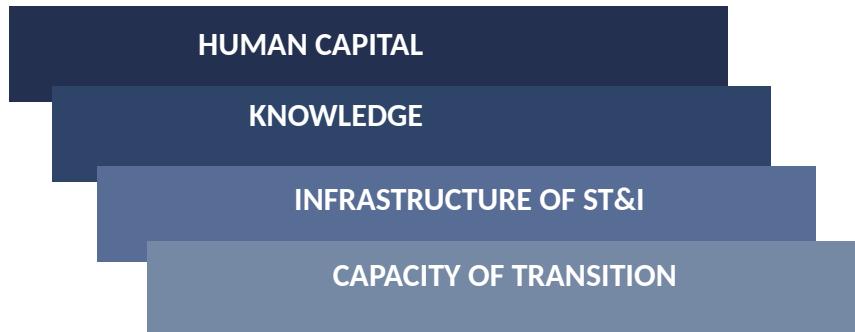


CHAPTER V

FINAL DISPOSITIONS

5.1 - STRATEGIC RESOURCES AND EXPECTED RESULTS OF THE EXECUTION OF THE BN ST&I STRATEGY

The identification and obtainment of the necessary technologies for the fighter of the future and naval, naval air and marine assets of the Navy of Tomorrow and of the Future will only come true using management techniques for the several human and material components involved in the process of discovery, development and demonstration of new technologies. The DGDNTM, main executive institution of the Governance of the BN ST&I, will make efforts to obtain, prepare and maintain these techniques and components, forming four great sets of strategic resources of the ST&I, as follows:



5.1.1 - Strategic Resources of the ST&I

a) Human capital

The formation and the application of mechanisms to maintain professionals of ST&I in critical specialties represent permanent challenges for the BN. The DGDNTM will try to minimize the impacts of the strong loss of specialized personnel, by establishing and intensifying partnerships with the Academy, through the joint production of scientific papers of basic and applied research; and the proposition of themes for master's dissertations and PhD and Post-PhD theses that interest the BN

Additionally, the actions to obtain academic scholarships, the continuous improvement of the Plan of Personnel Training (PLACAPE), the use of specialized military people in the Non-Paid Reserve (RM2), and the formation itinerary improvement of officials in technological careers are examples of efforts, among others, to be employed to preserve the hard core of scientific-technological capacity that interest the BN.



RESEARCHER FROM IEAPM

b) Knowledge

The scientific discoveries generate new knowledge and Technologies that expand capacities and enable the use of innovative concepts. The knowledge resulting from trial, success and failure leads to new technological paths that contribute with the reduction of risk in the different stages of the research and development, becoming a real patrimony to be multiplied and defended. The DGDNTM, by interacting with the other members of the “triple helix”, will prospect and assess emerging technologies of the future, with potential naval applications, accompanying the scientific development in disciplines of interest of the BN. Likewise, it will develop systems that ensure the adequate protection and preservation of the entire collection of information and scientific-technological knowledge of interest for the sector.



RETINUE OF THE BN VISITING MACKGRAPHE - MACKENZIE UNIVERSITY

c) Infrastructure of ST&I

The material set composed of installations and laboratories of the ICT and research centers, intra and extra BN, is the base for the execution of projects of R&D and ST&I of interest of the Force. To maintain the availability of this infrastructure, which has very high costs of acquisition and ownership, it is necessary to perform **a narrow cooperation among all members of the “triple helix”, in order to provide mutual support and obtain synergetic effects to transform projects of R&D and ST&I in operational capacities.**

d) Capacity of transition

The projects, partnerships, and best practices of the SCTMB, allied to an adequate distribution of financial resources, will be oriented to maintain the transition of technologies that interest the BN between different stages of technological maturity, so that ideas, scientific concepts and technological development can overcome the high initial risks of lack of success, reaching the stage of technological demonstrators. This capacity of transition will allow prototypes to be transferred to the Operative and Material Sectors of the BN, where the steps after homologation, licensing and commissioning will be concluded, turning into products.

5.1.2 - Results expected from the strategy

The strategic resources of ST&I (Human Capital, Knowledge, Infrastructure of ST&I, and Capacity of Transition) will be systematically used to obtain the expected results, as follows: meeting the demands of R&D of the ST&I related with the performance of the fighter and naval, naval air and marine assets, regarding to the Navy of Tomorrow and of the Future, represented by the operational capacities desired.

5.2 - THEMATIC FIELDS OF ST&I

The projects of R&D of ST&I of the BN will be related to these fields, and will use, in a matrix structure, the strategic resources of ST&I. The DGDNTM will be responsible for their management, establishing the level of cooperation between the different sectors of the BN involved, in order to allow the orientation of the technological prospection, the prioritization of projects in accordance with the required operational capacities, and the adequate balance of resources to enable the concretization of technologies. The efforts of ST&I will be grouped by Thematic Fields of ST&I.

The Thematic Fields of ST&I, which interest the BN, are sets of themes that interest the Force, which are related to programs and projects of the ST&I. They have characteristics in common from the point of view of its application by the Operational and Material Sectors, and the operational capacities to be obtained. They are:

- a) Systems of C4ISR⁷;**
- b) Cybernetic Defense and Security;**
- c) Operational Environment;**
- d) Nuclear and Energy;**
- e) Naval, Naval Air and Marine Platforms;**
- f) Performance of the Fighter; and**
- g) Nuclear, Biological, Chemical, Radiology Defense and Explosive Artifacts Defense (DefNBQRe).**

⁷C4ISR – Command, Control, Communications, Computers, Intelligence, Surveillance and Recognition.

5.2.1 - The Thematic Fields of ST&I will be defined by the DGDNTM, in conjunction with the Operative and Material Sectors, reflecting the current strategic imperative for the BN. Its main purpose is to help managers and administrators in the alignment and distribution of efforts among the several members who are, directly or indirectly, part of the BN ST&I Governance (clients, SCTMB, Government, Academy and Industry).

5.2.2 - The existence of the Thematic Fields of the ST&I allows the establishment of performance indicators (of efficacy, efficiency and effectiveness), as well as **projects prioritization criteria** of the ST&I among them, in order to guide the matrix distribution of the strategic resources of the ST&I. So that, it can be obtained a better follow-up of the **programs and projects evolution** by the clients. Besides, the use of human, material and financial resources to perform the expected results improves.

5.2.3 - Appendix A and D of this Strategy present each Thematic Field of ST&I of the BN, by its strategic motivations, of the respective strategic action, of the approach to the items related with projects of ST&I, sub-areas and associated lines of research.

