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# NON-TECHNICAL SKILLS IN THE CIVIL AVIATION SECTOR

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**ABSTRACT**

**Purpose:** This study aims to identify and present a framework of non-technical skills for the civil aviation sector.

**Theoretical Framework:** This study critically evaluates and identifies the non-technical competences in the aviation sector that promote superior performance among employees.

**Design/Methodology/Approach:** We conducted a literature review of scientific journals and official documents from the aeronautics sector to achieve the aim of this study. In the first phase, a critical analysis was conducted of the concepts of soft and non-technical skills. In the second phase, we analyzed various general soft skills models and non-technical skills models in the aeronautics sector.

**Findings:** At the end of the study, an integrative framework of 15 non-technical skills for the civil aviation sector is proposed: assertiveness, leadership, verbal communication, critical thinking, trust, interpersonal relationships, situational awareness, ability to solve problems, flexibility and adaptability, responsibility, time management, decision-making skills, workload management, teamwork, and stress management and resilience.

**Research, Practical & Social Implication:** The Study provides a practical framework for the assessment and development of people, contributing to advances in aviation safety and performance.

**Originality/Value:** This study, which provides a comprehensive understanding of non-technical skills in the civil aviation sector, fills a significant gap in the literature when skills manage human resources. It also offers a practical framework for their assessment and development, thereby contributing to advances in safety, security, and aviation performance.

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## COMPETÊNCIAS NÃO TÉCNICAS NO SETOR DA AVIAÇÃO CIVIL

**RESUMO**

**Proposta:** Este estudo tem como objetivo identificar e apresentar um quadro de competências não técnicas para o sector da aviação civil.

**Estrutura Teórica:** Este estudo avalia e identifica de forma crítica as competências não técnicas no sector da aviação que promovem um desempenho superior dos trabalhadores.

**Projeto/Metodologia/Abordagem:** Para atingir o objetivo deste estudo, foi realizada uma revisão da literatura em revistas científicas e documentos oficiais do sector aeronáutico. Numa primeira fase, foi efetuada uma análise crítica dos conceitos de competências transversais e não técnicas. Numa segunda fase, analisámos vários modelos gerais de competências transversais e não técnicas no sector aeronáutico.

**Conclusões:** No final do estudo, é proposto um quadro integrador de 15 competências não técnicas para o sector da aviação civil, que são as seguintes: Assertividade; Liderança; Comunicação verbal; Pensamento crítico;

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Confiança; Relações interpessoais; Consciência situacional; Capacidade de resolução de problemas; Flexibilidade e adaptabilidade; Responsabilidade; Gestão do tempo; Tomada de decisão; Gestão da carga de trabalho; Trabalho em equipa; e Gestão do stress e Resiliência.
**Implicações Sociais, Práticas e de Pesquisa:** O Estudo fornece um quadro prático para a avaliação e desenvolvimento das pessoas, contribuindo para avanços na segurança e no desempenho da aviação.
**Originalidade/Valor:** Ao proporcionar uma compreensão abrangente das competências não técnicas no sector da aviação civil, este estudo preenche uma lacuna importante e um vazio na literatura, numa altura em que os recursos humanos são geridos por competências.

**Palavras-chave:** Aviação Civil, Recursos Humanos, Competências Transversais, Competências Não Técnicas.

**COMPETENCIAS NO TÉCNICAS EN EL SECTOR DE LA AVIACIÓN CIVIL**

**RESUMEN**
**Objetivo:** Este estudio pretende identificar y presentar un marco de competencias no técnicas para el sector de la aviación civil.
**Marco Teórico:** Este estudio evalúa críticamente e identifica las competencias no técnicas en el sector de la aviación que promueven un rendimiento superior entre los empleados.
**Diseño/Metodología/Enfoque:** Para alcanzar el objetivo de este estudio, realizamos una revisión bibliográfica en revistas científicas y documentos oficiales del sector aeronáutico. En una primera fase, se llevó a cabo un análisis crítico de los conceptos de competencias blandas y no técnicas. En una segunda fase, analizamos diversos modelos generales de competencias blandas y no técnicas en el sector aeronáutico.
**Conclusiones:** Al final del estudio, se propone un marco integrador de 15 competencias no técnicas para el sector de la aviación civil, que son las siguientes: Asertividad; liderazgo; comunicación verbal; pensamiento crítico; confianza; relaciones interpersonales; conciencia de la situación; capacidad de; resolución de problemas; flexibilidad y adaptabilidad; responsabilidad; gestión del tiempo; capacidad de toma de decisiones; gestión de la carga de trabajo; trabajo en equipo; y gestión del estrés y resiliencia.
**Repercusiones Sociales, Prácticas y de Investigación:** El Estudio proporciona un marco práctico para la evaluación y el desarrollo de las personas, contribuyendo a los avances en la seguridad y el rendimiento de la aviación.
**Originalidad/Valor:** Este estudio, que ofrece una comprensión exhaustiva de las competencias no técnicas en el sector de la aviación civil, llena un vacío y una laguna importantes en la bibliografía en un momento en que las competencias gestionan los recursos humanos. Al mismo tiempo, ofrece un marco práctico para su evaluación y desarrollo, contribuyendo así a los avances en seguridad, protección y rendimiento de la aviación.

