https://doi.org/10.1590/jatm.v18.1414 ORIGINAL PAPER

Application of Design Science Research in Brazilian Air Force Technology Transfer Processes

Edvaldo Antonio das Neves[1*], Herlandi de Souza Andrade[2], Araken Alves de Lima[3], Francisco Cristóvão Lourenço de Melo[1]

1. Departamento de Ciência e Tecnologia Aeroespacial – Instituto Tecnológico de Aeronáutica – Programa de Pós-Graduação em Ciências e Tecnologias Espaciais – São José dos Campos/SP – Brazil.
2. Universidade de São Paulo – Escola de Engenharia de Lorena – Departamento de Engenharia Química e de Produção – Lorena/SP – Brazil.
3. Instituto Nacional de Propriedade Industrial – Academia de Propriedade Intelectual, Inovação e Desenvolvimento – Divisão de Pós-Graduação em Propriedade Intelectual e Inovação – Rio de Janeiro/RJ – Brazil.

***Corresponding author:** edvaldo.neves@gmail.com

ABSTRACT

The objective of this article is to communicate the results of the study that formed the basis for the development of a method for commercializing technologies, developed by a Technological Innovation Center (TIC) responsible for the Scientific, Technological, and Innovation Institutions (STIs) of the Brazilian Air Force (FAB), brought together in the Aeronautical Innovation System (SINAER). It emphasizes the process of entering into licensing and technology transfer agreements, with an emphasis on those of interest to national defense. Its creation was conducted through Design Science Research (DSR), which is a rigorous process of designing artifacts to solve problems, evaluating what has been designed, and communicating the results obtained. The method proved to be effective in organizing the actions and competencies of each element involved in the negotiation and execution of contracts, fulfilling the objectives of the Ministry of Defense (MD) in transferring the technologies generated by its STIs, making it feasible to prescribe the solution found for the class of problems identified.

Keywords: Technology transfer; Defense industry; Aerospace industry.

INTRODUCTION

The objective of this article is to present the results of the study, developed between 2021 and 2025 and conducted using the Design Science Research (DSR) method to propose a solution to a problem in the area of innovation management at the Air Force Command (COMAER), here referred to as the Brazilian Air Force (FAB).

The solution consists of designing a method, characterized as an artifact, to guide technology transfer processes by organizing the procedural flow of direct negotiations for the conclusion of contracts of this nature between the FAB's Scientific, Technological, and Innovation Institutions (STIs) and companies.

The method includes technologies of interest to national defense, primarily demanded by companies that make up the Defense Industrial Base (DIB), formed by organizations that, among other things, conduct activities in Brazil related to the research, development, and industrialization of defense products or systems but also applies to dual-use technologies of interest to other companies in the productive sector.

Received: Oct. 07, 2025 | **Accepted:** Oct. 28, 2025
Peer Review History: Single Blind Peer Review.
Section editor: Raul Bonadia Rodrigues

It also articulates the activities of the FAB's STIs and its Technological Innovation Center (TIC), considering Brazilian science, technology, and innovation (ST&I) legislation and negotiation techniques available in the literature. The solution meets the needs of the studied organization and prescribes solutions for organizations with similar problems, derived from the need to coordinate several STIs that share the same TIC. In common, these STIs develop technologies that can be characterized as of interest to national defense, whose transfer to the productive sector requires prior authorization from the Ministry of Defense (MD).

As with all studies conducted using the DSR method, this one describes the construction of the artifact, understood as the organization of the components of the internal environment to achieve objectives in a given external environment (Simon 1996).

The relevance of the study lies in the impacts that the legal regime of ST&I has had on public universities and research institutes given that, since the first legal document of this regime, Law No. 10,973/2004 (Innovation Law), STIs have become producers of technologies for the national productive sector, and the phenomenon has gained academic attention, fostering the area of knowledge focused on understanding the university-company interaction, whether through technology transfer, technical cooperation in research, or the provision of specialized technical services, as provided for in this law (Brazil 2004).

Thus, this article specifically aims to contribute to the area of knowledge related to Innovation Management, focusing on the transfer of aerospace and defense technology conducted by the FAB's STIs, linked to the MD and the guidelines established by it. This ministry, through MD Ordinance No. 3,063/2021, instituted the Defense Science, Technology, and Innovation Policy, encouraging partnerships between military STIs and companies in the development of defense products, including technology transfer and licensing. Complementarily, it also instituted GM-MD Ordinance No. 3,439/2021, which approved the MD's Intellectual Property Policy, providing guidelines in this regard.

Studies of this nature are based on the Triple Helix concept, where Etzkowitz (2003) highlights the interaction between government, universities and industry, emphasizing that the government acts beyond its traditional role as regulator and plays an active role in innovation, while universities generate new creations to be introduced into the market by companies. The Triple Helix has become an internationally recognized model serving as a guide for public policies aimed at developing a successful innovation strategy and inducing economic development (Etzkowitz and Zhou 2017).

