As engenharias agregando conhecimento em setores emergentes de pesquisa e desenvolvimento 2

Henrique Ajuz Holzmann
(Organizador)

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APRESENTAÇÃO

Na sociedade atual, onde cada vez mais se necessita de informações rápidas e eficientes, o repasse de tecnologias é uma das formas mais eficazes de se obter novas tendências mundiais. Neste cenário destaca-se as engenharias, as quais são um dos principais pilares para o setor empresarial. Analisar os campos de atuação, bem como pontos de inserção e melhoria dessa desta área é de grande importância, buscando desenvolver novos métodos e ferramentas para melhoria continua de processos.

Estudar temas relacionados a engenharia é de grande importância, pois desta maneira pode-se aprimorar os conceitos e aplicar os mesmos de maneira mais eficaz. O aumento no interesse se dá principalmente pela escassez de matérias primas, a necessidade de novos materiais que possuam melhores características físicas e químicas e a necessidade de reaproveitamento dos resíduos em geral. Além disso a busca pela otimização no desenvolvimento de projetos, leva cada vez mais a simulação de processos, buscando uma redução de custos e de tempo.

Neste livro são apresentados trabalho teóricos e práticos, relacionados a área de engenharia, dando um panorama dos assuntos em pesquisa atualmente. De abordagem objetiva, a obra se mostra de grande relevância para graduandos, alunos de pós-graduação, docentes e profissionais, apresentando temáticas e metodologias diversificadas, em situações reais. Sendo hoje que utilizar dos conhecimentos científicos de uma maneira eficaz e eficiente é um dos desafios dos novos engenheiros.

Boa leitura

Henrique Ajuz Holzmann

SUMÁRIO

CAPÍTULO 15

THE EVOLUTION OF REGULATION OF THE AIR NAVIGATION ACTIVITY IN BRAZIL

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ABSTRACT: The objective of this work is to analyze the evolution of the regulation of air navigation activity in Brazil, identifying the main stages of regulation in the last years. Greater emphasis will be given to showing the need to make normative adjustments, to fill gaps and occasional conflicts with the improvement of the sector's governance structure, regarding the assignment of roles and responsibilities. The governance structure of the sector presents areas that can be improved. With regard to the regulation, execution and inspection of Brazilian airspace, it is identified here an opportunity for improvement in the attribution of responsibilities for aviation regulation in the Country, mainly to airspace control, since, currently, these three functions are carried out by the same governmental and military body, the Department of Airspace Control - DECEA. The identification of the benefit of the level of coordination between civil aviation regulators, focusing on airspace control, is a key issue in this work. With the elimination of the concentration of functions by the country's air navigation regulatory agency, the State can improve governance, assign roles and responsibilities to the sector, manage incentives, coordinate operations and regulate the structure, resulting in improved performance economic-operational.

KEYWORDS: Regulation; governance structure; airspace control; coordination.

A EVOLUÇÃO DA REGULAÇÃO DA ATIVIDADE DE NAVEGAÇÃO AÉREA NO BRASIL

RESUMO: O objetivo deste trabalho é analisar a evolução da regulação da atividade de navegação aérea no Brasil, identificando as principais etapas da regulação nos últimos anos. Maior ênfase será dada à demonstração da necessidade de ajustes normativos, para preenchimento de lacunas e eventuais conflitos com o aprimoramento da estrutura de governança do setor, quanto à atribuição de papéis e responsabilidades. A estrutura de governança do setor apresenta áreas que podem ser aprimoradas. No que se refere à regulação, execução e fiscalização do espaço aéreo brasileiro, identifica-se aqui uma oportunidade de melhoria na atribuição de responsabilidades pela regulação da aviação no País, principalmente ao controle do espaço aéreo, uma vez que, atualmente, essas três funções são exercidas pelo mesmo órgão governamental e militar, o Departamento de Controle do Espaço Aéreo - DECEA. A identificação do benefício do nível de coordenação entre os reguladores da aviação civil, com foco no controle do espaço aéreo, é uma questão fundamental neste trabalho. Com a eliminação da concentração de funções pela agência reguladora da navegação

aérea do país, o Estado pode aprimorar a governança, atribuir funções e responsabilidades ao setor, gerenciar incentivos, coordenar as operações e regular a estrutura, resultando em melhor desempenho econômico-operacional.
PALAVRAS-CHAVE: Regulamento; estrutura de governança; controle do espaço aéreo; coordenação.

1 | INTRODUCTION

A few years after Alberto Santos Dumont's first and historic flight in Paris, 1906 a huge development in aviation was initiated, when planes began to cover increasingly larger distances, and long before World War II, well-known pioneers flew from continent to continent crossing oceans in heroic adventures.

At the beginning, planes took off from "airports" that were nothing more than areas like pastures and football fields or, with some luck, stretches of road [1].

Already free from the conflicts of the World War I, the 1920's benefited from the recent development of the aeronautical manufacturing for military purposes. The aeronautics' potential began to be explored as a subsidiary force for mail transportation, and progressively its air network was being consolidated and regulated. The mail airlines eventually expanded its services to fly passengers. The air transport got a new boost in the United States and Europe as it progressively incorporated passengers. In addition to the domestic services, international flights were multiplying. The last barriers to establishing a huge network all around the world were broken through by the crossing of the oceans. Many air transport companies were successfully created as a way of aiding governments. The credibility and reliability raised the demand. The companies grew up and the infrastructure was developed due to the organization of the service. In 1920, the Federal Inspection for Maritime and Fluvial Transportation was created in Brazil, hence, assignments towards navigation and the aviation industry that were still emerging at the time were piled up.

