This project is co-financed by the European Union
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Aviation industry

Market structure, Performance, Key players

The main companies of the aviation industry are TAI, TEI, HAVELSAN, ROKETSAN, ALP Aviation, Kale Aviation, GE, Lockheed Martin, Boeing, Airbus, Spirit, Sage, Bombardier.

70% of SME companies interviewed in the aviation industry only machining precision aircraft and aircraft engine parts to the main aircraft industry or aircraft engine manufacturers. They work with materials such as super alloys (INCO 718, RN88, RN41, Waspalloy), Stainless steel, Titanium and Aluminum. 30% of companies mainly manufacture parts for aviation, as well as other sectors (such as white goods, ceramics, rail systems, automotive and food). 20% of the companies directly manufacture aircraft engine parts for abroad. And it seems that only 10% invested in the chemical treatment of aircraft parts. Again, 20% of the companies interviewed are engaged in software, engineering design and parts manufacturing for the aircraft industry. and only 10% have developed themselves in the field of software and can produce electronic cards and devices.

Of the interviewed SMEs, 30% of those established before 2000, 60% of those established between 2001-2010, and 10% of those established between 2011-2020.

While the number of employees in the interviewed SMEs is 20% with less than 10 employees, the company with 11-50 employees is 40%. A firm with more than 50 employees is 40%. The number of engineers with less than 5 engineers is 30%, while those between 6-10 are 70%.

Geometric tolerances and other quality control trainings have been completed in all companies.

Some of the software used for CAD CAM; CATIA5, Siemens NX, SOLIDWORKS, VERICUT, VOLUMILL for mold making; CIMATRON for EDM; FIKUS.

80% of the companies have AS9100 certification. While 10% of companies have ISO9001, 10% do not have a certified certificate. Firms also have a total of 11 NADCAPs that they received for custom manufacturing or chemical processes.

30% of the companies obtained a total of 7 patents for the products they developed.

None of the SME interviewed produce products by mass production directly to the final consumer. In this context, companies do not have PLM, Industrial Design, Project Management, Verification, Analysis and Test software and do not produce prototypes. (Note: A company that only manufactures software and electronic devices uses REDMINE for Project Management, SUBVERSION (SVV) for Configuration tracking, PVCS for Version tracking, and DOORS for Requirements Tracking.)

Again, 80% of companies do not need reverse engineering and they do this with the scan head attached to the CMM when necessary.

Technical support and technological development tools required by SMEs

Current technical basis requires an entire variety of tools to be used in design and production;

Structural analysis program (ANSYS),
Computational Fluid Dynamics (CFD)
3D Additive Printer capable of printing Inconel718 and related trainings

Trainings on Powder Metallurgy and grain size evaluation.
Augmented Virtual Reality software UNITY (including CLOUD technology) and trainings.
Object Recognition, Augmented Reality software VUFORIA (top level licenses) and trainings.
Artificial Intelligence software DOORS license and training
Training in Level2 and Level3 NDT within the scope of EN 4179 Aviation Non-Destructive Testing Standard
NDT (Magnetic particle equipment, liquid penetrant) test equipment and training is needed.
Training in chemical processes related to titanium material.

There is a need for an accredited laboratory in the field of aviation that can perform the following tests from the tests to be applied for test coupons of forged materials;

Residual Stress
Crack Propagation
Creep Test
Stress Rupture Test
Fatigue
LCF (low cycle fatigue)
SLCF (stress low cycle fatigue)
PLCF (plain low cycle fatigue)
Rupture Test

In terms of project management, Primavera or MS Project software and corresponding training is needed. Training on Business Development will be useful, too.

Placing industrial SMEs in Eskişehir's innovation eco-system

One of the software companies in Eskişehir is FPGA-based, LTG MIL-STD-1553B IP CORE serial bus (Mux Bus) national and original products, as well as ARINC 429, CAN Bus, AFDX etc. in the same concept especially for military systems in the defense, aerospace industry. continues to develop products. The same firm developed the Graphical Flight Simulator used in the theoretical and flight training of multi-engine aircraft in Civil Aviation training institutions. The company took part in the nationalization studies of the Defense Industry. Although it produced usable products, it could not sell. The company predicts that in the future, nationalization efforts will gain momentum, so their work will find its true value.

Since the aircraft engine manufacturer TEI is located in Eskişehir, most of the aviation SMEs in the city are specialized in the machining of precision aircraft engine parts. For example, some companies have reached 4000 pieces / year in the production of precision engine parts from super alloy materials. This number is much higher than the numbers used by the aviation industry. This is an indication that the companies in the sector have proven themselves.

