A Work Project, presented as part of the requirements for the Award of a Master Degree in Finance from the NOVA – School of Business and Economics.

THE EVOLUTION AND AUTOMATION IN A&D INDUSTRY

BEATRIZ LEITÃO CABRITA FIGUEIREDO SANTOS 33960

A Project carried out on the Master in Finance Program, under the supervision of:

Rosário André

03-01-2020

Abstract

The Aerospace and Defense Industry generated more than $1.2 billion in revenues in 2018 and the perspectives are for the market to keep growing. With the increase in air traffic and the growing investments in defense, technologies take relevant place in the market. The conducted analysis shows the growth of the emerging technologies and the impact they can have in the industry.

Keywords: Robotics, Aerospace and Defense, IoT

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209)

Aerospace and Defense – The Future of the Industry

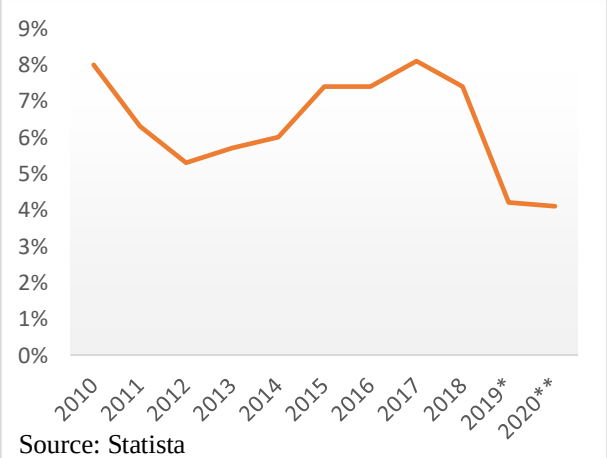
As Boeing referred on its annual report of 2018, the company "(…) continues to lead in technology and innovation, deliver for its customers and invest in its people and future growth" and a prove of that is the gratification received, for 6 consecutive years, as a top global innovator within Aerospace and Defense companies[1].

For innovation to be possible, companies must adapt and embrace different technologies, and that is valid for the entire A&D industry. In the following analysis will be demonstrated how the chosen topic takes relevant place in the market and contribute to its growth.

In 2020 global aviation industry is expected to more than triple total profits in relation to 2011, reaching a value of $29.3 billion[2].

One reason for the industry to keep on growing is that, as can be seen in exhibit 1, global air traffic passenger demand has constantly been growing since 2010, even though 2019 wasn't a good year for the commercial aerospace segment in particular. However, the defense sector sustained the industry growth, as governments were requested to increase their defense budgets and security threats have narrowed. Thus, the industry of A&D is expected to achieve its natural growth in 2020[3]. The number of airline passengers is expected to grow at a 4.6% CAGR till 2038[4].

Exhibit 1: Annual growth (%) in global air traffic passenger demand



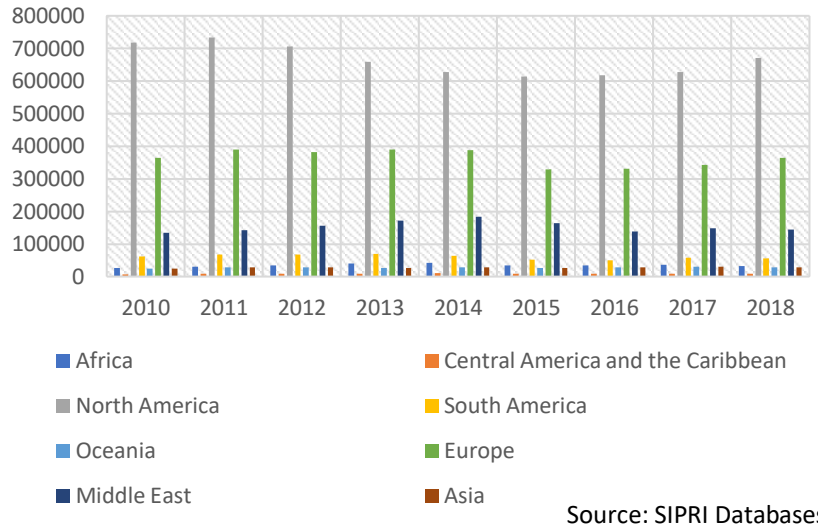
Source: Statista

In respect to global defense, a robust investment has been made. As in exhibit 2, North America and Europe are the regions spending more in defense since 2010, such that the U.S. accounted

