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Cyber Sailor:
The Communications and Information Systems staff to ensure Command and Control of tomorrow's naval military operations

Dário Tito dos Santos Silva Precioso

Master in Information Systems Management

Supervisor:
PhD Luís Filipe da Silva Rodrigues, Invited Assistant Professor,
ISCTE-IUL

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TECNOLOGIAS
E ARQUITETURA

Department of Information Science and Technology

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Resumo

Nos últimos anos, ocorreu um significativo desenvolvimento em sistemas de informação e equipamentos de comunicação militares. Como resultado deste desenvolvimento, tem havido uma necessidade de inovação na forma como os sistemas militares de comunicações e informação (CSI), que suportam o Comando e Controlo, se organizam e fazem face a esta disrupção tecnológica.

O rápido avanço da ciência e da tecnologia coloca uma carga significativa nas operações militares, bem como no padrão de formação e treino dos militares que trabalham com sistemas de informação em suporte à capacidade de comando e controlo.

Com o intuito de encontrar soluções para esta problemática, foi levantada a seguinte questão de investigação "Quais são as competências essenciais de Sistemas de Informação do pessoal afeto às CSI na Marinha Portuguesa?", e utilizada uma metodologia mista (qualitativa e quantitativa) para responder à mesma.

Com base numa amostra de 55 respostas a um questionário, procedeu-se à análise semântica das respostas com recurso ao Leximancer e concluímos que sistemas, evolução, formação, processos, equipamentos, resiliência e largura de banda são fatores essenciais para garantir o sucesso das funções atribuídas às CSI da Marinha Portuguesa.

Esta pesquisa contribui com um modelo conceptual explicativo dos fatores essenciais para o sucesso das funções de CSI da Marinha Portuguesa e para uma melhor compreensão dos requisitos de treino em Tecnologias de Informação e Comunicação (TIC) para o desenvolvimento dos militares afetos a essa área. O modelo conceptual permite ainda explicar os temas, conceitos e relacionamentos que ajudam a identificar o que é necessário para garantir a formação e treino nas TIC mais adequado e bem-sucedido.

Palavras-Chave: Avaliação Tecnológica; Ambiente Militar; Tecnologia da Informação; Educação Militar; Comando e Controlo.

Abstract

In recent years, there has been a significant development in military information systems and communication equipment. As a result of this development, there has been a need for innovation in how military communications and information (CIS) systems, which support Command and Control, are organized and cope with this technological disruption.

The rapid advancement of science and technology places a significant burden on military operations and the standard of education and training of military personnel working with information systems in support of the command and control capability.

To find solutions to this problem, the following research question was raised “What are the essential Information Systems competencies of the personnel assigned to the CIS in the Portuguese Navy?” A mixed methodology (qualitative and quantitative) was used to answer the same.

Based on a sample of 55 responses to a questionnaire, a semantic analysis of the responses was carried out using Leximancer, and we concluded that systems, evolution, training, processes, equipment, resilience, and bandwidth are essential factors to guarantee the success of functions assigned to the CIS of the Portuguese Navy.

This research contributes with an explanatory conceptual model of the essential factors for the success of CIS functions in the Portuguese Navy and a better understanding of the training requirements in Information and Communication Technologies (ICT) for the development of the military assigned to this area. The conceptual model also explains the themes, concepts and relationships that help identify what is needed to ensure the most appropriate and successful training in ICT.

Keywords: Technology Assessment; Military Environment; Information Technology; Military Education; Command and Control.

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List of abbreviations

C2 - Command and Control

C3S - Consultation, command, and control systems

CIO - Chief Information Officer

CIS - Communications and information systems

COBIT - Control Objectives for Information and related Technology

CSI - Comunicações e Sistemas de Informação

DAE-STI - Weapons and Electronics Department - Electronics Service - Information Technology Section

DOP-SCSI - Operations Department - Communications and Information Systems Service

DT - Digital Transformation

EMA - Estado-Maior da Armada

EU - European Union

FMN - Federated Mission Networking

FNP - Portuguese Naval Force

HR - Human resources

ICT - Information and Communication Technologies

IM - Information Management

IMA - Information Management Assistant

IMDA - Infocomm Media Development Authority

IP - Internet Protocol

IS - Information Systems

ISCTE-IUL - Iscte - Instituto Universitário de Lisboa

ISSM - Information Systems Success Model

IT - Information Technology

ITGI - IT Governance Institute

ITIL - Information Technology Infrastructure Library

ITSM - Information Technology Service Management

JW - Joint Warrior

LA - Linhas de ação

MBA - Master of Business Administration

MN - Mission Networks

MSc - Master of Science
NATO - North Atlantic Treaty Organization
NCIA - NATO Communications and Information Agency
NNEC - NATO Network Enabled Capability
NOCO - Northern Coasts
NRP - Navio da República Portuguesa
NSWAN - NATO Secret Wide Area Network
OE - Objetivos estratégicos
OS - Objetivos setoriais
PEOU - Perceived ease of use
PhD - Philosophy Doctor
PRTMARFOR - Portuguese Naval Force
PU - Perceived usefulness
SERVQUAL - Service Quality
SICA - Automated Information and Communication Systems
SICAM - Navy Automated Information and Communication Systems
SNMG1 - Standing NATO Maritime Group 1
SSG - SkillsFuture Singapore
STI - Superintendence of Information Technologies
SWOT - Strengths, weaknesses, opportunities and threats
TAM - Technology Acceptance Model
TIC - Tecnologias de Informação e Comunicação
UTAUT - Unified theory of technology acceptance and use
VoIP - Voice over Internet Protocol

Chapter 1 – Introduction

1.1. Contextualization of the problem

In recent years there has been a significant development in information systems and military communications equipment, with the need to innovate in how the military communications and information systems (CIS) that support the Command and Control are organized and fight amid this technological disruption (A. Hill & Niemi, 2017).

According to the mission report for the frigate NRP *Álvares Cabral* participation in the NATO Naval Force (2016), Standing NATO Maritime Group 1 (SNMG1), command and control capabilities in modern military operations rely on increasingly comprehensive and sometimes more complex information systems intending to make the appropriate information available at the appropriate time, place, and format to support the respective decision-making process.

The need to resize and rationalize the human resources allocated to operational units, as well as the need to train more elements with skills in the areas of information systems and cyber-defence (Estado-Maior da Armada, 2018), with the ability to provoke offensive and defensive actions in cyberspace (Nunes, 2020, p. 54), requires a deeper reflection on what is the most balanced model for the management of human resources allocated to the CIS, and how to adapt their education and training (Pinto, 2017).

The rapid technical and technological advance places high pressure on military operations and the quality of the training of the military personnel who operate with Information Systems supporting the Command and Control capability.

Also, currently, a sailor is taking charge of numerous complex naval weapons systems that nearly all depend on the cyber domain to ensure their lethality, so the Portuguese Navy must foster IT and cyber literacy, programming skills, and robust cyber hygiene across all the operational units, because “Every Sailor a cyber warrior” (Doug, 2019).

The lack of or inadequate technological training on these systems, which can potentiate dissatisfaction in the military assigned to this area, may cause difficult situations due to their inefficient use.

1.2. Motivation and topic relevance

According to the doctrine adopted by NATO (2011), the primary role of military CIS is to serve the Military Command, allowing it to exercise Command and Control (C2) of forces in geographically dispersed areas.

As a secondary role, military communications must provide a suitable mechanism to pass information securely, quickly, and reliably, ensuring connectivity with the higher, peer, and subordinate echelons (NATO Combined Communication Electronics Board, 2010).

This role of military CIS is also stated in the national doctrine when it states that "The fulfilment of the missions assigned to the Navy requires effective Command and Control (C2) capabilities, practicable in situations of peace, crisis or conflict and adapted to the structure of the organization, force device, and operational concepts" (Estado-Maior da Armada, 2005).

The rapid evolution of systems transformed how military communications started to be managed. While before, they were based on the exploration of proprietary systems, in which the Information Management (IM) process in support of C2 was ensured by the same operators and technicians, according to an interview with Rear Admiral Oliveira e Silva (personal communication, October 23, 2017), but currently it is necessary to operate a great diversity of IM and computer systems, based on several types of technological infrastructures, by differentiated operators and technicians, as stated by the Captain Bulcão Sarmento in an interview (personal communication, November 17, 2017).

These CIS systems have brought an undeniable added value to the C2 exercise, so much so that NATO created a program aimed at creating a network and information infrastructure to ensure connectivity at all levels between allied countries, called NATO Network Enabled Capability (NNEC) (Inácio, 2018).

This project evolved in 2015 to the current Federated Mission Networking (FMN), maintaining its primary objective of being "a capability to support C2 and decision-making in future operations through improved information sharing" (NATO Allied Command Transformation, 2020).

The FMN Vision is to ensure "Day Zero Interoperable Forces", and to achieve that, all FMN Affiliates will be required to improve the way they train, plan and operate together

while adapting the way they transform their national capabilities to ensure even more effective training, planning and operating together in the future (FMN J6, 2018).

One of the main pillars of the FMN is people, along with processes and technology, thus developing a joint and combined training programme with the various affiliates aimed at developing and sharing knowledge in this area, facilitating integration and interoperability in missions (Supreme Headquarters Allied Powers Europe & NATO Allied Command Transformation, 2018).

Given this current evolution, with the perspective of its uninterrupted continuity, it is necessary "an efficient and balanced organization and management of the associated resources" (Estado-Maior da Armada, 2005) assigned to the CIS, preparing them not only for today but for the future (O. Silva, personal communication, October 23, 2017).

In the Navy's strategic planning, namely in the Sector Directive of the Superintendence of Information Technologies (STI), we may verify that the Vision of the Superintendent of Information Technologies (Roque, 2021) is to "Ensure adequate information for decision-making in a safe, timely, innovative and simple way".

In the SWOT[1] analysis outlined in his current action plan (Roque, 2022), the Superintendent acknowledges that the Portuguese Navy lacks personnel with suitable ICT/IS skills. However, given the exponential growth of the ICT/IS industry, he also believes that constant and up-to-date training, both technical and higher education, must be provided to enable individuals to handle the difficulties and assure innovative technological competence.

To this end, a sectorial strategic objective was created (OS2 - "Increase the capacity to retain people"), which has the following line of action (LA2.03): “Improve people's qualifications in the scope of Information Technologies and Management” (Roque, 2021), thus demonstrating a top-level concern for human resource capacity building in this area.

As represented in the Strategic Directives of the Navy Chief of Staff, the Navy's highest governance structure is also concerned with utilising technology and allocating resources to guarantee that the mission is accomplished.

[1] SWOT analysis is a framework for identifying and analysing an organization's strengths, weaknesses, opportunities and threats.

Two strategic objectives (OE) were included in the management of Admiral Mendes Calado, which ended in December 2021, namely OE no. 5: "Accelerate the digital transition, improving efficiency in processes and resource management," and OE no. 7: "Optimize the presence and control in maritime spaces under national sovereignty or jurisdiction," in support of the Navy's mission to "contribute so that Portugal uses the Sea." (Calado, 2021)

In his Strategic Directive (2022), the current Navy Chief of Staff, Admiral Gouveia e Melo, reaffirms the importance of technology, aiming for "A Navy that is holistic, ready, useful, focused, significant, and technologically advanced."

To this end, he understands that the Navy must exercise and develop a Command and Control capability based on a central nervous system that is resilient and networked within the larger structure of the Armed Forces' communication, sensor, and data systems and that only a technologically advanced Navy with high material and human readiness will be able to meet the future's challenges.

Among numerous strategic objectives, the following are deemed the most pertinent to the topic at hand:

- Raise material and personnel readiness (objective P2) through its initiative 21: Adequate professional training to Increase IT understanding, IT security, and network administration; and create a cyber defence speciality for enlisted personnel.
- Enhancing Human Capital (objective F2) through its initiative 44: Foster the development of opportunities for the personal and professional growth of the human capital of the Navy, including:
    - PhDs, Masters, MBAs, and post-graduate degrees will promote training in technology and managerial fields.
    - Promoting individual initiative in the acquisition of knowledge through financing and remuneration, with a focus on emerging technologies
- Accelerate the digital transformation and computerization (objective TA2) through its initiative 61: Enhance the Navy's command, control, communications, networks, and information capability by implementing technology-based infrastructures and modern, resilient, redundant command and control systems.

The purpose of this research should provide the Portuguese Navy with the knowledge that can be used to achieve its strategic objectives and, consequently, its mission: "To protect and promote Portugal's interests in and through the sea." (Melo, 2022)

1.3. Conceptual basis

For a better understanding of the subject and this work, it is considered fundamental to explain some more concepts, which are described hereafter:

- Automated Information and Communication Systems (SICA), namely those of the Navy (SICAM), is the "set of equipment, methods, and procedures, organized to perform functions of storage, transfer and/or processing of information, in support of the consultation, command, control, communications, and management of an organization", which support, "directly or indirectly, the fulfilment of the mission of one of the Navy's functional areas, or all of these, simultaneously and equitably" (Estado-Maior da Armada, 2005).
- Command and Control (C2), according to NATO doctrine, transposed to national doctrine, is defined as "the authority, responsibility, and activity of the Commander in directing and coordinating the military forces and in the implementation of orders related to the execution of operations" (Estado-Maior da Armada, 2005).
- According to the NATO doctrine, the consultation, command and control systems (C3S) is the collective term for communication and information systems, sensor systems and facilities which enable authorities and their staff to carry out consultation, command and control activities (NATO, 2006, p. 2.11).
- Information Management (IM) is considered as the "effective exercise of Command and Control capability, by the Commander, Director or Chief, depends ultimately on the effectiveness with which he is provided with the right information, at the right time, place and format, to support the respective decision-making process." (Estado-Maior da Armada, 2005).
- Mission Networks (MN) provide “governed single instances of capability, including the Communication and Information System (CIS) architecture, management, processes, and procedures created for an operation, exercise, training event, or interoperability verification activity”. Through sustainment and application of the three capability elements (people, process and technology), federated mission networks can be effectively and efficiently generated (Supreme Headquarters Allied Powers Europe & NATO Allied Command Transformation, 2018).

1.4. Questions and research goals

This research aims to analyse the current needs of CIS staff that ensure the C2 capability of the Portuguese Navy's military operations, as well as to foresee the technological evolution in this area and what are the needs for training in Information Systems and of personnel assigned to CIS.

Thus, the following starting question is posed:

- What are the essential Information Systems competencies of the personnel assigned to the CIS in the Portuguese Navy?

This analysis, therefore, has the following general activities:

- Identify the essential technological competencies of the personnel assigned to Communications and Information Systems in the Portuguese Navy to ensure the future of the Command and Control capability of naval military operations.
- To achieve the above objective, the following work will be developed:
    - Carry out a literature review on this subject.
    - Assess and identify the technical training needs of personnel assigned to the CIS, responsible for maintaining and operating the military Command and Control capability.
    - Analyse how the Navy military personnel assigned to the CIS consider themselves technologically capable of performing their functions.
    - Evaluate the expectations and needs of the technological evolution of the Command and Control capacity for the conduct of naval military operations by the Portuguese Navy.
    - Understand which of the essential competencies in the CIS area, to be acquired through education and training, the military of the Portuguese Navy should possess.

The following summary diagram of the research approach that will be adopted is presented below:

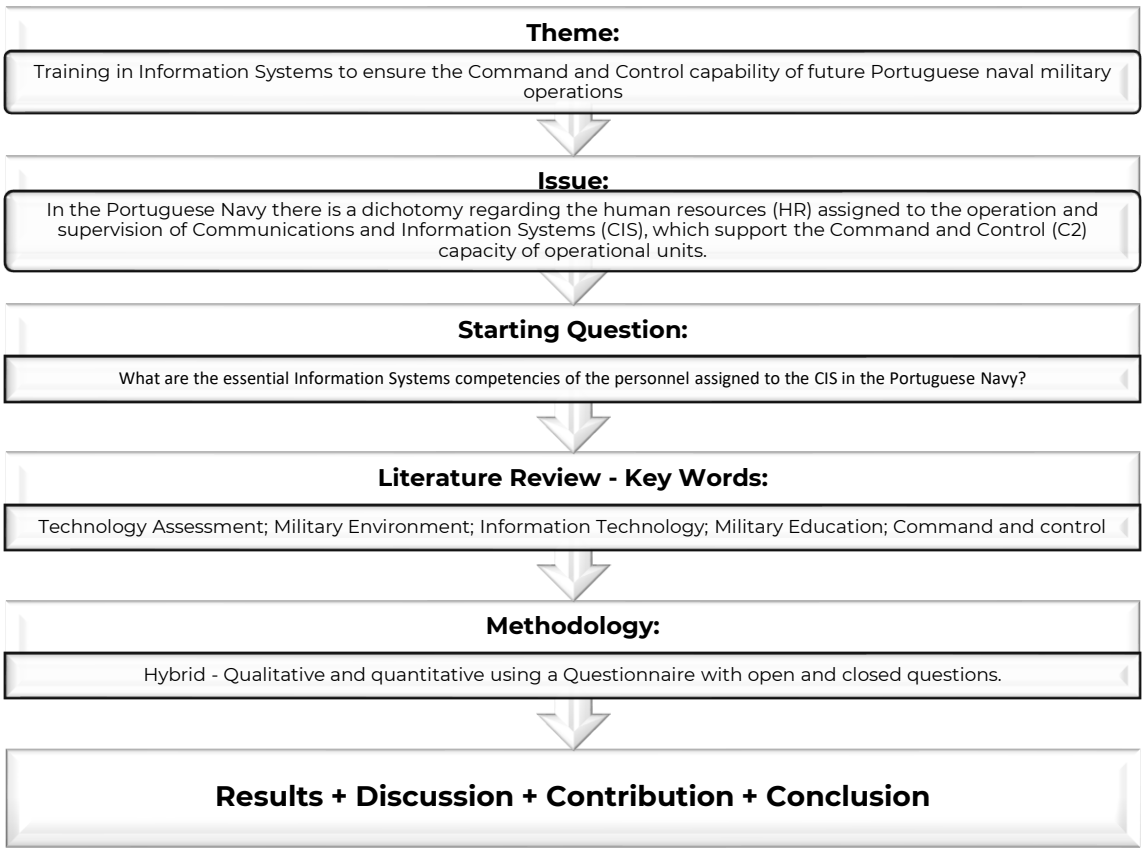

Figure 1 – Summary diagram of the research approach

The research aims to develop an evaluation model of the necessary competencies for those who provide service in the area of information systems in the Portuguese Navy, also analysing the good practices introduced by the Information Technology Infrastructure Library and a reverse SERVQUAL (Reverse SERVICE Quality) model (B. McNaughton et al., 2010).

To assess the current and future state of the technical training needs of the military, a questionnaire with closed and open questions will be carried out.

