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Competencies of the Brazilian Air Force fighter pilot to operate Electronic Warfare systems of the Gripen-NG aircraft: a prospective view

Competencias del piloto de caza de la Fuerza Aérea Brasileña para operar sistemas de Guerra Electrónica de la aeronave Gripen-NG: una visión prospectiva

Competências do piloto de caça da FAB para operar sistemas de Guerra Eletrônica da aeronave Gripen-NG, uma visão prospectiva

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ABSTRACT

This work aims to analyze to which extent the Electronic Warfare Doctrinaire Course (EWDC), conducted by the Group of Specialized Tactical Instruction (GITE), develops the skills required for Brazilian Air Force (FAB) fighter pilots to operate the Infrared Search and Track (IRST) system of the Gripen-NG aircraft. Through the documentary research of the educational content of CDGE, the competencies developed in the mentioned course were identified. The skills required to operate the system (IRST), but its turn, were characterized by the application of the Delphi Method. The research and analysis were outlined using the theoretical basis presented by Carbone et al. (2009) about skill management and the proposed by Sacristán (2013), Perrenoud (1999) and other authors who address education competencies. By following the analysis of the data collected, it was noted that 53% of the competencies related to knowledge, 67% of those related to skills and 87% of the competencies related to the attitudes are developed in the course in question, corresponding to 73% of the competencies in total. Thus, it was possible to notice that there is a gap of competencies. In this sense, it is possible to act ahead in the adoption of measures to reduce the gap identified, contributing to the maintenance of a high-level training of the Brazilian Air Force (FAB) fighter pilots, future operators of Gripen-NG aircraft.

Keywords: Competencias. Gripen. Guerra electrónica. Infrared search and track.

RESUMEN

Este trabajo se destina a analizar en qué medida el Curso Doctrinario de Guerra Electrónica (CDGE), impartido por el Grupo de Instrucción Táctica Especializada (GITE), desarrolla las habilidades requeridas para pilotos de caza de la FAB (Fuerza Aérea Brasileña) para operar el sistema de Búsqueda por Infrarrojo y Rastreo (en inglés Infrared Search and Track(IRST) de la aeronave Gripen-NG. Se identificaron, por medio de investigación documental del contenido didáctico del CDGE, las competencias desarrolladas en dicho curso. Las competencias necesarias para operar el sistema (IRST) fueron caracterizadas por medio de la aplicación del Método Delphi. La investigación y el análisis fueron delineados utilizando la fundamentación teórica presentada por Carbone et al. (2009) sobre gestión por competencias y el preconizado por Sacristán (2013), Perrenoud (1999) y otros autores que abordan competencias en la enseñanza. Después del análisis de los datos recolectados, se verificó que el 53% de las competencias relacionadas con los conocimientos, el 67% de las ligadas a las habilidades y el 87% de las competencias relacionadas con las actitudes se desarrollan en dicho curso, correspondiendo al 73% de las competencias en total. Por lo tanto, fue posible percibir que hay un hueco (gap) de competencias. En este sentido, se hace posible actuar por anticipado en la adopción de medidas para disminuir la brecha identificada, contribuyendo en la preservación de un alto nivel de preparación de los pilotos de caza de la Fuerza Aérea Brasileña (FAB), futuros operadores de la aeronave Gripen-NG.

Palabras clave: *Competencias. Gripen. Guerra electrónica. Infrared search and track.*

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The acronyms of the words Electronic Warfare Course Doctrinaire (EWDC), Electronic Warfare (EW), Guiding Questions (GQ) and Specific Objectives (SO) were employed in English. The other acronyms and abbreviations contained in this article correspond to those used in the original article in Portuguese.

RESUMO

Este trabalho se destina a analisar em que medida o Curso Doutrinário de Guerra Eletrônica (CDGE), ministrado pelo Grupo de Instrução Tática Especializada (GITE), desenvolve as competências necessárias aos pilotos de caça da FAB para operar o sistema Infrared Search and Track (IRST) da aeronave Gripen-NG. Foram identificadas, por meio de pesquisa documental do conteúdo didático do CDGE, as competências desenvolvidas no referido curso. Já as competências necessárias para operar o sistema (IRST) foram caracterizadas por meio da aplicação do Método Delphi. A pesquisa e análise foram delineadas utilizando-se a fundamentação teórica apresentada por Carbone et al. (2009) sobre gestão por competências e o preconizado por Sacristán (2013), Perrenoud (1999) e outros autores que abordam competências no ensino. Após análise dos dados coletados, verificou-se que 53% das competências relacionadas aos conhecimentos, 67% daquelas ligadas às habilidades e 87% das competências relacionadas às atitudes são desenvolvidas no curso em questão, correspondendo a 73% das competências no total. Dessa forma, foi possível perceber que existe um gap de competências. Nesse sentido, torna-se possível agir por antecipação na adoção de medidas para diminuir a lacuna identificada, contribuindo-se na preservação de um elevado nível de preparo dos pilotos de caça da Força Aérea Brasileira (FAB), futuros operadores da aeronave Gripen-NG.