In this sense, Matos (2022) states that the creation of Aeronautics Institute of Technology (ITA) was the result of a successful industrial policy, where the interaction between government, universities and industry helped to establish the DIB, influenced by the military's perception of the importance of aerospace power, by contributing to the training of engineers and the development of aeronautical technologies, essential for the sustainability of the industry. Suzigan and Albuquerque (2008) also state that one of the historical roots of the Triple Helix can be found in the Brazilian defense sector, resulting in the creation of Embraer, one of the largest aircraft manufacturers in the world, as a direct result of the creation of ITA and its aeronautical engineering course, preceding the creation of this industry.

Without losing sight of what has been discussed, it is necessary to specify the object of the study, considering that the artifact is focused on technology transfer, in a broad sense, through the commercialization of technologies materialized by specific legal instruments. In this sense, Andrade *et al.* (2016) state that the commercialization of technology is not synonymous with technology transfer and establish a distinction between these two terms, since commercialization is a process that, supported by legislation relating to intellectual property (IP) rights, involves commercial and technical aspects so that the technology developed by one organization can be transferred to another. Technology transfer, on the other hand, is a process that goes beyond commercialization, as it involves the transmission of knowledge about the technology to the receiving organization, enabling it to use it.

Thus, in order to effectively transfer technologies, STIs must first commercialize them, in accordance with the law. In this paper, technology transfer, in a broad sense, will be understood as a result of the negotiation process aimed at commercialization. In this sense, Article 6 of the Innovation Law allows STIs to enter into licensing agreements for technologies protected by IP rights, such as patents and technology transfer agreements, in the strict sense, a contractual modality that applies to technologies that are unpatented, unpatentable, or maintained as know-how (Brazil 2004).

Having clarified the concept, it is worth mentioning that two decades after the entry into force of Law No. 10,973/2004, there is still a constant adaptation of the legal framework designated as the "Innovation Framework" as the legal regime for ST&I, now also comprising Law No. 13,243/2016 (Legal Framework for Innovation) and Decree No. 9,283/2018, which regulates it (Bacelar and Sampaio 2020).

The Innovation Law encourages public universities and public research institutes to promote licensing and technology transfer to companies that make up the national productive system (Cruz *et al.* 2020; Garnica and Torkomian 2009; Miranda *et al.* 2019).

However, institutions with many years of experience in technology transfer management still face difficulties and most TICs encounter various barriers to mediating the university-company relationship and promoting the transfer of academic knowledge to the business sector (Fernandes *et al.* 2018; Pires and Silva 2023).

Ribeiro *et al.* (2019) also state that the legal provision changed much of the legal framework with the aim of leveraging the effective functioning of the Triple Helix in the country, leading higher education institutions to implement measures in line with the new model.

Therefore, the adaptation of STIs to the new legislation is of paramount importance, given that they themselves establish their processes in accordance with legal requirements aimed at creating an environment conducive to innovation, without losing sight of the fact that strict legality prevails in the Brazilian public sector's legal model, *i.e.*, public entities must proceed only as established by law (Souza Filho and Carvalho 2022).

Having introduced the topic, its objective, and justifications, it is appropriate to present the DSR method used to conduct the study.

METHODS

Lacerda *et al.* (2013) state that DSR aims to study, research, and investigate the artificial and its behavior, both from an academic and organizational point of view, and constitutes a rigorous process of designing and communicating the results obtained as defined by Çağdaş and Stubkjær (2011). To conduct it, it is necessary to follow the sequential steps of Awareness, Suggestion, Development, Evaluation, and Communication (Takeda *et al.* 1990).

Awareness highlights the problematic situation to be solved, in addition to emphasizing the external environment and its main points of contact with the formalized artifact, the interested actors, and the class of problems and existing artifacts, pointing out their limitations. Based on awareness, it is necessary to conduct a systematic review of the literature, with known empirical solutions. In this study, the literature consulted deals with the role of TICs in technology transfer management, for which the method was developed.

The suggestion stage explains the premises and requirements for the construction of the artifact and attempts at its development. It justifies the choice of tools, such as case studies and action research, for the development of the artifact, configured as a method, given that it is characterized by a set of steps used to perform a task.

The development stage explains the components and causal relationships that generate the desired effect so that the artifact achieves its objectives, which in this study consist of promoting the commercialization of FAB's STIs technologies to national companies.

The evaluation, in turn, was based on the observational method by the first author of the study, a member of the TIC, in interaction with actors from internal and external environments during the implementation of the artifact, which made it possible to formalize a regulation in the studied organization, evaluated in a business environment, allowing the solution developed to be prescribed for similar organizations.

RESULTS AND DISCUSSION

As mentioned, in the awareness stage, it is necessary to discuss the problematic situation to be resolved. In this study, it derives from the need to comply with Art. 15-A of the Legal Framework, which determines that these policies provide for the organization and management of the processes that guide TIC technology transfer (Brazil 2016). Thus, the legal apparatus influences the choice of the format of the artifact for transferring technologies.