The data will be processed with a semantic analysis tool like Leximancer. After being analysed, a theoretical model explaining the technological needs of the CIS military will be proposed to the academy.

The uniqueness and value of this research roots in its holistic understanding of the CIS military's technological requirements and its application as a problem-solving intervention in information technology training requirements by identifying the primary themes for responsible attention required for improved military operations, performance, and efficiency.

We were able to determine the relational strengths between specific concepts using Leximancer (Cretchley, Gallois, et al., 2010), providing valuable indicators to aid us in the analysis of textual data, "from words to meaning to insight," and developing a conceptual framework (Smith & Humphreys, 2006). As a result, a conceptual model is proposed, based on a literature review and our methodological approach, to understand the concepts that may influence military IT training needs involving CIS personnel and their activities to support command and control.

This research contributes to a better understanding of the IT training requirements for CIS military developments, allowing us to propose a new conceptual model to explain the themes, concepts, and relationships that aid in identifying what is required to ensure successful and adequate IT training for the CIS personnel.

1.5. Structure and organization of the dissertation

This work is organised into five chapters reflecting the research in different stages and conclusions.

The first chapter introduces the research topic and problem, its defined objectives, a conceptual framework, the adopted research methodology, and a brief description of the work's structure.

The second chapter reflects the theoretical framework, called Literature Review, where several academic works from the military universe are analysed, as well as conceptual models applied in the academy in general terms, aiming at creating a theoretical-conceptual model that will guide the subsequent research.

The third chapter is dedicated to the Research Methodology used in data collection and processing in its two sub-phases and the analysis methods used.

The fourth chapter presents the analysis of the results obtained in the analytical phase, according to the methodology indicated for each of the sub-phases of the research.

The fifth and last chapter presents this study's general conclusions, discussing the results, the study's main contributions, recommendations, limitations, and proposals for future work.

Chapter 2 – Literature review

Apart from work developed by the author on this theme (2018), the literature is scarce on studies directly related to the topic in question in the military domain. However, some generic frameworks can be applied and adapted, such as the Technology Acceptance Model (TAM) (Venkatesh & Bala, 2008), Information Systems Success Model (ISSM) (DeLone et al., 2003), and Evaluation Framework for Information Technology (IT) Service Management (B. McNaughton et al., 2010).

In all these models, there is a common denominator regarding the topic under analysis: the IT support staff is a fundamental aspect of ensuring the system's quality, the information, and the service provided by Information Technologies and Systems.

However, some academic works developed on CIS in the Armed Forces through the Military University Institute should also be analysed to deepen the knowledge of the subject.

Thus, in the next subchapters, several academic works from the military domain will be analysed, and also on TAM, ISSM, ITIL[2], and the Skills Framework for Information and Communications Technologies, aiming to build a theoretical model that allows answering the research question.

[2] Information Technology Infrastructure Library

2.1. The CIS in the Portuguese Armed Forces

2.1.1. A strategic approach

Commander Jesus Alves recently developed a study on "Digital Transformation in the Armed Forces: Strategic Perspective" (2021).

In this study, he identified the importance for the Military Organization of a strategic plan for Digital Transformation (DT) aiming to "Ensure that the command and control and decision processes in the Armed Forces are more agile and able to respond to the challenges arising from disruptive technological advances" (Alves, 2021).

It found that at the international level, the approach encompasses information and knowledge superiority, integrated technology systems based on interoperability, operations in cyberspace and more optimised services focused on people and technology.

In the case of the Spanish Armed Forces, its plan focuses on information and knowledge management on a single platform oriented towards integrated services in an Integrated Defence Information Infrastructure, emphasising people and technology.

The alignment of strategy with the processes inherent to the value chain of the Armed Forces highlights that DT should be centred on providing the decision-maker, whether operational or back-office, with the best information for timely decision-making being the principle of CIS for C2. In the context of military operations, the best information in the early decision process has added value in concluding the decision cycle before the adversary interrupts his similar process before he can conclude it.

He also presented the importance of digital literacy for the whole organisation and introduced the EU Digital Competency Framework, which is articulated in five areas: (i) data and information literacy; (ii) communication and collaboration; (iii) digital content creation; (iv) security; and (v) problem solving (Carretero et al., 2017, pp. 9–16).

Each of the five areas can be broken down into several competencies, for a total of 21:

Table 1- DigComp competence areas and competencies

COMPETENCE AREAS	**COMPETENCES**
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content
2. Communication and collaboration	2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.3 Engaging in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 2.6 Managing digital identity
3. Digital content creation	3.1 Developing digital content 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licences 3.4 Programming
4. Safety	4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment
5. Problem-solving	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps

Source: (Kluzer & Priego, 2018)

As presented in Table 2, this framework defines proficiency levels linked to the competencies required given the complexity of tasks, problems and autonomy levels, allowing the assessment of the level to enter a qualification or requalification process (Clifford et al., 2020).

Table 2 – Main keywords that feature the proficiency levels

Overall Levels	**Foundation**		**Intermediate**		**Advanced**		**Highly specialized**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Complexity of tasks	Simple task	Simple task	Well-defined and routine tasks and straightforward problems	Tasks and well-defined and non-routine problems	Different tasks and problems	Most appropriate tasks	Resolve complex problems with limited solutions	Resolve complex problems with many interacting factors
Autonomy	With guidance	Autonomy and guidance when needed	On my own	Independent and according to my needs	Guiding others	Able to adapt to others in a complex context	Integrate to contribute to the professional practice and guide others	Propose new ideas and processes to the field
Cognitive domain	Remembering	Remembering	Understanding	Understanding	Applying	Evaluating	Creating	Creating

Source: (Carretero et al., 2017)

This demonstrates the importance of the CIS staff for the Armed Forces' DT strategic plan, as indicated in the sector directive of the Superintendence of Information Technologies (Roque, 2021) for the particular case of the Navy.

The various studies conducted by the Joint Research Centre (Carretero et al., 2017; Clifford et al., 2020; Kluzer & Priego, 2018), of the European Commission, within the scope of digital skills and competencies are also beneficial, with the necessary adaptations, for the analysis of the digital skills of the personnel assigned to the CIS of the Portuguese Navy.

2.1.2. The organizational and operational level

Several studies were also conducted in the organisational and also operational scope of CIS in the Portuguese Navy and the Defence sector, namely aiming at a possible reorganisation in the area of Information and Communication Technologies (ICT), as well as proposals for governance models and a study on what the future of ICT in the Navy should be.

Captain Ferreira Seuanes, in his study on the "Reorganisation of ICTs in National Defence" (2013), where he analyses potential governance models for ICTs, indicates that it is necessary to have a staff with the necessary expertise to exploit the capabilities provided and to carry out their responsibilities more effectively.

It also states that resource management is a crucial factor in the success of an organisation, consisting of the optimal investment in IT capabilities and the use and allocation of IT resources[3] whose activity is aimed at meeting business needs.

In his work, a questionnaire was carried out on the maturity of process management in IT, based on the COBIT model (Control Objectives for Information and related Technology), from the IT Governance Institute (ITGI).

In this analysis, several opportunities for improvement were identified, namely in the management of human resources allocated to IT. It was verified that:

- The IT function has an established organization that is documented and aligned with the IT strategy but is not flexible and adaptive.
- Both the functions to be performed by IT staff and those to be performed by users are defined, as well as the requirements and expertise of IT staff.
- IT roles and responsibilities are formalised and implemented, but a continuous evolution process is not in place.
- Support service and incident management procedures are standardised and documented, but training is informal and left to the discretion of the individual.
- Issues and incidents are manually controlled and individually monitored, and no formal reporting system is in place.
- Timely response to issues and incidents is not measured, and incidents may go unresolved.

[3] By IT resources he mean staff, applications, technology, infrastructure and data

- IT configuration control depends on the technicians' knowledge and experience, with the tools that manage configuration differing between platforms.

One of its conclusions is the need to ensure the proper management of the National Defence IT human resources, keeping staff competent and motivated to create and deliver IT services (Seuanes, 2013).

In the study "Future of ICT in the Navy, in which model and with which resources?" by Lieutenant-Commander Damião Lopes (2020), it is shown that there is a correlation between the main changes in the organisational structure of ICT with the significant technological milestones that have occurred in the Navy and the importance of its human capital and the Navy's ability to train them.

Notwithstanding reporting the importance of basic curricular training, he also mentions the importance of continuous training in IT, with various curricular units to be provided as complementary training by functional area, according to Table 3:

Table 3 – Training complement for IT Staff

CU / Area	*Network and systems admin.*	*Software development*	*Cyber-security and defence*	*Information management*
Introduction to object-oriented programming		**X**	**X**	
Databases	**X**	**X**	**X**	**X**
Operating systems	**X**	**X**	**X**	
Software engineering		**X**		
Computer architecture	**X**			
Advanced programming		**X**		
Distributed systems	**X**	**X**	**X**	
Information systems modelling		**X**		**X**
Computer networks	**X**		**X**	
Internet programming				
Visual programming		**X**	**X**	**X**
Computer security	**X**		**X**	
Project management	**X**	**X**	**X**	**X**

Source: (Lopes, 2020)

Although his study focused on the Officers' category, he proposes a feasibility study for creating a new class in the Sergeants' and enlisted men's categories in the area of ICT/informatics, including the proposal of the competition model and training for both categories.

2.1.3. The Human Resources allocated to CIS

The author also developed a study (2018) where he tried to identify the needs of the Portuguese Navy concerning the Operators and Supervisors assigned to the CIS, particularly regarding their skills and expertise, to fill the existing positions in this area.

The naval units of the frigate type were considered the best case study for having a greater scope and operational needs of CIS, compared to other naval units and whose needs are easily adaptable to those.

In its study, the detailed maps of positions, detail, shipboard regulations, notes and mission reports were verified, using as a model unit the NRP "Álvares Cabral" (class "Vasco da Gama"), for having participated, between 2015 and 2016, in several multinational exercises (mission reports of 2015, and 2016), besides national ones, in an isolated way or integrated into the SNMG1.

There are onboard the frigates class "Vasco da Gama", in full manning, nineteen CIS elements, with job description detailed in Appendix A – Detailed Job Maps of the Portuguese Navy Frigates for the CIS Staff.

According to the internal organisation (norms of 2006, and 2011), those elements are separated into two different Departments, the Operations - Communications and Information Systems Service (DOP-SCSI), which is made up of two sections: Radio and Signals; and the Weapons and Electronics - Electronics Service - Information Technology Section (DAE-STI).

The elements assigned to the DOP-SCSI have to ensure the following:

- Management, supervision and operation of communications systems and equipment;
- Management, use and conservation of the systems, equipment, material and cryptographic publications, as well as the respective vital lists;
- Management and control of publications and manuals;
- Processing all message traffic, received and transmitted, according to the procedures in force (national or NATO);
- To garrison, operate or supervise a tactical radio wave;
- Ensure visual communications (flags and light morse), encoding and decoding transmitted and received signals (norm of 2003);

- Act as an external messenger.

Furthermore, the elements assigned to the DAE-STI, generally with specific training as computer technicians, are responsible for the technical component:

- Servers and associated software;
- Computers, peripherals and associated software;
- Printers (local and network);
- Network storage units;
- Racks for network components;
- Network assets (routers, switches, hubs, media converters, patch panels, network cables, network sockets and VoIP phones).

Table 4 – Comparison of functions on board

Basic skills	***DOP - SCSI***	***DAE - STI***
Radio	**X**	
Signals	**X**	
Cypher	**X**[4]	
Networks		**X**
Information management	**X**	**X**
Basic maintenance	**X**	**X**
Technical maintenance		**X**

Source: (Precioso, 2018)

In the Joint Warrior 151 (JW151) exercise in the north of Scotland, C2 was provided not only by formal military messaging and voice radio communications but also by e-mail and other NATO Secret Wide Area Network (NSWAN) services, such as information sharing portals and chat-type tools. In a note made by the ship at the time (mission report of 2015), it was estimated that about 40% of the information relating to the exercise was only on NSWAN, and a growing trend could be considered in the future.

The report produced arising from its integration into SNMG1 in 2016, which includes participation in the Northern Coasts 2016 (NOCO16) and Joint Warrior 162 (JW162) exercises, also states the following:

- "NATO agencies and partner countries increasingly use IP services to exchange operational information at the expense of other services."

[4] It already includes recent digital cipher, including for networks.

- "The chat service is increasingly used in the conduct of military-naval operations, allowing the exchange of information in real-time for decision support, and its permanent availability is vital."
- "By the proliferation of IP communications, with information reaching the user directly with almost instantaneous response times (chat and email tools), radio communications are beginning to be left in the background in naval operations, almost as redundant rather than primary." (mission report of 2016).

It is thus possible to see that the future of naval military communications increasingly involves the use of network (or IP) services, generally dependent on satellite communications. However, it is necessary to ensure and safeguard the C2 capability through other means, such as visual or radio communications.

Regardless of the organisation on board, the human resources assigned to the CIS must guarantee the ability to operate and ensure the permanent availability of these services and systems.

The embarked staffs also have personnel assigned to the CIS to ensure the proper C2 of the Naval Forces and Units, as is the case of the Staff of the FNP[5] or PRTMARFOR (Portuguese Naval Force) and SNMG1.

In his study, Sergeant Rijo de Almeida was interviewed as Information Management Assistant (IMA) for the PRTMARFOR; he indicated that he felt "difficulties in assuming the functions in full because he had no education or training in the area of information systems" and considers that "we should have specific training and be knowledgeable in the areas in which communications has evolved (Information Systems)".

Also, the Communications Officer Post Delivery report (2016) states, "*The CIS staff of the PRTMARFOR is essentially composed of officers and sergeants specialized in communications, which as a rule in the Navy, do not have in-depth skills in the area of networking. These skills are essential for the integration on board of the communications infrastructure and its exploitation and troubleshooting during the mission period*." and *"...must-have skills in the administration and exploitation of systems, networks and services in the area of communications and information systems*."

[5] Força Naval Portuguesa

A good example is the SNMG1 Staff because although they are supported by the onboard resources and the NATO Communications and Information Agency (NCIA), they can ensure the management of information in the force, through the promulgation of instructions and subsequent supervision, by various means (IP services, signals and radio), and also by a component considered more technical, such as the management of NSWAN and its services for the respective staff.

2.1.4. CIS training and education in the Portuguese Navy

In the same study, the author analysed the existing training in the Navy for sergeants and enlisted men in communications. The following career courses in the Navy: CFP01 - Training Course for Enlisted Personnel in Communications (Escola Tecnologias Navais, 2004) and the CFS10 - Training Course for Sergeants in Communications (Escola Tecnologias Navais, 2005).

These two introductory training courses, described in Appendix B – Analysis of CIS Training in the Navy, allow the exercise of the above functions without the component of networks and information systems. Although this is considered an expected competence, it is not included in the training plans.

There is no basic training in the field of Information Systems and networks, but rather two specialization courses in computer techniques (EKR01 and EKR02) and two adaptation courses in network administration concepts (DKI35 and DKI36) (also described in Appendix B – Analysis of CIS Training in the Navy). These courses can be taken by military personnel of any class, subject to the rules published in the entrance contest (Escola Tecnologias Navais, 2006b, 2006a, 2007a, 2007b).

The first two courses are more comprehensive, covering the subjects of the adaptation courses and, in the end, better suited to the needs indicated in Subchapter 2.1.3. In addition, they address more technical matters, such as the administration of microcomputer resources and the resolution of hardware anomalies.

Table 5 summarises the skills acquired in both Communications and IT training and the possible places they can exercise these skills.

Table 5 – Comparison of training in CIS and IT and their application

Basic skills	***Communications training***	***IT training***	***Application***
Radio	**Yes**	**No**	**Naval Units, Staff, Comms Centres**
GMDSS	**No**[6]	**No**[7]	**Naval Units, Comms Centres**
Signals	**Yes**	**No**	**Naval Units**
Cypher	**Yes**	**No**	**Naval Units, Staff, Comms Centres**
Networks	**No**	**Yes**	**Naval Units, Staff,**
Information management	**Yes**[8]	**Yes**[9]	**Naval Units, Staff, Comms Centres**
Basic maintenance	**Yes**[10]	**Yes**	**Naval Units, Staff, Comms Centres**
Technical maintenance	**No**	**Yes**	**Naval Units, Staff, Comms Centres**

Source: (Precioso, 2018)

To ensure all these skills are in a single element, it would be necessary to adapt the communications course for non-commissioned officers, sergeants, and enlisted men by integrating the specialization course in computer techniques, with due adaptation to information systems.

Also, for the area of cyber defence, which currently lacks specialised personnel (Estado-Maior da Armada, 2018), this would bring benefits, as it would prepare personnel with more comprehensive basic training in CIS, which would be later complemented and updated.

[6] Needs specific training for this competence.
[7] Needs specific training for this competence.
[8] It only has at the procedural level and not electronic information management.
[9] Through skills in e-mail and web systems administration, among others.
[10] Only diagnosis and interconnection with technical maintenance personnel.

2.2. The Technology Acceptance Model (TAM)

2.2.1. The evolution of the TAM

The technology acceptance model (TAM) is a theory of information systems that describes how consumers come to accept and employ new technologies.

According to the TAM, when faced with new technology, various factors influence their decision about how and when to utilize it. Fred Davis (1989) introduced the following basic concepts of this model:

- Perceived usefulness (PU) - "the degree to which an individual believes that utilizing a certain system will improve their job performance." It refers to whether or not someone considers a piece of technology beneficial for the task at hand.
- Perceived ease of use (PEOU) —"the degree to which an individual believes that utilizing a specific technology would be effortless" (Davis, 1989). If the technology is simple to use, the hurdles will be overcome. On the other hand, if something is difficult to use or has a sophisticated interface, no one has a favourable opinion of it.

External influences, such as social influence, play a significant role in determining an individual's attitude. When these factors are in place, people will develop an attitude toward and willingness to use technology. However, perceptions vary according to age and gender, as everyone is unique.

The TAM has been explored and expanded continuously—the two significant improvements being the TAM 2 (Venkatesh, 2000; Venkatesh & Davis, 2000) and the unified theory of technology acceptance and use or UTAUT (Venkatesh et al., 2003). Furthermore, in e-commerce, a TAM 3 has also been proposed, including the effects of trust and perceived risk on system use (Venkatesh & Bala, 2008).

2.2.2. TAM 3 and its relevance to this work

Earlier models have elucidated how and why people adopt and use information technologies (ITs) in the workplace. However, from an organizational standpoint, the more critical problem is how managers make educated decisions regarding interventions that can result in increased adoption and successful use of information technology.

There is a dearth of literature on IT implementation research that examines the role of interventions in assisting such managerial decision-making. There is a need to understand how diverse interventions can affect the well-established factors of IT adoption and use.