Palavras-chave: *Competências. Gripen. Guerra eletrônica. Infrared search and track.*

1 INTRODUCTION

The susceptibility of the Aerospace Power to technological developments is manifested in the continuous and growing need for the acquisition of state-of-the-art equipment in order to achieve strategic advantage. This demand involves the concentration of efforts by the Brazilian Air Force (FAB) in reconciling the training to use the systems acquired, thus keeping it capable of mantaining the airspace sovereignty. This understanding is supported by means of the following assertive:

> [...] An essential point is the fact that transformation is associated with people, since it involves three elements and their interactions, namely: the "domain of advanced technologies", which generate new capabilities and lead to "new concepts of operation", diversifying and maximizing the desired effects, and the "organizational change," which shapes the structure and redefines work processes in order to provide efficiency in the application of the means available. Therefore, the greatest transformation to be achieved by the FAB should occur in the human resources field [...]. (BRASIL, 2017, p. 29).

In this context, by means of the National Defense Strategy (END), it was defined that FAB should purchase fighter aircrafts that,

> [...] gradually replace those currently used, seeking the potential standardization; the acquisition and development of armaments, and self-defense systems, aiming at self-sufficiency in their integration into the aircrafts. (BRASIL, 2008, p. 126).

As a result of this strategic planning, in October 2014, the contract of acquisition of 36 (thirty six) Gripen-NG aircrafts, called at FAB as F-39, was signed with a delivery schedule and delivery forecast of the first aircraft in 2019 and the last in 2024 (FERREIRA; JUNIOR, 2016).

The aircraft Gripen-NG incorporates advanced technology in almost all its dimensions and the beginning of the operation of this vector will cause a technological breakthrough (FERREIRA; JUNIOR, 2016).

This conceptual change can be evidenced by the diversity of new systems[1] that, as part of the F-39, will be incorporated to the FAB, with emphasis in the scope of the present study on those related to Electronic Warfare (EW).

In the specialized literature there are several definitions for EW, but in the FAB context, EW is understood to be the use of electromagnetic energy to destroy, neutralize or reduce enemy combat capability, seeking to take advantage of the use of the opponent's electromagnetic spectrum[2] and in order to ensure the efficient use of their own electromagnetic emissions (BRASIL, 2016a).

Because it deals with the use of such a broad environment, such as the electromagnetic spectrum, and because it deals with advanced technologies, it is possible to infer that, in order to correctly apply the concepts of EW, there is a need to understand a wide range of variables, involving several areas of knowledge. Notwithstanding the complexity of the topic, EW's

[1] The following systems can be mentioned: Active Electronic Scanning Array (AESA) radar, radar interferer, Non Cooperative Threat Recognition (NTCR), Disposable Decoy Brite Cloud, Infrared Search and Track (IRST), among others (SAAB, 2017).

[2] The electromagnetic spectrum includes the Radio Frequencies (RF), infrared, visible and above that of visible (ADAMY, 2004, p. 78, our translation).

strategic character makes the exchange of knowledge about the subject occur in a restricted way, to maintain the advantage on the side of those who have already developed this capability.

In this sense, as recommended by the END, it is understood that FAB must "prioritize the formation, inside and outside Brazil, in technical-scientific, military and civilian fields that allow the attainment of technological independence" (BRASIL, 2008, p. 46). Thus, in order to obtain the desired self-sufficiency, the need to develop training and training tools to improve capabilities in the field of EW is autonomously perceived, without depending only on the knowledge passed on by other Air Forces or elements outside FAB.

Therefore, in accordance with the superior guidelines, the Brazilian Air Force Command (COMAER), through DCA 11-45, Strategic Conception Air Force 100, understands that,

> [...] as new capabilities are developed, or even new weapon systems are acquired and put into operation, the organization must be prepared for Air Force military and civilian personnel to acquire and maintain the necessary skills for this new reality. An effective weapon system operated by skilled and innovative staff is a very powerful set. The FAB should be able to modernize its training techniques and specialization while preserving the standards and discipline necessary to achieve the effectiveness identified in FAB 's vision for the future. (BRASIL, 2017, p. 32).

Discussing the concept of competence presented in DCA 11-45, Carbone et al. (2009) point that it is a synergistic combination of knowledge, skills and attitudes, expressed by the professional performance within a particular context of the organization. In this sense, in accordance with the definition presented by the author referenced and by drawing a parallel with the vision presented in DCA 11-45, it is verified that the FAB should enable future F-39 pilots to acquire and maintain knowledge, skills and attitudes necessary to the new reality. Mercado (2002) examines the idea in depth, including to the discussion the reflection of technology in the curriculum and competencies developed by the learning.