Most of the companies in the sector define themselves as a company that follows technology and renews itself. Some companies have become very good in terms of quality control and have proven themselves. It is seen that even large companies that will produce parts have the confidence to have the company do the quality control of their parts directly. Quality control measurements, which could be done in 8 hours in the past, have been reduced to 4 hours by using CMM. Recently, by using visual reverse engineering apparatuses, this time can be reduced to 45 minutes without sacrificing quality.

Some companies draw an assertive SME profile in the field of mechanical design and engineering calculations, especially for the aviation industry. In addition to these works, they think that their

contribution to Eskişehir industry will increase with the project of developing and manufacturing a small-scale turbine engine (they have 5 patents). As an SME, there are no competitors for the turbine engine it works with, test subjects, related design and manufacturing. However, since the field he works in is unique, his market share is very low.

Companies are aware that the aviation industry is constantly changing and renewing itself. There is currently a slowdown due to the pandemic. However, aviation is a sector open to development. it is even seen as a must for the defense industry. Defense and aviation industry is viewed as the business of the future. and it is aimed to specialize in this field.

As the demand for national UAV, aircraft and helicopter projects has increased recently, Eskişehir aviation sector has been positively affected by this.

Some companies do not experience the pandemic effect because they can do business in different sectors. The experience obtained from different references and easy adaptation to various manufacturing methods can make these companies strong. Some companies have the ability to make very fast turnarounds in the production of parts that require complex and special cutting tools.

Before the pandemic, the double-aisle aircraft market was growing. Small aircraft are now expected to be in demand. As the increase in aircraft engine demand will increase the production of parts, this is expected to be reflected in the turnover.

Difficulties experienced by SMEs in R&D and Innovation

Most of the companies have difficulties in finding qualified engineers and technical staff and there is a problem of retaining qualified technical staff.

Firms have had several attempts to work with universities, but no progress has been made. It is believed that there will be financial difficulties in R&D for large projects.

Although some companies are competent in aviation engineering, they cannot aspire to big projects. In addition to financial difficulties due to the high letter of indemnity required, they sometimes face problems such as inadequate workshop spaces. Since TÜBİTAK's support for R&D projects is over the age limit, they cannot benefit from them either.

The prevailing opinion is that TUBITAK started to show a more flexible and constructive approach in paving the way for companies, but that regional technological structuring institutions took a much stricter approach and this slowed down the business.

Summary of Insights and Conclusions

One of the software companies in Eskişehir have realized the importance of this due to the absence of a national USB-enabled 1553 Avionic Interface Unit and made studies on the subject. and has been successful in this regard.Within the Turkish Armed Forces, existing aircraft, helicopters, ships, etc. as a result of the national qualification of the Mil-Std-1553B cards used in the units on the platforms and ground support systems, a significant contribution will be made to the country's economy and an important step will be taken for the security of the country.

The same firm seems to have focused itself on transitioning to “Industry 4.0”, "Machine Learning”, “Augmented Reality”, “Virtual Reality” and from there on “Artificial Intelligence”, where it witnessed rapid

changes in technology. It is obvious that these applications will become widespread in every field. Among its goals is the application of these issues to the aviation industry.

Most of Eskişehir aviation SMEs cannot find technical staff. Firms can overcome the problem by recruiting senior students of technical universities as part-time interns, training them, and then giving jobs to those they like. The same may be true for vocational high schools.

Certification of quality control and test devices in the laboratories of universities is important for the industry. Later, it will be opened to SMEs for a fee and waste of resources will be prevented.

Some companies are on the way to complete their certifications by investing in chemical processes as well as machining and sheet metal manufacturing in aviation.

It is seen that some of the companies have production plans for some aircraft components. Before such productions, it is recommended to get expert support on the relevant subject.

Within the framework of clusters in Eskişehir, it is recommended that companies request training from their experts on the subject of opening the sector to foreign markets and conducting market research.In addition, it will be useful to create working groups within the cluster related to these.

It will be beneficial for SMEs to contact ATAP and receive training on 3D additive manufacturing technologies.

If certain conditions are met, there are companies that want to produce glass ceramic materials. It is recommended that they turn the subject into a project and receive TÜBİTAK support and academic support within this framework.

There are SMEs that want to produce raw carbide bars. A feasibility study on the subject should be considered. If deemed appropriate, it is recommended to turn the subject into a project and receive TÜBİTAK support and expert support within this framework.