**Palabras clave:** Aviación Civil, Recursos Humanos, Competencias Blandas, Competencias no Técnicas.

## 1 INTRODUCTION

Currently, the entire civil aviation sector is growing with the introduction of new technologies and business models; therefore, there is a need for all professionals to acquire, develop, or enhance their skills to face the emerging challenges of today's job market. Along with the development of technical skills, the improvement of non-technical skills (NTS) in the context of civil aviation is essential to ensure safety, error prevention and management, crisis management, resource optimization, regulatory compliance, and the improvement of human performance and customer service standards.

Thus, the need to develop an integrative model of non-technical skills (soft skills) that can serve as a basis for recruitment, selection, assessment, team building, and talent

management processes of professionals in the civil aviation sector represents a strategic instrument for the organizational success of companies in the civil aviation sector.

The following starting question was formulated for this study: What are the non-technical skills of professionals in the civil aviation sector to perform their tasks or functions? To answer this question, the research methodology used in this study was a literature review of scientific articles and manuals specific to the civil aviation sector. The literature review is a vital part of the entire research process, as it allows you to "locate, analyze, synthesize, and interpret previous research related to your area of study" (Bento, 2012, p. 1). The same author also states that a literature review is "indispensable not only to define the problem well but also to obtain a precise idea of the current state of knowledge on a given topic, its gaps, and the contribution of research to the development of knowledge" (Bento, 2012, p. 1). This idea is supported by Correia and Mesquita (2014, p. 14), who state that the literature review "provides the context for the study and demonstrates its timeliness and relevance." Reis (2018) stated that the literature review "identifies the existing bibliography on the subject of the work, from which the information considered relevant and necessary to the research problem should be taken and compiled" (Reis, 2018, p. 71). Bento (2012) pointed out that researchers must always be selective and consider their line of research. This aspect is also highlighted by Correia and Mesquita (2014, p. 226), in which "it is expected to find a summary of the most important literature, focusing only on the chosen topic; it is not, therefore, an exhaustive review" of all the documentation found, read, or analyzed.

We conducted a literature review on the topic of non-technical skills in the civil aviation sector. We sourced data for the literature review from various online sources such as Scopus, Web of Science, B-On, Google Scholar, the International Civil Aviation Organization (ICAO), and the International Air Transport Association (IATA). We used the following keywords to search for the data: 1st phase – competencies, competencies, competence, competency, and soft skills; 2nd phase - civil aviation, non-technical competencies, non-technical competencies, and non-technical skills. In both phases, the keywords were translated into Portuguese, French, and English with different translations. As suggested by Oliveira and Ferreira (2014), the literature review carried out in this study was organized based on a funnel structure, that is, from the general to the particular, as follows: Presentation of the concept of competency, non-technical competencies or skills, technical competencies, soft skills and their characteristics, presentation of various models of soft skills and non-technical skills in the civil aviation sector, and presentation of a proposal for an integrative model of non-technical skills for the civil aviation sector.

## 2 COMPETENCY CONCEPT

McClelland (1973) presents competence as a predictor of employee performance and success. Richard Boyatzis, with the publication of his book "The Competent Manager," was one of the main driving forces behind the introduction of competency-based human resources management in the workplace.

Despite extensive research on the term "competency" in recent years, a literature review reveals that the scientific community has not yet established an exact definition or a widely accepted one. Gupta (2011) noted a lack of consensus on the definition of the concept of competency, presenting 17 definitions of the same word from various authors between 1976 and 2004. The authors pointed out that different authors define the word based on the context in which they use it. Kupczyk and Stor (2017), in their book 'Competency Management: Theory, Research, and Business Practice', presented 15 different definitions. The researcher's analysis of these definitions revealed that they are complementary, originating from other definitions that have undergone further development in various scientific investigations, thereby generating new definitions.