> [...] The recognition of an increasingly technological society must be accompanied by the awareness of the need to include in the academic curriculum the skills and competencies to deal with the new technologies. In the context of a knowledge society, education requires a different approach in which the technological component cannot be ignored [...]. (MERCADO, 2002, p. 11).

Currently, the doctrinal training in the EW field of FAB operational pilots occurs through the Electronic Warfare Doctrinal Course (CDGE), which is taught in the Group of Specialized Tactical Instruction (GITE) and its objective is,

> [...] to provide basic doctrinal training for military personnel working in the area of Electronic Warfare and using systems or equipment that require doctrinal knowledge about this subject. (BRASIL, 2012, p. 8).

Reflecting about the way the training shall be planned on the competencies model, Deluiz (2001) states that the knowledge and skills acquired in the educational process should provide a practical and immediate utility, related to the organization's objectives and mission, in order to guarantee the differential or the competitive advantage. Applying this theory in the FAB environment, it is understood that the content of the CDGE should develop competencies that have practical utility to FAB objectives.

In view of the foregoing context, it is understood that FAB pilot training planning needs to follow technological evolution and be guided by competencies in order to investigate whether the learning developed during the training of pilots in the EW area has being following the progress provided by the the Gripen-NG aircraft, the following research problem was established: to what extent does the Electronic Warfare Doctrinal Course develop the skills required for FAB fighter pilots to operate Electronic Warfare systems on the F-39 Gripen-NG aircraft?

In view of the large number of existing EW systems in the F-39, for the purpose of delimitation of this work, it has been defined that this article will deal only with the Infrared Search and Track (IRST) system.

It is possible to identify the importance of this equipment since it is able, among other functions, to follow the targets through heat emission. Thus, it becomes possible to **track**[3] an aircraft passively, without alerting it. Thus, the enemy will not be able to realize that it is being followed (ADAMY, 2004) and will have trouble identifying the right moment to begin evasive maneuvers to avoid armament, consisting in a relevant operational advantage.

From the problem described, the following guiding questions were established:

GQ1: What are the competencies required to operate the IRST system?

GQ 2: Which competencies required to operate the IRST system are developed in CDGE?

[3] Track the angle target, speed and distance, allowing the weapon to be launched.

To find a direct answer to the problem question, it was established as a General Objective of the work to analyze the correlation between the competencies developed in the CDGE and those necessary to the FAB fighter pilots to operate the IRST system.

In order to outline the actions of the present research, aiming at the achievement of the General Objective, the following Specific Objectives (SO) were defined:

SO1: identify the competencies required to operate the IRST system; and

SO2: to identify the competencies required to operate the IRST system are developed in the CDGE.

The result of the work provides support for analysis, from a prospective perspective, the pertinence of the current model of qualification, allowing a possible re-adaptation, besides serving as the beginning of the process of mapping the competencies required to operate the Gripen-NG aircraft as a whole. Thus, it is understood that there is a contribution towards the improvement in the future operation of the aircraft F-39, presenting relevance in the FAB current context.

The study can be classified as descriptive, since, when establishing an analysis between developed and required competences, it seeks to obtain and display data representative of a given situation (GIL, 2002).

Regarding the procedures used, it is classified as a documentary research, because there is a need to search the standards and guidelines that guide the CDGE, i.e., the research will be developed based on material already elaborated which has not yet received an analytical treatment. Under the same criteria, the research can also be seen as a survey because, through the application of a questionnaire, the objective was to identify the skills required to operate the IRST system by requesting information to a group of people about the problem studied in order to then, upon analysis, obtain the conclusions corresponding to the data collected (GIL, 2002).

2 CONTEXTUALIZATION

2.1 Skill management theory

The present work used as a foundation the theory of the management by competences, since it has been pointed out as an alternative managerial model to the instruments traditionally used (BRANDÃO; BAHRY, 2005).

The management by competencies proposes to,

> guide efforts to plan, capture, develop and evaluate, at the different levels of the organization (individual, group and organizational), the skills necessary to achieve its objectives. (CARBONE et al., 2009, p. 50).

Carbone et al. (2009, 41) argue that in this type of management there is the implicit understanding that,

> the domain of certain competencies - those rare, valuable, difficult to be developed - provide the organization a performance superior to that of its competitors [...].

In this way, it is important to verify if FAB has being training its personnel to master the skills related to the operation of (GE) EW systems and to obtain a performance superior to that of the enemy in the use of the aircraft F-39.