The first scheduled air transport companies were funded in 1927: VARIG and *Sindicato Condor* (later, *Cruzeiro do Sul*). In that year, the market was covered by many domestic and international networks. Since 1927, the French company *Latecore* began to make connections between Brazil and France. In 1929 Nyrba, later known as *Panair do Brasil,* began its operations [2].

The Brazilian civil aviation was strengthened in the 1940's. On April 22, 1932 the Department of Civil Aviation, a body of the former Ministry of Road and Public Works, was created by the president Getúlio Vargas.

Later, on January 20, 1941, the Ministry of Aeronautics was created, gathering naval aviation, military aviation, and civil aviation. The latter was detached from the Ministry of Road and Public Works. Other remarkable facts of this decade were the creation of two dozen air transport companies and the formation of a big fleet, the creation of hundreds of flying clubs devoted to training pilots and, during the war, the creation of a network of airports

with paved runways, also equipped for the instrument approach procedure. This boost was only possible by the 1940's when plenty of American airplanes were withdrawn from the war and put in market at low cost and in good financing conditions. This led to the emergence of countless airlines, almost all of them in operation, however, with very fragile financial structure. In this scenario, air transportation gained importance by promoting integration and development due to the country's large territory (which fostered continuity and similarity to the American process), precarious road transport and difficulty to access remote places of the territory, especially the north region of Brazil.

Aviation was consolidated worldwide and, even though a new level was achieved, and repercussions were felt, the 1940's were overshadowed by the next decade. The main countries in the globe introduced jet aircraft in air transportation. The 1950's were really revolutionary, and it solidly fostered civil aviation in terms of production, technology, safety and comfort. In Brazil, this crucial milestone was reached in 1959 when two Caravale aircrafts from VARIG were put into operation.

By the end of the 1980's, the Brazilian aviation kept itself as one of the top ten aviation services in the world in terms of production services, number of airports, number of pilots and air traffic control network. This prominent position in the global scenario began in the 1940's and was sustained over time, which led to the crystallization of its gains during the economic expansion in the 1970's [3]. Even today, Brazil continues to be the only developing country seen as an aeronautical power inside the International Civil Aviation Organization (ICAO). It occupies a place of privilege on its Board of Directors since its creation.

2 | ECONOMIC ELEMENTS IN REGULATION

2.1 Introduction

A specific and careful procedure is required in order to implement a regulation, or to overhaul an existing one. The regulation must be implemented as a planning process, covering the study stages, the establishment of goals, the creation of a range of intervention options, the evaluation and selection, as well as the organization of this implementation. "The Regulator's Decalogue" developed by the OECD [4] systematizes the stages of a regulatory conception. Such stages will be, then, described and analyzed.

Due to its importance to a country's development, one of the most relevant sectors regarding "regulation" is the infrastructure sector. Its features are specific technologies with scale and scope economies in the provision of basic services – natural monopoly; in addition to products consumed on large scale, often by captive consumers and that have great demand.

Several economic infrastructure activities are natural monopolies. Therefore, the government in most countries regulates the prices charged by the monopolies to protect

the consumer. Pressured by customers, on one hand, governments tend to regulate prices fixing them to supply cost. On the other hand, private investors become vulnerable to the governments' arbitrary actions once, as a matter of course, investments in infrastructure are very hard to recover. Hence, regulation is also a way to protect investors by inducing them to make investments at a reasonable cost.

Consequently, regulation can be perceived as necessary to protect both users and investors [5]. However, this has direct and indirect costs implied.

The implementation of regulation must be reconsidered: Should the need for regulation be replaced by competitive solutions whenever possible? However, for doing such thing, it is paramount to take into account the structure of the market that is being regulated; the access barriers; the number of competitors, both real and potential (vertical structure); and the vertical relations that affect the market power (vertical structure), according to the Systematization of the Regulatory Plan, Figure 1. Frequently, the institutional features of a country do not fit its regulation mark, which has unpredictable effects.

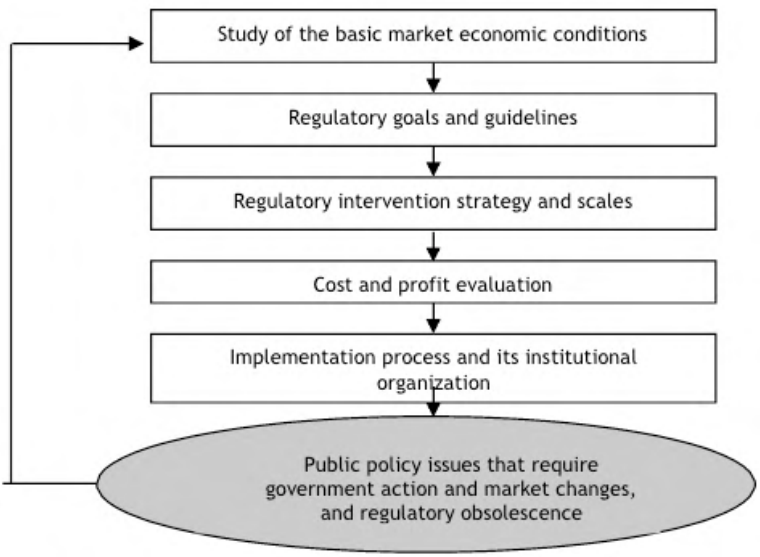

Figure 1 - Systematization of the Regulatory Plan.

