Piaggio Aero Industries is an Italian aircraft manufacturer with a rich history. It was founded by Rinaldo Piaggio in 1884 and started as an outfitter for ocean liners. The first Piaggio aircraft was the P.2 monoplane (1923), and the company became an important supplier of bombers and other aircraft during the Second World War. After the Allied forces destroyed most of Piaggio’s facilities, the company turned to a different business and came up with a new means of transportation intended to be cheap and easy to use: the world famous Vespa scooter was born. As the Vespa conquered Italy, Piaggio rebuilt its aircraft activities. Nowadays, Piaggio Aero is a completely separate company; the only thing it shares with the scooter manufacturer is its name. It is in the hands of some remarkable parties, among which are the Ferrari family, the government of Abu Dhabi and the Tata Group from India.

**REDESIGNING THE AVANTI**

Currently, Piaggio is making its way back to the domain of military aircraft. Rather than designing completely new planes, it is taking the P.180 Avanti as a baseline for a range of surveillance aircraft. The Avanti is Piaggio’s signature aircraft, featuring two pushprops and a lifting front wing – Piaggio does not want to call it a canard, as it provides no pitch control. An unmanned Avanti baptized Hammer-Head was presented earlier this year and is now undergoing ground testing. My internship, however, concerned another derivation, simply named Maritime Patrol Aircraft (MPA).

As the name suggests, the MPA will be used for surveillance in coastal areas. This type of mission is completely different from transporting business executives, so the original Avanti will need considerable revisions. The aircraft’s endurance is increased by nearly doubling the wing span and adding fuel tanks inside the fuselage, and some significant cut-outs are made in the fuselage such that additional instrumentation, e.g., radar and cameras, may be mounted. From a structural point of view, this results in a nearly completely new design. Piaggio is sticking to a metal airframe, but the changes are so thorough that the MPA requires a lot of work in terms of design, analysis, testing and certification.

I came to Piaggio’s engineering office in Pozzuoli with very little experience in the art of finite element analysis (FEA), but as I was eager to learn it the proper way, my supervisor kindly agreed to give me the time and resources to familiarize myself with the method and software (PATRAN/NASTRAN). During the three months I worked there, I got a fairly good idea of how the structural design process at Piaggio works. Starting from the aircraft’s global FEA model, which includes only a coarse representation of all structural parts, I created a fine model of the new structural in-board fuel tanks. This model allowed me to evaluate the stiffness and...
strength of the proposed design, which is important because the fuel tank itself will not be pressurized, while the rest of the fuselage will.

In addition to this, I also performed some smaller tasks, like evaluating the torsional stiffness of the tail section after some large cut-outs had been proposed – an external company responsible for the analysis of this section claimed that the effect of the cut-outs would be small, but my supervisor did not agree and wanted a second opinion. Finally, I also tried to validate the FEA model of the tail section by comparing the contemporary results with the FEA results found for the original Avanti in the 1990s, and with test results performed when the Avanti was being certified.

Piaggio’s office in Pozzuoli is a small research facility consisting of just thirty engineers. The company’s large design offices and manufacturing plants are all located in the north of Italy. Consequently I did not see any factories or even Piaggio aircraft during my internship, but I did get what I came for: I learned how to use the Finite Element Method from skilled and experienced engineers who gave me a good insight in how they use the tool; from top-level global modelling to in-depth detailed analysis.

HE WHO COMES TO NAPLES, CRIES TWICE
Meanwhile, I enjoyed student life in Naples. Besides having visited the city for half a day during a high school trip, I only knew it for having trouble with collecting garbage, being the home of a mafia family and hosting the football club where Diego Maradona had the best years of his career. When I arrived, a local told me the city has a saying: “He who comes to Naples, cries twice: when he sees it for the first time, and when he has to leave.”

This told me that it was a place that takes some time before you appreciate it. Upon arrival though, Naples gave me very positive impressions. Besides the occasional stinky trash can here and there, the city is full of small streets which somehow succeed in mixing total chaos (mainly due to the crazy traffic) with a relaxed, laidback atmosphere brought by the numerous pedestrians who are just enjoying life.

Naples’s student population is enormous: the city has four universities, the biggest of which has just under 100,000 students. Thanks to the Erasmus programme, there is also a large international student community, their backgrounds ranging from archaeology to mathematics and from Estonia to Portugal. I found it very easy to blend in with this group and with the locals, who introduced me to the best places to eat (Naples is the home of the pizza!) and go out, and showed me where to find the best espresso.

Another good thing about staying in this part of Italy is that there is simply a whole lot to see and do. Naples itself is full of cultural beauty from the 18th century, but also contains some hidden treasures like the remains of a large Roman amphitheatre that can be found underneath the contemporary streets and houses. It is close to Pompeii, the Roman city that was covered in ash after Mount Vesuvius erupted in the year 79 AD. The whole area is still volcanic today, which gives some peculiar natural phenomena. From Naples, you can take a ferry to Capri, also known as “the island where the sun is always shining”, where you can admire the bright blue sea water and the white villas built on the rocks. The list goes on and on; however long you stay, it seems you will never get bored.

That left me with a feeling recognized by many students: the internship was an amazing time, but it was way too short. With its unique atmosphere, delicious (and cheap!) food and drinks and a wide range of cultural and natural wonders, Naples is a city I will definitely visit again.

Figure 1. The P.180 Avanti serves as the basis for Piaggio’s military aircraft