The term competence is observed polysemically in the literature. Thus, for the purpose of this article, the following definition was used:

> [...] human or professional competencies are understood as synergistic combinations of knowledge, skills and attitudes, expressed by the professional performance in a given context or in a certain organizational strategy. (CARBONE et al., 2005 apud BRANDÃO, BAHRY, 2005, p. 180).

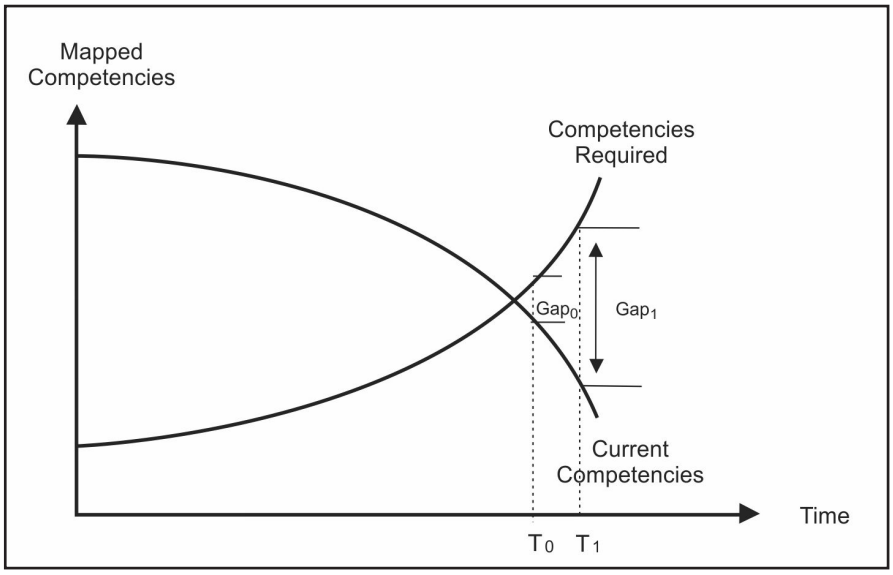
Paralleling the research problem, it is observed that, under the focus of skill management theory, to operate a EW system it is necessary to synergistically combine knowledge, skills and attitudes in the conduct of the mission.

In this scenario, knowledge is defined as the knowledge that the person accumulated throughout his/her life, something related to the memory of concepts, ideas or phenomena. Skill is understood as the ability of a person to put knowledge stored in his/her memory and to use them in an action. Attitude, in its turn, is defined as the predisposition of the person, who influences his or her behavior towards others, to work or to situations (CARBONE et al., 2009).

One of the processes of competency management is mapping, which was defined by Carbone et al. (2009), the identification of the gap, or gap between the competencies needed to reach the expected performance and the competencies available in the institution. This gap tends to increase over time if the organization does not take appropriate action to mitigate this effect.

Figure 1 illustrates the one mentioned in this text.

Figure 1 – Identification of the competency gap.



Source: Ienaga (1998 apud CARBONE et al., 2009).

In this sense, according to Carbone et al. (2009, p. 53), the mapping allows,

> not only the identification of the gap, but also the planning of actions of development of competencies that allow to minimize this gap,

focusing on fundraising, talent identification and allocation, or on the compatibility of corporate education tools. About the subject, Carbone et al. (2009, page 72) have stated.

> The subsystem of corporate education, for example, acts directly in the process of developing human competencies, promoting the socialization of existing competencies and providing the organization of learning actions that allow eliminating eventual skills gaps, as suggested by Freitas and Brandão (2006). It can also act in advance, developing today skills that will only be needed in the future.

Applying the theory presented, in this study we opted for the analysis, from the Minimum Curriculum and the Didactic Units Plan (PUD), of the competencies developed in the CDGE, a corporate education tool of the FAB, used to develop pilot skills in the EW area. In this way, it is sought to act in advance, understanding that the improvement of the content of the course can be decisive in the future operation of the IRST system of the aircraft F-39.

Bringing the relationship between curriculum and learning to the discussion, Sacristán (2013, p. 17) presented the following assertion: "From everything we know and that, in theory, can be taught or learned, the curriculum to teach is an organized selection of contents to be learned [...]". That is, the CDGE academic program, guided by curriculum, should define in an organized way what pilots are expected to learn.

Furthering the subject, Costa (2005) indicated that by using the notion of competency in the organization of the curriculum, it should not be dissociated from practice. In this way, the curriculum, in the point of view of the author mentioned, "should no longer define the knowledge to be taught, but rather the competencies that must be constructed" (COSTA, 2005, p. 53).

Complementing this idea, Deluiz (2001) has identified that in the competency model, the investigation of work processes and the identification of professional profiles are general indications for curriculum organization, which should be flexible.