To address this gap in the literature, Venkatesh & Bala (2008) draw on the vast body of research on the technology acceptance model (TAM), particularly on the determinants of perceived usefulness and perceived ease of use, too:

(i) develop a comprehensive nomological network (integrated model) of the determinants of individual-level (IT) adoption and use;

(ii) empirically test the proposed integrated model; and

(iii) present a research agenda focused on potential pre- and postimplementation effects.

Figure 2 illustrates the determinants of perceived usefulness and perceived ease of use: person differences, system characteristics, social impact, and facilitating factors. Individual differences include personality and/or demographic characteristics (e.g., an individual's qualities or states, gender, and age) that might affect an individual's perceptions of perceived utility and perceived ease of use.

System characteristics are the distinguishing aspects of a system that might aid individuals in developing favourable (or unfavourable) judgments of a system's utility or ease of use. Social influence encompasses a variety of social processes and techniques that influence how individuals acquire perceptions about various areas of information technology.

Finally, enabling conditions refer to organizational support that facilitates the application of information technology.

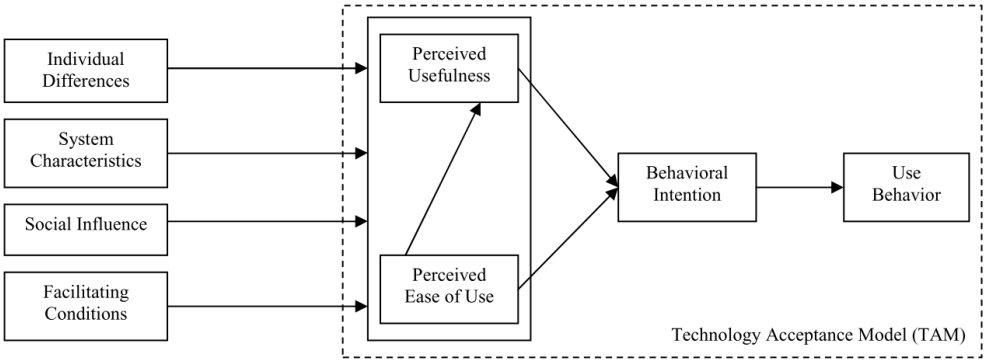

Figure 2 – TAM Theoretical framework

(Venkatesh & Bala, 2008)

One of the concepts introduced by the authors (Venkatesh et al., 2003) is the Perception of External Control, which can be defined as "The degree to which an individual believes that organizational and technical resources exist to support the use of the system".

In Figure 3, we can see how the Perception of External Control correlates with the Perceived Ease of Use:

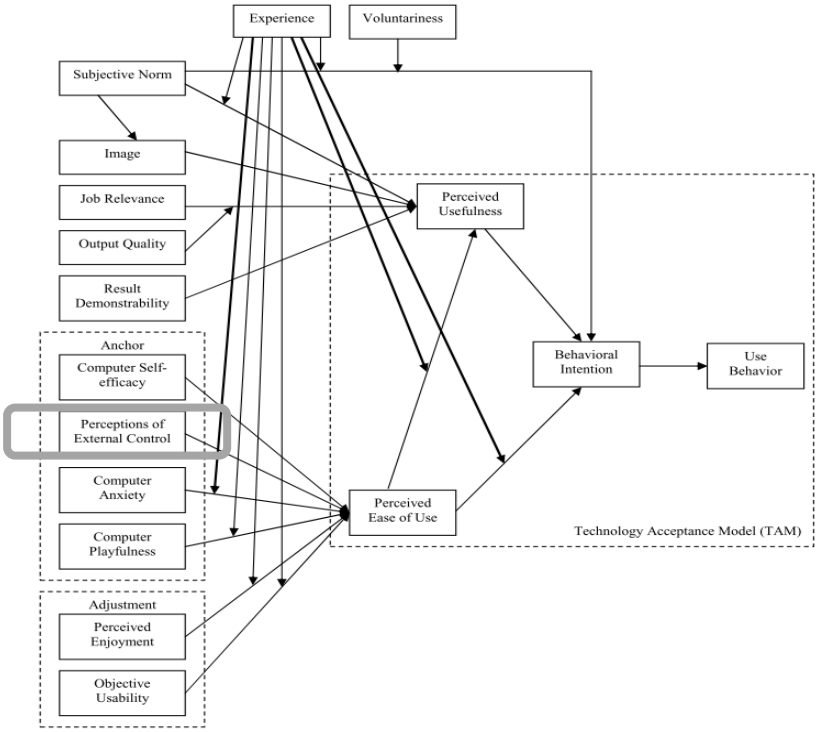

Figure 3 – TAM 3 with PEC highlighted

(Venkatesh & Bala, 2008)

Organizational assistance encompasses informal or formal activities or roles that assist employees in properly utilizing a new system. Organizations can assist in a variety of ways, including by establishing essential infrastructure, establishing dedicated helpdesks, recruiting systems and business process experts, and sending people to off-the-job training.

Prior research indicates that employees' perceptions of organizational support, that is, favourable conditions or perceptions of external control (Venkatesh, 2000; Venkatesh et al., 2003), will result in increased user adoption of new technologies.

Organizational assistance encompasses internal and external experts who can assist users in navigating the complexities of new systems and business processes. Thus, organizational support can significantly impact perceived utility and simplicity of use.

TAM3 asserts that external control perceptions are significant and stable predictors of perceived ease of use. Organizational support is a critical source of external control perceptions.

In this role, the CIS staff fits, providing organisational support to the end-users of the various information systems used to ensure C2 and thus facilitating their use of these technologies and systems.

2.3. Information Systems Success Model (ISSM)

2.3.1. The updated ISSM and its correlation to Service Quality

The Information Systems Success Model (also known as the Delone and McLean ISSM) is an information systems (IS) theory that aims to provide a comprehensive understanding of IS success by identifying, describing, and explaining the relationships between six of the most critical dimensions of success against which information systems are frequently evaluated.

It was initially developed by William H. DeLone and Ephraim R. McLean (1992) and was improved decades later in response to feedback from other scholars working in the field (DeLone & McLean, 2014; DeLone et al., 2003; Petter et al., 2008).

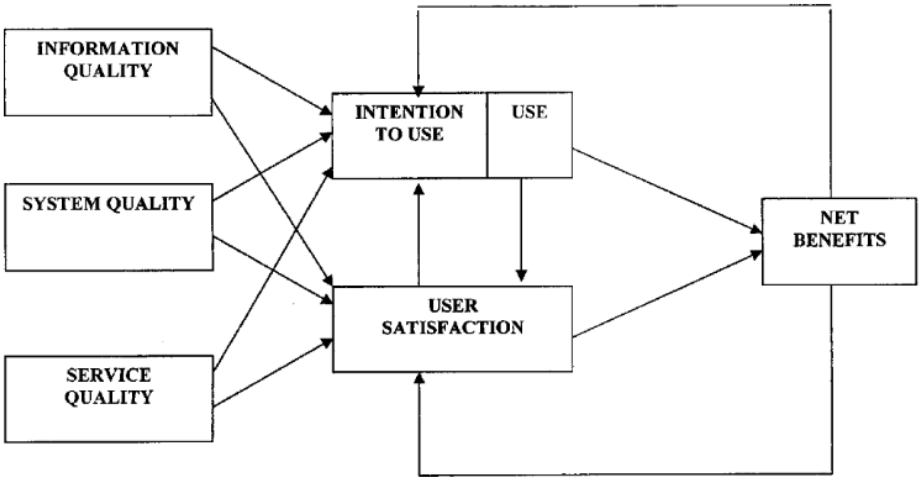

Figure 4 – Updated ISSM

(DeLone et al., 2003)

In one of its evolutions *(DeLone et al., 2003)*, Figure 4 is presented, where the quality has three major dimensions: "information quality", "systems quality", and "service quality". Each should be measured separately because, singularly or jointly, they will affect subsequent "use" and "user satisfaction".

In the “service quality” dimension, the SERVQUAL model (Berry et al., 1988; Rujukan, 2006) is used to measure several aspects, such as:

- Responsiveness – IS employees give prompt service to users;
- Assurance – IS employees have the knowledge to do their job well;
- Empathy – IS has users’ best interests at heart.

2.3.2. The ISSM and its relevance to the CIS Staff

For the present work, the ISSM presents several concepts (Kademeteme & Twinomurinzi, 2019) of great importance concerning the quality of services provided by CIS staff:

- The term "system quality" refers to the characteristics or features of an information system. System quality attributes include, but are not limited to, system flexibility, ease of use, response times, ease of learning, system reliability, and sophistication.
- The term "information quality" refers to the properties or characteristics of a system's outputs (processed data), such as dashboards or reports. For example, timeliness, completeness, currency, accuracy, relevance, conciseness, understandability, and usability are all information quality attributes.
- The term "service quality" refers to the level of support provided to users by IT support personnel or an ICT department. Technical competence, responsiveness, the personnel staff's empathy, reliability, and accuracy all fall under this construct. Service quality will be referred to as organizational factors in this study.

Also, user satisfaction refers to the degree to which users are satisfied with the information (output) from the information system. There is a causal relationship between user satisfaction and behavioural intention to continue using (DeLone & McLean, 2003).

As in the TAM, it is possible to observe an important correspondence in the users' acceptance of technology and the proficiency of the personnel who support it, namely the CIS staff.

2.4. Evaluation framework for IT Service Management (ITSM)

2.4.1. Use of the IT Infrastructure Library (ITIL) to evaluate ITSM

According to Blake McNaughton and Pradeep Ray (2006), IT Service Management (ITSM) is now a critical component of managing the Information Technology function. Transforming IT operations, help desk, and network services from their traditional roles into a well-governed, integrated, efficient, reliable, user- and business-oriented service delivery unit inside the organization is a significant priority for CIOs and IT Management today.

IT management's traditional functions (hardware and software installation, network/systems management, application management, and help desk) have been expanded to include business-oriented service support, in which IT services are planned and managed following their contribution to required business processes.

ITSM processes include incident management, problem management, release management, change management, configuration management, service level management, financial management of IT services, capacity management, IT service continuity management, and availability management, as defined by the Information Technology Infrastructure Library (ITIL).

They provided the following evaluation methodology for ITIL in their study (B. McNaughton et al., 2010), which is depicted in

Figure 5.

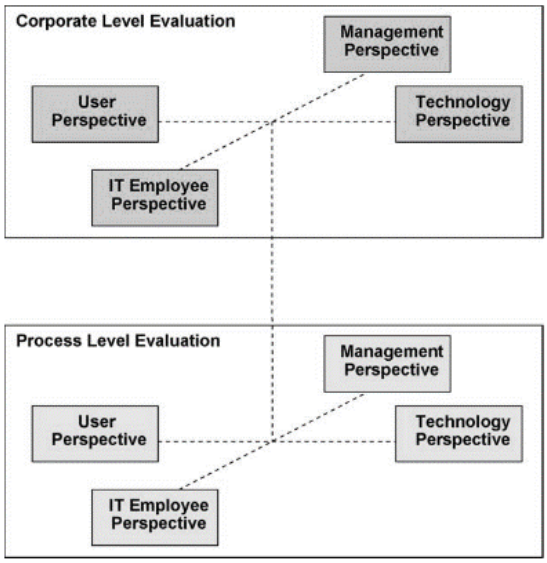

Figure 5 – Development of the ITIL evaluation framework
(B. McNaughton et al., 2010)

The four views of evaluation: management, technology, IT users, and IT employee personnel; were formed based on the anticipated benefits of implementing or upgrading ITSM inside the organization through ITIL.

The one deemed critical for this investigation is the IT Employees' Perspective: that of the IT department's people, mainly operational staff, impacted by ITIL-related change. This category may include first- and second-level support staff, network administrators, security professionals, database administrators, and application owners; these employees are directly responsible for implementing new procedures and modifications.

Additionally, survey questions were included in their study to assess the IT employee perspective via an IS Reverse SERVQUAL, which allowed respondents to reflect internally on their perceptions of the quality of service provided by those providing the service to determine whether ITIL was successfully instilling the concept of a service culture within the organizations IT department.

2.4.2. IS Reverse SERVQUAL

SERVQUAL, developed by Berry et al. (1988), is the most widely used service quality evaluation instrument due to its ease of use, simple structure, and generalizability.

It comprises five dimensions: tangibles, reliability, responsiveness, assurance, and empathy.

Since the quality of services is highly dependent on human behaviour, the quality dimensions of the measurement instrument vary according to the service context. For instance, in the health sector, "empathy" and "responsiveness" are more essential than "reliability," yet "reliability" is critical in transportation (José & Oliveira, 2009).

As a result, SERVQUAL dimensions can be adjusted to accommodate the unique service parameters, like the example provided in the work of Gandhi et al. (2018), where they defined four dimensions for the service quality evaluation in small and medium enterprises: Dependability, Agility, Professionalism, and Understanding.

A similar model can be adopted in the present study to be applied in evaluating the service provided by the CIS staff of the Portuguese Navy.

2.5.The Skills Framework for Information and Communications Technologies

The present study needs to analyse reference frameworks of competencies in the field of ICTs to determine which core competencies the CIS soldiers of the Portuguese Navy should possess to carry out their duties.

Section 2.1 introduced the EU Digital Competency Framework, focusing primarily on identifying and evaluating digital competencies for EU citizens rather than ICT professionals.

The Cybersecurity Competency Benchmark (2022), promulgated by the National Cybersecurity Centre of the National Security Office and aimed at all stakeholders in the field of training and hiring professionals, as well as other areas where the identification of cybersecurity competencies is crucial, was analysed.

Despite the importance of cybersecurity competencies for the Portuguese Navy's military, this reference tool is insufficient to identify all the necessary competencies. So instead, it uses the Skills Framework for Infocomm Technology (*Skills Framework For ICT*, n.d.), presented by the Government of Singapore, in work carried out by the Infocomm Media Development Authority (IMDA) and by SkillsFuture Singapore (SSG), as a point of reference.

This last reference describes ICT-related competencies in various areas, with Infrastructure; Operations and Support; and Cybersecurity being of particular significance to this study. Each of these domains presents distinct types of profiles and distinct levels of proficiency for each profile's competencies.

The following profiles were selected, based on the sort of work developed, as having areas of interest for the type of work developed aboard naval units and on land:

Associate Network Engineer; Associate Applications Support Engineer; Associate Infrastructure Support Engineer; Associate Systems Support Engineer; Associate Database Support Engineer; Associate Data Centre Operations Engineer; Associate Operations Centre Support Engineer; Associate Security Analyst; Security Operations Analyst.

The different profiles and accompanying competencies have been analysed and correlated with the reality of the Portuguese Navy; the results are provided below.

2.5.1. Generic Skills & Competencies

The following table gives us the ability to analyse, for each profile, which fundamental capabilities the staff should have regarding generic capabilities, which are sometimes also referred to as soft skills. Considering the findings of this investigation, it is possible to deduce the appropriate level of expertise for the Navy CIS Staff.

Table 6 – Comparison of the generic skills & competencies, profiles, and the Navy needs

	INFRASTRUCTURE			**OPERATIONS AND SUPPORT**						**CYBERSECURITY**		**NAVY**
GENERIC SKILLS & COMPETENCIES (TOP 5)	Associate Infrastructure Engineer	Associate Radio Frequency Engineer	Associate Network Engineer	Associate Applications Support Engineer	Associate Infrastructure Support Engineer	Associate Systems Support Engineer	Associate Database Support Engineer	Associate Data Centre Operations Engineer	Associate Operations Centre Support Engineer	Associate Security Analyst	Security Operations Analyst	CIS Staff
COMMUNI-CATION		B	B	B	B	B	B	B	B	B	I	B
INTERPERSONAL SKILLS				B	B	B	B	B	B			B
PROBLEM-SOLVING	I	B	B	B	B	B	B	B	B	I	I	B/I
SERVICE ORIENTATION	B			B	B	B	B	B	B		B	B
TEAMWORK	B	I	I	B	B	B	B	B	B	I	I	I

Subtitle:

B – Basic

I – Intermediate

2.5.2. Technical Skills & Competencies

The table below now presents the same analysis, considering the technical competencies.

Table 7 – Comparison of the technical skills & competencies, profiles, and the Navy needs

	INFRASTRUCTURE			OPERATIONS AND SUPPORT						CYBERSECURITY		NAVY
GENERIC SKILLS & COMPETENCIES	Associate Infrastructure	Associate Radio Frequency	Associate Network	Associate Applications Support	Associate Infrastructure Support	Associate Systems Support	Associate Database Support	Associate Data Centre Operations	Associate Operations Centre Support	Associate Security Analyst	Security Operations Analyst	CIS Staff
BUSINESS NEEDS ANALYSIS	2	2	2	2	2	2	2	2	2	2		2
CONFIGURATION TRACKING				1, 2		1, 2	1, 2		1, 2			2
CYBER AND DATA BREACH INCIDENT MANAGEMENT	3	3	3	2	2	2	2	2	2	2	3	2
INFRASTRUCTURE SUPPORT	1, 2	1, 2			1, 2	1, 2	1, 2	1, 2	1, 2	3		2
IT ASSET MANAGEMENT	2	2	2			2	2	2	2			2
NETWORK ADMINISTRATION AND MAINTENANCE	1, 2	1, 2	1, 2		1, 2		1, 2			1,2		2
NETWORK CONFIGURATION	2	2	2		2							2
NETWORK SECURITY	3										3	3
PROBLEM MANAGEMENT	3	3	3				3			3		3
PROCESS IMPROVEMENT AND OPTIMISATION	3	3	3	3	3	3	3	3	3			3
RADIOFREQUENCY ENGINEERING		3										3
SECURITY ADMINISTRATION						3	2			2	3	2,3
SERVICE LEVEL MANAGEMENT	3	3	3	3	3	3	3	3	3			3
SOFTWARE CONFIGURATION				2								2
STAKEHOLDER MANAGEMENT	2	2	2	2, 3	2, 3	2, 3	2, 3	2, 3	2, 3	2	3	2
SYSTEM INTEGRATION						3		3				3

Subtitle:

1 – Proficiency Level 1 (Basic)

2 – Proficiency Level 2 (Intermediate)

3 - Proficiency Level 3 (Advanced)

2.5.3. Skills analysis for the Navy CIS Staff

The following table provides a summary of the topics that were previously analysed. In addition, it details the degrees of competence required for CIS Staff, as well as a description of each of these competencies, categorised according to their respective skills areas of competence.