2.2 Regulatory Plan Components

Regarding the implementation of a regulation, or the overhaul of an existing one, a specific and careful procedure must be done. Like a planning process, the regulatory conception, the study stages, the establishment of goals, the creation of a range of intervention options, its corresponding evaluation and selection, as well as the organization of its implementation are separate elements. According to [6], the Chart 1 below, inspired

by the “Regulator’s Decalogue” developed by the Organization for Economic Co-operation and Development – OECD, systematizes the stages of a regulatory formulation, which will be described and assessed henceforth. It is highlighted that in 2012 the OECD Council recommended 12 (twelve) Principles on Policy and Regulatory Governance, as a summary or guideline for governments that need to improve their design, application and review of the regulatory marks [7].

In fact, there are several market failures, and to detect them in each specific case, a careful analysis of basic consumption and production of goods and services conditions is required. The main reason for the existence of state intervention in economic activity is to understand if the activity is necessarily essential for the economic process, and for life and environmental quality. Therefore, one must verify if one is dealing, in fact, with an essential service, its relation with other products and sectors, weather there are substitute products, in addition to the circumstances the consumer faces in order to make rational decisions.

As the market structures of the sector and its related sectors are being analyzed, one must be aware of how the external factors generated by the sector affect other sectors, and on the contrary, how external factors generated by other sectors influence the industry that is being analyzed.

In conclusion, economic and political circumstances need to be examined once the market conditions and the investors’ interests will depend on it.

Deviate provisions in these fields tend to cause a decrease in investments and conflicts between companies, consumers and the regulator body.

THE REGULATOR’S DECALOGUE

According to the OECD Reference Checklist for Regulatory Decision-Making (OECD 1197), every project or regulatory overhaul must be set accordingly to the answers of the following questions:

1. Is the problem correctly defined?
The problem to be solved should be precisely stated, giving evidence of its nature and magnitude, and explaining why it has arisen (identifying the incentives of affected entities).
2. Is the government action justified?
Government intervention should be based on explicit evidence that government action is justified, given the nature of the problem, the likely benefits and costs of action (based on a realistic assessment of government effectiveness), and alternative mechanisms for addressing the problem.
3. Is regulation the best form of government action?
Regulators should carry out, early in the regulatory process, an informed comparison of a variety of regulatory and non-regulatory policy instruments, considering relevant issues such as costs, benefits, distributional effects and administrative requirements.
4. Is there a legal basis for regulation?
Regulatory processes should be structured so that all regulatory decisions rigorously respect the “rule of law”; that is, responsibility should be explicit for ensuring that all regulations are authorized by higher-level regulations and consistent with treaty obligations, and comply with relevant legal principles such as certainty, proportionality and applicable procedural requirements.
5. What is the appropriate level (or levels) of government for this action?
Regulators should choose the most appropriate level of government to take action, or if multiple levels are involved, should design effective systems of co-ordination between levels of government.
6. Do the benefits of regulation justify the costs?

Regulators should estimate the total expected costs and benefits of each regulatory proposal and of feasible alternatives, and should make the estimates available in accessible format to decision-makers. The costs of government action should be justified by its benefits before action is taken.

7. Is the distribution of effects across society transparent?

To the extent that distributive and equity values are affected by government intervention, regulators should make transparent the distribution of regulatory costs and benefits across social groups.

8. Is the regulation clear, consistent, comprehensible and accessible to users?

Regulators should assess whether rules will be understood by likely users, and to that end should take steps to ensure that the text and structure of rules are as clear as possible.

9. Have all interested parties had the opportunity to present their views?

Regulations should be developed in an open and transparent fashion, with appropriate procedures for effective and timely input from interested parties such as affected businesses and trade unions, other interest groups, or other levels of government.

10. How will compliance be achieved?

Regulators should assess the incentives and institutions through which the regulation will take effect, and should design responsive implementation strategies that make the best use of them.

Figure 1 – Regulator's Decalogue [8].

2.2.1 Regulation Goals and Guidelines

As the theoretical bases for economic regulation are described, basic goals that serve as guideline to the regulatory design must be mentioned. Obviously, such goals need to be set upon each specific case of regulatory intervention, directly related to the failures detected after a careful study of the characteristics of the production circumstances in the analyzed market. One must seek to compensate or to stop the effects of competitive imperfection; to encourage productive efficiency, innovation and the necessary investments; to optimize specially the consumer's well-being; to establish competitive behavior, as well as to meet social and economic general goals that were established [9].

The key element for the public service sector institutional structure is to meet the established general social and economic goals. In countries where these goals are responsibility of the public service's legal entity, these services, as a principle, would be essential for guaranteeing citizenship rights. Therefore, "the best possible market configuration" must be ensured by the State, as well as provided by means of governmental entities or hiring private companies, in some scenarios by means of concessions – a currently and widely used apparatus for the operation of airports in Brazil.