APPENDIX A

THEMATIC AREAS OF THE ST&I DETAILING

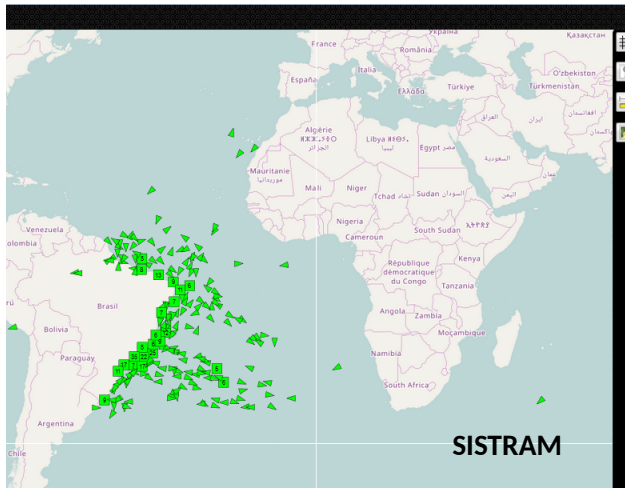
The content of this Appendix aims at presenting each Thematic Area of the ST&I of the BN, through its actions and strategic motivations, and projects of ST&I, in order to enable and facilitate the postulations and deliberations regarding to the admissibility of the R&D projects of the ST&I, as well as prioritize them within the referred projects, related to the System of Science, Technology and Innovation of the Navy (SCTMB).

1 - SYSTEMS OF COMMAND, CONTROL, COMMUNICATIONS, COMPUTER, INTELLIGENCE AND RECOGNITION (C4ISR):

1.1 - Strategic motivation

1.1.1 - Maritime situational awareness

Considering the strategic motivation that the Country disposes of assets with capacity of providing surveillance, control and defense of the Brazilian jurisdictional waters (AJB); its territory



and aerial space, including the continental and the maritime areas; it should also maintain the safety of the lines of maritime communications (LCM) and the lines of aerial navigation, especially in the South Atlantic; this leads to the admissibility of the existence of R&D projects of national ST&I, which contribute with the Brazilian Maritime Situational Awareness (CSM), related with the surface, subsurface and air environments; as well as the increasing knowledge of the operational environment (maritime, riverine and atmospheric) of the AJB.

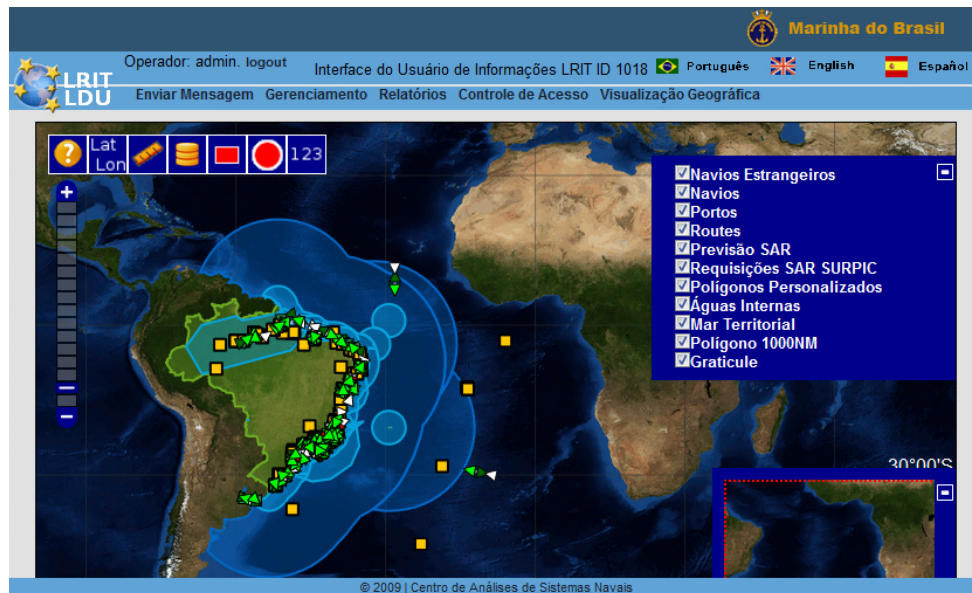
CSM is known as the understanding of the military and non-military facts, activities and circumstances, inside and associated with the maritime environment, which are relevant for the current and future actions of a country where the maritime environment are the oceans, seas, bays, estuaries, rivers, coast regions and ports. The concept of CSM also refers to, but is not limited to, the safety of the waterway traffic, environmental protection, measures against terrorism and safeguard of human life at sea.

The purpose of the CSM is to develop the ability to identify the existing threats and the relevant events, as soon as and as far as possible from the country, by integrating data of intelligence, surveillance, observation and navigation systems, interacting in the same operational picture.

Therefore, it is necessary to work with a structure that involves data collection, monitoring, naval and air assets sensors, and the proper analyses of the facts, leading to fast, accurate answers that contribute with the Brazilian CSM.

Besides, considering the strategic motivation in terms of looking for constant improvement of the command, control, and monitoring capacity and of the intelligence system of the institutions involved in the National Defense, it implies, that, referring to projects of R&D of the ST&I related to the Naval C4ISR systems, these should also contemplate the interconnection with other institutions involved in the National Defense.

And the role of the BN with the Brazilian CSM is to consolidate information about intelligence, monitoring, control, sharing of information and, if necessary, action.



LONG RANGE IDENTIFICATION AND TRACKING SYSTEM - LRIT

1.1.2 - Dissuasion of hostile forces and technologies of monitoring and control

Considering the strategic motivations in the sense of:

- a) Dissuading the concentration of hostile forces in the land borders and in the AJB limits, and preventing the use of national aerial space;

- b) Developing capacities to monitor and control the aerial space, the territory and the AJB. This development must be based on the use of monitoring technologies based on land, maritime, air and space; and which are under complete and unconditional national domain;

- c) Both lead to the need of capacities of detection, localization and follow-up of hostile forces (in the environments of surface, submarine and air), until the limitations of the AJB, based on the use of monitoring technologies from land, maritime, air and space which are under complete and unconditional national domain; and

- d) On the other hand, it also contributes with the admissibility of the existence of projects of R&D of national ST&I which contribute with the Brazilian CSM, related to environments of surface, subsurface and air; as well as the increasing knowledge in the operational environment of the AJB, both with capacity to interconnect with other institutions involved in National Defense.

1.1.3 - Network Centric Warfare - NCW

- a) The spatial and cybernetic sectors will, together, allow that the ability to visualize the country does not depend on foreign technology, and that the three Forces, together, can work as a network, instructed by monitoring which is also based on the space;
- b) There should be a repertoire of practices and operational capacities of the fighters to meet the requirements of monitoring/ control, mobility and presence; specifically concerning the requirement that each fighter must count on means and skills to work in a network, not only with other fighters and contingents of their own Force, but also with fighters and contingents of other Forces.



c) It must ensure the sea denial task. For that, Brazil will count on a submarine force, composed of conventional submarines and submarines with nuclear propulsion. Brazil will maintain and develop its ability to project and manufacture both submarines with conventional propulsion and those with nuclear propulsion. The investments and partnerships necessary to execute the project of the submarine with nuclear propulsion will be accelerated. There will be submarines armed with missiles, and the capacity to project and manufacture them. There will be autonomy in cybernetic technologies to guide the submarines and their weapon system, allowing them to work in a network with other naval, land and air forces; and

d) the technologies of communications, including vehicles that monitor the land and ocean surface, from space, must be faced as enhancing instruments for initiatives of defense and combat.