Table 8 – Summary table of the skills analysis

SKILL AREA	SKILLS & COMPETENCIES	NAVY CIS STAFF LEVEL	DESCRIPTION
INFORMATION MANAGEMENT	Operational Needs Analysis	2	Document operational requirements and identify basic needs as well as potential solutions
OPERATING SYSTEMS	Configuration Tracking	2	Verify accuracy, completeness, and currency of information in configuration logs and review unauthorised changes, diversions, or inappropriate use of software assets
SECURITY	Cyber and Data Breach Incident Management	2	Provide real-time incident and status reporting, and identify affected systems and user groups
COMPUTER ARCHITECTURE	Infrastructure Support	2	Analyse issues or incidents encountered by users and conduct troubleshooting, and roll out upgrades
INFORMATION SYSTEMS MANAGEMENT	IT Asset Management	2	Procure and categorise IT assets across different lifecycle stages, and monitor IT asset levels regularly
COMPUTER NETWORKS	Network Administration and Maintenance	2	Monitor network performance, investigate and resolve network faults or downtime
COMPUTER NETWORKS	Network Configuration	2	Implement and configure servers and devices in line with the network blueprint, and manage user network access
SECURITY	Network Security	3	Install, configure, and test network security
PROBLEM-SOLVING	Problem Management	3	Handle specific problems from diagnosis and prioritisation to the identification and implementation of solutions
INFORMATION AND DATA LITERACY	Process Improvement and Optimisation	3	Identify and implement the adoption of process improvement and optimisation methods
RADIO AND SIGNALS COMMUNICATIONS	Radio Frequency Engineering	3	Set up and tune radio frequency (RF) and analyse faults
SECURITY	Security Administration	2,3	Run system diagnostic tools, and install and update simple, basic security programmes, virus protection and system patches Administer, configure, and troubleshoot security programmes and mechanisms, and analyse the impact of patches and updates on system and networks

SKILL AREA	SKILLS & COMPETENCIES	NAVY CIS STAFF LEVEL	DESCRIPTION
INFORMATION SYSTEMS MANAGEMENT	Service Level Management	3	Monitor service levels, review, and report service delivery deviations
OPERATING SYSTEMS PROGRAMMING	Software Configuration	2	Apply standard scripts and tools to deploy software products and document release and deployment activities as well as modifications to software configurations
INFORMATION SYSTEMS MANAGEMENT	Stakeholder Management	2	Identify key stakeholder relationships, needs and interests, and coordinate with stakeholders on a day-to-day basis
DISTRIBUTED SYSTEMS	System Integration	3	Perform basic compatibility assessments and integrate selected system components according to a plan
DATABASES	Database Administration	2	Conduct basic installation, configuration and upgrade of databases and servers, and perform routine data backup and recovery activities
COMMUNICATION AND COLLABORATION	Communication	1	Communicate information with others to respond to general inquiries and to obtain specific information.
COMMUNICATION AND COLLABORATION	Interpersonal Skills	1	Recognise internal feelings and emotional states to manage interpersonal relationships in social situations.
PROBLEM-SOLVING	Problem Solving	1, 2	Identify easily perceivable problems and follow guidelines and procedures to solve the problems. Identify less perceivable problems and use problem-solving tools and techniques to solve the problems.
INFORMATION SYSTEMS MANAGEMENT	Service Orientation	1	Exceed customer needs and expectations and handle service challenges with a positive mindset. Demonstrate an understanding of the organisation's service vision, mission, and values.
COMMUNICATION AND COLLABORATION	Teamwork	2	Facilitate work team activities, provide assistance and support needed by team members and promote ownership and commitment among team members to work goals to improve team performance.

Subtitle:

1 – Proficiency Level 1 (Basic)

2 – Proficiency Level 2 (Intermediate)

3 - Proficiency Level 3 (Advanced)

2.6. Summary of the literature review and conceptual models

This chapter analyses various academic and doctrinal articles from military and civilian academic institutions and organisations.

This study presents a strategic vision of digital transformation for the Armed Forces and the various areas of digital competence identified by the European Union that can be applied in this study.

Using COBIT, a governance model is described, and a study of its maturity within the National Defence universe is performed. Several aspects of the IT staff that need to be improved are identified.

The studies on CIS training in the Navy, as well as operational requirements and training and education proposals for CIS personnel, are all discussed in detail.

As a result of these studies, it was possible to identify an opportunity to improve the current management and training model of the personnel assigned to the CIS in the Portuguese Navy through the development of more and better CIS competencies that allow for the proper functioning of onboard systems and the appropriate management of information, to ensure the C2 of military operations.

As stated by TAM, one of the factors to consider when evaluating user acceptance of technology is the perception of external control, which is introduced by IT support personnel. It indicates something similar, but from a different perspective, where its three quality dimensions also influence user intention to use and satisfaction, in addition to influencing user satisfaction.

Additionally, the studies presented on information technology service management and information technology infrastructure library (ITIL) emphasise the importance of the IT staff perspective, demonstrating the utility of using the IS Reverse Servqual, an adaptation of the SERVQUAL applied to IT service providers, namely with the evaluation of the four dimensions of dependability, agility, professionalism, and understanding.

Table 15 ends by summarising the analysis of a framework of competencies that CIS staff should possess, as well as its categorisation, relating to all the literature reviews.

This enables the presentation of the following conceptual map, which will serve as a guide for the remaining development of the work and will allow for the assessment of the fundamental competencies of the Navy military dedicated to CIS support:

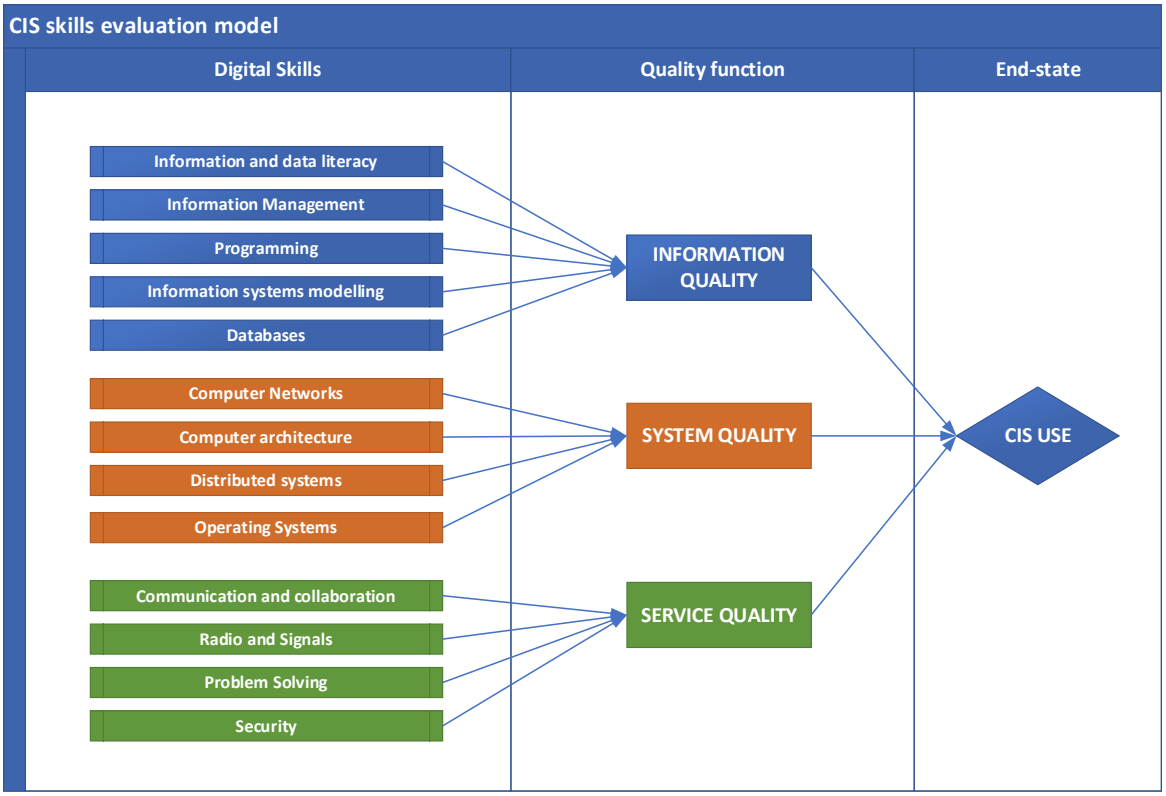

Figure 6 – CIS skills evaluation model

Chapter 3 – Research Methodology

The present dissertation was written as an executive summary and elaborated following an objectivist ontology and positivist epistemology based on critical thinking, using a hybrid (qualitative and quantitative) research strategy. The research design was essentially that of a case study, that of the Portuguese Navy, in the transversal time horizon.

This methodological process is adopted, considering that "social phenomena and their meanings have an existence that is independent of the social actors" and that "the phenomena and knowledge confirmed through the senses can be recognized as valid knowledge" (Santos et al., 2016, p. 17 and 18), being necessary to follow a critical and qualitative analysis of the collected information, involving "the search for the scientifically supported answers, allowing the construction of the credible argument, and not only the issuing of opinions, thus creating knowledge" (Santos et al., 2016, p. 23).

3.1. Research design

Based on the knowledge acquired by reading books on research methodologies, namely "*Manual de Investigação em Ciências Sociais*" (Van Campenhout et al., 2019), "*Orientações metodológicas para a elaboração de trabalhos de investigação*" (Santos et al., 2016), "*Metodologia do Trabalho Científico*" (Carvalho, 2009), "*Investigação por questionário*" (M. M. Hill & Hill, 2012), and "Writing your dissertation" (Swetnam, 2009), a constant path of three phases, with two sub-phases was adapted to achieve the investigation question.

The first phase, similar to the grouping of the four initial stages[11] advocated by Quivy and Campenhoudt (2019, p. 5), is designated as the exploratory phase, where the questions to be addressed were posed, after an exploration of the state-of-the-art, through document analysis, literature review and exploratory interviews, with the aim of "...achieving a deeper and more subjective understanding of the object of study" (Santos et al., 2016), and the model of analysis to be followed was built.

[11] Stages: 1 - The starting question; 2 - The exploration: exploratory readings / interviews; 3 - The problematic; 4 - The construction of the analysis model.

The second phase, the analytical phase, is similar to stages 5 and 6[12]. It will consist of two sub-phases where data will be collected and analysed, namely a quantitative sub-phase, where a closed-ended questionnaire will be used for further descriptive statistical analysis and testing and validation of the theoretical model, and a qualitative sub-phase, where an open-ended questionnaire will be used, conducting interviews with individuals with recognized merit and experience in this area, seeking to achieve the objective and answer the research question.

The third and last phase, equal to stage 7 advocated by Quivy and Campenhoudt[13] (2019), was the conclusive phase, with the assessment and weighting of results, thus presenting conclusions and future implications on the subject investigated.

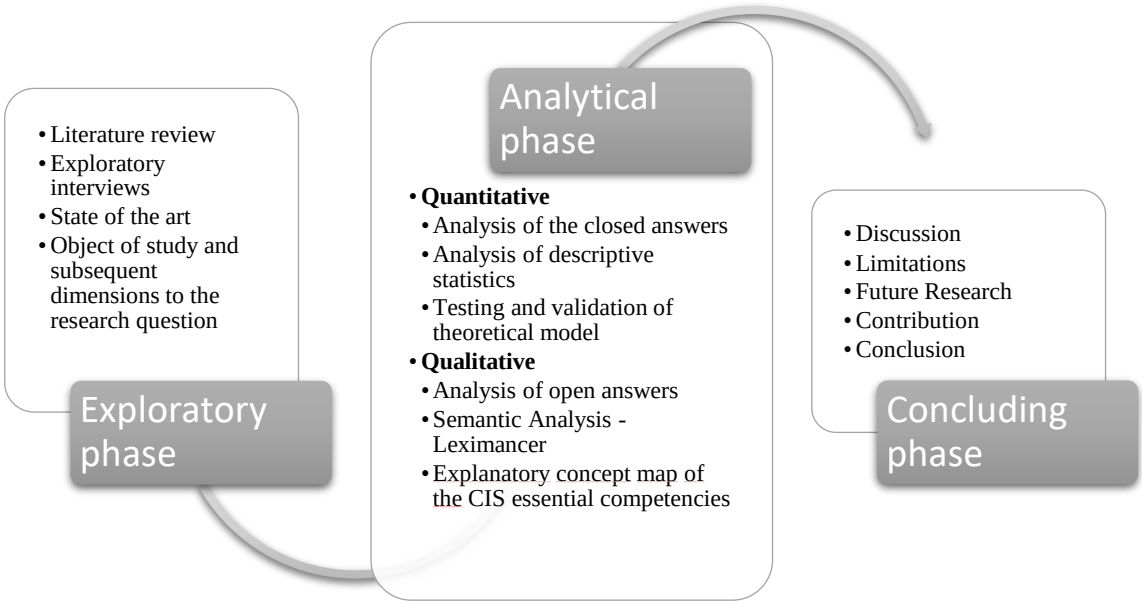

Figure 7 – Methodological approach

The primary methods of data collection and processing were document analysis, literature review and questionnaires (closed and open-ended), thus ensuring that these instruments would produce information in sufficient quantity and quality to support the research (Santos et al., 2016; Swetnam, 2009).

Following the research carried out, with the collection of information aimed at answering the questions and meeting the study objectives, summarised in figure 1, critical

[12] Stages: 5 - The observation; 6 - The analysis of the information.
[13] Stage 7 - The conclusions.

reasoning was applied "in search of scientific truth" by reading and analysing critically, "being aware of the argument, the evidence, the context and the type of language" (Santos et al., 2016), not forgetting that "data only come into existence through the theoretical effort that builds them" (Van Campenhout et al., 2019).

Given the broad scope of the topic in question, with a tremendous multidisciplinary of human resources (HR) assigned to the CIS, it becomes essential to delimit the object of study.

Thus, it is intended to define the object of study as: "The personnel assigned to the operation, supervision, and management in the CIS area, in naval units of the frigate type and embarked operational staffs, of the Portuguese Navy".

3.2. Data collection

Considering that the object of study is: "The personnel assigned to the operation, supervision, and management in the CIS area, in naval units of the frigate type and embarked operational staffs, of the Portuguese Navy", the target population was limited to military personnel of the Portuguese Navy.

Microsoft Forms was chosen as the platform for creating, disseminating, and collecting data through a questionnaire. This is a user-friendly tool for those who produce the questionnaire and those who respond to it. Moreover, it is one that the Navy uses for similar purposes; the author used his Navy-authorized user profile with Microsoft Forms.

Following the completion of an investigation into all the active and reserve members of the Navy who were currently serving their country and who matched the desired profile, a total of 694 people were found to have the potential to be of interest to the research.

The author sent a request to the Office of the Chief of Staff of the Navy to authorise the questionnaire disclosure to the military personnel in question. This resulted in the procedure getting underway. This request was formally authorised after completing the verification process by the Directorate of Training for the Navy. As a result, on October 27, 2022, the questionnaire was distributed to the designated members of the Navy.

Both quantitative and qualitative analyses were planned to use the same questionnaire to collect data. The quantitative analysis planned to use statistical methods to characterise the target population. The qualitative analysis planned to use semantic analysis to develop a concept map.

The processing of the data was carried out in the following manner:

- A synopsis of the socio-professional information obtained from each interviewee, as well as a reading of the findings;
- The organising of the data that was collected into groups according to the goals in order to structure the study of those data;
- Analysis of the information obtained from the questionnaire's responses.

3.3. Structure of the questionnaire

The questionnaire for this study was produced in Portuguese, the official language of the target group, based on the literature review performed, especially the matter presented in subchapter 2.5 and the provided “Skills analysis for the Navy CIS Staff”.

Most evaluation questions consisted of multiple-choice questions based on adaptations of the Likert scale (Vagias, 2008), considering it is “commonly used to measure attitudes, knowledge, perceptions, values, and behavioural changes” (Vogt & Johnson, 2011) and beneficial for carrying out a self-assessment of skills (Croasmun, 2011), as is also intended in this study; however, some open-ended questions were also included, as they are seen extremely valuable "when we want to examine a given topic in depth" (Santos et al., 2016).

It was separated into five sections. The first section of the study aimed to obtain the participant's agreement and determine if he/she belonged to the selected target population by asking whether he/she "Had experience as a military officer deployed in an operational environment, with functions related to the field of CSI (e.g., assigned to the Communications and Information Systems Service, the Information Systems Section, or similar)".

The second section is to collect socio-professional information about the participant, including his or her rank, speciality, or specialisation, categorised into four categories: communications personnel, with or without IT training, and other classes, with or without IT training. In addition, they questioned the age of the participants in multiples of 10, the number of years of experience they had in an operational environment (naval units and forces, marines, and others), and their gender (male, female or if they preferred not to indicate it).

The third section examines the skills requirements of CSI people, and the questions were constructed using the Table 8 skills framework. Closed-range questions are presented using an adaptation of the Likert scale based on the mediation of the level of importance between 1 and 5 (Vagias, 2008), as well as an open-ended question in which participants are allowed to express their opinions/ideas on additional competencies they deem to be necessary.

Based on the preceding section, the same questions were posed in a fourth section to understand better the CSI staff's perception of their individual and technical competencies for the performance of their duties.

Based on the studies performed over the EU Digital Competency Framework (Kluzer & Priego, 2018), these competencies were evaluated at the primary level (performing simple tasks with guidance), the intermediate level (performing tasks of some complexity and without supervision), the advanced level (performing complex tasks and able to supervise others), and the highly specialised level (performing highly complex tasks and interdependencies, capable of generating new ideas for problem-solving).

The fifth and final section consists of an open-ended question for semantic analysis, using Leximancer 5.0, allowing the researcher to be “aware of the global context and significance of concepts” (Smith & Humphreys, 2006), asking the participants, based on their knowledge and professional experience, how they anticipate the evolution of the Portuguese Navy's Command and Control capacity concerning the conduct of naval military operations.

Chapter 4 – Results presentation and analysis

4.1. Characterisation of the replies obtained

To collect the data for the present study, 694 e-mails were sent with the questionnaire indicated in the previous chapter. The questionnaire was available to be answered between 17 October and 8 November 2022, and 55 responses were received, representing 7.9% of the target population.

Of these, 54 responses were considered valid, of which six had indicated that they were not part of the target population, and one was discarded as incomplete. Quantitative and qualitative analysis will be performed on the 48 completed questionnaire responses, representing 6.9% of the target population.

In total, we had 45 responses from males but just three from females; this amounts to a meagre 6.3% of that universe when one considers that the ratio of women serving in the armed services currently stands at 12% (António Ideias Cardoso, Ana Tinoco, 2020). Therefore, segregation based on gender is deemed unnecessary for the current analysis.

13 officers (27%), 18 non-commissioned officers (35%) and 17 enlisted personnel (38%) answered the questionnaire, according to the ranks (Portuguese abbreviation) in the table below:

Most of the respondents were from the communications area (89.6%), of which 29.2% had specific training and education in IT:

In terms of age, the sample was practically split between the 31 to 40 (31.1%), 41 to 50 (35.4%) and 51 to 60 (31.3%) age groups, with only one response under 30 years old.