Regulation should not only be goal-oriented, but it should also have minimum costs of development and application. Transaction costs between agents in the market, between society's final interest, and the interest and specific actions of public and private entities – conflicts between entities and beneficiaries, as well as the risk of the regulation exploitation by specific groups - should be reduced as much as possible. These elements demand that the regulatory mechanism to have a satisfactory level of transparency [9].

2.2.2 Regulatory Intervention Strategies and Dimensions

Consequently, we have several categories of "remedies" as outlines of the activity that should be regulated: the definition of access conditions; types and amounts of services

set by the administrative power (quantity regulation); output conditions; price policy; performance and quality indicators; and other aspects related to regulation.

Once the goals are defined, options of regulatory actions in several segments and resources to be used must be evaluated. From entry and output restrictions to product and price specifications, equipment and several other parameters. These “regulatory remedies” are part of a regulatory tactic, which can be measured by how the Public Power will be able to guarantee the provision of goods or services under the regulation, as well as the choices of intervention.

2.2.3 Regulatory Propositions Assessment

Defined measures and strategies, aligned with goals determined by the regulation, must be subjected to an efficiency test. Usually, the regulation must be tested in its capacity to: increase productivity and allocation efficiency; innovation; power to prevent monopolies; development of a competitive environment, in addition to meeting the goals for social, industrial and regional policy.

Regulation must also be measured by its administrative costs for application and its outcomes, for it is known that the regulator and his regulatory policy are subjected to several risks. These risks are systematized in literature under the denomination of regulatory or governmental failures [10]; [11]. The Public Power is limited in its capability to control regulated sectors, and, in general, it has been placed in disadvantage regarding information about the sector’s economic reality in relation to the companies. Therefore, regulators are always at risk of misinterpreting pros and cons on how its measures can affect companies, consumers and society when making assessments. It’s important to mention that regulators must report not to society only, but also to the main political agents – spread among several agencies and administrative levels.

The regulatory action is established in a complex field of conflicting interests where representatives of the society’s general interests are pressured by several individual interests. It can result in several failures and bad outcomes.

2.2.4 Implementation Process

Therefore, we must expect influence and resistance actions derived from the involved sectors, aiming at exploiting regulation according to their interests.

It must be considered that companies subjected to regulation usually react to the imposed limitations. They take actions contrary to the regulation goals, such as the co-optation of sectors of the Public Power.

Regulatory measures have an efficiency lifespan; as its lifespan fades, it becomes necessary to overhaul the regulation.

New regulatory practices says that before signing new concession contracts, the

Public Power must be soundly structured. It must have agencies equipped with the necessary skills and having the human and material resources needed to fulfill their function [12].

Agencies need to be established focusing on fulfilling three main objectives: to protect consumers from the abuse of companies with great market power; support the investment process by protecting investors from arbitrary actions by the Government; and promote efficiency [13].

In order to meet these goals, the agency must perform several functions, such as [14]:

- To define the basis and criteria for permission to enter the market;
- To ensure compliance with regulatory specifications;
- To establish technical regulations on safety and technical procedures, as well as to monitor compliance;
- To monitor the revenue collection process, as well as the continuity and accessibility of services and its respective quality;
- To define the basis for tax calculation;
- To make the users' rights public;
- To organize public hearings;
- To regulate and to apply disciplinary procedures;
- To bring up relevant issues to the Judiciary System;
- To edit annual report and to suggest policy measures to the Executive Power when necessary.

Obviously, challenges will arise in order to accomplish these goals. Usually, on one hand, the establishment of taxes is a process full of political fuel; on the other hand, investors demand reliable profitability prospects to start investing; however, investment outcomes, long-term evolution of economic and political scenarios are unpredictable [14].

One very important point to be discussed is the regulation structure, in other words: whether every sector must have its own agency, or the regulation of several sectors should be done by one agency. This discussion has been highlighted in literature [5]. Furthermore [6], on one hand, a specialized agency would have better conditions to require specific knowledge about its sector; on the other hand, the agency would be too close to the regulated body and it could lead to a process of co-opting the agency. In its turn, a unified body tends to be politically strong when facing entities, they regulate, also when facing sectorial administrators, as long as the unified agency provides communication between its several sectors.