Therefore, from the concepts presented, it is understood that the curriculum of the CDGE should be flexible and focused on practical activities, in order to adapt to the development of the intended competencies.

In addition, it is observed that the concepts of competency management and learning from the curriculum converge in the sense of seeking the qualification of the pilot to mobilize what has been studied in competences, herein defined as knowledge, skills and attitudes, making it possible to act appropriately situations you may experience during the missions.

2.2 Skills required to operate the IRST aircraft F -39 system

In order to enumerate the competencies necessary to operate the Gripen aircraft IRST system, the Delphi Method was used.

According to Cardoso et al. (2005), the Delphi Method has been one of the 286 most used instruments in the completion of prospective studies. Wright and Giovinazzo (2000) present Delphi as a technique 288 that seeks to establish a consensus of opinions in a group of 289 experts on future events.

According to Wright and Giovinazzo (2000), the advantages of the Delphi Method can be listed as the possibility of making predictions in situations of lack of historical data and anonymity in the answers, eliminating the influence of factors such as the respondent's academic or professional status, or his/her ability to speak, in the consideration of the validity of their arguments.

On the other hand, the same authors also present as disadvantages and limitations of the tool the statistically unacceptable treatment and the excessive dependence of the results regarding the selection of the specialists, with the possibility of introduction of bias by the choice of the respondents.

Regarding the limitations mentioned, Wright and Giovinazzo (2000, page 64),

> [...] the Delphi Method does not intend to make a statistically representative survey of the opinion of a particular group, essentially referring to a limited and select group of specialists who, through their logical reasoning ability, their experience and objective exchange of information seeks to arrive at joint opinions on the proposed issues, not applying statistical validity of the sample in this situation.

Given the points presented, the Delphi Method has shown to be the most appropriate for the study in question, considering that it was intended to obtain a projection, through the professional experience and reasoning ability of the selected experts, in a scenario without historical data, of the future need for pilot training, without aspiration of statistical validity.

Regarding the selection of specialists, Cardoso et al. (2005, page 68) have stated:

> [...] profound knowledge of the subject, whether by academic training/specialization, or by experience of acting in the field in question. Depending on the subject and research objectives, the participation of specialists from different backgrounds and areas of expertise is even recommended.

Based on the above description, for the present study, those with experience in first-class aircraft[4] and knowledge in the area of EW were selected as specialists within the universe of fighter pilots. The selected group had 3 experimental test pilots, experienced in all front-line aircraft of FAB and in others abroad, 2 Gripen C/D[5] pilots and 3 A-1 pilots, all of whom have the CDGE and 5 are trained in the Specialization Course in Electromagnetic Environment Analysis[6].

Based on the assumption that the knowledge about EW and the operation of first-line fighter aircraft were common points, the diversification of the type of piloted aircraft was aimed at allowing the different professional experiences of the selected ones to complement each other in the search for consensus on the subject, greater robustness to the result and attenuating the possibility of introduction of bias in the research.

The questionnaires were applied through Google® Forms. In the first series of questions, it was sought to establish, in the view of the experts, what are the competencies necessary for an FAB fighter pilot to operate the IRST. In the conclusions of Carbone et al. (2009), the competencies were broken down into three categories of analysis, already described in the previous section, namely: knowledge, skills and attitudes.

The answers of the first questionnaire were used in an examination, aiming to eliminate ambiguities, repetitions and (or) inaccuracies, to elaborate the second questionnaire, which sought to analyze the consensus among the specialists. This questionnaire presented 17 knowledge items, 16 skills and 23 attitudes, which were analyzed by the same specialists, to verify the level of agreement. In the present work, it was considered acceptable when the coefficient of concordance (Cc) presented values Cc $\geq$ 60%, following the one proposed by Santos (2001).

[4] 1st line of the fighter aviation refers to the following Units: 1st GDA, 1st GAVCA, 1st/4th GAV and 1st/14th GAV, operating the aircraft F-5M, in addition to the 1st/10th GAV and 3rd/10th GAV operating the aircraft A-1 and A-1M (BRASIL, 2016b). In the future, the F-39 Operator Units will comprise this Group.

[5] Version prior to Gripen-NG.

[6] *Lato Sensu* Specialization Course ministered at the Brazilian Aeronautical Institute of Technology (ITA). A prerequisite to this is to have completed the CDGE (BRASIL, 2015a).

According to the author mentioned, this coefficient is determined according to Equation 1.

$$Cc = (1 - Vn/Vt) \times 100 \quad (1)$$

Where,

Cc = Coefficient of concordance expressed as a percentage;

Vn = Number of specialists in disagreement with the predominant criterion; and

Vt = Total number of specialists.