As for the experience, one of the most critical factors for analysing the answers (Chapman et al., 2021), 64.6% of the respondents had more than ten years of work in an operational environment.

Table 9 – Characterisation of the sample

		N=48	N %
Navy Rank	1MAR	2	4,2%
	1SAR	10	20,8%
	1TEN	6	12,5%
	CAB	10	20,8%
	CFR	3	6,3%
	CMG	2	4,2%
	CMOR	5	10,4%
	CTEN	2	4,2%
	SAJ	4	8,3%
	SCH	3	6,3%
	SMOR	1	2,1%
Training	Communications (C, CCT, CRO) with an IT background (EKR01/02 or other)	14	29,2%
	Communications (C, CCT, CRO) not trained in IT (EKR01/02 or other)	29	60,4%
	Other class with an IT background (EKR01/02 or other)	1	2,1%
	Other classes not trained in IT (EKR01/02 or other)	4	8,3%
Age range	16 - 20	0	0,0%
	21 - 30	1	2,1%
	31 - 40	15	31,3%
	41 - 50	17	35,4%
	51 - 60	15	31,3%
	61 - 70	0	0,0%
Experience	Less than 2 years	1	2,1%
	From 2 to 4 years	5	10,4%
	From 5 to 7 years	5	10,4%
	From 8 to 10 years	6	12,5%
	Over 10 years	31	64,6%
Gender	Prefer not to say	0	0,0%
	Male	45	93,8%
	Female	3	6,3%

4.2. Quantitative Phase

4.3.1. Analysis of 3rd part of the questionnaire – CIS competences

The first part of the statistical analysis is intended to examine the third section of the questionnaire, where the importance of the indicated competencies will be analysed from the respondents' perspective.

Table 10 – Analysis of responses to the 3rd part of the questionnaire, considering the mean, mode and standard deviation

t	Mean	Mode	Max	Min	Standard Deviation
Communication	4	4	5	3	1
Interpersonal Skills	4	4	5	2	1
Problem Solving	4	4	5	3	1
Service Orientation	4	4	5	2	1
Teamwork	4	4[a]	5	0	1
Operational Needs Analysis	4	4	5	3	1
Cyber and Data Breach Incident Management	4	4	5	1	1
Infrastructure Support	4	4	5	2	1
IT Asset Management	3	4	5	0	1
Network Administration and Maintenance	4	4	5	1	1
Network Configuration	4	4	5	1	1
Network Security	4	5	5	1	1
Problem Management	4	4	5	3	0
Process Improvement and Optimisation	4	4	5	3	1
Radio Frequency Engineering	4	4	5	2	1
IT Security Administration	4	4	5	1	1
Service Level Management	4	4	5	0	1
Software Configuration	3	4	5	0	1
Configuration Tracking	3	4	5	0	1
Stakeholder Management	3	4	4	0	1
System Integration	3	4	5	0	1
Database Administration	4	4	5	0	1
a. Multiple modes exist. The smallest value is shown					

Subtitle: (0) - Doesn't know/no answer; (1) - Not important; (2) - Not very important; (3) - Average importance; (4) - Very important; (5) – Vital.

Checking the mean, most of the skills were identified as being “very important”, except for five that were assessed as being of “average importance” (IT Asset Management, Software Configuration; Configuration Tracking; Stakeholder

Management; System Integration). However, mode analysis reveals that a more considerable proportion of responses suggest that all talents are crucial and one is deemed essential (Network Security).

4.3.1. Analysis of 4th part of the questionnaire – CIS staff's perception of their individual and technical competencies

Considering the same questions, the respondents' perspective on their level of skills was analysed:

Table 11 – Analysis of responses to the 4th part of the questionnaire, considering the mean, mode and standard deviation

	Mean	Mode	Max	Min	Standard Deviation
Communication	3	3	4	0	1
Interpersonal Skills	3	2	4	0	1
Problem Solving	3	3	4	0	1
Problem Solving	3	3	4	0	1
Teamwork	3	3	4	0	1
Operational Needs Analysis	2	2	4	0	1
Cyber and Data Breach Incident Management	2	2	4	0	1
Infrastructure Support	2	2	4	0	1
IT Asset Management	2	2	4	0	1
Network Administration and Maintenance	2	2	4	0	1
Network Configuration	2	2	4	0	1
Network Security	2	3	4	0	1
Problem Management	2	2	4	0	1
Process Improvement and Optimisation	2	3	4	0	1
Radio Frequency Engineering	2	3	4	0	1
IT Security Administration	2	3	4	0	1
Service Level Management	2	3	4	0	1
Software Configuration	2	2	4	0	1
Configuration Tracking	2	2a	4	0	1
Stakeholder Management	2	2	4	0	1
System Integration	2	2	4	0	1
Database Administration	2	1a	4	0	1
a. Multiple modes exist. The smallest value is shown					

Subtitle: (0) - Doesn't know/no answer; (1) - Basic level; (2) - Intermediate level; (3) - Advanced level; (4) - Highly specialised.

It is possible to verify that soft skills are perceived as being at an advanced level, while the rest, more technical or "hard" skills, are seen as being at an intermediate level.

4.3.2. Comparison with the analysis presented in the bibliography

By making a comparison with the data shown in Table 8, it is possible to verify which competencies exist in the Navy by the study sample:

Table 12 – Skills analysis summary table

Skill Area	Skills & competencies	Importance	Perception	Skill analysis Table 8	Situation
Communication and Collaboration	Communication	Very important	Advanced level	Basic level	Above the level
	Interpersonal Skills	Very important	Advanced level	Basic level	Above the level
	Teamwork	Very important	Advanced level	Intermediate level	Above the level
Computer architecture	Infrastructure Support	Very important	Intermediate level	Intermediate level	At the level
Computer Networks	Network Administration and Maintenance	Very important	Intermediate level	Intermediate level	At the level
	Network Configuration	Very important	Intermediate level	Intermediate level	At the level
Databases	Database Administration	Very important	Intermediate level	Intermediate level	At the level
Distributed systems	System Integration	Average importance	Intermediate level	Advanced level	Below the level
Information and data literacy	Process Improvement and Optimisation	Very important	Intermediate level	Advanced level	Below the level
Information Management	Operational Needs Analysis	Very important	Intermediate level	Intermediate level	At the level

Skill Area	Skills & competencies	Importance	Perception	Skill analysis Table 8	Situation
Information systems management	Service Orientation	Very important	Advanced level	Basic level	Above the level
	IT Asset Management	Average importance	Intermediate level	Intermediate level	At the level
	Service Level Management	Very important	Intermediate level	Advanced level	Below the level
	Stakeholder Management	Average importance	Intermediate level	Intermediate level	At the level
Operating Systems	Configuration Tracking	Average importance	Intermediate level	Intermediate level	At the level
Operating Systems / Programming	Software Configuration	Average importance	Intermediate level	Intermediate level	At the level
Problem Solving	Problem Solving	Very important	Advanced level	Basic or Intermediate level	Above the level
	Problem Management	Very important	Intermediate level	Advanced level	Below the level
Radio and Signals communications	Radio Frequency Engineering	Very important	Intermediate level	Advanced level	Below the level
Security	Cyber and Data Breach Incident Management	Very important	Intermediate level	Intermediate level	At the level
	Network Security	Very important	Intermediate level	Advanced level	Below the level
	IT Security Administration	Very important	Intermediate level	Intermediate level or Advanced level	At the level

The soft skills are above the indicated value, being one of the substantial aspects, while most of the hard skills are at the desired value, except for the following, all of which are considered “Very Important” and need to be increased through training: System Integration; Process Improvement and Optimisation; Service Level Management; Problem Management; Radio Frequency Engineering; Network Security.

4.3. Qualitative Phase – Leximancer analysis

The final question of the questionnaire aimed to obtain a response to the expectations and needs of the technological evolution of the Command and Control capacity for the conduct of naval military operations by the Portuguese Navy, conducting a textual content analysis with the data obtained, using Leximancer (v. 5.0), to examine the underlying concepts (common text elements identified here as "concept names") and themes (representing clusters of finding concepts).

Participants' responses to the open question totalled 55 sentences (and 586 words were collected and analysed). The process of analysis consisted of three steps:

Initial exploratory analysis portrayed the data as word clusters, named entities, and concepts. Like other analytic techniques, in-text analysis data are evaluated in a grounded manner to extract meaning, enhance comprehension, and advance empirical knowledge (Rapley, 2011). Although most of the analytical processes were performed by the software, some manual interventions were required to reduce similar words, singular and plural forms, or words with the same etymology root of a simple word (e.g., 'system' and 'systems', 'communication' and 'communications'). In addition, some other terms, such as "alone," "bigger," and "just," were omitted from this initial global analysis since they did not contribute to the results meaning.

Identifying Key Concepts - Using Leximancer, a visual concept map and statistical outputs were developed to detect the primary subjects in textual data and emphasise their relationships. This is extremely useful for (1) searching for significant themes and concepts in textual data, (2) analysing textual data clusters in a graphical format (i.e. a concept map), and (3) navigating among the concepts while mining the text for deeper contextual relationships (Cretchley, Rooney, et al., 2010).

Identification of Concept Map - The final step consisted of a pattern analysis of the concepts grouped into themes. Leximancer collects concepts on multiple levels to represent themes, revealing their interdependence. It can recognise clusters of words – based on their frequency – that generally appear near the main text – a potential concept – and then group them in a network with all notions. The concepts are clustered into higher-level themes, displayed as coloured circles - heat-mapped - to highlight the relationships between concepts and the proximity of the themes to each concept – the closer a theme is to a concept, the stronger the association between that theme and that

concept. Through this method, we examined the participant data in a visual/graphical format known as concept maps.

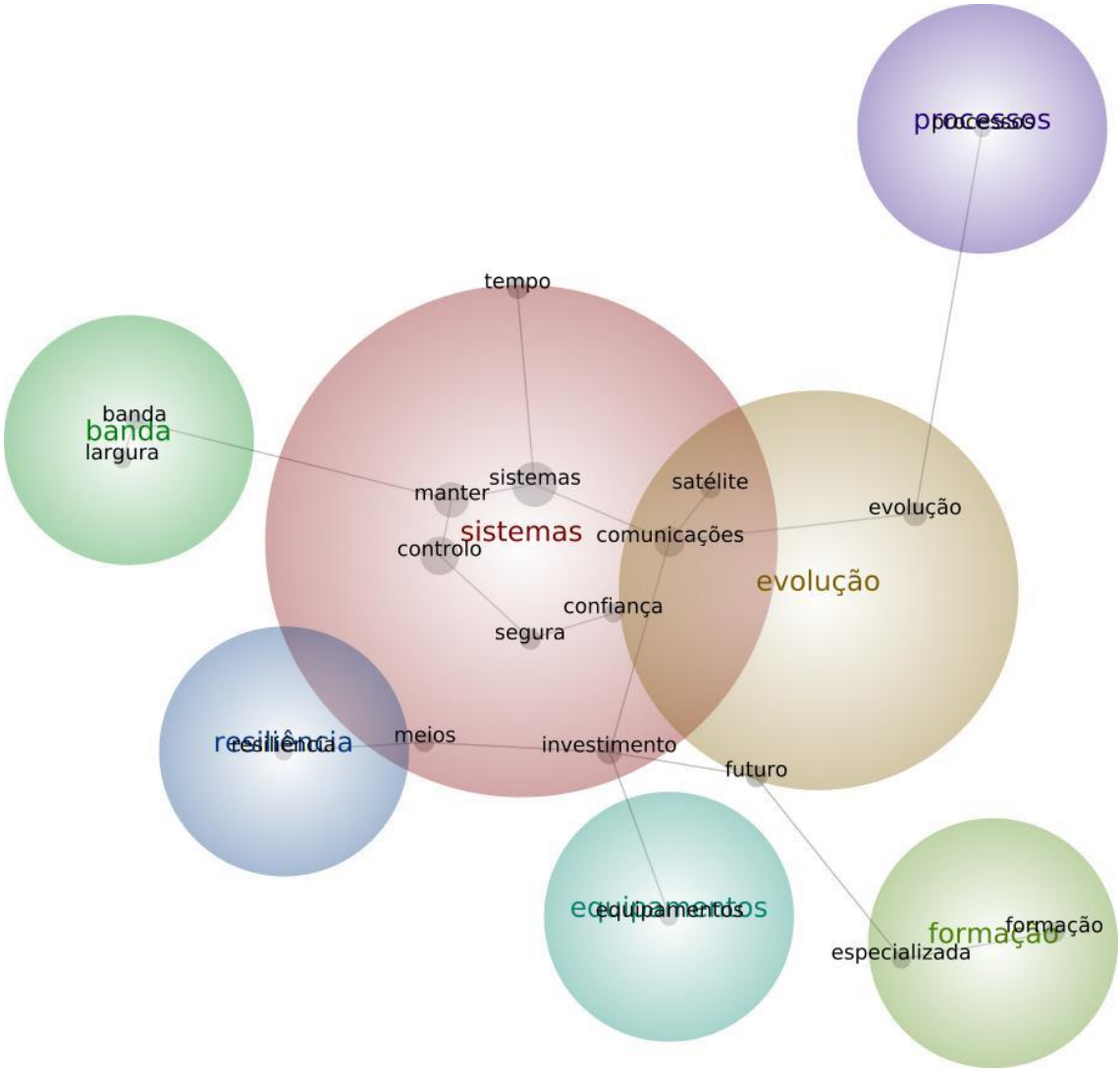

Figure 8 – Concept map – the evolution of C2 in the Portuguese Navy (in Portuguese)

The concept map highlighted seven main themes related to the evolution of command and control. The central theme, with 28 hits, is "systems" (*sistemas*), followed by "evolution" (*evolução*), with 14 hits. Then we have "training" (*formação*) with 7, "processes" (*processos*) with 3, "equipment" (*equipamentos*) with 3, "resilience" (*resiliência*) with 2 and "bandwidth" (*largura de banda*) with 2.

The greater the dot, the more prominent the concept it represents. Similar concepts are organised into themes, which are represented by coloured bands. The significance of each topic is shown by its colour, although the size of the circle is irrelevant. According to the

colour wheel, red is the most significant theme, while purple is the least significant theme (Anagnostopoulos & Bason, 2015).

In a more detailed analysis, different concepts related to each theme are presented. For example, as for the theme “systems”, the concept of “control”, “communications”, “investment”, “time”, “security”, “means”, and “trust” are indicated. These concepts turn out to be related to the perspective of increasing the computerization of command and control systems, including the communications used in their support, the integration of these same systems, and consequent ease of sharing information in good time, the necessary investment for the modernization of these CSI systems and means, and the need to guarantee the security of means and information, reinforcing trust throughout the system.

The theme "evolution" presents the concepts of "future" and "satellite", where it is expected that technological evolution will increase the number of systems and information to be used in the future, which will be very dependent on the ability to use satellite communications, also indicated in the theme “bandwidth”, which indicates that it will be necessary to use more and more bandwidth in satellite communications, to allow the proper exchange of information from the systems in use, in military operations, characterized by the use of systems of proprietary communications (independent of commercial operators and likely to be used in any scenario where regular communications may not exist, thus reinforcing the need for satellite communications).

“Training” introduces the concept of “specialization”, the action necessary to allow operators and personnel involved with Command and Control systems to keep them taking the best advantage of them.

The theme “processes” indicates the need to update current processes, which are more automated, facilitating the decision-making process.

Finally, the theme “equipment” indicates that an expected modernization of the equipment used to operate the command and control systems will occur, and “resilience” is indicated as an objective to be achieved, either by modernizing the equipment, which must be increasingly robust and secure, or also by changing processes and procedures, allowing the ability to exercise command and control in a decentralized manner, without losing capabilities or information.

Chapter 5 – Conclusions and future research

5.1. Main conclusions

Considering the literature review, it was possible to identify an opportunity to improve the current management and training model of the personnel assigned to the CIS in the Portuguese Navy through the development of more and better CIS competencies that allow for the proper functioning of onboard systems and the appropriate management of information, to ensure the C2 of military operations.

Both the Technology Acceptance Model (TAM), the Information Systems Success Model (ISSM) and the IT Service Management (ITSM) indicate the critical role of the Personnel that supports IT to ensure the quality of the information, the system, and the service, which will enable proper use of communications and information systems in support of command and control.

All areas of digital skills, shown in Figure 6, were considered "very important" and "average importance" by the survey participants. However, further analysis would have to be carried out, studying the perspective of users of CSI systems that are supported by the support staff presented in this study to validate the conceptual map.

Checking the quantitative analysis and in response to the objective "Assess and identify the technical training needs of personnel assigned to the CIS, with responsibility for maintaining and operating the military Command and Control capability.", it can be seen that the skills presented in Skills Framework for Information and Communications Technologies (subchapter 2.5), are considered necessary by the participants, and therefore can be considered valid for this study, thus responding to this objective.

Regarding the objective of "Analyse how the Navy military personnel assigned to the CIS consider themselves technologically capable for the performance of their functions.", the need to improve some of the skills through training was identified: System Integration; Process Improvement and Optimisation; Service Level Management; Problem Management; Radio Frequency Engineering; Network Security.

The analysis using the Leximancer was intended to respond to the "Evaluate the expectations and needs of the technological evolution of the Command and Control capacity for the conduct of naval military operations by the Portuguese Navy."

In this analysis, regarding the topics and concepts presented, there is a tendency to consider the increase in command and control systems in use, their evolution and associated means and equipment. One of the highlighted aspects is their integration and increasing their resilience and security, as well as the increased need to use satellite communications and the associated bandwidth.

The FMN concept introduced in subchapter 1.2, leveraged by its three pillars: people, processes, and technologies has aspects in common with the map of concepts indicated in the study and is mentioned by some respondents.

Thus, in response to the starting question for this study, "What are the essential Information Systems competencies of the personnel assigned to the CIS in the Portuguese Navy?" to ensure the future of the national command and control capability, which should pass through FMN standards, it is considered that they should have the following skills:

Communication Skills

Interpersonal Skills

Problem Solving

Teamwork

Operational Needs Analysis

Cyber and Data Breach Incident Management

Infrastructure Support

IT Asset Management

Network Administration and Maintenance

Network Configuration

Network Security

Problem Management

Process Improvement and Optimisation

Radio Frequency Engineering

IT Security Administration

Service Level Management

Software Configuration

Configuration Tracking

Stakeholder Management

System Integration

Database Administration

5.2. Contributions to the scientific and business community

5.2.1. Academic implications

The continuous evolution of technology and information systems is undeniable, not passing aside the military reality and the armed forces. Thus, the present study contributes to the academy with the military perspective of several frameworks studied and analysed in the civilian world.