1.2 - Strategic action

To endow and to habilitate the BN so that it can provide the country with the necessary CSM; to dissuade hostile forces to the limits of the AJB; to develop national monitoring and control technologies that are in agreement with the Brazilian AJB and LCM, and act, operationally, in centric network.

1.3 - Focus on the ST&I projects

Projects of R&D of ST&I are admissible as long as they aim at and contribute to the existence of Systems and Subsystems of Naval C4ISR, enabling the work of the BN operationally focused on networks (NCW), based on the use of technologies that are under complete and unconditional national domain, which may be interconnected with other institutions involved in National Defense.

2 - CYBERNETIC DEFENSE AND SECURITY

2.1 - Strategic motivations

The National Defense Strategy establishes the following Strategic Sectors: space, cybernetic and nuclear, which must be strengthened. Concerning the Cybernetic Sector, the country must dispose of the ability to oppose to cybernetic attacks. Therefore, it is essential to have and maintain, in constant improvement, safety devices and algorithms of cybernetic defense, as well as adopt procedures, protocols and processes that minimize the vulnerability of the naval systems which have support from Information and Communication Technology (ICT), allowing their re-establishment.

2.2 - Strategic Action - to endow and to habilitate the BN in cybernetic safety, in order to minimize the vulnerability to cybernetic attacks (cybernetic defense) of the systems that interest the Naval Power, with support from the ICT.

2.3 - Focus of the ST&I projects - projects of R&D of ST&I that aim at cybernetic security and the minimization of the vulnerability to cybernetic attacks (cybernetic defense) of the systems that interest the Naval Power, which have support from ICT, also including systems that integrate critical infrastructures of the Country.

3 - OPERATIONAL ENVIRONMENT

3.1 - Strategic motivation

The Country must dispose of means with capacity of surveillance, control and defense: of the Brazilian jurisdictional waters (AJB); its territory and aerial space, including the continental and maritime areas; and must also maintain the security of the maritime lines of communication (LCM) and the lines of air navigation, especially in the South Atlantic (including also Antarctica).

3.2 - Strategic Action

To improve the knowledge about the operational environment (maritime, fluvial and atmospheric) of the AJB and LCM, especially in the South Atlantic (including Antarctica), so that the BN can provide the Country with the necessary CSM.

3.3 - Focus of the ST&I Projects

Projects of R&D of ST&I which aim at and contribute to the increasing knowledge of the operational environment of the AJB and LCM are admissible, especially in the South Atlantic (including Antarctica), so that the BN can provide the Country with the necessary CSM.

4 - NUCLEAR AND ENERGY

4.1 - Strategic motivations

4.1.1 - In accordance with the search for international peace and safety, **the Country is signatory of the Treaty on the Non-Proliferation of Nuclear Weapons**, and highlights the need to fulfill Article VI, which establishes the negotiation for the total elimination of nuclear weapons from nuclear powers, **emphasizing the right of all countries to use nuclear technology for peaceful purposes**. In this sense, Brazil commits to the strictly peaceful use of nuclear energy, resulting from the Constitution and the adherence to International Treaties. However, it affirms the strategic need to develop and dominate this technology.

Brazil needs to guarantee the balance and versatility of its energy matrix and make progress in fields such as agriculture and health, which may benefit from the nuclear technology. Besides, it can develop the project of the submarine with nuclear propulsion, among other initiatives that require technological independence in terms of nuclear energy.

4.1.2 - Three sectors of strategic importance must be strengthened: space, cybernetic and nuclear.

4.1.3 - The complete **nationalization and development, in industrial scale, of the fuel cycle (including conversion and enrichment)**, must be completed in terms of the program of the submarine with nuclear propulsion, as well as the technology for building reactors, for exclusive use of Brazil.

4.1.4 - The potential to project and build nuclear thermoelectric generators, with technologies and courses of national domain, should be improved, even if developed from partnerships with foreign States and companies. Nuclear energy must be employed with criteria, and be subjected to strict safety controls to protect the environment, as a way to establish the national energy matrix, adjusting the variations in the supply of renewable energies, especially hydroelectric power; and the increased capacity to use nuclear energy in a broad spectrum of activities (including the fields of agriculture and health), considering that this also includes strategic projects, such as: Brazilian Multipurpose Reactor (RMB) and Desalination (DSAL).



TEAM IN CHARGE OF DEVELOPING THE CASCADE TO ENRICH THE FUEL OF THE BRAZILIAN MULTIPURPOSE REACTOR.

4.2 - Strategic action

To develop and to dominate the use of nuclear Technologies, for peaceful purposes, and renewable energies, in order to conclude the project of the submarine with nuclear propulsion, and to contribute to the balance and versatility of the Brazilian energy matrix, as well as developing fields such as agriculture and health.

4.3 - Focus of the ST&I projects

Admissible projects of R&D of ST&I are those that:

- Concerning the development of the project of the submarine with nuclear propulsion, it should contribute with the conclusion of the construction of the aforementioned naval assets, observing its complete nationalization and development, in industrial scale, of the fuel cycle (including the conversion and enrichment), and the technology to build reactors, for exclusive use of Brazil; and
- Regarding the contribution to the balance and versatility of the Brazilian energy matrix, and in fields such as agriculture and health, to improve the potential to project and build nuclear thermoelectric plants, with technology and ability of national domain, even if developed by partnerships with foreign States and companies, being subjected to strict safety controls and protection of the environment; as well as increase the capacity to use nuclear and renewable energy in a broad spectrum of activities (including fields of agriculture and health), considering that this includes strategic projects, such as: Brazilian Multipurpose Reactor (RMB) and Desalination(DSAL).

5 - NAVAL, AIR NAVAL AND MARINE PLATFORMS

5.1 - Strategic Motivations

5.1.1 - To dispose of means with capacity of surveillance, control and defense: of the Brazilian jurisdictional Waters (AJB); its territory and air space, including the continental and maritime areas; maintaining the safety of the lines of maritime communications (LCM) and lines of air navigation, especially in the South Atlantic.

5.1.2 - To dissuade the concentration of hostile forces in land borders and the limits of the AJB, besides preventing them from using the national air space.

5.1.3 - To develop, among other initiatives that require technological Independence in terms of nuclear energy, **the project of the submarine with nuclear propulsion.**



**DEFENSORA FRIGATE
PATROLLING THE PRE-SALT AREA**

5.1.4 - To develop the logistic capacity to strengthen mobility, especially in the Amazon region. That is why it is important to have structures of transport and command and control, which may operate in a wide variety of circumstances, including the extraordinary conditions imposed by the war.

5.1.5 - Each fighter must dispose of technologies and knowledge that allows to apply, in any region in conflict, both land and maritime, the imperative of mobility. This imperative, combined with the ability of combat, must serve the platforms and weapon systems available for the fighter.

