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EDITORIAL

Critical Technologies for Aerospace and Defense Applications: The Pursuit of Autonomy

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The Brazilian National Strategy of Defense defines three strategically important sectors: space, cybernetics and nuclear, which are reckoned to be essential and decisive for the national defense. According to this document, partnerships and the purchase of products and services abroad should be harmonized with the purpose of ensuring a wide range of capacities and technologies in Brazil. Moreover, it states that our national independence has to be achieved by an autonomous technological capacity building, and warns that whoever does not master critical technologies is neither independent for defense nor for development. However, achieving autonomy on critical technologies for aerospace and defense applications depend upon a multilayer set of actions and institutional structures.

It is well known that Aerospace and Defense systems are intrinsically complex structures, which depend on the interdisciplinary knowledge and the mastering of several areas of science and technology. Any large aerospace or defense system comprises a large number of subsystems, whose performances depend upon the quality grade of several components, sensors and materials.

Harnessing of critical and restricted access technologies for Aerospace and Defense Applications is not an easy enterprise, which usually demands several distinct technological task levels to be accomplished. Examples of critical and restricted access technologies are: liquid rocket engines, inertial navigation/stabilization systems, special composite materials and alloys, hypersonics, compact nuclear power reactors, laser isotope separation, amongst several others, not to mention all the sensing and control technologies intrinsically associated with those.

The Aerospace Science and Technology Department – DCTA – is composed of several institutes; each of them is primarily devoted to a specific technological task level on the process of seeking solutions for the associated critical technologies, including: academic education, basic and advanced research, development, certification and flight testing.

Amongst these institutes, the Institute for Advanced Studies (IEAv) focus mostly on the research level pursuit of critical technologies, although it also contributes with Post-Graduate education and the development of some systems in areas of expertise that are exclusively or mainly available at IEAv. Over its 30 years of existence, IEAv has strongly contributed to the national technological independence by mastering science and technology in several areas of strategic interest, such as: laser isotope separation processes, Fiber Optic Gyroscope (FOG), hypersonics, nuclear reactors for space applications, infrared sensors, geospatial intelligence, just to mention a few.

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Similarly, the other institutes in DCTA also perform some extent of research activities in specific areas of expertise, besides endeavoring in other technological task levels, depending mostly upon the managerial and technical boundary conditions imposed by each critical technology, rather than relying on more formal analyses or benchmarking, *e.g.*, by applying the concept of Technology Readiness Level. Nevertheless, keeping synergic relationship among all the institutes of DCTA is mandatory for the successful achievement of technological independence in the aerospace and defense realm. This relationship extends beyond the borders of DCTA, bringing to the game board other governmental institutions, universities, funding and regulatory agencies, industries and research groups that are involved with science and technology for aerospace or defense.

The result of decades of investment on aerospace and defense science and technology has rewarded Brazil with strategic solutions and spin-offs in several technological areas, more than paying off all the investments made along its history; for instance, it is worth to mention the bio-fuel engines for terrestrial and aerial vehicles, the birth of EMBRAER, amongst many others.

The balance between education, research and development is also a key aspect to overcome future asymmetry or scarcity in some of these task levels, which are of foremost relevance for the survival of technological independence in the aerospace and defense fields.

Any misbalanced initiative that is intended for short-term results may only lead to short-lived technological independence, due to the lack of mid/long-term updating on technological evolutionary trend, usually by loss of expertise or by premature obsolescence of the adopted technologies.

Additionally, the reduced level of replacement of expertise with the desired and specific skills demanded for the search of solutions for critical aerospace and defense technologies has posed a great challenge for a smooth and efficient transfer of knowledge and experience from retiring researchers and technicians to the new generations of aerospace and defense personnel.

Future is unpredictable; however, science and technology history has proved that a solid groundwork on education, research and development is indispensable for any self-sustainable enterprise in strategic areas. Furthermore, keeping the know-how and expertise in already harnessed strategic technologies is as important as attempting to unveil new ones.