3 | THE BRAZILIAN SCENARIO

In Brazil, the Brazilian civil aviation has undergone numerous transformations since 1927, the year of the maiden flight of Brazil's first civil aviation company. From an incipient market in the 1920s, the country now had a Brazilian Scheduled Air Transport System, consisting of scheduled airlines, initially regulated and supervised by the Department of Civil Aviation – DAC, a Military Body and, later by the National Civil Aviation Agency - ANAC, founded in 2005. In airspace control, regulation was established later on, when the Air Routes Board – DR was founded, in 1942. If one goes back in time, it is observed that, in Brazil, aviation was divided into Army and Naval. At the same time, the communication between the Brazilian and the European authorities were already indicating the importance of an independent Air Force. This longstanding desire to unite these aviation branches added to events triggered by World War II were precisely the elements that led to a stride of immeasurable proportions in the history of the Armed Forces: the creation of the Ministry of Aeronautics on January 20, 1941, through Decree-Law 2,961/41, undertaking the mission of guaranteeing national security and promoting technological, economic and social development in Brazil. It derived from three distinct origins – the Army, the Navy and the Ministry of Road and Public Works –, hence, it would be up to the new Ministry to balance the simultaneous interests of National security, and economic, technological and social development that substantiated the airpower: the Air Force, the Civil Aviation, the Aeronautical Infrastructure and Industry, and the training of aeronautical professionals. During the Second World War in Europe, the geographical position of Brazil and the size of its territory soon became the focus of the United States of America. Brazil faced pressure from the U.S.A. so they could mainly occupy the Northeast of Brazil and install air bases that would allow flights to Africa and the East. Simultaneously, they intended to prevent the Axis countries from taking these routes. By mid-1941, these bases and air routes were already existing [2]. Brazil's aviation expanded due to the joint efforts between the two countries, by means of getting aircrafts, and the training and qualification of professionals. Still in October 1941, eight Boards were founded, including the Air Routes Board, being implemented as early as 1942. With the end of the war, one of the biggest tasks was to accommodate the air bases of the North-Americans, for the Brazilian troops were still very small, considering that, at that time, a large number of officers left the Brazilian Air Force - FAB to perform in other activities, mainly in the commercial aviation field. Aiming to address these flight protection deficiencies, the Ministry of Aeronautics has expanded its Flight Protection Services. Each Air Zone headquarter then had a Regional Flight Protection Service (SRPV), hence a huge system was developed, and the Air Routes Board was its central body. In the international field, at the end of World War II, the international community identified the need for the development of common norms, principles and standards to regulate the rapid growth of a mode of transportation that would revolutionize, in subsequent years, the way humans deal

with geographical distances and the speed of trade flows: the civil aviation. In this sense, standards would need to be established to ensure the safety and compatibility of operations between States [15].

Due to this growing in national and international civil aviation, on October 20, 1949, the International Air Navigation Studies Commission – CERNAI was founded, through Decree No. 27.353, with the purpose of dealing with matters related to the establishment and conduct of the Brazilian air policy in the international field.

Still regarding flight protection in the early 1950s, the Air Routes Board played a key role in the initial organization of the Brazilian airspace control. There was a large investment in the Amazon region and in aerospace science and technology. In the early 1960s, after detecting operational problems in flight protection equipment, the Air Routes Board had the first air traffic control radars, VHF Omnidirectional Range and Instrument Landing System (ILS) installed at the airports in order to eliminate the problems detected [16].

With greater integration in mind, the Air Routes Board was replaced with the Electronics and Flight Protection Board (DEPV) [16], with the purpose of directing, guiding, coordinating and controlling the specialized activities in electronics, communications, air traffic, navigation, meteorology, phototechnics and cartography. In this year, the Ministry of Aeronautics also approved the initial studies for the implementation of the Air Defense and Air Traffic Control System (SISDACTA). The integration of the Brazilian air traffic control and air defense services was then sealed. On October 5, 2001, DEPV was replaced with the creation of the Department of Airspace Control - DECEA. From then on, a plan was established with the creation of the Air Routes Board, in which air traffic was regulated "as far as possible"; then the DEPV was founded and nearly all the Brazilian airspace was regulated by means of phraseology, secured by the Search and Rescue Service – Salvaero; and finally a whole Flight Protection System was established when the DECEA was founded, to the "third degree" – which means not only information nor flight protection, but effective control with the entire Surveillance System in place, including in the Amazon, from where the entire Brazilian territory and surrounding areas are visible, either at sea or in the border zone, and integrated with the Brazilian airspace defense. There was a change in paradigm: from then on, the pilot would no longer be the one to inform his position. The air traffic controller was the one identifying where the aircraft is and what must be done for effective air traffic control over 22 million km². Over time and in such way, the Air Force Command established itself – through DECEA as a regulator, controller and provider of air navigation services in the country.

3.1 Governance

Over time, the Brazilian Air Force has taken the lead in matters relating to the national, and international, regulation of the Brazilian airspace. Throughout history, "landmarks" were instituted in order to regulate the activity in the country. It began when the Brazilian Air Code

was signed in 1938, considering it was necessary to provide the country with laws capable of efficiently regulating civil and commercial aviation and that the Brazilian laws should comply with the existing air law conventions and trends [17], and when the Air Routes Board was founded in 1942, in spite of the emphasis on primary dedication to services related to air routes and the National Air Mail – CAN. The Flight Protection Department was also internally founded, and it was responsible for, among its tasks, organizing and standardizing the services of interest to air traffic safety. On November 18, 1966, the Brazilian Air Code was amended by Decree-Law No. 32, which already referred to Air Law, Conventions and Treaties, in addition to reference to Aerodrome Protection Zones. In the item related to Air Traffic, there are references regarding the observations to the Code, Conventions and International Acts, as well as the regulations and instructions issued. In 1972, the Electronics and Flight Protection Board – DEPV was founded [18], and its Regulation was established by Decree No. 81.998, of 19.07.1978, in which, among its powers, it is responsible for the elaboration of norms, procedures, principles, criteria and programs relevant to Flight Protection. In addition, it coordinates and controls the fields of Electronics, Aeronautical Telecommunications, Research and Development, as well as it investigates violations of air traffic rules, which demonstrates the broadening of the spectrum of regulation of Air Navigation services.