[1] Boeing's Website
[2] Statista
[3] Deloitte Article – "2020 Global Aerospace and Defense Industry Outlook"
[4] Statista

more than 96% of the total military expenditure of North America[5]. Foreign military sales, in the U.S. reached almost $56 billion in 2018, increasing 33% relatively to the year before, and realized more than $44 billion till September of 2019. Countries members of NATO, in Europe have a 2% of GDP goal for their defense spending[6]. Even though, Europe and the United States play an important role in the global defense market, Asia is an emerging player and will take a strong position in the next decades.

Exhibit 2: Military expenditure by geography (millions of dollars) at current prices and exchange rates



Source: SIPRI Databases

Asia presents higher defense spending due to the biggest regional powers as China, India and Japan. China is "the fastest-growing aviation market globally" and, after the U.S, is the biggest defense spending nation accounting for 14% of the global defense spending. It is expected that in 20 years from now, the Chinese aviation market will be worth around $1.3 trillion and the increasing demand for aircrafts could eventually generate a $1.6 trillion prospect for aftermarket services (2019-2038). India's defense spending for 2019-2020 will increase over 9%, representing a total budget of almost $45 billion and plans for the next 5 years are to spend $130 billion in order to modernize the army and strengthen combat abilities. In respect to Japan, the defense budget for 2019-2020 accounts for $50.3 billion, increasing 1.2% relatively to 2018[7]. By 2023, global defense spending is forecasted to reach $2.1 trillion, having an expectation of growth at a CAGR of around 3% (between 2019 and 2023) [8].

[5] SIPRI Databases
[6] Deloitte Article – "2020 Global Aerospace and Defense Industry Outlook"
[7] Deloitte Article – "2020 Global Aerospace and Defense Industry Outlook"
[8] Deloitte Article – "2020 Global Aerospace and Defense Industry Outlook"

To perform the market necessities, companies will have to improve their production capacity and the overall value chain, as more opportunities arise. Implement a smart and connected factory, use "digital twin" (replicating a physical asset in the digital world, enabling teams to learn, test and visualize a product in a virtual environment), or even use IoT data with artificial intelligence (AI) and machine learning (ML) are examples of technologies that can improve the Industry's value chain[9]. Without doing major investment, companies can push 10 to 12% in factory operation and labor efficiency if implement agile factory initiatives[10].

Automation in A&D

When talking about automation in the A&D industry, a vast variety of technologies can be discussed such as robotics, automated cockpits or Internet of Things. However, there is one factor that is probably the hardest to get: digitally reinvent the industry. Changing mentalities is usually more complex than it seems. Nevertheless, researches show that 67% of aerospace and defense executives have as a top priority of their organizations, innovating new products and services and 97% "say they are willing to digitally reinvent their business and industry"[11]. What all these technologies that are emerging have in common is that they all have a similar purpose, being either augment companies' ability to engage with the different stakeholders, improve revenue, enhance supply chain performance or simply be more efficient. For the purpose of this report, robotics and IoT will be analyzed more in deep.

Robotics can be used for many different purposes and in A&D industry is used to manufacture aircraft components replicating activities, – such as welding, drilling, painting and cutting – to handle material, to help fabricating engines and in assembly automation. Companies are also using robots to reduce human workload so that people can focus on high added value activities.