Boyatzis presented the first definition of competency in his 1982 book 'The Competent Manager,' defining it as an intrinsic characteristic of a person that leads to effective or superior performance in carrying out an activity. Boyatzis (1982) further emphasized the interconnectedness of these characteristics, which can include motives, traits, aspects of self-image or social roles, or even a set of skills. The second definition was presented by Spencer and Spencer in their 1993 book, 'Competence at Work: Models for Superior Performance'. The authors supplement Boyatzis' definition by emphasizing the need to contextualize and consider the internal and external environments when analyzing jobs. Spencer and Spencer (1993) defined competency as an intrinsic characteristic, that is, a deep and structured part of a person's personality that can predict their behavior in a wide variety of situations and/or professional activities. According to Rouco (2012), competency is a set of knowledge, skills, attitudes, behaviors, and values that, according to a reference standard, leads to superior performance in carrying out a task or function in a given work context. For his part, Ceitil (2016, p.41), in his book *'Gestão e Desenvolvimento de Competências*' (Competence Management and Development), presents competences "as structured modes of action, required, exercised, and validated in a given context.". ICAO (2018b) defines competency as a combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

The analysis of the various definitions of competency identified several common points: The performance of a certain task or activity is required and exercised in a certain context. This is mainly linked to the way in which the individual performs them and the context in which they find themselves; a characteristic of the individual themselves, structured within them; attributes, or those associated with the function they perform, traits and/or aptitudes, that is, cognitive aspects; knowledge, that is, a more technical aspect; and qualifications. In short, in the context of this research, competencies can be defined as a set of technical and cognitive characteristics needed to perform a given task or function in each socio-professional context according to a criterion or benchmark.

In this study, we categorized skills into two groups: technical skills, which are directly related to the execution of a function or task; and non-technical skills, which are skills unrelated to the function or task. The US approach compares non-technical and soft skills. Flin and O'Connor (2008) characterized soft skills as non-technical skills, that is, cognitive and social skills that complement technical skills and contribute to safe and efficient performance. According to Cooper and Fry (2023), non-technical skills (NTS) involve recognizing and managing human performance limitations, making sound decisions, effectively communicating, leading, and maintaining situation awareness, which, when combined with strong technical skills, differentiates between acceptable and outstanding performance.

According to Rouco (2012), these are skills that employees can transfer from one function or action to another, that is, they are transversal to all professions. Robles (2012) corroborates the previous statement, stating that the greatest and best characteristic of non-technical skills (soft skills and transversal skills) is that they are not only revealed in a single profession, that is, a clear and direct reference to the transversality of the aforementioned. Ceitil (2016) reinforces the importance of their existence in the broadest and most diverse contexts, regardless of the context or activity.

Kechagias (2011) stated that non-technical skills (soft skills and transversal skills) are essential for human development, social interaction, and success in the workplace. Vyner (2018) states that non-technical skills (soft skills and transversal skills) are those parts of human personality that help us achieve what we want through and with other people in a way that everyone feels comfortable with. It is also important to note that, as part of human personality, non-technical skills (soft skills and transversal skills) manifest themselves in people regardless of their gender (Rao, 2012). Vyner (2018) argues that these competencies are found in the essence of the person, in who and how we are, in the way we speak, and in the way we relate

to other people, among others. Bawge and Sapate (2017) state that non-technical skills (soft skills and transversal skills) have a broad spectrum and encompass the following domains: personality, communication, motivation, discipline, leadership, reasoning, negotiation and decision-making, problem-solving, team spirit, and interpersonal and social relationships, among others.

Rao (2012) pointed out that there is a change in the mindset of companies to emphasize not only technical skills but also non-technical skills and that, in the future, a perfect symbiosis between technical and non-technical skills will be needed for individuals to become successful professionals. Lazarus (2013) points out that possessing technical skills is no longer sufficient to face today's highly competitive job market. Frank (2019) pointed out that these skills characterize the relationships between people, or the way an individual faces their day-to-day life and work.

Fan et al. (2017) stated that one of the reasons for the paradigm shift in competency management is the fact that there is greater awareness of the importance of non-technical skills in the job market and their ability to differentiate between individuals. The same authors argued that non-technical skills are already too important for a successful career. However, the author pointed out that in the coming years, these competencies will become increasingly important owing to a combination of macro-trends. Vasanthakumari (2019) noted that these competencies are important for establishing interpersonal relationships, making appropriate decisions, communicating effectively with others, and individuals' professional development.

To align with the terminology in the civil aviation sector, we refer to soft skills or transversal skills as non-technical skills. In the following section, we present competency models for various sectors of activity, particularly in the civil aviation sector.

## 3 FINDINGS

As mentioned in the previous section, and to achieve the objectives of this study, this section provides a critical analysis of the non-technical skills models of the various authors and then a comparison with the non-technical skills of the civil aviation sector.