In addition to the legislation, it is also necessary to discuss the function of TICs, given that the same legislation determines that all STIs must have a TIC, with duties defined in Article 16 of the law (Brazil 2004; Castro and Souza 2012).

The consulted literature covers the Brazilian reality after 2018, when the law was regulated through Decree No. 9,283/2018, and consists of case studies from a perspective in which a single public STI has its own TIC to support the management of its innovation policy, as mentioned in Article 15-A.

Article 16, in turn, allows the public STI to associate with other STIs to form a TIC, common to all, to support unique innovation policies. This is the case of the FAB, in which a single TIC, subordinate to the Department of Aerospace Science and Technology (DCTA) and named Innovation Management Coordination (CGI/DCTA), supports 17 STIs that constitute the Aeronautics Innovation System (SINAER).

Thus, the artifact resolves this situation by interfacing the organization's internal environment, through the system that brings together its STIs and its TIC, to achieve objectives in the external environment, composed of legislation, the MD, its legal advisory oversight body, and companies for which the technologies are intended, preferably those of interest to national defense. The defined objectives consist of entering into licensing and technology transfer agreements between STIs and companies.

It should be noted that the concept of technology of interest to defense does not yet have well-established boundaries. When Decree No. 9,283/2018 regulated the Legal Framework, Article 82 of the decree established that in cases of assignment, licensing, or transfer of technology of interest to national defense, public STIs would be required to obtain prior authorization from the MD. This article also defined that these technologies would be defined by a joint normative act of the MD and the Ministry of Science, Technology, and Innovation (MCTI) (Brazil 2018).

However, at the time this study was completed, the aforementioned normative act had not yet been published by the executive branch. Given this legal gap and because it is linked to the MD, the CGI/DCTA follows Ordinance GM-MD No. 1,112, of March 4, 2024, which sets out the areas of technological interest intended to guide the conduct of research and development activities under the MD and its Armed Forces to deliberate on the technologies that should be submitted for consultation and prior approval by the ministry when it comes to the assignment, licensing, or technology transfer of STIs from the FAB.

Continuing with the analysis of the legislation, it can be stated that the ST&I legal regime establishes procedures for the conclusion of two types of contracts. The first provides for the granting of an exclusivity clause to the recipient of the technology, requiring STIs to promote a competitive process among companies interested in receiving the technology. The other type, in which no exclusivity clause is granted, allows STIs to negotiate directly with the interested company or companies (Brazil 2004).

In the case of the FAB, due to the Armed Forces' own demand for products derived from the technologies it develops, the licensing and technology transfer processes avoid granting an exclusivity clause to the recipient, aiming to develop as many suppliers as possible in the domestic market. This condition is essential for defining the scope of the developed artifact.

However, the legislation does not provide guidelines for conducting direct negotiations between STIs and companies and does not comment on the content of legal instruments. Because of this, documents and guidelines provided by legal advisory bodies are used, which act as external elements when it comes to artifacts aimed at technology transfer.

When referring to most public STIs, consisting of universities and research institutes, indirect public administration bodies, composed of autonomous agencies and foundations, legal advice is provided by the Federal Attorney General's Office (PGF), a body belonging to the Attorney General's Office (AGU). This body established a Permanent Chamber of Science, Technology & Innovation (CP-CT&I/PGF) in 2019, with the aim of providing a more secure legal environment for STIs. The group prepared the document "Collection of Opinions and Legal Instruments of the Legal Framework for Science, Technology, and Innovation," published in October 2020, containing opinions and drafts of the various legal instruments provided for in this legislation (Rodrigues *et al.* 2022).

However, the PGF does not advise the entire universe of public STIs, due to the organizational division of the AGU, which has specialized bodies. In these bodies, there is the figure of the federal attorney, who performs advisory and litigation functions for the direct administration, and the federal prosecutor, who provides judicial and extrajudicial representation, legal advice, and assistance to federal public agencies and foundations, which constitute the indirect administration (Veríssimo 2019).

Thus, the literature analyzes how the PGF provides legal advice to STIs in the indirect administration through opinions and contract templates. However, the studied organization is part of the direct public administration and is advised by the Office of the Comptroller General (CGU) through federal attorneys, so the existing artifact does not serve it.

The CGU's understanding differs from that of the PGF because it requires legal instruments to be linked to ST&I projects, in accordance with Normative Guideline No. 7, of 2021, of the Specialized Virtual Residual Federal Legal Advisory Office (E-CJU Residual), an agency linked to the CGU. Thus, the licensing and technology transfer promoted by the FAB's STIs must be linked to an R&D project, comprising the Project Description and Implementation Plan, the TIC Opinion, and authorization from the STI director.

Thus, in suggesting and developing the artifact, it is necessary to consider that the CGU, when determining the content of a process to certify its legality under the ST&I legal regime, is an important actor in the external environment, together with the MD and companies interested in entering into a contract with the FAB's STIs.

Considering that the FAB prioritizes direct negotiations without granting exclusivity to the recipient, the artifact is structured around this modality. Thus, we now discuss the stages of Suggestion and subsequent Development.