5.1.6 - To ensure the task of sea denial. For that, Brazil will count on the submarine force, composed of conventional submarines and submarines with nuclear propulsion. Brazil will maintain and develop its ability to project and manufacture both submarines with conventional propulsion, as well as nuclear propulsion.

It will accelerate the investments and partnerships necessary to execute the project of the submarine with nuclear propulsion. It will arm the submarines with missiles and develop ability to project and manufacture them. It will bring autonomy to cybernetic technologies to be used in the submarines and their weapon systems, allowing them to work in a network with other naval, land and air forces.

5.1.7 - To ensure the ability of power projection. For that, the Navy will have Marines, in permanent readiness condition. The existence of such assets is essential to defend the naval and port installations, as well as archipelagos and oceanic islands of the AJB, to work in international peace operations and



humanitarian operations anywhere around the world. In fluvial routes, they will be essential to guarantee the control of the margins during the riverine operations.

NAVAL POWER

5.1.8 - The naval surface force should count on both large ships, able to operate and stay for a long time in high sea, and on smaller ships, dedicated to patrolling the coast and the main Brazilian navigable rivers. A requirement for the maintenance of this fleet will be the capacity of the Air Force to work with the Naval Aviation, to guarantee the control of the air space in the expected level, in case of conflict/war.

Among the high sea ships, the Navy will address special attention to the project and manufacturing of multiple purpose ships and aerodrome ships. The Navy will also count on combat, transport and patrol crafts, be them oceanic, coastal or fluvial. They will be conceived and manufactured considering the same concern about functional versatility, which will guide the construction of the high sea warships.

The Navy will increase its presence in navigable routes in the two major river bays, Amazonas and Paraguai-Paraná, using patrol ships, cargo ships, both including helicopters adapted to the water regime⁸.

⁸Fluviometric conditions of the waterways.

5.2 - Strategic Action

To contribute to BN so that the Force can have naval, naval air and marine platforms to compose the Naval Power, according to the aforementioned strategic motivations.

5.3 - Focus of the ST&I projects

Projects of R&D of ST&I aiming at and contributing to the BN so that it can have naval, air naval and marine platforms are admissible, according to the aforementioned strategic motivations.



OCEAN PATROL SHIP "APA"

6 - PERFORMANCE OF THE FIGHTER

6.1 - Strategic Motivations

6.1.1 - to develop the repertoire of practices and operational abilities of the fighters to meet the requirements of monitoring/control, mobility and presence;

6.1.2 - each fighter should be trained to approach combat in order to attenuate the rigid and traditional forms of command and control, leading towards flexibility, adaptability, audacity and surprise in the battle field. This fighter will be both a person being commanded, who can obey, execute the initiative, in the absence of specific orders, and guide oneself in times of uncertainty and the unexpected of a battle – and a source of initiatives, able to adapt the orders to the reality of a changing situation; and



6.1.3 - The Brazilian military person must be qualified to dominate the technologies and operational practices, in order to identify themselves with the demanding or extreme peculiarities and geographic characteristics of the Country. That is the only way in the practice, to materialize the concept of flexibility, within the characteristics of the national territory and the geographic and geopolitical situation of Brazil.

6.2 - Strategic Action

To contribute so that the BN can have fighters who fulfill the necessary abilities, aiming at improving the efficacy, efficiency and capacity of survival.

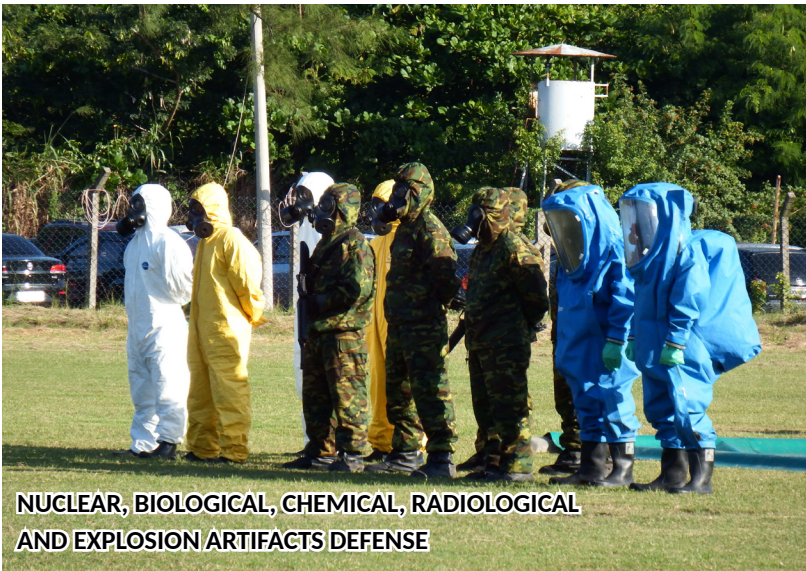
6.3 - Focus of the ST&I projects

Projects of R&D of ST&I which aim at contributing with the improved efficacy, efficiency and survival of the fighters are admissible.

7 - NUCLEAR, BIOLOGICAL, CHEMICAL, RADIOLOGICAL AND EXPLOSIVE ARTIFACTS DEFENSE (DefNBQRe)

7.1 - Strategic Motivations:

7.1.1 - the Country should dispose of an agile structure, able to prevent terrorist actions and to lead counter-terrorism operations. This implies the need for the Country to dispose of means which also contribute with the same purposes;



NUCLEAR, BIOLOGICAL, CHEMICAL, RADIOLOGICAL
AND EXPLOSION ARTIFACTS DEFENSE

7.1.2 - considering that the terrorist action can also include threats from chemical, biological weapons, or the ones known as “dirty bombs”, there is the need for that agile structure to also be able to neutralize or minimize the damage resulting from these threats;

7.1.3 - besides, it is also necessary to consider the possibility of incidents or accidents related to the use (development, operation, and decommissioning) of installations which use nuclear, biological, chemical or radiological materials.

7.2 - Strategic action

To contribute so that the BN can have defense instruments that relate to the aforementioned strategic motivations, and oppose to such threats.

7.3 - R&D of the ST&I projects approach

Aiming at and contributing to establishment of an agile structure and assets able to prevent terrorist action are admissible; leading to counter-terrorism actions; and aiming at opposing to the occurrence of incidents or accidents related to the use (development, operation, and decommissioning) of installations using nuclear, biological, chemical, radiological materials and explosion artifacts.