Table 1 illustrates the literature review of soft skills conducted by different authors. Table 1 illustrates the skills for which at least two authors advocate their importance in the workplace.

**Table 1**

*Integrative model of soft skills from different sectors of economic activity.*

| | Robles (2012) | Dean and East (2019) | Parlamis and Monnot (2019) | Whittemore (2018) | World Economic Forum (2016) | Eisenrach and Hansson (2016) | Foster, Wiczer and Eberhardt (2019) |
|---|---|---|---|---|---|---|---|
| Communication | X | X | X | | | X | X |
| Teamwork | X | X | X | | | X | X |
| Problem solving | | X | | X | X | X | X |
| Flexibility and adaptability | X | | | X | X | X | |
| Critical thinking | | | | X | X | X | X |
| Creativity | | | | X | X | X | |
| Decision-making | | | | | X | X | |
| Service orientation | | | | | X | X | |
| Motivation | | X | | | | X | |
| Empathy | | | X | X | | | |
| Responsibility | X | | | | | X | |
| Conflict management | | | X | | | X | |
| Proactivity | X | | | | | | X |
| Professionalism or work ethic | X | | | | | | X |
| Enthusiasm | | X | | | | | X |
| Leadership | | X | X | | | | |
| Emotional intelligence | | | | X | X | | |

Table 1 shows that various sectors of economic activity increasingly recognize transversal skills as critical or strategic assets. An integrative model, based on the work of various authors, shows the transversal nature of competencies and their relevance to promoting organizational success and maintaining competitive advantage through human resources. In Table 1, communication emerges as a key skill, as emphasized by Robles (2012), Dean and East (2019), Parlamis and Monnot (2019), Eisenrach and Hansson (2016), and Foster et al. (2019). The same authors also highlight teamwork as indispensable. Problem-solving is highlighted by Dean and East (2019), Whittemore (2018), the World Economic Forum [WEF] (2016), Eisenrach and Hansson (2016), and Foster et al. (2019). Flexibility and adaptability, another key attribute, are emphasized by Robles (2012), Whittemore (2018), the World Economic Forum [WEF] (2016), and Eisenrach and Hansson (2016). In rapidly changing environments, individuals must demonstrate agility and openness to new ideas and approaches. Critical thinking and creativity are highlighted by Whittemore (2018), the World Economic Forum [WEF] (2016), Eisenrach and Hansson (2016), and Foster et al. (2019) as essential for innovation and problem-solving. Decision-making is considered crucial by the World Economic Forum (2016) and Foster et al. (2019) for effective leadership and strategy

implementation. Service orientation, empathy, responsibility, conflict management, proactivity, professionalism, enthusiasm, leadership, and emotional intelligence are recognized by several authors as critical and essential for individual and organizational success.

Human factors are widely considered to be the most important and complex, but also the most vulnerable dimension of any aeronautical system (Ruff-Stahl et al., 2016). Higuera (2015) identified a set of 10 non-technical skills that, regardless of the task or job held, whether pilot, air traffic controller, or even aircraft mechanics, are considered to be the most important for an individual to be successful in this sector and are as follows: communication, critical thinking, people competencies (customer contact), proactivity (team spirit, honesty, conscientiousness of one's abilities, reliability and responsibility, hard work, and leadership).

The Careers in Aerospace website (2020) identifies the non-technical skills that employers in civil aviation are looking for, which are as follows: written and oral communication; problem-solving; analytical skills; empathy and emotional intelligence; teamwork; leadership; innovation and creativity; interpersonal relationships; organizational and management skills; time management; flexibility; self-motivation; ability to motivate others; confidence/responsibility; self-management; commitment; willingness to learn; cultural awareness; practical intelligence (especially for the maintenance or engineering field); and attention to detail.

In the context of civil aviation pilots, Flin et al. (2003) reported that, during the 1990s, the aviation community placed considerable emphasis on the non-technical skills of crews as a crucial factor for flight safety. Ruff-Stahl et al. (2016) also pointed out that in recent years, there has been a paradigm shift in pilot skills. From the traditional concept of 'stick-and-rudder,' a clear reference to the in-flight control systems of an aircraft, to a strand of non-technical skills called 'Soft Skills,' which encompass the concepts of crew resource management (CRM) and conflict resolution strategies, At the same time, Moschler and McGhee (2016) pointed out that the concept of non-technical skills was introduced in the context of civil aviation through the concept of CRM.