Given what was mentioned in the awareness stage, with the definition of the problematic situation and the elements of the external and internal environments, the developed artifact that interfaces between these environments could be conceived due to a restructuring of the innovation management model at FAB, through the reconfiguration of its internal environment. It began in 2017 and resulted in the creation of SINAER, which, among other changes, linked the TIC (CGI/DCTA) directly to the DCTA.

Previously, TIC, created in 2006, was headquartered at the Institute for Industrial Development and Coordination and advised the other STIs (Alván 2012). Because it had no governance authority over them, it had difficulty conducting technology transfer processes to the productive sector. Contributing to this was the absence of innovation policies from the STIs to guide their actions and of a process that defined the competencies and distributed the necessary actions among the STIs and the TIC, a fundamental condition for achieving the desired objective.

In view of this, Leite *et al.* (2023) state that SINAER was created with a view to effective innovation management within the FAB, using a systemic governance model as a response to the problems of poor communication and coordination among the various research and development institutions involved, as it enabled more effective management of innovation-related processes by structuring itself in a systemic manner. In this system, DCTA is the central body, and all FAB's STIs constitute the links, directly subordinate to this central body, when it comes to innovation management. The links must comply with the rules issued by the central body, being advised by their innovation cell, which performs a subsidiary function to CGI/DCTA.

In this system, the standards issued by the central body for STIs, designated in Table 1, are called Air Force Command System Standards (NSCAs). Shortly after the establishment of SINAER, most of the NSCAs were instituted, but the NSCA that would organize the management of technology transfer processes required further study for its formulation, justifying the research described in this article. There was also a need for greater interaction between CGI/DCTA and the STIs and the responsible legal advisory body (CGU) so that the first author of the study could suggest the artifact's design and propose its development with the collaboration of the aforementioned bodies during the design of the method.

Table 1. SINAER Scientific, Technological, and Innovation Institutions.

STI	Acronym
Department of Aerospace Science and Technology	DCTA
Aeronautics Institute of Technology	ITA
Institute of Aeronautics and Space	IAE
Institute of Advanced Studies	IEAv
Institute for Industrial Development and Coordination	IFI
Institute for Flight Research and Testing	IPEV
Alcântara Launch Center	CLA
Barreira do Inferno Launch Center	CLBI
Aeronautics Logistics Institute	ILA
Aeronautics Computing Center in São José dos Campos	CCA-SJ
Center for Aeronautical Engineering Studies and Projects	CEPE
Airspace Control Institute	ICEA
Aeronautics Chemical-Pharmaceutical Laboratory	LAQFA
Institute of Aerospace Medicine	IMAE
Air Force University	UNIFA
Institute of Operational Applications	IAOp
Institute of Economics, Finance, and Administration of Aeronautics	IEFA

Source: Elaborated by the authors.

The design of the artifact considered NSCA 80-1 – Aeronautics Innovation System Standard, in force since 2018 and reissued in 2024, which established SINAER, its structure, purpose, and competencies, and assigned STIs the competence to negotiate and manage the technology transfer agreements they generate, in accordance with specific TIC standards and their own innovation policies, still to be developed. The DCTA was assigned the competency to advise and support STIs in these agreements.

Based on this premise, the STIs linked to SINAER established their respective innovation policies in 2023, covering the last regulatory gap that had existed since the system's creation and enabling the design of the NSCA, which would address the organization of the unified method for managing technology transfer processes.

Among the tools for designing the NSCA, which would contain the artifact, a specific case served as a case study, providing input for its design and construction by providing the assumptions for designing the method, considering a series of legal and negotiation steps.

The case in question was the process for signing a technology transfer agreement for a space probe vehicle, in a microgravity environment, called VSB-30, between the Institute of Aeronautics and Space (IAE) and the company Avibras Aeroespacial S.A., which began in 2017 with the publication of a technological offer, in accordance with Article 6 of Law 12.243/2016, which was not yet in effect at the time. Strictly speaking, the publication of an extract from the technological offer was only required in cases of granting exclusivity to the recipient of the technology, which was not the case, but the organization proceeded in this manner due to the lack of internal regulations on the matter.

During the negotiations, Decree No. 9,283/2018 was published, and for the first time, it was necessary to comply with the provisions of its Article 82, which required prior consultation with the MD, another external interested party, given that the space vehicle, which has characteristics of ballistic missiles, could be considered a technology of interest to national defense. On this occasion, the MD considered the request and responded favorably to the continuation of the technology transfer to the requesting company, which belongs to the IDB.

After negotiating and drafting the contract, the process was forwarded for legal review in 2019. In this context, the Legal Advisory Office of São José dos Campos (CJU/SJC), linked to the CGU, required the preparation of a ST&I project as mentioned. As a result, CGI/DCTA and IAE had to comply with this requirement, and the contract was signed in 2020, thus becoming the first to be signed after the Legal Framework came into effect.