MARINES IN ACTION IN RIO DE JANEIRO DOWNTOWN

APPENDIX B

ORGANIZATIONAL STRUCTURE OF SCTMB

The structure of the Science, Technology, Innovation System of the Navy (SCTMB) is organized as a network. **Directorate General for Nuclear and Technological Development (DGDNTM)** is the **Sectorial Board Institution of the Brazilian Navy for subjects related to ST&I, located close to the top of the Chain of Command of the BN, and in a hierarchical circle compatible with the Authorities of the ST&I and the other Singular Forces and extra-BN organizations related to the topic.**

THE RESTRUCTURING CEREMONY OF THE ST&I SYSTEM OF THE NAVY

Therefore, the ST&I is more relevant to reach the technological autonomy and superiority of the Naval Power, addressing efforts to the **Strategic Objectives of the ST&I** defined doctrinally which, to sum up, aim at:

the nationalization of systems and equipment;

the domain of knowledge and technologies that serve the Naval Power;

the adoption of a management model which tries to increment the activities of ST&I;

the establishment of a favorable environment for innovation and industrial competitiveness;

the dissemination of ST&I activities, contributing with the increasing visibility and recognition of the BN for the internal and external audience; and

and the protection of the ST&I intellectual property.

An essential requirement for the organization of the SCTMB is to dispose of partnerships and interchange knowledge, not only among the BN organizations that are part of the SCTMB, but also among homologous organizations of other Singular Forces or extra-BN Institutions, of the Foundations related to the activity of ST&I, Industry and Academy, aiming at the technological update and the sustainable and lasting innovation, based on the well-established concepts of the “Triple Helix”.

SCTMB is composed of several Military Organizations of the BN, such as: The Navy State (EMA), General Board of the Navy; Sectorial Board Institutions; the ICT-BN, in which the Technological Center of the Navy in São Paulo (CTMSP) and the Technological Center of the Navy in Rio de Janeiro (CTMRJ) stand out; the Specialized Boards of the Navy (DE), in charge of establishing the technical requirements of the systems and equipment being developed in the Navy; companies related with the BN; Foundations that support the ST&I related to the BN.

APPENDIX C

GOVERNANCE OF ST&I OF THE BN

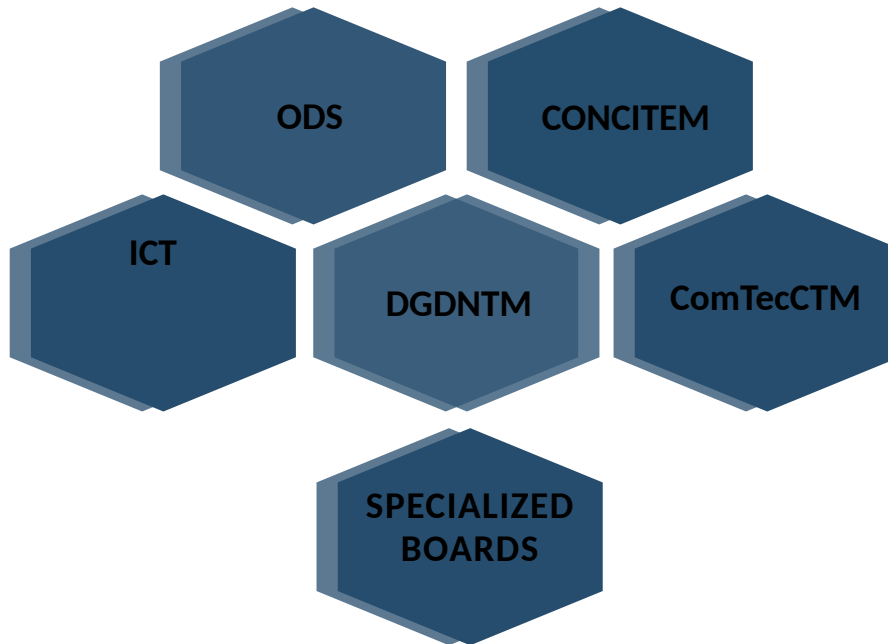
The Governance of ST&I of the BN is executed by the Naval Staff (EMA), and the Directorate General for Nuclear and Technological Development (DGDNTM), as its central executive institution.

As a General-Assistance institution there is the Council of Science and Technology of the Navy (CONCITEM); and, in the Technical Assistance, the Technical Commission of Science, Technology and Innovation of the Navy (ComTecCTM). The Research and Development institutions are the Institutions of Science, Technology and Innovation of the Brazilian Navy (ICT-MB).

CONCITEM is the highest Collegiate body of the ST&I of the BN, and is composed of the Sectorial Board of the Navy, run by the Chief of the Naval Staff.

ComTecCTM is the Technical Collegiate of the ST&I of the BN, which assists CONCITEM, and is composed of the representatives of the Institutions of Sectorial Board of the Navy; by the ICT-BN, among which the Naval Technological Center in São Paulo (CTMSP) and the Naval Technological Center in Rio de Janeiro (CTMRJ) stand out; by the Specialized Boards of the BN; and by other organizations invited by the BN; run by the General-Director of Nuclear and Technological Development of the Navy.

ST&I SYSTEM OF THE BN



APPENDIX D

DETAILED SUBAREAS AND LINES OF RESEARCH APPROACHED BY THE THEMATIC FIELDS OF ST&I

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Systems of Command, Control, Communications, Computer, Intelligence, Surveillance, and Recognition (C4ISR)</p>	<ul style="list-style-type: none"> - Maritime Situational Awareness (CSM); - Systems and Subsystems of Naval C4ISR; and - Network Centric Warfare - NCW. 	<p>Counter-terrorism, Safety, Asymmetric and Expeditionary Warfare:</p> <ul style="list-style-type: none"> - Spectral target behavior; - Image processing; - Mechanical and acoustic properties of materials; - Optical properties and spectroscopy of materials; - Thermal property of materials; - Magnetic materials and components; - Electro-optic materials and components and optic magnet; - Photoelectric materials;

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Systems of Command, Control, Communications, Computer, Intelligence, Surveillance, and Recognition (C4ISR)</p>	<ul style="list-style-type: none"> - Maritime Situational Awareness (CSM); - Systems and Subsystems of Naval C4ISR; and - Network Centric Warfare - NCW. 	<p>Counter-terrorism, Safety, Asymmetric and Expeditionary Warfare:</p> <ul style="list-style-type: none"> - Radio propagation; - Tactic systems; - Tracking systems; - Satellite communication systems; - Communication systems with RF; - Submarine communication systems; - Monitoring and control of the area; - Use of photonic technology; and - Use of radio networks with IP protocol.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Systems of Command, Control, Communications, Computer, Intelligence, Surveillance, and Recognition (C4ISR)</p>	<ul style="list-style-type: none"> - Maritime Situational Awareness (CSM); - Systems and Subsystems of Naval C4ISR; and - Network Centric Warfare - NCW. 	<p>Decision-making processes:</p> <ul style="list-style-type: none"> - Environmental management; - Data base management; - Monitoring and control of the area; - Computer systems and technologies; - Communication, organization and management of information and knowledge; - Models and architecture for intelligent systems; - Network of distributed computers and systems; - Information systems; - Systems and methods of simulation and staging; - Decision-making process; - Data fusion; - Computer intelligence; - Computational nanotechnology; - Nanodevices and nanomaterials; - Systems of control and automation; - Tactic systems; - Tracking systems;