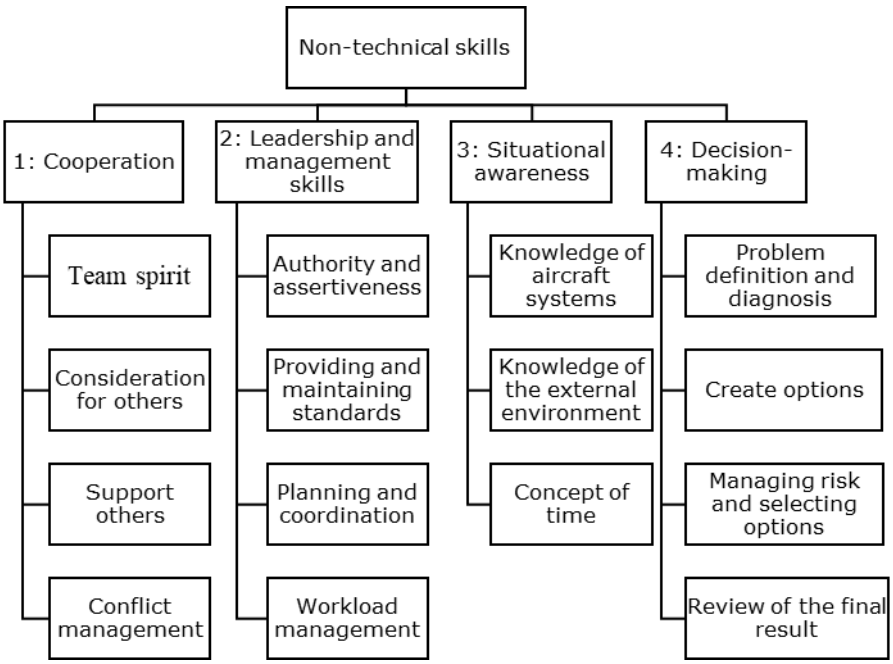
According to Skybrary (2020), CRM is a management system that allows the optimal use of all available resources, people, equipment, and procedures to promote safety and optimize the efficiency of flight operations. On the other hand, the EASA (2017) stated that the aim of this program is to improve the cognitive and interpersonal skills necessary for effective flight management. In the same publication, the European Civil Aviation Regulatory Agency stated that cognitive competencies are mental processes used by an individual to obtain and

maintain situational awareness to solve-problems and aid decision-making. Regarding interpersonal competencies, the European regulator highlights two extremely important competencies: communication and teamwork. De Looze et al. (2015) state that being able to communicate effectively is recognized as a vital skill in a wide range of aviation professions, especially in the operation of complex machinery such as aircraft.

According to Skybrary (2020), CRM includes a broad spectrum of knowledge, skills, and attitudes, including communication, situational awareness, problem-solving, decision-making, and teamwork. In addition to these competencies, Moschler and McGhee (2016) state that skills associated with leadership and the ability to create and establish a climate of trust within the crew are equally important. Flin et al. (2003) divided the concept of non-technical competencies, as shown in Figure 1.

**Figure 1**

*Non-technical CRM skills.*




Source: Adapted from Flin et al. (2003) and Ruff-Stahl et al. (2016).

Table 2 shows an integrative model of pilots' non-technical skills.

**Table 2**

*Integrative model of non-technical skills for pilots.*

| | CRM (Single Pilot) | CRM (Multi-Pilot) | Skybrary (2020) | Moschler an McGhee (2016) | Finn et al. (2003) |
|---|---|---|---|---|---|
| Situational awareness | X | X | X | | X |
| Workload management | X | X | | | X |
| Decision-making | X | X | X | | X |
| Surprise and startle effect | X | X | | | |
| Resilience | X | X | | | |
| Personality awareness | | X | | | |
| Human error | | X | | | |
| Attitudes and behavior | | X | | | |
| Self-evaluation and self-criticism | | X | | | |
| Stress management | | X | | | |
| Assertiveness | | X | | | X |
| Ability to receive and process information | | X | | | |
| Effective communication and coordination in and out of the cockpit | | X | X | | |
| Leadership | | X | | X | X |
| Cooperation | | X | | | X |
| Synergy | | X | | | |
| Delegation | | X | | | |
| Problem-solving | | | X | | X |
| Teamwork | | | X | | X |
| Confidence | | X | | X | |

Dapica and Peinado (2021) identified six non-technical skills from the list of pilot skills according to the Evidence-Based Training Paradigm (EBT), which are: communication, leadership and teamwork, problem-solving and decision-making, situational awareness, and workload management. According to Macleod (2005), De Looze et al. (2015), and EASA (2017), the scope of the CRM program goes beyond the cockpit of an aircraft, as crews interact with other crews, air traffic controllers, and ground support personnel in areas such as flight operations, maintenance, and ground handling. It is therefore necessary to broaden the spectrum of non-technical skills in the civil aviation sector to cover as many interfaces as possible within a crew, such as aircraft mechanics, air traffic controllers, and cabin crews.