[9] DXC.technology – "How A&D organizations can achieve digital manufacturing transformation"
[10] Deloitte Article – "2020 Global Aerospace and Defense Industry Outlook"
[11] Accenture Article – "Launchpad to Relevance Aerospace and Defense Technology Vision 2018"

Aerospace Robotics market is projected to grow at a CAGR of 16.9% (from 2017 to 2025), reaching a total of $7.3 billion in 2025[12].

There are different sorts of robots being the most known the cartesian, the six-axis and SCARA (selective compliance articulated robot arms). Cartesian robots are very operator friendly, have lower costs and at the same time boost performance since they have linear servomotors, modules and standardized components. This type of robots makes linear movements along three axes. "Six-axis robot move forward and back, up and down, and can yaw, pitch, and roll (…)" which makes it good to simulate complex movements as a human arm. SCARA robots are good for vertical constructions which makes them more limited. Also, in terms of load, the cartesian robots are better than SCARAs and six-axis robots since these don't have capacity to make bearing assemblies of more than 100kg[13]. Therefore, depending on the purpose and type of activities the robot will be doing, it can be better to use different types of machines. Despite the fragilities of SCARA, it will praise global growth in the aerospace robotics market, reaching more than $2 billion in 2025. SCARA will reach a market size of around $135.4 million in Japan, about $759 million in China (in terms of addressable opportunity), almost $373 million in Germany and around $422 million in the U.S., that will keep 20.2% growth[14]. Robots have a big impact in A&D companies since they allow manufacturing processes to be more efficient and support manage order backlogs and a prove of that is that companies as Boeing and Airbus are already using this type of technology in order to do so[15].

Internet of Things in A&D was valued at $91.5 billion in 2018, more than 7% of the global aerospace and defense market expected revenues in the same year. In 2023, IoT is forecasted to be worth more than $183 billion[16].

[12] Variant Market Research – Market Research Report
[13] Machine Design – "The Difference between Cartesian, Six-Axis, and SCARA robots"
[14] Business Wire – "Global Aerospace Robotics Market Analysis 2019-2025"
[15] Allied Market Research – Global Opportunity Analysis and Industry Forecast, 2014-2022
[16] Mojix – "How IoT is Disrupting the Aerospace and Defense Industry" and Research and Markets – "Global Aerospace & Defense Industry Almanac 2019: Market Size Value 2014-2018 and Forecast to 2023"

There are important advantages that the IoT has to the A&D industry that should be enhanced. The flight is safer and more economical as IoT is the key to data collection and distribution making flights more efficient. By using predictive AI (fed by data gathered from a jet engine) it is possible to predict the needs of the engine, adjusting thrust levels and heading to a 10 to 15% fuel reduction. Taking the Boeing 747 as example, with a fuel deposit up to 238,604 liters[17] and a price per barrel of $78.12[18], costs can be reduced up to $17,586.1 for each aircraft. IoT can also reduce grounding times and improve costs and efficiencies in this matter through sensors to monitor engine performance from different angles. With the 737 MAX grounding, Boeing's customers have costs of more than $1 billion, daily and with these technologies some of these costs could have been mitigated.

Key Takeaways

Along the report is possible to see that the A&D industry has a big potential and high perspectives to grow, as in this year the industry is expected to realize total profits more than three times the achieved in 2011. However, it is important that companies within the industry can reinvent themselves in order to go along with the market perspectives to grow.

Robotics in the aerospace market will continue to increase and avail the capabilities of this technology can lead companies to improve their value chain and allow higher efficiency levels. 93% of the industry executives are committed to the fact that enabling intelligence anywhere entails an agile infrastructure developed around IoT related technologies which can enables companies to operate in a more efficient manner than it could be possible without them[19].

Concluding, automation and other technologies take an important place in aerospace and defense industry as they can boost companies' growth and will have a big impact on how the sector will evolve.

[17] Flight Deck Friend – "How much does a jumbo jet (Boeing 747-400) burn"
[18] Airportwatch – IATA Jet Fuel Price Monitor Information"
[19] Accenture Article – "Launchpad to Relevance Aerospace and Defense Technology Vision 2018"