In response to the second questionnaire, it was found that all the skills indicated by the specialists reached a level of agreement equal to or greater than 60%. Tables 1, 2 and 3 present the skills enumerated by the experts, with their respective coefficients of concordance.

Table 1 – Knowledge.

Code	Description of competencies	Cc
C1	Know the basic foundations, operating principle and capabilities of an IRST system.	100%
C2	Know the characteristics and propagation properties of the emissions in the IR range.	100%
C3	Know the main Electronic Attack Measures (jamming) applicable against an IRST system.	100%
C4	Know the main limitations of an IRST system.	100%
C5	Know the types of electromagnetic emission used by current vectors, both friendly and enemy sources, mainly those of South America.	87,5%
C6	Know the influence of atmospheric variables (clouds, rain, etc.) on the propagation of IR radiation and on the performance of the IRST system.	100%
C7	Know the advantages and disadvantages of using IRST versus Radar for detection and target engagement in the air combat environment.	100%
C8	Know the vulnerabilities and advantages of using the IRST system against a real threat in South America.	100%
C9	Know the advantages and disadvantages of using passive detection equipment.	87,5%
C10	Know the different characteristics of Infrared emission of fighter aircraft engines (pure jet, turbofan, etc.) and other vectors (propeller aircraft, helicopters, etc.).	87,5%
C11	Know the basic foundations and limitations of an IRST system.	100%
C12	Know the basic concepts of propagation.	100%
C13	Know the basic concepts of Electronic Warfare.	87,5%
C14	Know the tactics of using passive sensors.	87,5%
C15	Know the divisions and characteristics of the electromagnetic spectrum.	87,5%
C16	Know how the images/plots of the detection IRST are produced until their interface with the pilot.	62,5%
C17	Know the limitations of integration between the subsystems of the aircraft in order to detect possible limitations in the use of the aircraft in the air combat environment.	87,5%

Source: The author.

Table 2 – Skills.

Code	Description of competencies	Cc
H1	Identify if the atmospheric condition allows the use of the IRST system.	100%
H2	Analyze whether the operation of the IRST system matches the theory, properly identifying a malfunction.	100%
H3	Calculate, in an estimated way, the effectiveness (maximum range/minimum signal level for monitoring, etc.) of the IRST system.	100%
H4	Identify in real time the possible limitations of the IRST system and apply mitigating measures (Eg: change of sensor to RADAR).	100%
H5	Evaluate and plan the conditions for combined or isolated employment of the IRST system.	100%
H6	When there are threats in the scenario, be effective in choosing the appropriate sensor (RADAR/IRST).	100%
H7	Identify possible restrictions of the IRST system on visual identification measures.	87,5%
H8	Define the best doctrines of employment of the IRST system.	75%
H9	Operate the IRST system, together with other aircraft systems, correctly and efficiently in order to gain tactical advantage.	100%
H10	Interpret correctly the forms of presentation of images/plots of the targets and their variations according to the conditions of radiation and atmosphere.	100%
H11	Interpret the occurrence of Electronic Attack (jamming) against the IRST system.	100%
H12	Identify your target correctly using the IRST system within a complex multi-aircraft scenario (**TARGETING** and **SORTING**).	100%
H13	Recognize and identify the existence of false targets.	100%
H14	Recognize and identify the presence of friendly forces (wings, friendly attacking forces, etc.).	100%
H15	Plan and analyze possible results expected of using the IRST system.	87,5%
H16	Maneuver appropriately for greater effectiveness in the use of the IRST system.	100%

Source: The author.

Table 3 – Attitudes. (to be continued)

Code	Description of competences	Cc
A1	Appreciate the EW courses within the scope of the FAB.	100%
A2	Appreciate the knowledge of Electronic Warfare as a multiplying factor of combat capacity.	100%
A3	Take the initiative to acquire knowledge about the capabilities of Electronic Attack Measures (jamming) and reduction of enemy signature.	100%
A4	Appreciate the knowledge about EW equipment that could degrade the use of the IRST.	100%

(conclusion)