In December 1986, the Brazilian Aeronautical Code [19] was founded to replace the Brazilian Air Code, in order to simplify the existing laws, as well as to be in compliance with the Federal Constitution of Brazil, in order to conform it to the needs resulting from the profound transformations air transportation, civil and commercial aviation and all services directly or indirectly linked to air navigation had been through. Air navigation is one of the most dynamic segments of the world we live in, as it has been systematically updated and improved.

From 2006 on, there was a rupture with country's economic situation. There was an exponential growth in aviation as a mode of transportation. Land was replaced with air transportation. Great part of the population that did not have access to air transportation, began to have it. Therefore, there was a gap between the airport installation and air navigation infrastructures and the repressed demand, resulting in the so-called "aerial blackout" (overbooking)[1]. Thus, the recent growth has brought a series of challenges, even though Brazil has airport availability and domestic air network coverage that seem to be suitable, and the country is one of the few with relevant aviation industry. The airport infrastructure, largely provided by *Infraero*, the company that managed the airports responsible for, at the time, more than 95% of the civil air traffic, did not grow at the same pace as demand. The runway and courtyard system also had limitations, also leading to the management of airspace control, but to a lesser extent, as shown in figure 3.1 [20].

1 Brazilian aviation crisis, which took place in 2006, leading to the collapse of the Civil Aviation System. It encompassed numerous flight delays and cancellations, until early 2007.

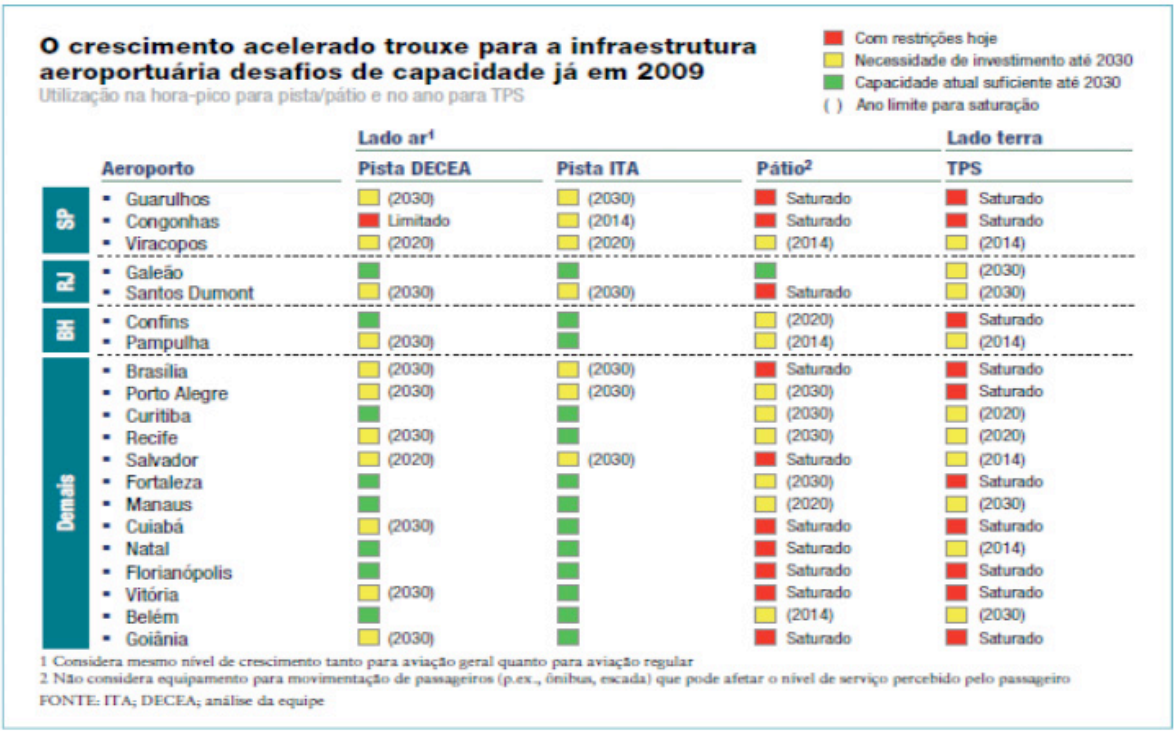

Figure 3.1 – Infrastructure Limitations [20].

In the medium and long term (by 2030), given predicted growth, it will be needed investments to increase current capacity by 2.4 times (from 130 million to 310 million passengers per year, or the equivalent of nine Guarulhos airports). To limit the capacity means not only leaving passengers unattended, with adverse effects on the economy, but also regressing on many of the sector's recent achievements, such as increased competition, which has allowed the prices the passengers pay to fall and the use of air transportation to increase (figure 3.2). [20].

At the time, it was observed that, while the expansion of airport infrastructure emerged as the paramount and immediate need for action, at the same time there were other opportunities for action in the field, so that the country could reach its "full potential".