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Systems of Command, Control, Communications, Computer, Intelligence, Surveillance, and Recognition (C4ISR)</p>	<ul style="list-style-type: none"> - Maritime Situational Awareness (CSM); - Systems and Subsystems of Naval C4ISR; and - Network Centric Warfare - NCW. 	<p>Decision-making processes:</p> <ul style="list-style-type: none"> - Sensors and micro-systems; - Satellite communication systems; - Communication systems with RF; and - Underwater communication systems. <p>Safety of Waterway Traffic:</p> <ul style="list-style-type: none"> - Remote sensing of the atmosphere; - Studies and modelling of weather and climate; - Biosphere-atmosphere and ocean-atmosphere interaction; - Image processing; - Remote sensing applied to geosciences; - Spectral target behavior; - Radio propagation; - Technology in systems of navigation, propulsion and hydrodynamics;

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Systems of Command, Control, Communications, Computer, Intelligence, Surveillance, and Recognition (C4ISR)</p>	<ul style="list-style-type: none"> - Maritime Situational Awareness (CSM); - Systems and Subsystems of Naval C4ISR; and - Network Centric Warfare - NCW. 	<p>Safety of Waterway Traffic:</p> <ul style="list-style-type: none"> - Technology in systems of register, control and simulators; - Data base management; - Tactic systems; - Tracking systems; - Communication systems with RF; - Satellite communication systems; and - Control and automation systems.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Cybernetic defense and security</p>	<ul style="list-style-type: none"> - Cybernetic security; and - Cybernetic defense. 	<p>Automation:</p> <ul style="list-style-type: none"> - Control of dynamic systems; - Identification of systems; - Modelling and optimization of systems; - Robotics; - Manufacturing systems; and - Intelligent systems. <p>Computer engineering:</p> <ul style="list-style-type: none"> - Information Systems; - Information Technology (IT) governance, modelling and management of information systems; - Information management; - Information security; - Security of computer networks;

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Cybernetic defense and security	<ul style="list-style-type: none"> - Cybernetic security; and - Cybernetic defense. 	<p>Computer engineering:</p> <ul style="list-style-type: none"> - Analytic simulation models; - Graphic computer systems; - Image processing and computer vision; - Distributed systems; - Parallel computing; - Intelligent systems/computational intelligence; - Codification of cryptographic systems; - Codes/turbo decoder; - Theory of quantum information; - Systems of quantum computing; - Quantum processing of information; - Quantum distribution of keys; - System safety evaluation; and - Computational complexity.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Cybernetic defense and security	<ul style="list-style-type: none"> - Cybernetic security; and - Cybernetic defense. 	<p>Electric engineering:</p> <ul style="list-style-type: none"> - Electromagnetic compatibility; - Electromechanical energy conversion; - Sensors and actuators; - Electric, magnetic and electronic circuits; - Electric/electronic power systems; - Electronic systems and controls/ industrial; - Radio defined by software; - Applications of adaptive transmission; - Semiconductor devices; - Applications in electronics, optoelectronics, photonics, and microelectronics; - Instrumentation and electric, magnetic, electronic, biomedical and microelectronic measures; - New materials; - Projects of integrated circuits; and - Sensors and actuators.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Cybernetic defense and security	<ul style="list-style-type: none"> - Cybernetic security; and - Cybernetic defense. 	<p>Telecommunications and Telematics:</p> <ul style="list-style-type: none"> - Applications in Communication Networks; - Planning and management of telecommunication systems; - Architecture, topology, interconnection and safety in networks; - Antennas and propagation; - Electromagnetic compatibility; - Optical networks and communications; - Mobile communications; - Micro-wave devices and circuits; - Digital modulation; - Digital speech processing; - Digital sign processing; - Recognition of patterns; - Improvements in the performance of digital signal transmission using the forward error correction (FEC) technique (Viterbi, Reed-Solomon etc.); and - Applications in artificial neural networks.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Cybernetic defense and security</p>	<ul style="list-style-type: none"> - Cybernetic security; and - Cybernetic defense. 	<p>General Physics:</p> <ul style="list-style-type: none"> - Mathematical methods of Physics; - Optics, light intertwining and polarization; - Classic, physics, quantum, mechanic of particles and fields; - Characterization and measurements of entanglement; - Electricity and magnetism, fields and loaded particles; - Simulation of quantum circuits; - Properties and characterization of quantum channels for transport and validation of a safe communication; - Application in quantum optics; - Applications in quantum teleportation; and - Application in quantum mechanics.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Operational Environment	<p>- Operational environment (maritime, fluvial and atmospheric) which influence the naval, naval air, marine assets or contribute with the Brazilian CSM.</p>	<p>Oceanography:</p> <ul style="list-style-type: none"> - Circulation and characterization of water masses; - Numerical oceanography modelling and data assimilation; - Monitoring of the mean sea level to foresee extreme events; - Coupled ocean-atmosphere model; - Large-scale oceanic observations, based on networks of fixed and deriving instruments; - Special weather forecasts; - Monitoring of several stressors in the Coast Zone; - Oceanic technology, facing the growing demand for data obtained from autonomous vehicles and subsurface platforms (AUVs, Argo floats, gliders, etc.)**