It adds more value to the scientific area of information systems, especially in using command and control systems and integrated decision support systems. However, from the analysis carried out, it appears that there is still a small number of studies in the scope of basic skills on the personnel that will support command and control systems and decision support, which highlights the importance of this investigation for the international community, which is why it was written in English.

In this way, the work presented not only enriches, even more, the entire state of the art in IS but also provides that future studies can conclude from this, further developing this scientific area and originating even more significant results for the understanding of the adoption and the impact of the evolution of command and control systems in the conduct of military operations.

5.2.2. Business-level implications

It is also anticipated that the present study will be able to be utilised by the Portuguese Navy for the development of its training programmes, as well as in supporting the building of its command and control systems, thereby contributing to the Portuguese Navy's current strategic objectives.

5.3. Research limitations

First, it is crucial to note that the conclusions offered in this thesis are the product of a study with inherent limitations. The sample size is limited and represents only one setting, in this case, the Portuguese Navy. In this light, this study is exploratory, meaning that its findings cannot be applied to other situations.

Another drawback is the methodology employed in this study, as the quality and amount of data acquired are highly dependent on the participation of survey respondents. In general, people do not value their participation in particular situations for a variety of reasons. Thus, there is always the chance of biased responses, as respondents may be aware of the study's goal and react based on what they believe to be "right," thereby affecting their response. By maintaining the respondents' anonymity, we reduced the bias of their responses, but this may still have occurred.

5.4. Future research proposals

For future work, the following proposals are presented:

- Repeat the study with a more significant sample, comparing responses by rank, level of training and experience.
- Carry out a study, this time with the perspective of users of the CIS systems, to deepen knowledge and validate the conceptual map shown in Figure 6.
- Conduct a similar study, but with other NATO navies, to verify whether the present study can be extended to the reality of other countries or if it only applies to the national reality.

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Appendix A – Detailed Job Maps of the Portuguese Navy Frigates for the CIS Staff

Table 13 presents a summary of the frigates' job map in the original language in which it was created by the author (Portuguese)

Table 13 – Frigate Position Map Summary

Nº	Cargo principal	Cargos secundários	Funções
1402	B163 Chefe da Secção de Rádio	B161 Chefe da Secção de Mensagens	SU321 garantir o processamento da documentação respeitante às atividades secção e prepará-la p/despacho; SU331 prestar as informações e esclarecimentos relativos à sua área; SU370 chefiar pessoal serviço/secção s/sua responsabilidade assegurando cumprimento ordens/instruções
1403	B165 Chefe da Secção de Sinais	B162 Chefe da Secção do Material Criptográfico B164 Chefe da Secção de Publicações	SU321 garantir o processamento da documentação respeitante às atividades secção e prepará-la p/despacho SU331 prestar as informações e esclarecimentos relativos à sua área SU370 chefiar pessoal serviço/secção s/sua responsabilidade assegurando cumprimento ordens/instruções
1404 1405 1412 1414	B084 Adjunto Chefe de Secção		SU106 auxiliar no tratamento de assuntos que lhe sejam cometidos no âmbito da área atribuída SU177 coadjuvar o chefe no âmbito das competências que lhe forem delegadas
1406 1407 1408 1409 1410 1411 1413 1415 1416 1417 1418	H029 Operador Comunicações e Sistemas Informação		MO212 operar circuitos e redes de comunicações em teleimpressora MO213 operar circuitos e redes de comunicações em radiotelefonia MO214 operar circuitos e redes de comunicações em radiotelegrafia MO810 operar os sistemas criptográficos e equipamentos com eles relacionados SC812 manusear e distribuir mensagens ou publicações
3221	B641 Chefe Secção de Sistemas Informação		SC301 manter ou controlar o arquivo de documentação SC302 exercer os atos de expediente e registos inerentes as suas atividades SC307 apresentar sugestões no sentido da melhoria da organização métodos e meios de trabalho SU321 garantir o processamento da documentação respeitante às atividades secção e prepará-la p/despacho SU370 chefiar pessoal serviço/secção s/sua responsabilidade assegurando cumprimento de ordens/instruções
3222	B640 Técnico de Sistemas Informação		MO401 interpretar especificações técnicas MO923 manter actualizados arquivos técnicos de material/registos meios atribuídos âmbito área atribuída SU327 assegurar a resolução dos problemas de ordem técnica/administrativa da sua área de competência

Source: (Precioso, 2018; Superintendencia Pessoal, 2017b)

Table 14 presents a more detailed job map and training plan, for the different types of frigates of the Portuguese Navy, in the original language it was created by the author (Portuguese).

Table 14 – Summary of the Detailed Job Maps of the frigates in normal and complete manning

Nº	CARGO PRINCIPAL	CARGOS SECUNDÁRIOS	FUNÇÕES	QUALIFICAÇÕES	VGAM		BDIA
					COM.	NOR.	NOR.
1402	B163 CHEFE DA SECÇÃO DE RÁDIO	B161 CHEFE DA SECÇÃO DE MENSAGENS	SU321 GARANTIR O PROCESSAMENTO DA DOCUMENTAÇÃO RESPEITANTE ÀS ATIVIDADES SECÇÃO E PREPARÁ-LA P/DESPACHO	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X		X
			SU331 PRESTAR AS INFORMAÇÕES E ESCLARECIMENTOS RELATIVOS À SUA ÁREA	ASH01 APERFEIÇOAMENTO EM HIGIENE E SEGURANÇA NO TRABALHO			
			SU370 CHEFIAR PESSOAL SERVIÇO/SECÇÃO S/SUA RESPONSABILIDADE ASSEGURANDO CUMPRIMENTO ORDENS/INSTRUÇÕES	ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE			
				ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC			
1403	B165 CHEFE DA SECÇÃO DE SINAIS	B162 CHEFE DA SECÇÃO DO MATERIAL CRIPTOGRÁFICO	SU321 GARANTIR O PROCESSAMENTO DA DOCUMENTAÇÃO RESPEITANTE ÀS ATIVIDADES SECÇÃO E PREPARÁ-LA P/DESPACHO	ASH01 APERFEIÇOAMENTO EM HIGIENE E SEGURANÇA NO TRABALHO	X	X	X
		B164 CHEFE DA SECÇÃO DE PUBLICAÇÕES	SU331 PRESTAR AS INFORMAÇÕES E ESCLARECIMENTOS RELATIVOS À SUA ÁREA	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
			SU370 CHEFIAR PESSOAL SERVIÇO/SECÇÃO S/SUA RESPONSABILIDADE ASSEGURANDO CUMPRIMENTO ORDENS/INSTRUÇÕES				
1404	B084 ADJUNTO CHEFE DE SECÇÃO		SU106 AUXILIAR NO TRATAMENTO DE ASSUNTOS QUE LHE SEJAM COMETIDOS NO ÂMBITO DA ÁREA ATRIBUÍDA	ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC	X	X	X
			SU177 COADJUVAR O CHEFE NO ÂMBITO DAS COMPETÊNCIAS QUE LHE FOREM DELEGADAS	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR			
				ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
				ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE			
1405	B084 ADJUNTO CHEFE DE SECÇÃO		SU106 AUXILIAR NO TRATAMENTO DE ASSUNTOS QUE LHE SEJAM COMETIDOS NO ÂMBITO DA ÁREA ATRIBUÍDA	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X	X	X
			SU177 COADJUVAR O CHEFE NO ÂMBITO DAS COMPETÊNCIAS QUE LHE FOREM DELEGADAS	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR			
				ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE			
				ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC			
1406	H029 OPERADOR COMUNICAÇÕES E		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR	X	X	X
			MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA	ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE			

	SISTEMAS INFORMAÇÃO		MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
			MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS	ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC			
			SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	ISS01 ESTÁGIO ELEMENTAR SOCORRISMO			
1407	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE	X	X	X
			MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA	ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC			
			MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR			
			MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
			SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES				
1408	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE			
			MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA	ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC			
			MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR			
			MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
			SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES				
1409	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X		X
			MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR			
			MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA	ACO37 APERFEIÇOAMENTO NA OPERAÇÃO DO SICC			
			MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS				
			SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES				
1410	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR	X		X
			MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
			MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA	ACO40 APERFEIÇOAMENTO OPERAÇÃO SUB-SISTEMA SUPERVISÃO E CONTROLE			
			MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS				
			SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES				
1411	H029 OPERADOR COMUNICAÇÕES E		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR	X	X	X
			MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA	ACO57 CURSO OPERAÇÃO DO SISTEMA DE			

	SISTEMAS INFORMAÇÃO		MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	PROCESSAMENTO DE MENSAGENS "MOST4"			
1412	B084 ADJUNTO CHEFE DE SECÇÃO		SU106 AUXILIAR NO TRATAMENTO DE ASSUNTOS QUE LHE SEJAM COMETIDOS NO ÂMBITO DA ÁREA ATRIBUÍDA SU177 COADJUVAR O CHEFE NO ÂMBITO DAS COMPETÊNCIAS QUE LHE FOREM DELEGADAS	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4" AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR ANL04 APERFEIÇOAMENTO BÁSICO DE LIMITAÇÃO DE AVARIAS PARA CADETES E PRAÇAS	X	X	X
1413	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X	X	X
1414	B084 ADJUNTO CHEFE DE SECÇÃO		SU106 AUXILIAR NO TRATAMENTO DE ASSUNTOS QUE LHE SEJAM COMETIDOS NO ÂMBITO DA ÁREA ATRIBUÍDA SU177 COADJUVAR O CHEFE NO ÂMBITO DAS COMPETÊNCIAS QUE LHE FOREM DELEGADAS	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4" AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR	X	X	X
1415	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X	X	X
1416	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X		X
1417	H029 OPERADOR		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR	X		X

	COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"			
1418	H029 OPERADOR COMUNICAÇÕES E SISTEMAS INFORMAÇÃO		MO212 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM TELEIMPRESSORA MO213 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEFONIA MO214 OPERAR CIRCUITOS E REDES DE COMUNICAÇÕES EM RADIOTELEGRAFIA MO810 OPERAR OS SISTEMAS CRIPTOGRÁFICOS E EQUIPAMENTOS COM ELES RELACIONADOS SC812 MANUSEAR E DISTRIBUIR MENSAGENS OU PUBLICAÇÕES	AKE10 APERFEIÇOAMENTO OPERAÇÃO DO SINGRAR ACO57 CURSO OPERAÇÃO DO SISTEMA DE PROCESSAMENTO DE MENSAGENS "MOST4"	X		
3221	B641 CHEFE SECÇÃO DE SISTEMAS INFORMAÇÃO			EKR02 CURSO DE ESPECIALIZAÇÃO EM TÉCNICAS DE INFORMÁTICA - SARGENTOS ANL03 APERFEIÇOAMENTO AVANÇADO LIMITAÇÃO AVARIAS PARA SARGENTOS	X	X	3213
3222	B640 TÉCNICO DE SISTEMAS INFORMAÇÃO		MO401 INTERPRETAR ESPECIFICAÇÕES TÉCNICAS MO923 MANTER ACTUALIZADOS ARQUIVOS TÉCNICOS DE MATERIAL/REGISTOS MEIOS ATRIBUÍDOS ÂMBITO ÁREA ATRIBUÍDA SU327 ASSEGURAR A RESOLUÇÃO DOS PROBLEMAS DE ORDEM TÉCNICA/ADMINISTRATIVA DA SUA ÁREA DE COMPETÊNCIA	ANL04 APERFEIÇOAMENTO BÁSICO DE LIMITAÇÃO DE AVARIAS PARA CADETES E PRAÇAS EKR01 CURSO DE ESPECIALIZAÇÃO EM TECNICAS DE INFORMÁTICA - PRAÇAS	X	X	3214

Source: (Precioso, 2018; Superintendencia Pessoal, 2017b, 2017a, 2017c)

Appendix B – Analysis of CIS Training in the Navy

Table 15 – Summary of the analysis of CIS training in the Navy

	CFS10	CFP01
	CURSO DE FORMAÇÃO DE SARGENTOS DE COMUNICAÇÕES	**CURSO DE FORMAÇÃO PRAÇAS COMUNICAÇÕES**
Duração estimada do Curso	1530 tempos/219 dias úteis.	1260 tempos/ 180 dias úteis.
Caracterização funcional da classe:	Exercer funções no âmbito da direcção, coordenação e controlo da utilização e operação dos sistemas e equipamentos de comunicações (EMFAR).	Exercer funções, no âmbito da execução, da utilização e operação dos sistemas e equipamentos de comunicações (EMFAR).
Cargos Tipo Designados:	- Supervisor de comunicações rádio a bordo de unidades navais; - Supervisor de comunicações tácticas e visuais a bordo de unidades navais; - Supervisor de equipamentos e sistemas de comunicações; - Supervisor do centro de mensagens; - Administrador de sistemas de comunicações; - Encarregado do material de criptográfico; - Formador; - Serviço de escala: divisões / quartos / bordadas.	- Operador de equipamentos e sistemas de comunicações; - Adjunto do supervisor do centro de mensagens; - Adjunto ou encarregado do material de cifra; Serviço de escala: divisões / quartos /bordadas.
Competências esperadas (apenas as técnicas pois as outras são transversais):	- Capacidade para orientar e coordenar a utilização dos sistemas de Comunicações e de Informação, bem como supervisionar o processamento e compilação da informação para apoio ao comando; - Colaborar em briefings / debriefings de operações navais; Planear, no seu âmbito e supervisionar a preparação e execução das Comunicações para apoio às operações navais, de acordo com a análise da documentação operacional.	- Capacidade para operar sistemas e equipamentos de comunicações para apoio táctico e administrativo ao comando no âmbito das operações navais e do serviço naval em terra; - Capacidade para operar circuitos radiotelefónicos administrativos para apoio ao comando no âmbito do comando, controle, comunicações e informação; - Capacidade para integrar eficazmente as equipas do centro de comunicações, na execução de tarefas em todos os graus de prontidão para combate; Capacidade para se integrar eficazmente no departamento de operações e respectivos serviços técnicos, executando tarefas de natureza administrativa.
Padrões funcionais/ocupacionais (não estão incluídos os navais por serem transversais):	- Supervisionar o funcionamento do Centro de Comunicações; - Supervisionar, no âmbito das comunicações os procedimentos de operações de reabastecimento no mar; - Supervisionar o cumprimento das medidas de segurança do material e das comunicações; - Colaborar na avaliação das capacidades, possibilidades e lim itações das Telecomunicações em apoio às operações; - Coordenar a elaboração do Radio Tactical COMPLAN (Communication Plan) - RTC, sendo responsável pela sua actualização; - Supervisionar todas as comunicações em circuitos onde se utiliza o protocolo do ACP 125; - Assegurar a correcta utilização do procedimento visual, da transmissão e recepção de mensagens por Morse Luminoso e bandeiras; - Supervisionar a operação de sistemas e equipamentos de Comunicações; Supervisionar, no âmbito das comunicações os procedimentos de manobras e evoluções.	- Operar circuitos radiotelefónicos administrativos em português e em inglês; - Operar circuitos internos de comunicações; - Utilizar os sistemas criptográficos; - Utilizar códigos de baixo grau; - Preencher e actualizar quadros de situação operacional; - Manusear publicações nacionais e NATO; - Manusear publicações tácticas; - Efetuar comunicações visuais utilizando o procedimento por raquetes e bastões, sinais de bandeiras e /ou morse luminoso; - Operar sistemas e circuitos de processamento e encaminhamento de mensagens; - Operar circuitos radiotelefónicos tácticos; - Utilizar publicações nacionais e NATO, e efectuar a sua gestão documental; - Operar os sistemas e equipamentos de telecomunicações existentes a bordo das Unidades Navais e Unidades em Terra; - Aplicar procedimentos de segurança da informação e das comunicações; Efectuar comunicações e procedimentos associados às chamadas de socorro e urgência.

	EKR02	EKR01
	CURSO DE ESPECIALIZAÇÃO EM TÉCNICAS DE INFORMÁTICA - SARGENTOS	**CURSO DE FORMAÇÃO PRAÇAS COMUNICAÇÕES**
Duração estimada do Curso	506 tempos/ 76 dias úteis.	259 tempos/ 37 dias úteis.
Caracterização funcional da classe:	Executar tarefas no âmbito das atividades de administração de redes, administração de recursos de microinformática e implementação dos inerentes procedimentos operacionais de segurança informática.	Executar tarefas no âmbito das atividades de administração de redes, recursos de microinformática e sistemas de correio eletrónico, incluindo a implementação dos inerentes procedimentos operacionais de segurança informática.
Cargos Tipo Designados:	- Técnico de informática - Administrador de rede local Serviço de escala: divisões	- Técnico de informática - Adjunto de administrador de rede local Serviço de escala: divisões
Competências técnicas:	- Capacidade para implementar procedimentos operacionais de segurança informática; - Capacidade para administrar recursos de microinformática; - Capacidade para administrar redes locais ao nível dos domínios de utilizadores; - Capacidade para administrar sistemas de correio-electrónico; - Capacidade para prestar apoio a utilizadores de sistemas de informação; - Capacidade para administrar e manter recursos de microinformática; - Capacidade para administrar sistemas web; - Capacidade para produção de conteúdos multimédia; - Capacidade para executar a manutenção de redes de área e locais; Capacidade para ministrar atividades de formação e instrução na área da informática.	- Capacidade para colaborar na implementação de políticas de segurança informática; - Capacidade para administrar recursos de microinformática; - Capacidade básica para administrar redes locais ao nível dos domínios de utilizadores; - Capacidade para colaborar na administração de sistemas de correio-electrónico; - Capacidade para prestar apoio a utilizadores de sistemas de informação; - Capacidade para administrar recursos de microinformática; - Capacidade para produção de conteúdos multimédia; - Capacidade para colaborar na manutenção de redes de área e locais; Capacidade para colaborar em atividades de manutenção de microinformática.
Padrões funcionais/ocupacionais:	- Implementar procedimentos operacionais de segurança em redes, sistemas informáticos e sistemas de informação e comunicação; - Administrar redes locais; - Administrar sistemas de correio eletrónico; - Administrar de recursos de microinformática; - Configurar e resolver problemas de hardware; Explorar as ferramentas do MS Office.	- Implementar procedimentos operacionais de segurança em redes e sistemas informáticos; - Colaborar na administração de redes locais; - Colaborar na administração de sistemas de correio eletrónico; - Configurar e resolver problemas de hardware; - Utilizar ferramentas do MS Office; Colaborar na administração de recursos de microinformática.