Air traffic controllers are among the most stressful and challenging in the world. Professional specificities require specific skills. According to Table 3, Sheoran (2016) highlighted the following skills as essential for a good air traffic controller.

**Table 3**

*Non-technical skills for air traffic controllers.*

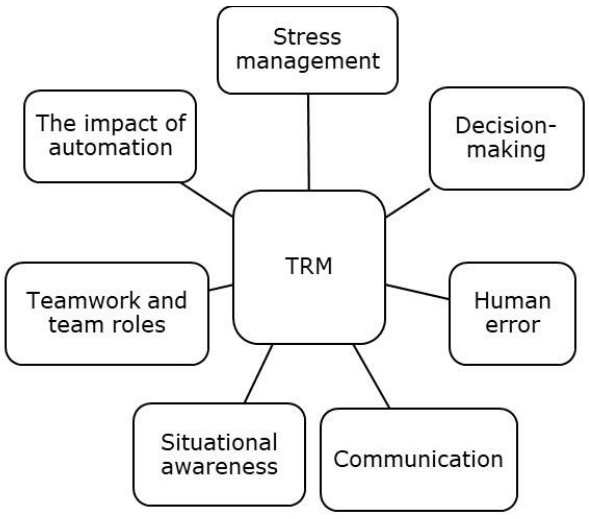
| | |
|---|---|
| Rapid decision-making | Flexibility |
| Resistance to stress | Communication |
| Spatial awareness | Cognitive intelligence |
| Visualization Capability | Teamwork |
| Prioritization | Numerical Proficiency (Mathematics) |
| Multitasking capability | Medical and mental condition |

Source: Adapted from Sheoran (2016).

Still directly related to this profession, EASA, through Regulation (EU) 2015/340, which establishes the technical requirements and administrative procedures relating to air traffic controllers' licenses and certificates, defined in Article ATCO.D.010 that, during the initial training of these professionals, they must complete a Human Factors module. Among other things, this module covers the following non-technical skills: professional conduct, teamwork, stress management, and communication. In the same text, the regulator makes it compulsory to complete human factor training throughout your career [Articles ATCO.D.045 and ATCO.D.080], which covers the following concepts: team resource management (TRM), fatigue management, and stress management. Similar to the CRM concept for the piloting profession mentioned above, this program is defined by the use of strategies to make the best use of all available resources—information, equipment, and people— to optimize traffic services (Skybrary, 2020). Figure 2 shows that this model comprises several dimensions.

**Figure 2**

*Air traffic controller TRM dimensions.*




Source: Skybrary (2020).

In contrast, ICAO DOC. 9806, published in 2002, identifies the essential cognitive skills for performing these functions, as illustrated in Table 4.

**Table 4**

*Non-technical skills for air traffic controllers.*

| | |
|---|---|
| Sense of perception | Planning capacity |
| Atenção ou vigilância | Communication |
| Cognitive intelligence | Problem solving |
| Information Processing | Decision-making |
| Situational awareness | Motivation |

Source: Adapted from ICAO [Doc. 9806] (2002).

Table 5 shows a summary model of non-technical skills for air traffic controllers.

**Table 5**

*Summary model of non-technical skills for air traffic controllers.*

| | Sheoran (2016) | (UE) 2015/340 | TRM | ICAO Doc. 9806 |
|---|---|---|---|---|
| Decision-making | X | | X | X |
| Stress management and resistance | X | X | X | |
| Conscience | X | | | |
| Visualization capability | X | | | |
| Prioritization | X | | | |
| Multitasking capability | X | | | |
| Flexibility | X | | | |
| Communication | X | X | X | X |
| Cognitive intelligence | X | | | X |
| Teamwork | X | X | X | |
| Numerical Proficiency (Mathematics) | X | | | |
| Medical and mental condition | X | | | |
| Professional conduct | | X | | |
| Human error | | | X | |
| Consciência situacional | | | X | X |
| Impact of automation | | | X | |
| Situational awareness | | | | X |
| Attention or vigilance | | | | X |
| Information Processing | | | | X |
| Planning capacity | | | | |
| Problem-solving | | | | X |
| Motivation | | | | X |

After reviewing the literature on the competencies associated with air traffic controllers, Table 6 illustrates those that are most present, both at the authors' level and at the level of institutions associated with the aeronautics sector.