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Operational Environment	<p>- Operational environment (maritime, fluvial and atmospheric) which influence the naval, naval air, marine assets or contribute with the Brazilian CSM.</p>	<p>Oceanography:</p> <ul style="list-style-type: none"> - Infrastructure and technology to support oceanic operations (ships, oceanic observatoires etc.) - Environmental monitoring; and - Ocean-atmosphere interaction. <p>Marine Biotechnology:</p> <ul style="list-style-type: none"> - Bioincrustation and biocides; - Bioprospection of marine biodiversity; - Corrosion; and - Bioluminescence. <p>Submarine Acoustics:</p> <ul style="list-style-type: none"> - Processing of acoustic signs; - Underwater communications by acoustic method; - Underwater acoustics; and - Underwater acoustic propagation.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Operational Environment	<ul style="list-style-type: none"> - Operational environment (maritime, fluvial and atmospheric) which influence the naval, naval air, marine assets or contribute with the Brazilian CSM. 	<p>Geology, Geochemistry and Marine Geophysics:</p> <ul style="list-style-type: none"> - Characterization of the seabed; and - Transport of sediments and sedimentation. <p>Marine Biology:</p> <ul style="list-style-type: none"> - Bioinvasion and invading species; and - Evaluation of environmental impacts on marine ecosystems. <p>Oceanic Engineering:</p> <ul style="list-style-type: none"> - Tide currents; and - Refraction, diffraction and reflection of gravity waves. <p>Oceanic Technology:</p> <ul style="list-style-type: none"> - Autonomous underwater vehicles and subsurface platforms; and - Infrastructure and technology to support the oceanic operations.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Operational Environment	<p>- Operational environment (maritime, fluvial and atmospheric) which influence the naval, naval air, marine assets or contribute with the Brazilian CSM.</p>	<p>Meteorology:</p> <ul style="list-style-type: none"> - Numeric meteorological modelling and data assimilation; - Meteorological forecast; - Electromagnetic propagation; and - Ocean-atmosphere interaction. <p>Hydrographics:</p> <ul style="list-style-type: none"> - Tide gauge correction <p>Remote sensing:</p> <ul style="list-style-type: none"> - High-performance computing; - Development of algorithms; and - Monitoring of the oceanic space. <p>Cartography:</p> <ul style="list-style-type: none"> - Nautical cartography.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Nuclear and energy	<ul style="list-style-type: none"> -Generation of electronuclear energy to be used in naval assets and in thermoelectric plants; - Use of nuclear energy in areas related to agriculture and health; - Alternative energies; and - Nuclear Safety. 	<p>Advanced fuels and nuclear materials:</p> <ul style="list-style-type: none"> - Integrated nuclear reactor; - Nuclear reactor with passive safety systems; - Management systems and processes of radioactive rejects; - Nuclear instrumentation; and - Device for remote weld inspection in processes of manufacturing and maintenance of nuclear reactors. <p>Food Security (Food Irradiation):</p> <ul style="list-style-type: none"> - Techniques and processes to prolong the validity for the intake of meats, fruits, vegetables and greens by using food irradiation.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Nuclear and energy	<ul style="list-style-type: none"> - Generation of electronuclear energy to be used in naval assets and in thermoelectric plants; - Use of nuclear energy in areas related to agriculture and health; - Alternative energies; and - Nuclear Safety. 	<p>Ionizing radiation in Health, Biology and Agriculture:</p> <ul style="list-style-type: none"> - Use of ionizing radiation for the development of vaccines, bioremediators, probiotics, radioactive molecules for diagnosis and food biosafety therapy; and - Biological Tissue Bank, Biophotonics and Laser, brachytherapy, Dosimetry of Pre-Clinical and Clinical Radiations, Pharmacology, Hydrogel, Molecular Imaging, Pre-clinical Imaging, Nuclear Medicine, Clinical Research, Radio pharmacy, and Toxicology. <p>Sustainable/Alternative energies:</p> <ul style="list-style-type: none"> - Electrochemistry and Catalysis, Biomass Energy, Photovoltaic Solar Energy, Studies of Reliability, Hydrogen and Fuel Cells.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Nuclear and energy	<ul style="list-style-type: none"> - Generation of electronuclear energy to be used in naval assets and in thermoelectric plants; - Use of nuclear energy in areas related to agriculture and health; - Alternative energies; and - Nuclear Safety. 	<p>Advanced Materials:</p> <ul style="list-style-type: none"> - Biomaterials, Characterization of Materials. Composites, Crystals and Monocrystalline Fibers, Ceramic Materials, Photonic Materials, Metallic Materials, Nuclear Materials, Polymeric Materials, Extractive Metallurgy, Physical Metallurgy, Processes of Material Transformation, Surface Treatment, Glasses and glass-ceramics.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Naval, naval air and marine platforms</p>	<p>Naval, naval air and marine platforms</p>	<p>Platforms:</p> <ul style="list-style-type: none"> - Ships and vessels and their systems; - Combat cars and their systems; - Aircrafts and their systems; - Submarines and their systems; - Satellite; - Structural and electromagnetic armoring; - Non-crewed systems (air, surface and underwater); - Control and monitoring of propulsion, assistants and Control of Malfunctions; - Computer simulation; - Automation and control; - Robotics; - Instrumentation; and - Monitoring systems of batteries for submarines.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Naval, naval air and marine platforms</p>	<p>Naval, naval air and marine platforms</p>	<p>Special Materials:</p> <ul style="list-style-type: none"> - Energy materials for propulsion and missile combat, rockets and torpedos - Materials that absorb electromagnetic energy; - Metamaterials; - Composite materials; - Ceramic materials; and - Organic materials for the selective monitoring of gas and removal of contaminants.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Naval, naval air and marine platforms</p>	<p>Naval, naval air and marine platforms</p>	<p>Sensors and Weapon Systems:</p> <ul style="list-style-type: none"> - Radar; - Electronic war and IFF Systems; - Optic and optronic systems; - Sistemas para ações de reconhecimento; - Sensing and remote control; - Simulation, emulation and electronic attack measures, and electromagnetic countermeasures; - Instrumentation to help navigation; - Inertial control; - Stable platforms; - Mine War; - Explosive engineering; - Launching systems; - Intelligent ammunition; - Laser and its applications; - Cannons; - Rockets; - Missiles; - Training torpedos, classification of targets and combat;

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Naval, naval air and marine platforms</p>	<p>Naval, naval air and marine platforms</p>	<p>Sensors and Weapon Systems:</p> <ul style="list-style-type: none"> - Ammunition and green ammunition; - Non-lethal weapons; - Electronic sensors for monitoring of closed spaces; - Acoustic war systems; - Active and passive sonar systems; - System of instrumentation and acquisition of acoustic, magnetic, electric and pressure data; - Targets for calibration and training; - Misleading and camouflage systems; - Portable weapons; and - Acoustic location of firearm shots.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Performance of the fighter</p>	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Operational Evaluation and Operational Research:</p> <ul style="list-style-type: none"> - Human Performance and Health; - Material and Metallurgic Engineering; - Mechanical Engineering; - Physics; - Electronic Engineering; - Production Engineering; - Operational Research; - Ergonomics; and - Hygiene and Occupational Safety. <p>Sanitary Engineering:</p> <ul style="list-style-type: none"> - Studies and characterization of treatments and use of residue addressed to the fighter's health.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Performance of the fighter	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Computer science:</p> <ul style="list-style-type: none"> - Analytical models of simulation; - Programming languages; - Software engineering; - Data base; - Information Systems; and - Bioinformatics. <p>Others:</p> <ul style="list-style-type: none"> - Textile engineering. <p>Biomedicine:</p> <ul style="list-style-type: none"> - Bioengineering; - Cellular Biophysics; - Molecular biophysics; - Medical Engineering; - Studies with Biomaterials and biocompatible materials; - Studies in Biostatistics; and - Studies in Bioinformatics.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Performance of the fighter</p>	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Surgery:</p> <ul style="list-style-type: none"> - Experimental surgery; - Plastic and Restoring surgery; - Traumatological surgery; and - Neurosurgery. <p>Pharmacy:</p> <ul style="list-style-type: none"> - Analysis and Control of Medications; - Bromatology; - Pharmacognosy; -Biochemical and Molecular Pharmacology; - Clinical Pharmacology; - Drugs and dietary supplements using nanotechnology; - Neuropsychopharmacology; - Production of Drugs, Biodrugs, Dietary Supplements and Products for Health;