For instance, combining courtyard investments with improvements in air traffic control could, to some extent, reduce travel time, allowing for more straightforward routing, more efficient lift off and landing progressions, and shorter approach and landing circuits.

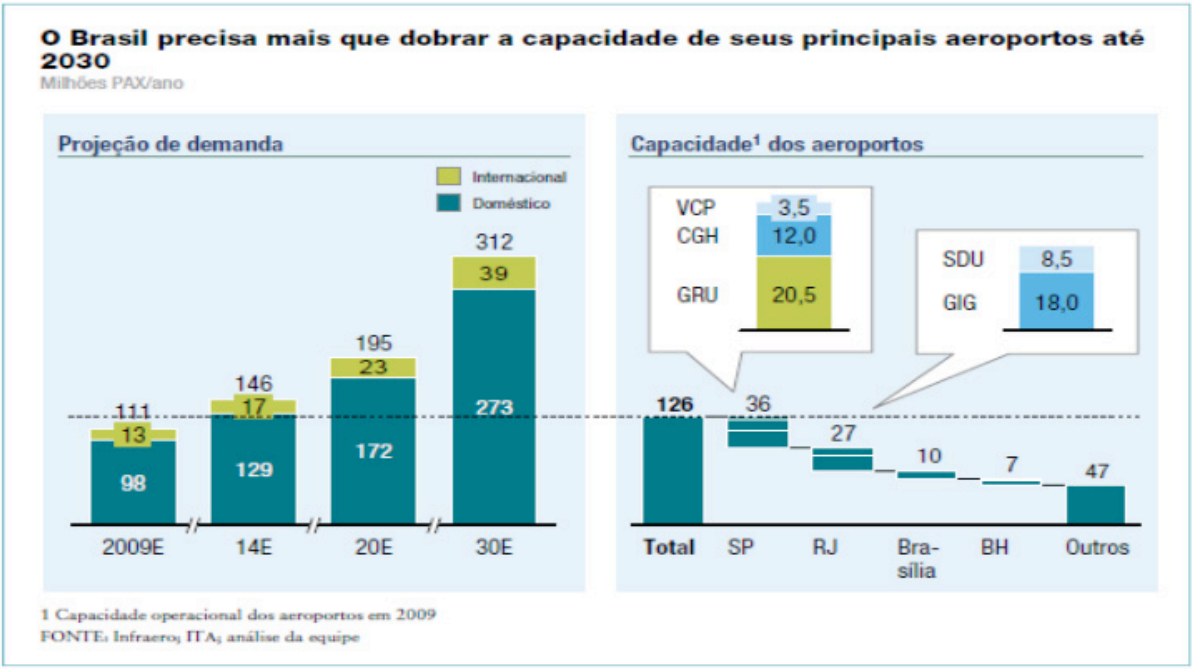

Figure 3.2 – Demand and Capacity Projection [20].

Reduced flight time means lower fuel consumption, lower operating costs and positive environmental impact. The technological evolution of avionics and satellite systems is highlighted, for Brazil can make use of them to enable such results. Regarding the attribution of roles and responsibilities, and the architecture (including hierarchy and the checks and balances system), it was observed that the governance structure of the industry presented points for improvement. For instance, it was not clear which entity was responsible for the long-term planning and coordination of the industry, including air transportation services, airport infrastructure and air traffic control, which was paramount given the massive interaction between these three components.

Regarding the pointed out necessity, the Brazilian Civil Aviation Secretariat - SAC was founded, through Provisional Measure No. 527 of March 18, 2011 and amended by Law No. 12,462 of August 4, 2011, which dealt with its powers in respect of coordinating and supervising actions focused on the strategic development of the civil aviation sector and the airport and aeronautical infrastructure in Brazil.

In fact, this need for coordination goes beyond the internal operations of the aviation industry: unlike Brazil, where the air navigation regulator is linked to the Ministry of Defense, almost all of the countries analyzed in [20] have regulators linked to the Ministry of Transport or Industry/Development, to facilitate integrated planning of the transport matrix.

With regard to the good practice of allocating regulatory, enforcement and monitoring

functions to separate agencies, an opportunity for further refinement in the assignment of responsibilities for the air navigation service has been identified, for these three roles are currently under the responsibility of the same agency, the DECEA (Department of Airspace Control). In spite of this, one must recognize that, during the intense development of air transportation in the country, much was due to the skilled management of the Brazilian Air Force, controlled by the Ministry of Aeronautics (1941) and, later, the Air Force Command (1999), by means of policies to promote operations that encompassed the training of pilots and other specialized professionals, in which the Department of Civil Aviation encouraged training schools and flying clubs; the construction of runways, especially in the Amazon region by the Amazon Airports Commission (COMARA); the immediate support for the community through the National Air Mail (1941); and the development of a strong and powerful knowledge base through the creation of the Aeronautics Institute of Technology (ITA: 1950) and other important institutes in the Department of Aerospace Science and Technology (DCTA) in São Jose dos Campos, which resulted in the emergence of several business initiatives focused on the Brazilian aviation industry, with EMBRAER as its main representative.

With regard to the assignment of roles and responsibilities, since the “aerial blackout” in 2006, there have been considerable advances and improvements in the industry’s governance with closer convergence and interaction between coordination and regulation aviation agencies (SAC/ANAC/DECEA), and emphasis on technical-operational regulation by the DECEA and subordinate bodies.