**Table 6**

*Integrative model of non-technical skills for air traffic controllers.*

| | |
|---|---|
| Rapid decision-making | Intelligence |
| Gestão e resistência ao stress | Teamwork |
| Communication | Situational awareness |

In the context of aircraft maintenance professionals, such as pilots and air traffic controllers, this profession is also regulated within the European legislative framework through Regulation (EU) 1321/2014, Part 66, on the continuing airworthiness of aircraft and aeronautical products, parts, and appliances, and on the certification of organizations and personnel involved in these tasks. Therefore, during the initial training of these professionals, they must complete a human factors module, which includes the skills illustrated in Table 7.

**Table 7**

*Non-technical skills in maintenance (Part 66).*

| | |
|---|---|
| Individual and group responsibility | Management, supervision and leadership |
| Motivation | Time and deadline management |
| Information Processing Capacity | Working under pressure (time) |
| Attention and perception | Workload management |
| Cognitive intelligence | Communication |
| Teamwork | |

Amy et al. (2016) carried out a study to identify the non-technical skills used by aircraft maintenance crews. The results identified the following non-technical skills: situational awareness, decision-making, leadership, teamwork, and communication. ICAO DOC. 9806, published in 2002, presents a set of essential cognitive competencies for aircraft maintenance: communication, leadership, assertiveness, decision-making, and stress management. From the literature review, Table 8 shows the integrative model of non-technical skills for aircraft maintenance professionals.

**Table 8**

*Integrative model of non-technical skills for aircraft maintenance professionals.*

| | |
|---|---|
| Individual and group responsibility | Management, supervision and leadership |
| Motivation | Time and deadline management |
| Information Processing Capacity | Working under pressure (time) |
| Attention and perception | Workload management |
| Cognitive intelligence | Communication |
| Teamwork | Assertiveness |
| Decision-making | Stress management |

Table 9 illustrates the non-technical skills for cabin crew members, which result from the EASA (2019) models through Part-CC of Regulation (EU) No. 1178/2011 and Zambas (2017) with 20 competencies.

**Table 9**

*Integrative model of non-technical skills for cabin crew members.*

| | |
|---|---|
| Personality awareness | Professionalism and responsibility |
| Human error and trust | Independence and trust |
| Attitudes and behavior | Empathy |
| Self-Assessment | Adaptability and flexibility |
| Stress and *stress management* | Consciência cultural |
| Cultural Awareness | Physical Fitness |
| Assertiveness | Good looks and elegance |
| Situational awareness | Self-control |
| Ability to acquire and process information | Resistance to *stress* |
| Interpersonal relationships | Attention to detail |
| Teamwork | Initiative and leadership |
| Communication | Organization |
| Friendliness and positivity | Time management |
| Caring and understanding | Discretion |
| Numerical competence | |

Cooper et al. (2023) present an integrative model of aviation in various contexts, both civil and military, as shown in Table 10.

**Table 10**

*Integrative model of non-technical skills in civil and military aviation.*

| **Doing** | **Thinking** | **Interacting** |
|---|---|---|
| Physical limitation | Knowledge | Team structure |
| Sensory limitations | Experience | Role definition |
| Health | Attitude | Leadership |
| Training | Motivation | Folowership |
| Competent | Confidence | Supervision skills/needs |
| Authorised | Workload | Interpersonal conflicts |
| Briefed | Fatigue | Communication |
| Fatigue | Stress | Mentoring |

Tysher et al. (2022) conducted a study on the occurrence of major accidents in European manufacturing industries (including the aviation industry). The results indicate that NTS deficiencies such as situational awareness, decision-making, problem-solving, communication, leadership, and time management played a crucial role. Miani et al. (2021) conducted a study with civil aviation students to find out which non-technical skills were most important for their future jobs and identified critical/analytical thinking, problem-solving, and decision-making. Ceschi et al. (2019) created the "NOTECHS+" scale to assess non-technical skills. The scale is

made up of three dimensions of non-technical skills: social skills (cooperation, leadership, and management), cognitive skills (decision-making and situational awareness), and emotional skills (resilience and emotional regulation).

The model summary of non-technical skills in civil aviation professionals was created by looking at the literature on the topic and using those mentioned by at least two authors or institutions. The results are shown in Table 11.