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Performance of the fighter	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Pharmacy:</p> <ul style="list-style-type: none"> - Drugs and products for the treatment of radioaccidents; - Drugs and products for the treatment of neglected conditions; - Production of Operative Rations and Supplements for Increasing Performance; and - Toxicology. <p>Genetics:</p> <ul style="list-style-type: none"> - Animal Genetics; - Human and medical genetics; - Molecular and Micro-organism genetics; - Plant Genetics; and - Mutagenesis.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Performance of the fighter</p>	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Operative Medicine:</p> <ul style="list-style-type: none"> - Physical Education; - Catastrophe Medicine; - Preventive Medicine; - Prevention of the improper use of psychoactive substances for the personnel; - Applied Psychology to the Operative Area, focusing on the ability to make decisions and manage stress in combat situations, and selection of Profiles and - Medical Simulation. <p>Microbiology:</p> <ul style="list-style-type: none"> - Biology and Physiology of Micro-organisms; and - Applied microbiology.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Performance of the fighter</p>	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Clinical Research or Clinical Trial:</p> <ul style="list-style-type: none"> - Pharmacogenomics; - Clinical and Effort Physiology; - Studies with Regenerative Medicine; and - Studies in Biomonitoring and Toxicology in human beings. <p>Education:</p> <ul style="list-style-type: none"> - Education Basics; - Educational Administration; - Educational Planning and Evaluation; - Education and Learning; - Curriculum; - Orientation and Counselling; and - Distance Education. <p>Education Artificial Intelligence (Learning Analytics):</p> <ul style="list-style-type: none"> - Virtual and increased reality in Education; and - Air, land and underwater filming by drones, aiming at preparing institutional videos.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Performance of the fighter</p>	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Data base of products, components and objects that release gas or toxic vapors in confined spaces.</p> <ul style="list-style-type: none"> - Control and removal of gas or toxic vapors in confined spaces. <p>Chemistry:</p> <ul style="list-style-type: none"> - Spectroscopy; and - Analytical Chemistry. <p>Chemical engineering:</p> <ul style="list-style-type: none"> - Industrial processes of Chemical Engineering; - Industrial operations and equipment for Chemical Engineering; operations of separation and mixture; and - Chemical Technology. <p>Methodology, procedures and practices for the evaluation of Human Factors and quantification of human reliability for application in safety analyses.</p>

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Performance of the fighter</p>	<ul style="list-style-type: none"> - Operational training of the fighters; and - Increment of the efficacy, efficiency and capacity of survival of the fighters. 	<p>Psychology:</p> <ul style="list-style-type: none"> - Experimental Psychology: Cognitive and attention processes. <p>Cognitive Psychology:</p> <ul style="list-style-type: none"> - Education and Learning Psychology: Staff training; and - Occupational and Organizational Psychology: Training and Evaluation, Human Factors at Work and Environmental planning and human behavior.

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Nuclear, Biological, Chemical, Radiological and Explosion Artifacts Defense (DefNBQRe)</p>	<p>- Organizational structures, instruments and equipments of DefNBQRe.</p>	<p>Nuclear Engineering:</p> <ul style="list-style-type: none"> - Industrial Applications of Radioisotopes; - Chemical, radiological and nuclear decontamination of the individual and the environment; - Investigation of possible agents of NBQR, with damaging potential to the environment; and - Methods of analysis of substances used as a NBQR agent, with damaging potential to the environment. <p>Chemistry:</p> <ul style="list-style-type: none"> - Organic synthesis; - Chemistry of natural products; and - Analytical Chemistry. <p>Sanitary Engineering Pharmacy</p>

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
<p>Nuclear, Biological, Chemical, Radiological and Explosion Artifacts Defense (DefNBQRe)</p>	<p>- Organizational structures, instruments and equipments of DefNBQRe.</p>	<p>Toxicology:</p> <ul style="list-style-type: none"> - Investigation of methodologies of toxicological evaluation (human/environmental); and - Environmental/fauna/flora monitoring with objective of distinguishing war agents from pre-existing substances. <p>Microbiology:</p> <ul style="list-style-type: none"> - Detection of micro-organisms that can be used as a biological agent with damaging potential to the environment; and - Monitoring of micro-organism by using techniques of cellular and molecular biology. <p>Epidemiology - Epidemiological Surveillance of potential bioterrorism agents.</p> <p>Biochemistry</p>

THEMATIC FIELD OF ST&I	OBJECTIVES	SUBAREAS AND LINES OF RESEARCH
Nuclear, Biological, Chemical, Radiological and Explosion Artifacts Defense (DefNBQRe)	- Organizational structures, instruments and equipments of DefNBQRe.	Nuclear and Radiological Defense (Identification and monitoring of areas and installations): <ul style="list-style-type: none">- Instrumentation for the measurement and control of radiation;- Industrial applications of radioisotopes;- Nuclear disintegration and radioactivity;- Properties of specific nuclei; and- Nuclear reactions and spreading.

ACRONYMS

AJB - Águas Jurisdicionais Brasileiras

AEN - Ações Estratégicas Navais

BID - Base Industrial de Defesa

CENAV - Conceção Estratégica Naval

CIT - Célula de Inovação Tecnológica

C4ISR - Comando, Controle, Comunicações, Computadores, Inteligência, Vigilância e Reconhecimento.

CF - Constituição Federal

ComTecCTM - Comissão Técnica de Ciência, Tecnologia e Inovação da Marinha

CONCITEM - Conselho de Ciência e Tecnologia da Marinha

CGCFN - Comando-Geral do Corpo de Fuzileiros Navais

ComOpNav - Comando de Operações Navais

CT&I - Ciência Tecnologia e Inovação

CSM - Consciência Situacional Marítima

DSAL - Dessalinização

DSAM - Diretoria de Sistemas de Armas da Marinha

DefNBQRe - Defesa Nuclear, Biológica, Química, Radiológica e Artefatos Explosivos

DGDNTM - Diretoria Geral de Desenvolvimento Nuclear e Tecnológico da Marinha

DGMM - Diretoria-Geral do Material da Marinha

ACRONYMS

DGN - Diretoria-Geral de Navegação

END - Estratégia Nacional de Defesa

ENCTI - Estratégia Nacional de Ciência Tecnologia e Inovação

LBDN - Livro Branco da Defesa Nacional

LCM - Linhas de Comunicações Marítimas

ICT - Instituição Científica, Tecnológica e de Inovação

ICT-MB - Instituição Científica, Tecnológica e de Inovação da Marinha do Brasil

IEAPM - Instituto de Estudos do Mar Almirante Paulo Moreira

INPI - Instituto Nacional de Propriedade Industrial

MB - Marinha do Brasil

NCW - Network Centric Warfare - NCW

NIT - Núcleo de Inovação Tecnológica

ODS - Órgão de Direção Setorial

PCTIDN - Política de Ciência, Tecnologia e Inovação para a Defesa Nacional

PDCTM - Plano de Desenvolvimento Científico, Tecnológico e de Inovação da Marinha

PEM - Plano Estratégico da Marinha

PND - Política Nacional de Defesa

P&D - Pesquisa e Desenvolvimento

RMB - Reator Multipropósito Brasileiro

SCTMB - Sistema de Ciência, Tecnologia e Inovação da Marinha do Brasil

SGM - Secretaria- Geral da Marinha

SPAN - Sistemática de Planejamento de Alto Nível

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