A5	Appreciate the study of the IRST system.	100%
A6	Seek to be aware on new IR detection technologies.	100%
A7	Encourage the use of EW systems available in the UAE.	100%
A8	Encourage the study and development of EW in the Air Unit.	100%
A9	Understand the importance of EW 's basic knowledge for operation of embedded systems.	100%
A10	Appreciate the need for a FAB Electronic Warfare stand for the study and development of a doctrine directed toward EW actions.	100%
A11	Recognize the importance of the Operational Evaluation (AVAOP) in periodic operational processes.	75%
A12	Seek to keep knowledge up to date with new possibilities and technologies.	100%
A13	Be willing to put the knowledge and skills developed into practice after the study of the equipment.	100%
A14	Be aware of any discrepancy or abnormal behavior of the IRST system in order to manage knowledge and identify limitations.	100%
A15	Encourage the Development of tactics in conjunction with other equipment and aircraft in order to utilize capacity in favor of other aircraft.	100%
A16	Appreciate the study of the systems of the aircraft to obtain the best performance of the equipment.	100%
A17	Appreciate the execution of operational exchanges with Air Forces operating IRST and other EW systems.	100%
A18	Encourage the development and practice of new tactics based on the use of EW equipment, especially IRST.	100%
A19	Seek innovative thinking in the operational area.	100%
A20	Take the initiative to develop tactics with the IRST system associated with datalink and radar for the air combat environment.	100%
A21	Recognize the importance of the existence of technicians (specialists and engineers) as a means of operational support.	87,5%
A22	Appreciate, in the same proportion, his/her own theoretical knowledge of the equipment and his/her own previous experience as a fighter pilot.	75%
A23	Appreciate the use of intelligence principles and information safeguards in EW knowledge management.	100%

Source: The author.

2.3 Skills developed in CDGE

In order to reach OE2, according to the concepts presented by Sacristán (2013) and other refereed authors, and in order to identify the necessary skills that are developed during the course, an analysis of the norms that govern the implementation of the CDGE was carried out by means of documentary research on the content of the Didactic Units Plan (PUD) and the Minimum Curriculum (ICA 37-507). This research was implemented by direct contact with the GITE and access to the FAB repository of laws, on the electronic site of the Aeronautical Documentation Center.

It should be noted that it was not possible to identify the competencies developed by the students after the course. Thus, the present study considered, for the purposes of analysis, that the approved students develop the competencies that are proposed in the program content, consisting of a limitation of the research.

3 PRESENTATION AND ANALYSIS OF RESULTS

After completing the application of the Delphi Method, 56 competencies were indicated by the specialists, subdivided into 17 knowledge items, 16 skills and 23 attitudes. These competencies were mainly correlated with the PUD, since it is more detailed in the description of the content and because it indicates the operational objectives of each discipline (BRASIL, 2015b), as indicated in Table 4.

Initially, it was identified that among the 17 knowledge items listed by the specialists, 8 are taught in the CDGE.

Thus, it is noticed that 47% of the expertise indicated by the specialists as necessary to operate the Gripen-NG IRST system are developed in the CDGE.

Upon further analysis, it was possible to observe that knowledge items C16 and C17 are totally dependent on the interaction with the aircraft Gripen-NG. Also, since the CDGE is not intended to enable the pilot in the operation of the aircraft, the aforementioned knowledge item, considered as specific, was disregarded in the scope of the present work. Therefore, there was a 53% relationship between the knowledge needed to operate the Gripen-NG IRST and those ministered in the CDGE.

Subsequently, it was identified that among the 16 skills listed by specialists, 2 are developed in CDGE, totaling 12.5%.

On the subject, similar to what happened with the knowledge, but in a more ostentatious way, the experts indicated 13 skills (H4 thru H16) directly dependent on the aircraft. Such a result is understandable, since, as already mentioned in this article, the ability was considered as the capacity of a person to put knowledge stored in his/her memory and to use it in an action. Therefore, it is consistent that the experts indicate as necessary skills that involve the execution of the flight itself.

However, "Developing skills is not like being content by having followed a program, but rather by not stopping it from building and testing" (PERRENOUD, 1999, p. 79). In this way, it is important to understand that the competency development process does not terminate at the end of a single theoretical course, since it must be continually improved in the operational units.

In order to maintain the established focus on the research problem, only the skills indicated by the experts that do not depend on the execution of the flight were considered. Therefore, there was a 67% ratio between the skills needed to operate the Gripen-NG IRST and those developed in the CDGE.

Finally, it was identified that in the PUD and Minimum Curriculum of the CDGE there are very broad and generic teaching objectives focused on the field of attitudes, namely:

> a) to be aware of the importance of Electronic Warfare as a multiplying factor in the combat capability of the Air Force and the importance of the dissemination of the doctrine established by COMGAR;
> b) to train entrepreneurial professionals with the capacity to promote the doctrinal and operational development of the Air Force; and
> c) to foster the development of critical thinking and technical knowledge to evaluate the use of airborne vectors in the light of Electronic Warfare doctrine, implementing appropriate solutions for the operational development of the (FAB). (BRASIL, 2012, p. 8).

Table 4 – Correlation of competences.

Required skills	CDGE Disciplines
C2, C6, C10, H1	Electro-optics (infrared).
C9	Use of passive detection equipment.
C11, C13, H3	Fundamentals of Electronic Warfare.
C12	Basic Concepts of Electronic Warfare.
	Propagation.
	Electromagnetic waves.
C15	Division of Electronic Warfare.
C1, C3 to C8, C14, C16, C17, H2, H4 to H16, A21 to A23	Not addressed.
A1 to A20	All subjects (general objective of the course).