Backed by the experience described above, Table 2 summarizes the essential premises for the suggestion stage that would design the method for direct negotiation between the STI and the company, in accordance with paragraph 2 of Article 6 of Law No. 10,973/2004, where exclusivity is not granted to the recipient or licensee. Eleven sequential stages were proposed, considering the need to comply with the legislation and rules affecting the process. Of these stages, only 4 can be waived if the nature of the technology does not fall within the cases provided for in Article 82 of Decree No. 9,283/2018. Due to the need to design and apply the method in the organization, action research was characterized as action research, which, combined with the case study, constitutes tools for the design of the artifact.

Compliance with the legal and regulatory principles mentioned in Table 2 formed the basis for the design of the stages of suggestion and development of the artifact, materialized by the draft of NSCA 80-13 – Licensing and Technology Transfer Process at COMAER, which regulates the matter at SINAER. It should be noted that this NSCA also regulates cases of competition for the conclusion of contracts with exclusivity clauses, but this modality is not part of the artifact as it has not been validated in a business environment.

As reported below, the suggestion was fully adopted in the design of the artifact, with no modifications necessary between the suggestion and development (Fig. 1).

The sequential steps that form the method for entering into licensing and technology transfer contracts, as shown in Fig. 1, are characterized as follows.

- Step 1: Formal start of negotiations through the receipt, by CGI/DCTA, of the company's letter of interest.
- Step 2: Establishment of an administrative management process (AMP) in accordance with the normative guidelines of the Ministry of Justice (MJ) and the Ministry of Planning, Budget, and Management (MPOG).

- Step 3: Formal statement by the STI, owner of the IP rights or holder of the technology, regarding the convenience and opportunity to meet the company's demand.
- Step 4: Consultation with the MD to obtain prior authorization in cases where the technology is considered to be of interest to national defense, provided that it is covered by MD-GM Ordinance No. 1,112, dated March 4, 2024. In this case, CGI/DCTA forwards the company's request to the MD. The process must contain a description of the technology and its purpose. Information about the applicant company is also forwarded to the MD for consideration.
- Step 5: Preparation of negotiations between CGI/DCTA and STI. The scope of the contract is clearly defined, in view of paragraph 6 of Article 6 of the law. In addition to the subject matter of the contract, the desired value of the technology and the means of remuneration for its exploitation, as well as everything that will accompany the process, must be made clear. This step, freely inspired by Quintella *et al.* (2019), considers the following actions:
  - Preparation for negotiation with definition of team participants; type of communication to be adopted and scheduling of meetings between the parties.
  - Characterization of the parties and those authorized to negotiate or close agreements.
  - Characterization of the technology, which involves the technological readiness level.
  - Definition of the subject of the negotiation, which involves the Innovation Policy of each STI; the geographical area and the possibility of licensing to third parties if the technology is protected by IP rights and rights to modification and improvements.
  - Financial aspects, such as reimbursement of development costs, investments needed to increase the technological readiness level and their sources of financing, sharing of financial resources obtained from commercialization, updates, and maintenance of the technology; limitation of liability, in addition to defining penalties and indemnities.
  - Updating and maintenance of the technology, such as fees charged by national and international IP offices; possibility of transferring know-how, rights to future developments and technical assistance.
  - Final evaluation and pros and cons of the technology, such as the definition of what is and is not negotiable.

In relation to the bibliography consulted, adaptations were made with the addition of the following topics:

- Criteria for evaluating technical qualifications, to be proven by the interested company, according to § 5 of Art. 12, of Decree No. 9,283/2018.
- Ability of creators and other employees to pass on the necessary knowledge and information to the recipient or licensee, in accordance with § 6 of Art. 6 of Law No. 10,973/2004.
- STI's capacity to prepare all technical documentation for the ST&I project in order to support potential licensing or technology transfer agreements.