Source: (Precioso, 2018)

Appendix C - Correlations - competency analysis

Correlations

		Communication	Interpersonal Skills	Problem Solving	Service Orientation	Teamwork	Operational Needs Analysis	Cyber and Data Breach Incident Management	Infrastructure Support	IT Asset Management	Network Administration and Maintenance	Network Configuration	Network Security	Problem Management	Process Improvement and Optimisation	Radio Frequency Engineering	IT Security Administration	Service Level Management	Software Configuration	Configuration Tracking	Stakeholder Management	System Integration	Database Administration
Communication	Pearson Correlation	1	,304*	,126	,211	-,078	,236	,213	-,058	,088	,275	,263	,308*	,301*	,147	,021	,186	-,066	,218	,281	,110	-,059	-,024
	Sig. (2-tailed)		,036	,393	,150	,600	,106	,146	,697	,553	,058	,071	,033	,038	,319	,890	,205	,655	,137	,053	,456	,690	,870
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Interpersonal Skills	Pearson Correlation	,304*	1	,271	,497**	,311*	,269	-,145	,116	,387**	,161	,211	,141	,088	,142	,268	,200	,322*	,303*	,208	,092	,301*	,190
	Sig. (2-tailed)	,036		,063	<,001	,031	,064	,325	,431	,007	,275	,150	,338	,551	,337	,065	,173	,025	,036	,156	,532	,038	,196
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Problem Solving	Pearson Correlation	,126	,271	1	,399**	,425**	,392**	,030	,202	,152	,047	-,040	-,190	,303*	,297*	,230	,036	,495**	,187	,221	,250	,295*	,412**
	Sig. (2-tailed)	,393	,063		,005	,003	,006	,838	,170	,303	,749	,788	,195	,036	,040	,117	,810	<,001	,204	,131	,086	,042	,004
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Service Orientation	Pearson Correlation	,211	,497**	,399**	1	,434**	,520**	,221	,253	,333*	,046	,150	,143	,152	,067	,281	,134	,429**	,234	,267	,353*	,232	,298*
	Sig. (2-tailed)	,150	<,001	,005		,002	<,001	,131	,083	,021	,755	,309	,332	,302	,652	,053	,364	,002	,110	,066	,014	,113	,040
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Teamwork	Pearson Correlation	-,078	,311*	,425**	,434**	1	,220	-,084	,022	,491**	,012	,013	-,070	-,099	-,157	,069	-,012	,600**	,495**	,481**	,408**	,486**	,553**
	Sig. (2-tailed)	,600	,031	,003	,002		,134	,568	,883	<,001	,935	,930	,635	,504	,288	,641	,938	<,001	<,001	<,001	,004	<,001	<,001
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Operational Needs Analysis	Pearson Correlation	,236	,269	,392**	,520**	,220	1	,155	,213	,238	,075	,211	,139	,331*	,100	,326*	,206	,307*	-,015	-,013	,244	,068	,196
	Sig. (2-tailed)	,106	,064	,006	<,001	,134		,292	,145	,103	,612	,150	,345	,022	,499	,024	,160	,034	,918	,930	,094	,647	,182
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Cyber and Data Breach Incident Management	Pearson Correlation	,213	-,145	,030	,221	-,084	,155	1	,127	,266	,454**	,432**	,508**	,087	-,026	-,090	,447**	-,069	,407**	,389**	,102	-,038	,085
	Sig. (2-tailed)	,146	,325	,838	,131	,568	,292		,391	,068	,001	,002	<,001	,554	,863	,544	,001	,642	,004	,006	,491	,800	,567
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Infrastructure Support	Pearson Correlation	-,058	,116	,202	,253	,022	,213	,127	1	,295*	,292*	,299*	,221	,134	,028	,477**	,350*	,261	,065	,062	,172	-,010	,110
	Sig. (2-tailed)	,697	,431	,170	,083	,883	,145	,391		,042	,044	,039	,131	,362	,849	<,001	,015	,073	,662	,676	,243	,947	,457
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
IT Asset Management	Pearson Correlation	,088	,387**	,152	,333*	,491**	,238	,266	,295*	1	,539**	,584**	,429**	-,025	-,022	,109	,343*	,556**	,590**	,535**	,523**	,425**	,410**
	Sig. (2-tailed)	,553	,007	,303	,021	<,001	,103	,068	,042		<,001	<,001	,002	,864	,880	,460	,017	<,001	<,001	<,001	<,001	,003	,004
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Network Administration and Maintenance	Pearson Correlation	,275	,161	,047	,046	,012	,075	,454**	,292*	,539**	1	,806**	,584**	,193	,133	,136	,485**	,121	,501**	,374**	,290*	,227	,105
	Sig. (2-tailed)	,058	,275	,749	,755	,935	,612	,001	,044	<,001		<,001	<,001	,189	,368	,356	<,001	,412	<,001	,009	,046	,121	,478
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Network Configuration	Pearson Correlation	,263	,211	-,040	,150	,013	,211	,432**	,299*	,584**	,806**	1	,740**	,057	,099	,216	,507**	,138	,387**	,360*	,324*	,168	,178
	Sig. (2-tailed)	,071	,150	,788	,309	,930	,150	,002	,039	<,001	<,001		<,001	,700	,502	,140	<,001	,351	,007	,012	,025	,253	,225
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Network Security	Pearson Correlation	,308*	,141	-,190	,143	-,070	,139	,508**	,221	,429**	,584**	,740**	1	-,105	-,165	,156	,560**	-,090	,252	,263	,020	-,157	,040
	Sig. (2-tailed)	,033	,338	,195	,332	,635	,345	<,001	,131	,002	<,001	<,001		,477	,263	,291	<,001	,542	,084	,071	,893	,287	,789
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Problem Management	Pearson Correlation	,301*	,088	,303*	,152	-,099	,331*	,087	,134	-,025	,193	,057	-,105	1	,534**	,018	-,024	,279	,018	,097	,143	,062	,133
	Sig. (2-tailed)	,038	,551	,036	,302	,504	,022	,554	,362	,864	,189	,700	,477		<,001	,904	,873	,055	,905	,514	,332	,677	,367
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Process Improvement and Optimisation	Pearson Correlation	,147	,142	,297*	,067	-,157	,100	-,026	,028	-,022	,133	,099	-,165	,534**	1	,070	,015	,369**	-,059	,079	,098	,251	,154
	Sig. (2-tailed)	,319	,337	,040	,652	,288	,499	,863	,849	,880	,368	,502	,263	<,001		,637	,920	,010	,691	,594	,508	,086	,297
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Radio Frequency Engineering	Pearson Correlation	,021	,268	,230	,281	,069	,326*	-,090	,477**	,109	,136	,216	,156	,018	,070	1	,270	,166	,157	,126	,049	,168	,161
	Sig. (2-tailed)	,890	,065	,117	,053	,641	,024	,544	<,001	,460	,356	,140	,291	,904	,637		,063	,259	,286	,392	,741	,252	,274
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
IT Security Administration	Pearson Correlation	,186	,200	,036	,134	-,012	,206	,447**	,350*	,343*	,485**	,507**	,560**	-,024	,015	,270	1	,019	,231	,236	,112	,112	,325*
	Sig. (2-tailed)	,205	,173	,810	,364	,938	,160	,001	,015	,017	<,001	<,001	<,001	,873	,920	,063		,897	,114	,106	,448	,447	,024
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Service Level Management	Pearson Correlation	-,066	,322*	,495**	,429**	,600**	,307*	-,069	,261	,556**	,121	,138	-,090	,279	,369**	,166	,019	1	,258	,375**	,578**	,629**	,643**
	Sig. (2-tailed)	,655	,025	<,001	,002	<,001	,034	,642	,073	<,001	,412	,351	,542	,055	,010	,259	,897		,077	,009	<,001	<,001	<,001
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Software Configuration	Pearson Correlation	,218	,303*	,187	,234	,495**	-,015	,407**	,065	,590**	,501**	,387**	,252	,018	-,059	,157	,231	,258	1	,795**	,300*	,371**	,408**
	Sig. (2-tailed)	,137	,036	,204	,110	<,001	,918	,004	,662	<,001	<,001	,007	,084	,905	,691	,286	,114	,077		<,001	,038	,009	,004
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Configuration Tracking	Pearson Correlation	,281	,208	,221	,267	,481**	-,013	,389**	,062	,536**	,374**	,360*	,263	,097	,079	,126	,236	,375**	,795**	1	,412**	,380**	,567**
	Sig. (2-tailed)	,053	,156	,131	,066	<,001	,930	,006	,676	<,001	,009	,012	,071	,514	,594	,392	,106	,009	<,001		,004	,008	<,001
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Stakeholder Management	Pearson Correlation	,110	,092	,250	,353*	,408**	,244	,102	,172	,523**	,290*	,324*	,020	,143	,098	,049	,112	,578**	,300*	,412**	1	,558**	,475**
	Sig. (2-tailed)	,456	,532	,086	,014	,004	,094	,491	,243	<,001	,046	,025	,893	,332	,508	,741	,448	<,001	,038	,004		<,001	<,001
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
System Integration	Pearson Correlation	-,059	,301*	,295*	,232	,486**	,068	-,038	-,010	,425**	,227	,168	-,157	,062	,251	,168	,112	,629**	,371**	,380**	,558**	1	,656**
	Sig. (2-tailed)	,690	,038	,042	,113	<,001	,647	,800	,947	,003	,121	,253	,287	,677	,086	,252	,447	<,001	,009	,008	<,001		<,001
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Database Administration	Pearson Correlation	-,024	,190	,412**	,298*	,553**	,196	,085	,110	,410**	,105	,178	,040	,133	,154	,161	,325*	,643**	,408**	,567**	,475**	,656**	1
	Sig. (2-tailed)	,870	,196	,004	,040	<,001	,182	,567	,457	,004	,478	,225	,789	,367	,297	,274	,024	<,001	,004	<,001	<,001	<,001	
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix D – Original questionnaire results (in Portuguese)

Cyber Sailor: o pessoal afeto às CSI para assegurar o C2 das operações militares do futuro

55	15:09	Fechado
Respostas	Tempo médio de conclusão	Estado

1. Aceita participar neste estudo?

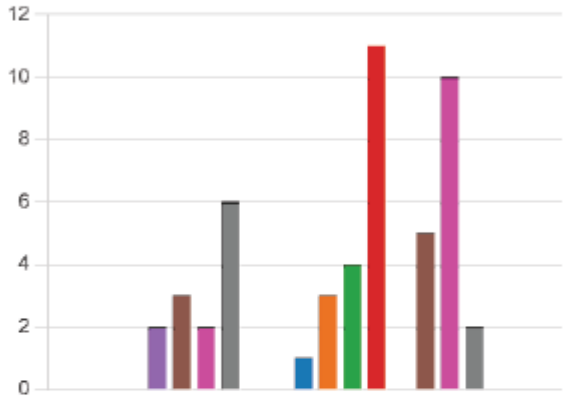
Sim	55
Não	0

2. Possui experiência enquanto militar embarcado em ambiente operacional, com funções relacionadas com a área de CSI (por exemplo, colocado no Serviço de Comunicações e Sistemas de Informação, na Seção de Sistemas de Informação ou equiparado)

Sim	49
Não	6

3. Posto

ALM	0
VALM	0
CALM	0
COM	0
CMG	2
CFR	3
CTEN	2
1TEN	6
2TEN	0
GMAR	0
SMOR	1
SCH	3
SAJ	4
1SAR	11
2SAR	0
CMOR	5
CAB	10
1MAR	2
2MAR	0
1GRT	0
2GRT	0

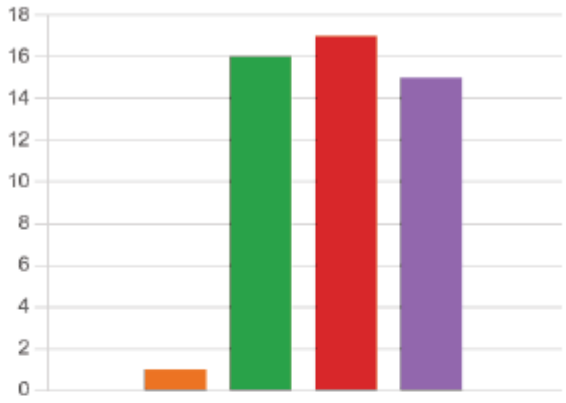


4. Especialidade/especialização

Comunicações (C, CCT, CRO) co...	14
Comunicações (C, CCT, CRO) se...	30
Outra classe com formação em I...	1
Outra classe sem formação em I...	4

5. Faixa etária

16 - 20	0
21 - 30	1
31 - 40	16
41 - 50	17
51 - 60	15
61 - 70	0



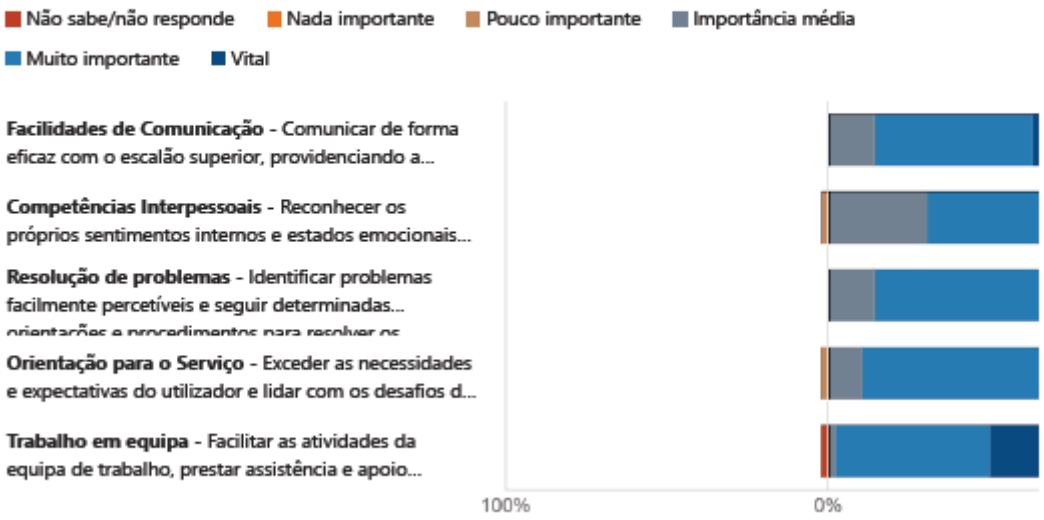
6. Anos de experiência em ambiente operacional (unidades e forças navais, de fuzileiros, Forças Nacionais Destacadas e outras)

Menos de 2 anos	1
De 2 a 4 anos	5
De 5 a 7 anos	6
De 8 a 10 anos	6
Mais de 10 anos	31

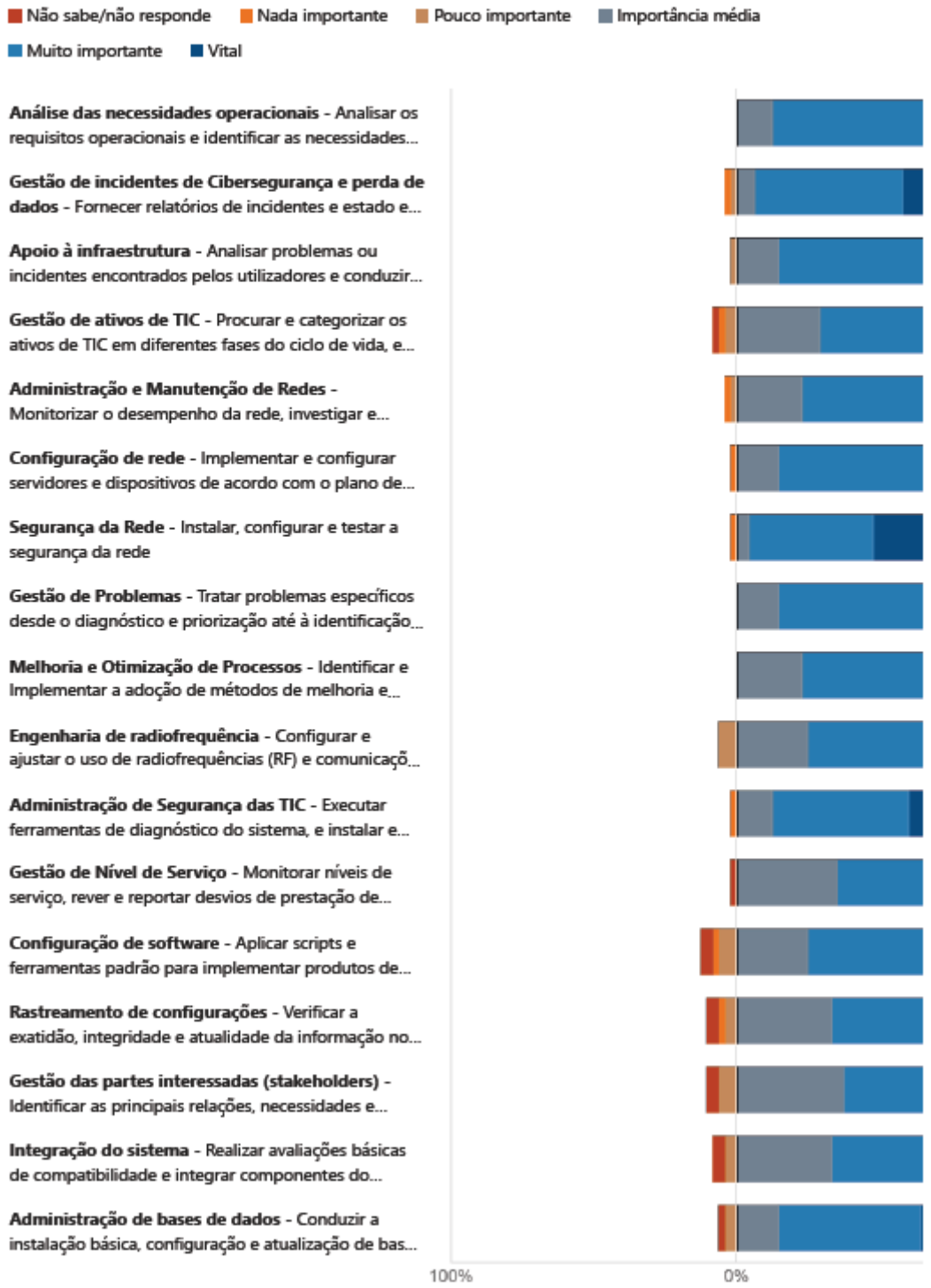
7. Sexo

Masculino	46
Feminino	3
Prefiro não dizer	0

8. Capacidades individuais (soft skills)



9. Capacidades técnicas (hard skills)



10. Além das competências acima indicados, identifica outras competências, relacionadas com a área CSI, que considere vitais?

20

Respostas

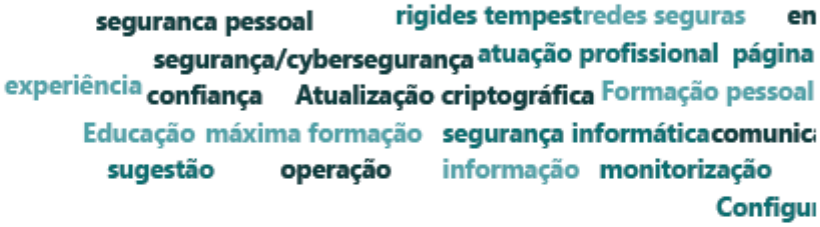
Respostas Mais Recentes

"Gestão de prioridades de equipamentos Vs matriz de capaci...