As examples of the advances, there is the implementation of more straightforward routes, minimizing the environmental impact; new air traffic circuits in the Sao Paulo and Macae Terminal Areas, the beginning of single runway operations at the Guarulhos airport and, subsequently, parallel operations; the “Brazilian SWIM” project; the coordination of the “A-CDM GRU Project”; the verification of departure and arrival procedures throughout the country; the supervision of the Quality Programs in Air Traffic Services; the strengthening of the Air Navigation Management Center - CGNA, focusing on collaborative management (coordination and decision of air traffic flow management measures); the verification of the Aerodrome Protection Zone Plans; etc.

Regarding economic regulation, there was the revision of Air Navigation Fees; the regulation of national air traffic services and the provision of economic policy advice to the government, including statistics and research; the involvement in the Technical Committee for Civil Air Navigation (CTNAV), recently implemented and added to the NATIONAL AIRPORT AUTHORITIES COMMISSION (CONAERO), in which SAC, ANAC, DECEA and *Infraero* take part.

4 | CONCLUSION

In the face of this scenario, it is observed today that the industry's governance structure still has points for improvement, bearing in mind that its governance structure is established almost entirely through Guidelines (DCA), Instructions (ICA), Government Decrees, Resolutions, among others. In a potentially competitive market, such as aviation, market monitoring conditions need to be established by means of constantly reviewing public policies, as a government project component, while at the same time meeting society's demands through public hearings, clarifications and regulatory impact analysis (RIA), broadly given to the population. For instance, the impact analysis process is divided into six stages in the United Kingdom: development, options, public consultation, final proposal, implementation and review.

Thus, considering that society is affected by government interventions, it should be given broad access to the regulatory process and actively participate in policy making. It is also paramount to clarify the criteria that underlie a given regulation, and to explain their expected effects and which groups will be most impacted by them.

Herewith, the application of an improvement policy of the regulatory system is accompanied, in most cases, by the adoption of the RIA, which is considered the main tool during this process [21].

Thus, it is possible to characterize the current scenario as the search for supporting tools in the improvement of the Brazilian regulatory system. These tools should allow for the improvement of regulatory choices by developing an appropriate system for the implementation and application of the RIA and of a public consultation methodology that ensures effective social participation in the regulatory process.

Regarding the regulation, execution and supervision of the Brazilian airspace, there is an opportunity for improvement in the assignment of responsibilities related to the regulation of air navigation in the country, for these three roles are currently under the responsibility of the same governmental and military agency, the Department of Airspace Control - DECEA. The gathering of these three practices in the same agency is not the best governance practice, for in the case of departments that are part of the same structure and under the same subordination, there is risk of interference and conflict in the execution of regulatory, supervisory and enforcement practices. A broader discussion about the existing air navigation regulatory model in the country is needed, especially regarding this gathering of practices. Currently, in the National Congress of Brazil, a Provisional Measure (MP) has been under discussion. It proposes the creation of a prospective civil air navigation company, linked to the Ministry of Defense, named *NAV Brasil Serviços de Navegacao Aérea S.A.*, in order to decentralize the implementation of air navigation services, with exclusive focus on this operation. Hopefully, these practices will contribute for the transformation of the model into one considered ideal. A company solely acting as an

air navigation service provider would also meet ICAO's recommendation in its Manual on Air Navigation Services Economics (Doc 9161), item 2.14, which presents an autonomous government entity with the purpose of providing air navigation services. This option has provided the following advantages worldwide: it ensures that revenues generated through the use of air navigation resources are transparently reinvested in operating and developing the facilities; it ensures that the users of air navigation services contribute directly to the upkeep and development of the facilities that they use (user pays principle); it reduces the financing burden on governments; it encourages the growth of a business culture and the improvement of the quality of services; it enables access to private capital markets; and it establishes a clear separation of the State organization responsible for regulating the operations and the organization responsible for providing the services. In case it is inviable to create the *NAV Brasil company*, the Brazilian Airport Infrastructure Company - *Infraero* could replace it, provided that its governance model is compliant, for it already provides air navigation services with 61 (sixty-one) facilities in the country, however, it also manages airports according to its work history.

Hence, the following benefits can be achieved:

a) Increased transparency through the publication of balance sheets with operating and financial indicators, Board of Directors representation and adoption of governance rules;

b) Improved incentive management skills through the establishment of a positions and salaries system closer to the existing governance of the industry, training programs, easier application of resources allocated to the system and the clear definition of individual and collective goals;

c) A separate structure, which provides greater importance to the practice, through the adoption of a presidency and board of directors dedicated uniquely to this role, with their own revenues, and responsible for generating results.

Thus, given that society is affected by government interventions, it should be given broad access to the regulatory process by actively participating in policy making. It is paramount to clarify the criteria that underlie a given regulation, and to explain their expected effects and which groups will be most impacted by them, and, consequently, to make it possible to improve regulatory decisions by determining social involvement, transparency, accountability, respect for due process of law, and economic thinking, weighing costs and benefits as the main elements of the policy-making process.

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ÍNDICE REMISSIVO

As engenharias agregando conhecimento em setores emergentes de pesquisa e desenvolvimento 2

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