Source: The author.

The scope of these topics is highlighted by the fact that these are general objectives of the course to be pursued at the end of all disciplines. As indicated by Carbone et al. (2009), attitude is the predisposition of the person to perform the action, related to **wanting to do**. Therefore, it was considered that, once the pilot develops the attitudes mentioned as general objectives of the course, he/she will consequently develop other more specific attitudes, arising from these principals. Thus, it was noticed that 20 attitudes reported by specialists as necessary are developed in CDGE (A1 to A20, inclusive), corresponding to 87% of the total indicated.

In summary, it was possible to observe that the CDGE develops 30 competencies pointed out by specialists as necessary to operate the IRST of the aircraft F-39 (8 knowledge, 2 skills and 20 attitudes). Considering the reservations presented in the analysis in relation to the dependent competencies of the aircraft, it is realized that 41 competencies are necessary (15 knowledge, 3 skills and 23 attitudes). Therefore, a percentage ratio between the totals developed and required is applied, and a 73% correspondence is observed, according to Table 1.

Using the theory presented by Carbone et al. (2009), it was possible to identify that there is a competence gap, mainly due to the inclusion of a new technological component in the process, the aircraft Gripen-NG. According to the authors cited, the organization FAB must seek ways to reduce this gap to the minimum possible and thus remain competitive, which, in the case of an Air Force, can be understood as preserving an equivalent operational capacity or higher than the threats.

It was noticed that, when conducting an analysis from the perspective of competence management, it was possible to identify a training gap in relation to the future need of FAB in the operation of the IRST in the aircraft Gripen-NG, which makes a corrective action feasible and by anticipation, in order to minimize or eliminate this gap, contributing to the preservation of a high level of training of FAB fighter pilots, future operators of the aircraft Gripen-NG.

The results also allow us to identify that, in the spite of a gap, the CDGE collaborates in improving the knowledge, skills and attitudes necessary for the operation of the IRST, since it develops 73% of the skills that are considered fundamental by the specialists. Consequently, it is understood that, regardless of any action to minimize the identified skill gap, there should be an effort to enable all future F-39 pilots to attend the CDGE before operating the aircraft's IRST system.

In addition, according to the theories presented by Costa (2005), Deluiz (2001) and Sacristán (2013), knowing the desired professional profile of the pilot (necessary skills), there is an indication of how the content of CDGE and other related courses can be improved if they are equated with the practices required by the fighter pilot to operate the various aircraft F-39 systems in the light of the competency model.

4 CONCLUSION

This work was motivated by the concern about the acquisition of the aircraft Gripen-NG by FAB, as it will bring with it a series of technological innovations, especially in the area of Electronic Warfare EW, which will require a high level of training by the pilots.

In this sense, the author tried to investigate, based on the concepts of management by competences, if the learning developed during the training of the pilots in the area of EW has followed the progress provided by the acquisition of the aircraft Gripen-NG.

To this end, the following research problem was stated: to what extent does the Electronic Warfare Doctrine Course develop the skills required by FAB fighter pilots to operate Electronic Warfare systems on the aircraft F-39 Gripen-NG?

Based on this questioning, it was decided to limit the study to the IRST system and presented, as a general objective of this work, to analyze the correlation between the competencies developed in the course and those necessary for the pilots to operate the refered system. In

Table 1 – Summary of results by analysis categories.

Competences	Developed	Needed	Percentage ratio
Knowledge	8	15	53%
Skills	2	3	67%
Attitudes	20	23	87%
Total	30	41	73%

Source: The author.

order to respond to the research problem and to achieve the general objective of this article, two guiding questions and two specific objectives were presented. The first one SO1 sought to identify the competencies needed to operate the IRST system. The second one SO2 had the purpose of identifying if the necessary competencies to operate the IRST system are developed in the CDGE.

Initially, to achieve the SO1, a survey was performed using the Delphi method, in two series, in which a group of 8 specialists listed the necessary competences. Subsequently, to achieve SO2, a documentary research was carried out, through the analysis of the PUD and the Minimum Curriculum of the CDGE, in which the necessary competencies developed in the course were identified.

Thus, through the analysis of the results obtained during the work, it was possible to respond to the research problem and to verify that 73% of the competencies required to operate the aircraft F-39 IRST system are developed in the CDGE, divided into 53% knowledge, 67% of skills and 87% of attitudes.

Finally, as a proposal for future work, it is suggested to map the competencies needed to operate other relevant systems of the aircraft Gripen-NG and to verify if the previous students of the CDGE actually develop the competencies foreseen in the program content.

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