"Nada a referir"

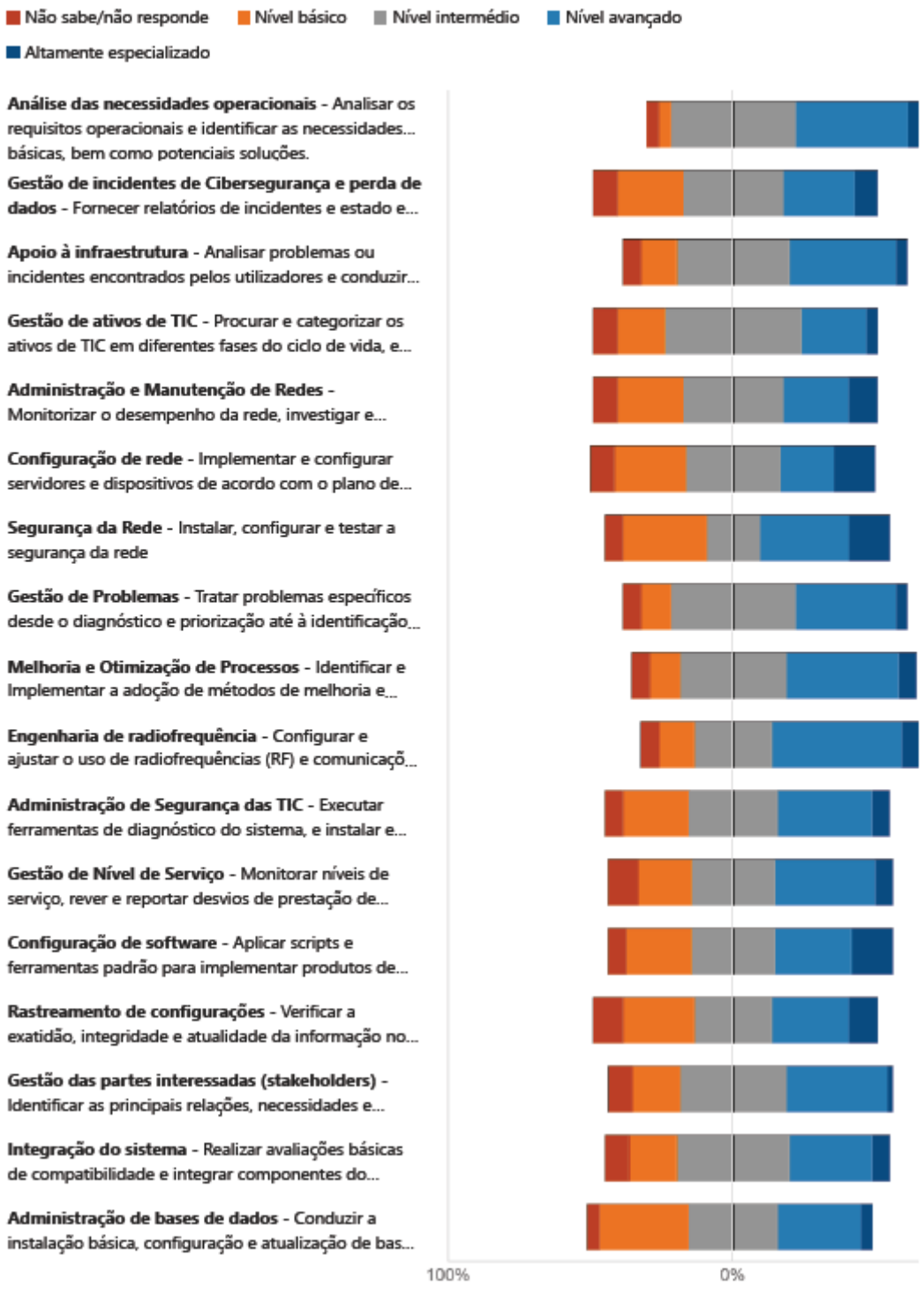
Atualizar

1 inquiridos (5%) responderam **Atualização criptográfica** a esta pergunta.



11. Capacidades individuais (soft skills)

12. Capacidades técnicas (hard skills)



13. Tendo em conta os seus conhecimentos e experiência profissional, como considera que será a expectável evolução da capacidade de Comando e Controlo, relativa à condução de operações militares navais, na Marinha Portuguesa?

45

Respostas

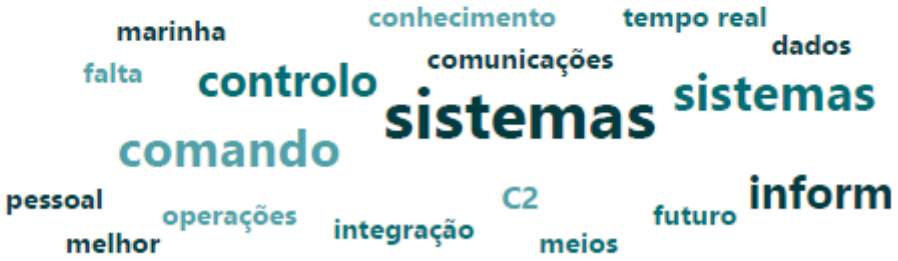
Respostas Mais Recentes

"A utilização da radiofrequências não pode continuar a ser ...

"Considero que a evolução natural será a "automatização" d...

Atualizar

13 inquiridos (28%) responderam **sistemas** a esta pergunta.



Appendix E – Group of exploratory interviews

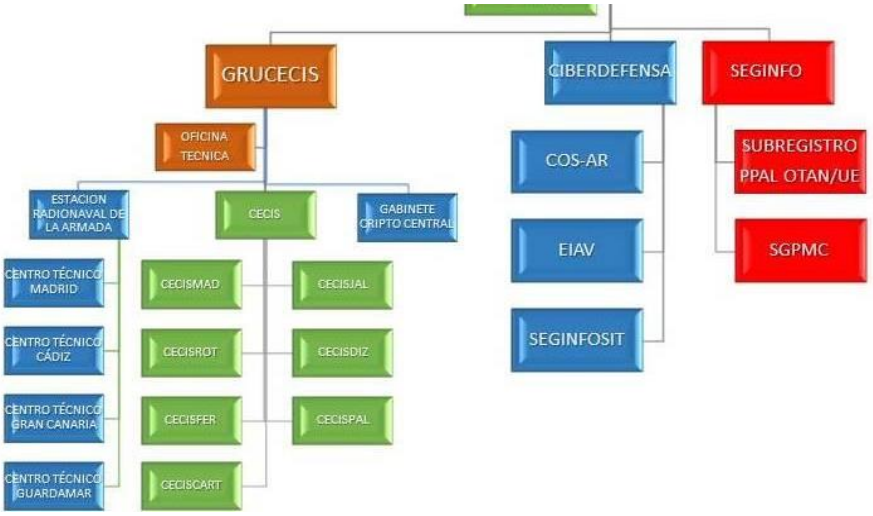
The next set is partially written in the original language of the interviews.

On 13 December 2017, a non-face-to-face semi-structured interview was conducted, using email, with Sergeant-in-Chief (Brigade COS OR-8) Francisco Guillen Jaen, responsible for the in-port classified networks, at CECISROT - Cuartel General de La Flota, in Rota.

During 2016, during the period of the Spanish command of SNMG1, this sergeant alone assumed the duties of N6 - responsible for the CSI of the MS of SNMG1 - seeking to ensure the due C2 and IM between the COMSNMG1, the superior command and the subordinate commands, and his training and experience acquired in the Spanish Navy were determinant to the success of his performance.

Initially, he framed the organisation of the Spanish Navy in this context, from which the original answer is transcribed:

"Con la ayuda de este pequeño esquema le voy a explicar un poco nuestro funcionamiento.



1. Grupo de Ciberdefensa. Responsable de la ejecucion de las acciones de ciberdefensa y acreditaciones de los sistemas especificos de la Armada. Se constituye en Centro de Operaciones de Seguridad (COS-AR), Equipo de Inspeccion y Análisis de vulnerabilidades y célula de Seguridad de la Informacion en sistemas (SEGINFOSIT).

2. Grupo de Seguridad de la Información. Organo que centraliza todas las actividades relacionadas con la seguridad de la informacion. De el depende el Servicio General de Proteccion de Material Clasificado (SGPMC) de la Armada y el Subregistro Principal OTAN del Cuartel General de la Armada.

3. Grupo de Centros de Explotacion CIS (GRUCECIS). Responsable de gestionar, controlar y explotar los sistemas de información y comunicaciones en el ámbito de la Armada. De el dependen orgánicamente todos los Centros de explotación CIS (CECIS) y la Estación Radio de la Armada (ERNAR) que agrupa a los Centros Técnicos, compuestos geográficamente por las diversas estaciones receptoras y transmisoras de la Armada.

En esta ultimo grupo es donde nos encontramos la mayoría del personal de comunicaciones que no esta embarcado, por lo tanto a lo largo de nuestra carrera solemos estar un tiempo a bordo y otro tiempo dando apoyo a las unidades. Por ejemplo yo ahora estoy destinado en CECISROT, (Rota).

En estos Centros de Apoyo la plantilla de personal suele ser un OF/COMTE con la especialidad complementaria de comunicaciones , 4 o 5 Suboficiales y algo de marinería (no mucha).

El personal de estos centros se encargan de labores de Mantenimiento y de apoyo a las UNIDADES navales en todo lo que respecta a comunicaciones y ayudarles a pasar las certificaciones antes de integrarse en cualquier misión /agrupación."

He then explained the functions of the on-board personnel:

"*Ahora le hablare un poco del personal que esta a bordo.*

Los barcos dependiendo de su importancia tendran mas o menos Suboficiales, la mision de ellos sera como sigue:

- COMUNICACIONES RADIO UHF/VHF/HF y Satelite.

(Montar ctos del OT COMMS y remotarlos al (CIC o Puente)

- CRIPTOCUSTODIO/CIFRA.

- REDES C1 Y C2 a nivel de superusario(el administrador de los sistemas esta en tierra y pueden ser de la especialidad de comunicaciones o de otra diferente).

- No se encarga de las comunicaciones del Puente, esta función la realiza el personal de Maniobra y Navegación.

Como ve el personal del barco se encarga de todo, por ello su formación de estudios es amplia en muchos aspectos."

"- REDES C1 Y C2 a nivel de superusario(el administrador de los sistemas esta en tierra y pueden ser de la especialidad de comunicaciones o de otra diferente).

¿Podría aclarar qué tipo de competencias son éstas? De forma sucinta, cómo se ejecutan? Esta es importante, pues pretendo analizar si nuestros operadores deben tener esas competencias.

A bordo el personal de comunicaciones debe ser capaz de gestionar un DC controlador de dominios, asi como gestionar la Web de a bordo, dar permisos y creacion de recursos compartidos. gestionar algunos aspectos de los ROUTERS.

Cuando digo nivel superusuario se refiere a que el personal de comunicaciones no debes saber como hacer instalaciones u otras tareas complejas, pero si debe saber como gestionar las redes de a bordo asi como hacer de nexo con los administradores del sistema ante una averia en la mar.

Como ve el personal del barco se encarga de todo, por ello su formación de estudios es amplia en muchos aspectos.

Este también es un aspecto que tengo que analizar: ¿cuál es la formación que nuestro personal debe tener? Para ello sería interesante saber cuál es su formación específica.

Con respecto a la formacion a parte de la propia de comunicaciones tradicionales, nosotros tambien nos han incluido en nuestra formacion las asignaturas de REDES y Hardware, esto comenzó hace ya unos 15 años cuando la informatica fue entrando en las comunicaciones Navales.

Con respecto a la Job Description de mi puesto, aqui es un poco diferente a los demas y va en linea de como trabajamos en la Armada, no se si recuerda que yo ocupaba dos puestos SCRS/SCNA, el primero se encargaba de la parte de comunicaciones (UHF,HF,VHF, SATCOM) OT COMMS de la fuerza OT INFO MANAGER...Y el segundo se encargaba de las redes NSWAN , gestion del KIT (DC, EXCHANGE, FS, MCCIS... tambien a nivel de superusuario) en coordinacion con el personal de NCIA, gestion del SharePoint Web. En definitiva en la trabajo que se hacia en la SNMG1 es como el que hace un suboficial del barco pero para un STAFF.

En estos puesto siempre se busca personal antiguo (con años de servicios) y con experciencia en OTAN."

Extract from the interview with the Director of the CCDCM, CFR Oliveira Inácio

Q1	**Como devem estar os RH de CSI preparados para desempenharem funções no CCDCM, ao nível de formação, perícias e competências?**
CCDCM	Quanto às valências na área de comunicações e sistemas de informação (CSI), os recursos humanos (RH) atribuídos a este centro da componente operacional do sistema de forças podem ser vistos numa ótica organizacional do CCDCM, razão pela qual poderão existir diferentes necessidades de conhecimentos em tecnologias de informação e comunicações (TIC): a) Pessoal de Comunicações, com funções de supervisores e/ou operadores CSI no Centro de Comunicações da Marinha (CCM); b) Pessoal de Comunicações, com funções de supervisores e técnicos de Cifra no Centro de Cifra da Marinha (CCIFM) e; c) Pessoal de Comunicações, com funções de técnicos de Informática no Serviço de Sistemas de Informação e Comunicações (SSIC). A formação ao nível dos cursos de carreira (formação e promoção) dos sargentos (CFS) e das praças (CFP) em comunicações (PAFM I) já incluem no seu plano curricular módulos de TIC, que habilitam os militares com conhecimentos básicos naquela área. a) No que se refere aos militares com funções de supervisores e operadores CSI no CCM, a formação obtida durante os cursos de carreira (CFS10 e CFP01), a formação obtida on-job, a formação adquirida decorrente de ações de formação que vão ocorrendo com as atualizações de sistemas (PAFM II) e, por fim, a experiencia adquirida no desempenho de funções, permite-lhes desempenhar corretamente as suas tarefas. b) O mesmo se aplica, de forma análoga, aos supervisores e técnicos do CCIFM. c) No que respeita aos técnicos de informática do SSIC, a sua formação já prevê, além do acima descrito, ações de formação complementares no âmbito do PAFM II e PAFN , de forma a atingirem conhecimentos mais específicos dentro da área das TIC.

Q2	Considera que o modelo atual é suficiente?
CCDCM	No passado recente, o CCDCM detinha capacidade para planear, desenvolver e executar séries de treino na área de ciberdefesa em exercícios navais através do CRISI – Capacidade de Resposta a Incidentes de Segurança e Informação. Para tal dispunha de operadores CSI qualificados, integrados nos turnos (1 por turno), com formação especifica na área da CSI, que garantiam uma cobertura 24H ao nível do 1ª escalão. Na sequência da revisão dos diplomas legais que ocasionaram a reforma estrutural na defesa nacional e nas Forças Armadas, foi aprovado o Decreto Regulamentar da Marinha, que estabelece a organização e competências das estruturas principais da Marinha, atribuindo, entre outras, as competências à DITIC no âmbito da ciberdefesa. Na perspetiva de otimização dos recursos e a fim de evitar duplicações de estruturas e maximizar os recursos disponíveis, os recursos (humanos e materiais), o conhecimento e a formação atualmente existentes na Marinha têm vindo a convergir para o Núcleo CIRC da DITIC. Assim, os recursos humanos antes alocados ao CCDCM para a área da ciberdefesa transitaram para no CORe-DITIC, para o Nucleo CIRC e deixaram de ser renovados, acabando por extinguir aquela capacidade no CCDCM. Perante o acima descrito, apesar de existirem algumas faltas de operadores CSI à lotação, dado que o CCDCM já não dispõe da Capacidade de Resposta a Incidentes de Segurança e Informação(CRISI), considera-se que o modelo atual de formação é abrangente e suficiente para corresponder às necessidades que os supervisores e/ou operadores CSI operador necessitam para o desempenhadas das suas funções.
Q3	**Considera que haveria vantagens em adaptar a formação dos sargentos e praças C, incluindo perícias na área da informática (sistemas de gestão de informação e domínios)?**
CCDCM	Tal como já referido, o plano de curso dos sargentos e praças C já inclui a formação em TIC, embora de forma abrangente ao nível da informática na ótica dos utilizadores, não aprofundando para matérias mais complexas. Adaptar estes cursos com matérias mais abrangentes no âmbito das TIC, no que diz respeito a gestão de informação e domínios seria, de facto, uma mais valia não só para os utilizadores mas, também, para o próprio funcionamento das organizações, uma vez que tal permitiria a não segregação de funções a desempenhar por supervisores e operadores CSI nos vários departamentos, Permitiria, também, um conhecimento mais abrangente dos sistemas em uso, uma vez que a evolução tecnológica poderia ser acompanhada com a evolução do conhecimento e. por fim, uma menor dependência dos órgãos de direção técnica no que respeita à analise de eventuais resoluções de anomalias nas CSI.

Q4	Como considera que se deviam preparar os RH afetos ao CSI na área da ciberdefesa (principalmente tendo em consideração que serão os primeiros a identificar ou serem sujeitos às ameaças cibernéticas na componente militar)?
CCDCM	No que se refere à área da ciberdefesa e em complemento ao anteriormente referido, importa recordar que de acordo com a definição da Política de Ciberdefesa Nacional e da reforma estrutural na defesa nacional e das Forças Armadas, a orientação superior na Marinha, relativamente à ciberderfesa, suscitou a edificação do Núcleo CIRC como o órgão competente para a gestão, operação e a manutenção da segurança e defesa do ciberespaço e da informação na Marinha, assegurando a capacidade de resposta a incidentes no ciberespaço e de segurança da informação na Marinha. De acordo com aquela orientação, e numa ótica de otimização de recursos, também as ferramentas, o conhecimento e a formação atualmente existentes na Marinha têm vindo a ser concentradas no CIRC. Atento o discurso do ALM CEMA, ALM Mendes Calado, é estabelecida a orientação superior para que que seja implementado um plano de ação que permita reforçar a capacidade de ciberdefesa da Marinha, fortalecendo a sua integração na correspondente capacidade nacional, designadamente em articulação com o Centro de Ciberdefesa e com o Centro Nacional de Cibersegurança. Esta orientação suscitou por porte do EMA a elaboração de um plano de ação para o reforço da ciberdefesa da Marinha, em alinhamento com aquele objetivo estratégicos na área dos recursos materiais traçados pelo atual ALM CEMA, o qual antevê a necessidade de formar recursos humanos para esta área em particular.

Source: (Precioso, 2018)