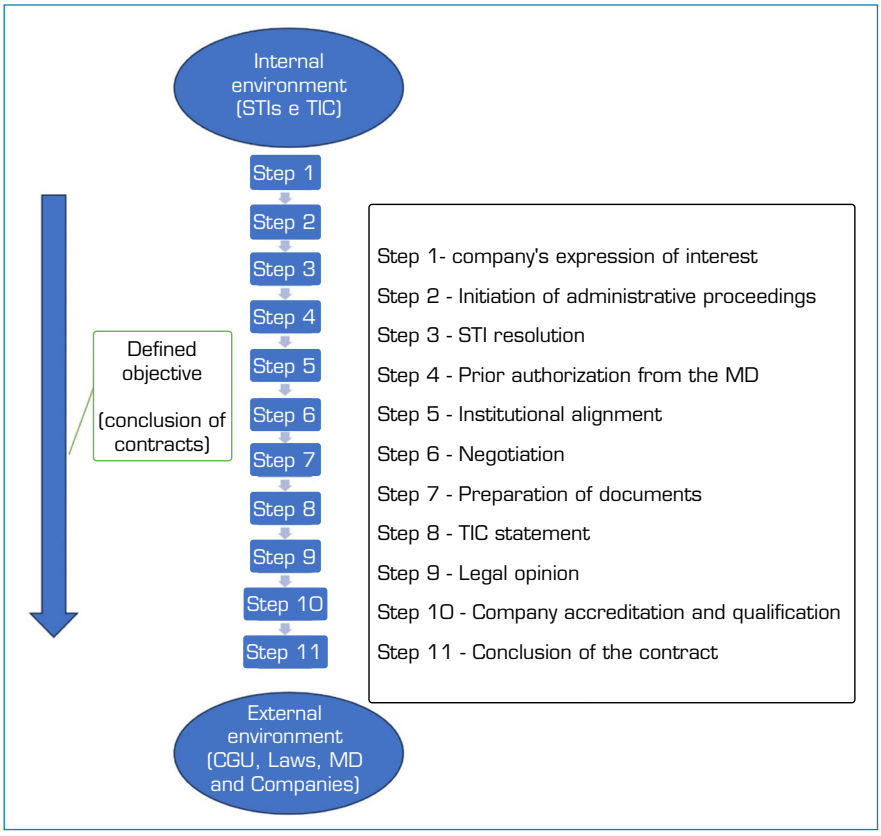
- Step 6: Meetings between STI, with the participation of CGI/DCTA, and the company that can clarify doubts about the functioning of the technology and the extent to which STI can support it, as defined in Step 5. The company will present its business plan so that, together with STI, a good financial agreement can be reached for both parties. Even if a preliminary valuation has been carried out, the actual valuation takes place during the negotiation. Once the negotiation is complete, it is verified that everything that has been agreed upon is recorded, and at the end of this stage, the company must confirm its interest in proceeding with the contract in order to continue the process.
- Step 7: Preparation of documentation consisting of the ST&I project and draft contract.
- Step 8: CGI/DCTA statement on the process and the draft contract, verifying the institutional alignment between the technology transfer and the STI's innovation policy.
- Step 9: Statement from the legal advisory body.
- Step 10: Verification of the company's legal and tax status and economic and technical qualifications.
- Step 11: Signing of the contract, finalizing the process.

After the suggestion and development of the artifact, two defense companies, members of the DIB, submitted their requests to the DCTA to receive technologies from the IAE collection. Through these processes, as shown in Table 3, it was possible to evaluate the artifact in a business environment.

Table 2. Stages of the Artifact and its premises.

No	Stage	Premise	Those involved
1	Acceptance of the company's expression of interest	§ 2 of Art. 6 of Law No. 10,973/2004, which allows direct negotiation when exclusivity is not granted to the technology recipient or licensee	Company and CGI/DCTA
2	Initiation of Administrative Proceedings	Interministerial Ordinance MJ/MPOG No. 1,677/15, which establishes the formalization of proceedings	CGI/DCTA
3	STI Resolution	Headline of Article 6 (Law No. 10,973/2004) that allows the public STI to enter into technology transfer and licensing agreements	STI
4	Prior authorization from the MD	Article 82 of Decree No. 9,283/2018, which requires public STIs to consult with the MD in advance in cases where the technology is considered to be of interest to national defense.	MD
5	Institutional Alignment	STI Innovation Policies with criteria for negotiation and § 6 of Art. 6 of Law No. 10,973/2004, which requires STIs to pass on everything that is negotiated in the contractual object.	STI and CGI/DCTA
6	Negotiation	What remains defined in the previous stage	STI, CGI/DCTA, and Company
7	Preparation of documents	E-CJU RESIDUAL Normative Guideline No. 7/2021, which establishes the mandatory nature of ST&I Projects.	STI
8	TIC statement	Art. 16, §1 of Law No. 10,973/2004, which so requires	CGI/DCTA
9	Legal Opinion	AGU Ordinance No. 1,399, of October 5, 2009, which so requires	AGU
10	Company accreditation and qualification	§ 5 of Art. 12, of Decree No. 9,283/2018, which determines proof of the legal and fiscal regularity and technical and economic qualification of the company for the exploitation of the creation.	STI and Company
11	Conclusion of the Contract	Legal regime of ST&I	STI and Company

Source: Elaborated by the authors.



Source: Elaborated by the authors.

Figure 1. Artifact.

Table 3. Contracts entered into through the artifact.

No	Technology	STI	Company	Year of signing
1	Brazilian 70mm Air-to-Ground Rocket System (SBAT-70), general-purpose bombs and their fuses and practice bombs	IAE	CSD	2024
2	SBAT-70	IAE	IMBEL	2024
3	PAPI (know-how)	IEAv/ICEA	ADVANCED	2025
4	PAPI (Computer Program)	IEAv	ADVANCED	2025
5	PAPI (know-how)	IEAv/ICEA	ASTC	2025
6	PAPI (Computer Program)	IEAv	ASTC	2025

Source: Elaborated by the authors.

During the eleven stages, both processes were successful in promoting the transfer of technologies considered to be of interest to national defense, as they are directly related to defense products. The processes received favorable opinions from the MD and legal counsel, and the legal instruments were effectively signed in 2024, establishing the first technology transfers within the scope of SINAER that complied with the proposed procedural flow, validating the artifact.