**Table 11**

*Model summary of non-technical skills in civil aviation.*

| | |
|---|---|
| Communication | Stress management and resistance |
| Teamwork | Problem-solving |
| Leadership | Empathy and emotional intelligence |
| Trust and responsibility | Organization and planning |
| Time and workload management | Attention to detail |
| Situational awareness | Flexibility |
| Decision-making | Self-motivation |
| Assertiveness | Assertiveness |
| Interpersonal relationships | Cognitive intelligence |
| Ability to process information | |

According to Table 11, we can conclude that the most frequent non-technical skills in the various models presented are the following: Effective communication, which is presented as a critical and essential skill in aviation, guarantees the transmission of clear and precise information between crew members and the various stakeholders. Effective communication includes verbal and non-verbal communication, listening skills, and adapting communication styles to different situations. Communication in aviation is a critical dimension that underpins all aspects of operations, air safety, air traffic coordination, emergency management, and training. Problem-solving is vital not only for safety and efficiency in aviation but also for the sustainability of the aviation sector as a whole, of which we highlight accident prevention, maintenance, crisis management, flight safety, innovation for the implementation of new solutions, training, regulation, and communication and coordination; Decision-making is fundamental and complex, involving rapid analysis of information, evaluation of risks and benefits, and consideration of safety protocols. The success of air operations depends on the quality of the decisions made in a timely manner and is directly related to safety, efficiency, and stakeholder satisfaction. In general, the aviation industry continues to develop technologies, procedures, and training to support decision-making. Leadership in aviation involves guiding and influencing others, making decisions, and inspiring confidence in times of uncertainty. Teamwork is essential for safety and efficiency in aviation, involving collaboration,

understanding team dynamics, and contributing to a positive environment. Situational awareness involves the ability to understand and correctly interpret the surrounding environment, predict future developments, and make informed decisions based on understanding. Stress management and resilience are essential for maintaining performance under pressure, including recognizing stressors, using coping mechanisms, and maintaining physical and mental health. Empathy and emotional intelligence are essential for creating a favorable working environment and effective decision-making. Confidence and responsibility are essential for creating and maintaining the trust of colleagues and passengers. Effective organizational and planning skills are needed to manage complex tasks and schedules. Attention to detail, situational awareness, flexibility, decision-making, self-motivation, assertiveness, interpersonal relationships, cognitive intelligence, and information processing are also essential for a safe and effective working environment.

As presented throughout this study, non-technical skills in civil aviation cover a broad framework of interpersonal, personal, cognitive, social, and self-management skills. Furthermore, it has been emphasized that non-technical skills complement technical skills and are essential for safe, efficient, and effective aviation operations. Non-technical skills contribute to the overall performance and safety culture in the aviation sector, which emphasizes the importance of training and developing technicians in this sector.

## 4 CONCLUSIONS

From this study, it emerged that HR managers face several challenges in keeping workers in the aeronautics sector with the right skills to perform their tasks or functions. One of the challenges is to keep the non-technical skills model up to date in the face of changes in the internal and external environments. Therefore, this study presents an integrative model of non-technical skills for the civil aviation sector, as illustrated in Table 12.

**Table 12**

*Integrative model of non-technical skills for the civil aviation.*

| Non-technical skill | |
|---|---|
| Assertiveness | Leadership |
| Communication | Critical thinking |
| Confidence | Interpersonal relations |
| Situational awareness | Problem-solving |
| Flexibility and adaptability | Responsibility |
| Time management | Decision-making |
| Workload management | Teamwork |
| Stress management and resilience | |

This study concluded that human resource managers face a permanent challenge in updating the non-technical skills profile of workers in the aviation sector in the face of changing internal and external environments. These challenges include offering training and development opportunities, taking cultural differences into account in a multicultural environment, such as the civil aviation sector, integrating non-technical competencies into formal training, and measuring the impact of training and development initiatives on the organization's performance and safety.

To keep the non-technical skills model up to date, HR managers should develop a tool for monitoring and evaluating non-technical skills in the workplace, including the possibility of training and development of non-technical skills in the company's training plan, taking cultural differences into account, integrating the training and development of non-technical skills with technical competencies, ensuring that employees meet regulatory standards for safety-critical roles requires effective management of non-technical skills. HR managers may struggle to measure the impact of non-technical skills training and development initiatives on organizational performance and safety and demonstrating that the return on investment in non-technical skills development can be challenging but is essential for securing support and resources for these initiatives.

Limitations: During the literature review, there were few publications of scientific articles on non-technical skill models in the civil aviation sector. Publications in the civil aviation sector are focused on and centered on the piloting profession. However, the scientific community has not adequately studied the broad spectrum of professionals in the civil aviation sector.

Future research should validate the model in Table 12 for each profession in the civil aviation sector, identify the specific skills, create a competency reference with the relevant definitions that are common to the entire civil aviation sector, and create a questionnaire with closed questions to gauge the importance or frequency of each competency. Considering that

training in the aviation sector is supported by different scenarios, it would be interesting to identify the non-technical skills required for each one.

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