Thus, still in 2024, after the signing of the first contract and the confirmation that the method worked and was understood by those involved, NSCA 80-13 was approved – Licensing and Technology Transfer Process in COMAER, which deals with the process for entering into licensing and technology transfer contracts and incorporates the artifact in the form of a method that establishes the competencies and actions of the STIs and CGI/DCTA (TIC) for entering into contracts of this nature.

After the signing of the first two contracts, referred to as 1 and 2 in Table 3, two new companies that had requested technology transfer were also served by applying the method contained in NSCA 80-13. Both entered into technology transfer contracts corresponding to the know-how for the use of Remotely Piloted Aircraft System (RPAS) for precision Approach Path Indicator (PAPI) inspection, developed jointly by the IEAv and ICEA, and a computer program license entitled PAPI Inspection using Remotely Piloted Aircraft, registered with the National Institute of Industrial Property (INPI) under number BR 51 2023 002743-0, developed solely by the IEAv. These agreements were signed in the first half of 2025, reinforcing the validity of the artifact.

At the time this article was written, there were 16 cases in progress relating to technologies developed by IAE, IEAv, IPEV, ICEA, and ITA, most of them in the aerospace and defense areas, considered to be of interest to national defense. Their progress, in their different stages, following the idealized flow and the implemented method, demonstrates that more STIs from SINAER are using the developed artifact, attesting to its functionality.

CONCLUSION

The study aimed to build an artifact, characterized by a method, conducted by DSR, whose proposed solution, in serving the organization studied, could also prescribe solutions for STIs with similar problems.

The solution developed and adopted by the FAB was derived from the problematic situation of complying with ST&I legislation in the sense of establishing a technology transfer management process articulating all STIs that share the same TIC and develop technologies whose transfer to the productive sector requires prior authorization from the MD.

The artifact for technology transfer manages to articulate the STIs and their TIC within a system, configuring the internal environment with the purpose of achieving objectives in the external environment composed of companies, the MD, and the legal advisory responsible in accordance with the legal regime.

Having been validated in a business environment, it can be said that the artifact consisting of a method with eleven sequential steps, designed for the FAB and materialized in NSCA 80-13.

The method is disseminated internally and taught to innovation agents in STI cells through training courses promoted by CGI/DCTA, such as the Innovation Manager Training Course, which takes place annually.

Considering that both in the Brazilian Army and in the Brazilian Navy, the organization of the ST&I area is structured similarly to the FAB's, where several STIs are advised by a single TIC, the method can be adopted by them without the need for major organizational adaptations.Finally, it may also be adopted by public STIs upon the regulation of Article 82 of Decree No. 9,283/2018 when the joint normative act between the MD and MCTI qualifying technologies of interest to National Defense is published.

CONFLICT OF INTEREST

No conflict of interest.

AUTHORS' CONTRIBUTION

Conceptualization: Neves EA; **Methodology:** Neves EA; Andrade HS; **Analysis:** Neves EA; **Writing – Original Draft:** Neves EA; **Writing – Review and Editing:** Neves EA; **Supervision:** Melo FCL; Lima AA; **Final approval:** Neves EA.

DATA AVAILABILITY STATEMENT

The data will be available upon request.

FUNDING

Not applicable.

DECLARATION OF USE OF ARTIFICIAL INTELLIGENCE TOOLS

DeepL was used for grammar correction.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Departamento de Ciência e Tecnologia Aeroespacial.

REFERENCES

Alván CAO (2012) Analise da Gestão da Propriedade Intelectual no Departamento de Ciência e Tecnologia Aeroespacial (PhD Thesis). São Jose dos Campos: Instituto Tecnológico de Aeronáutica. http://www.sophia.bibl.ita.br/biblioteca/index.asp?codigo_sophia=63433

Andrade HS, Urbina LMS, Follador AON, Neves EA (2016) Processos para comercialização da propriedade intelectual em um núcleo de inovação tecnológica. Rev Espacios 37(17):19.

Bacelar ACB, Sampaio S (2020) Linha do tempo de propriedade intelectual & inovação: identificação de marcos legais. Paper presented at: VI ENPI, 1749-1758. Natal, Brazil.

Brazil (2004) Lei n. 10.973, de 02 de dezembro de 2004. Dispõe sobre incentivos à inovação e à pesquisa científica e tecnológica no ambiente produtivo e dá outras providências. https://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/lei/l10.973.htm

Brazil (2016) Lei n. 13.243, de 11 de janeiro de 2016. Dispõe sobre estímulos ao desenvolvimento científico, à pesquisa, à capacitação científica e tecnológica e à inovação e dá outras providências. https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/lei/l13243.htm

Brazil (2018) Presidência da República. Casa Civil. Decreto nº 9.283, de 07 de fevereiro de 2018. Regulamenta a Lei no 10.973, de 2 de dezembro de 2004, a Lei no 13.243, de 11 de janeiro de 2016. https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/decreto/d9283.htm

Çağdaş V, Stubkjær E (2011) Design research for cadastral systems. Comput Environ Urban Syst 35(1):77-87. https://doi.org/10.1016/j.compenvurbsys.2010.07.003

Castro BS, Souza GC (2012) O papel dos Núcleos de Inovação Tecnológica (NITs) nas universidades brasileiras. Liinc em Revista 8(1):125-140. https://doi.org/10.18617/liinc.v8i1.465

Cruz SS, Santos A, Figueiredo JM, Santos ICL, Leite DB (2020) Transferência de tecnologia sob a ótica da Política de Inovação e do Marco Legal da Ciência, Tecnologia e Informação. Cad Prospecç 13(4):1024-1035. https://doi.org/10.9771/cp.v13i4.32706

Etzkowitz H (2003) Innovation in innovation: The triple helix of university-industry-government relations. Soc Sci Inf 42(3):293-337. https://doi.org/10.1177/05390184030423002

Etzkowitz H, Zhou C (2017) Hélice tríplice: inovação e empreendedorismo universidade-indústria-governo. Estud Av 31(90):23-48. https://doi.org/10.1590/s0103-40142017.3190003

Fernandes RF, Antenor MC, Andrade JS, Barros Filho MML, Araújo ALC (2018). Práticas de Transferência de Tecnologia: uma análise multicasos. Cad Prospecç 11(5):1342-1359. https://doi.org/10.9771/cp.v11i5.27316

Garnica L, Torkomian ALV (2009) Gestão de tecnologia em universidades: uma análise do patenteamento e dos fatores de dificuldade e de apoio à transferência de tecnologia no estado de São Paulo. Gest Prod 16(4):624-638 https://doi.org/10.1590/S0104-530X2009000400011

Lacerda DP, Dresch A, Proença A, Antunes Jr JAV (2013) Design Science Research: método de pesquisa para a engenharia de produção. Gest Prod 20(4):741-761 https://doi.org/10.1590/S0104-530X2013005000014

Leite BRA, Mussi RGS, Santos RL, Neves EA, Frey IA (2023) Sistema de inovação da aeronáutica: modelo sistêmico para gestão da inovação. Rev Ciênc Soc Perspect 22(42):65-76. https://doi.org/10.48075/revistacsp.v22i42.30643

Matos PO (2022) O protagonismo do poder aeroespacial nos Estados Unidos e seus reflexos no desenvolvimento da indústria aeronáutica brasileira. Rev Bras Estud Estratég 14 (28):69-87. https://doi.org/10.29327/230731.14.28-3

Miranda ALBB, Araujo IT, Freire BGO, Fernandes AJ (2019) Inovação nas universidades: uma análise do novo marco legal. ENIAC Pesqui 8(1):85-98. https://doi.org/10.22567/rep.v8i1.507

Pires EA, Silva KGVC (2023) A atuação dos núcleos de inovação tecnológica nas universidades: o caso brasileiro. GeSec 14(9):15331-15355. https://doi.org/10.7769/gesec.v14i9.2653

Quintella CM, Frey IA, Rohweder M, Versoza RL, Quintella GM (2019) Negociação e Mediação na Prática. In: Frey IA, Tonholo J, Quintella CM, editors. Conceitos e aplicações de transferência de tecnologia. Salvador: IFBA. p. 170-222.

Ribeiro MC, Soares AAC, Mendonça CMC (2019) Desafios da inovação e transferência de tecnologia no ambiente acadêmico: o caso da Universidade Federal do Amapá (UNIFAP). Cad Prospecç 12(5):1040-1051. https://doi.org/10.9771/cp.v12i5.33108

Rodrigues FCR, Rocha FC, Aguiar SR, Luz MCV (2022) Instrumentos jurídicos do Marco Legal de Ciência, Tecnologia e Inovação: estudo dos modelos de contrato de transferência de tecnologia de 2020 da Advocacia Geral da União. Cad Prospecç 15(4):1090-1106. https://doi.org/10.9771/cp.v15i4.48983

Simon HA (1996) The sciences of the artificial. 3rd ed. Cambridge: MIT Press.

Souza Filho GA, Carvalho HA (2022). Administration, management and public governance in Brazil. Int J Dev Res 12(7):57294-57301. https://doi.org/10.37118/ijdr.24949.07.2022

Suzigan W, Albuquerque EM (2008) A interação entre universidades e empresas em perspectiva histórica no Brasil. Belo Horizonte: UFMG; Cedeplar. In Portuguese.

Takeda H, Veerkamp P, Yoshikawa H (1990) Modeling design process. AI Mag 11(4):37-48. https://doi.org/10.1609/aimag.v11i4.855

Veríssimo DPA (2019) O papel da advocacia pública federal na concepção e implementação de políticas públicas. Rev Digit Const Garantia Direitos 11(2):43-59. https://doi.org/10.21680/1982-310X.2018v11n2ID15962