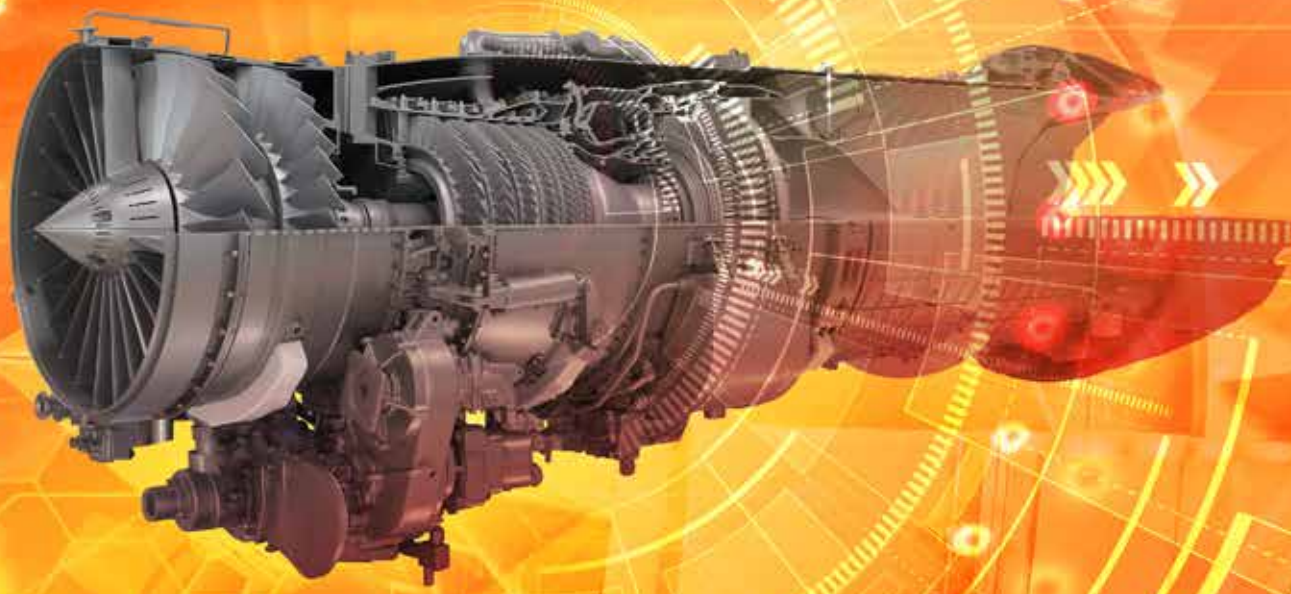
TEI POST

TUSAS Engine Industries Inc. Periodical Publication

ISSUE 140 2022

OUR COUNTRY'S MOST POWERFUL AVIATION ENGINE

TEI-TF10000



TÜRKİYE'S LEADING

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TURBODIESEL AVIATION ENGINE

TEI-TS
TURBOSHAF

TEI-TJ300
MEDIUM RANGE ANTI-SHIP MISSILE ENGINE

G MOTOR COMPANY

EI

YEARS

1400
FT ENGINE

T700-TEI-701D
FIRST INDIGENOUS HELICOPTER ENGINE

TEI-PG50
TWO-STROKE GASOLINE AVIATION ENGINE

FROM THE EDITOR

Hello,

We are delighted to meet our valued readers again in our 140th issue. In the "Cover Story" section of this issue, we feature the TEI-TF6000 and TEI-TF10000 engines. We have provided information about our company and the latest developments in the "Activities and Projects" and "News about TEI" sections.

In the "Achievement Board" section, we have shared all the awards that TEI has won throughout the year with you. In the "Events" section, we have covered various events that took place at TEI throughout the year, from the April 23rd "My Dream Future" art exhibition to the TEI Traditional Family Picnic, the Excellence Award Ceremony, and the Spring Tournament.

In the "Travel" section, you can read an article about the capital of the Czech Republic, Prague.

We look forward to meeting you again in our 141st issue.

IMPRINT

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Publisher
Regional Periodical

Printing Period
January – December

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FREEDOM
FUTURE
SOURCE OF
POWER

MESSAGE FROM THE CEO

I am delighted to once again come together with all of you on the occasion of the 140th issue of TEI Post.

The year 2022 marked a successful milestone for our company, as we achieved new successes in all areas of our operations. Since our inception in 1985, we have been advancing steadily and taking significant steps each year to meet the aviation engine needs of our country.

Under the 40-unit initial production contract for our TEI-PD170 turbodiesel aviation engine, we have successfully completed the delivery of all our engines in 2022. Furthermore, in the tests of the TEI-PD222, another member of our piston turbodiesel aviation engine family developed based on our TEI-PD170, we reached a power of 225 HP.

In the tests of Türkiye's first indigenous helicopter engine, the TEI-TS1400 reached 1,572 SHP in 2022.

In addition to these remarkable achievements, we launched Türkiye's first national turbofan engine, the TEI-TF6000, during a visit by the TSKGV Board of Directors of the Turkish Armed Forces Foundation to our company. We also introduced it to the public for the first time at TEKNOFEST Samsun.

We initiated the TEI-TF6000 project to address our country's need for a turbofan engine, utilizing our own resources. We designed the project to support technology development and demonstration on the path to the National Combat Aircraft's engine, with a configuration and gain the technology and showcase for the path to the engine of National Combat Aircraft. We also exhibited the afterburner version of the TEI-TF6000, the TEI-TF10000 engine, during the 2022 Türkiye Innovation Week with the participation of our President. Various derivative engines developed from the core of this engine can be used in different national platforms, including manned and unmanned training and combat aircrafts, business jets, regional passenger aircrafts, and civilian and military helicopters with take-off weights of up to 10 tons, as well as assault boats and power plants.

As part of the General-Purpose Helicopter Program, we delivered our 84th engine, the T700-TEI-701D turboshaft engine, which is the first helicopter engine produced in before the end of 2022. With the delivery of our engines to the Gendarmerie General Command along with the T70 helicopter in the final days of 2022, our engine became part of the inventory and put to official duty.

Our manufacturing contributions to global aviation continued to grow last year. As the largest supplier, we completed the sale of the 10,000th "blisk",which is one of the most technologically advanced part, produced for the LEAP engine, one of the world's most preferred next-generation commercial aviation in 2022.

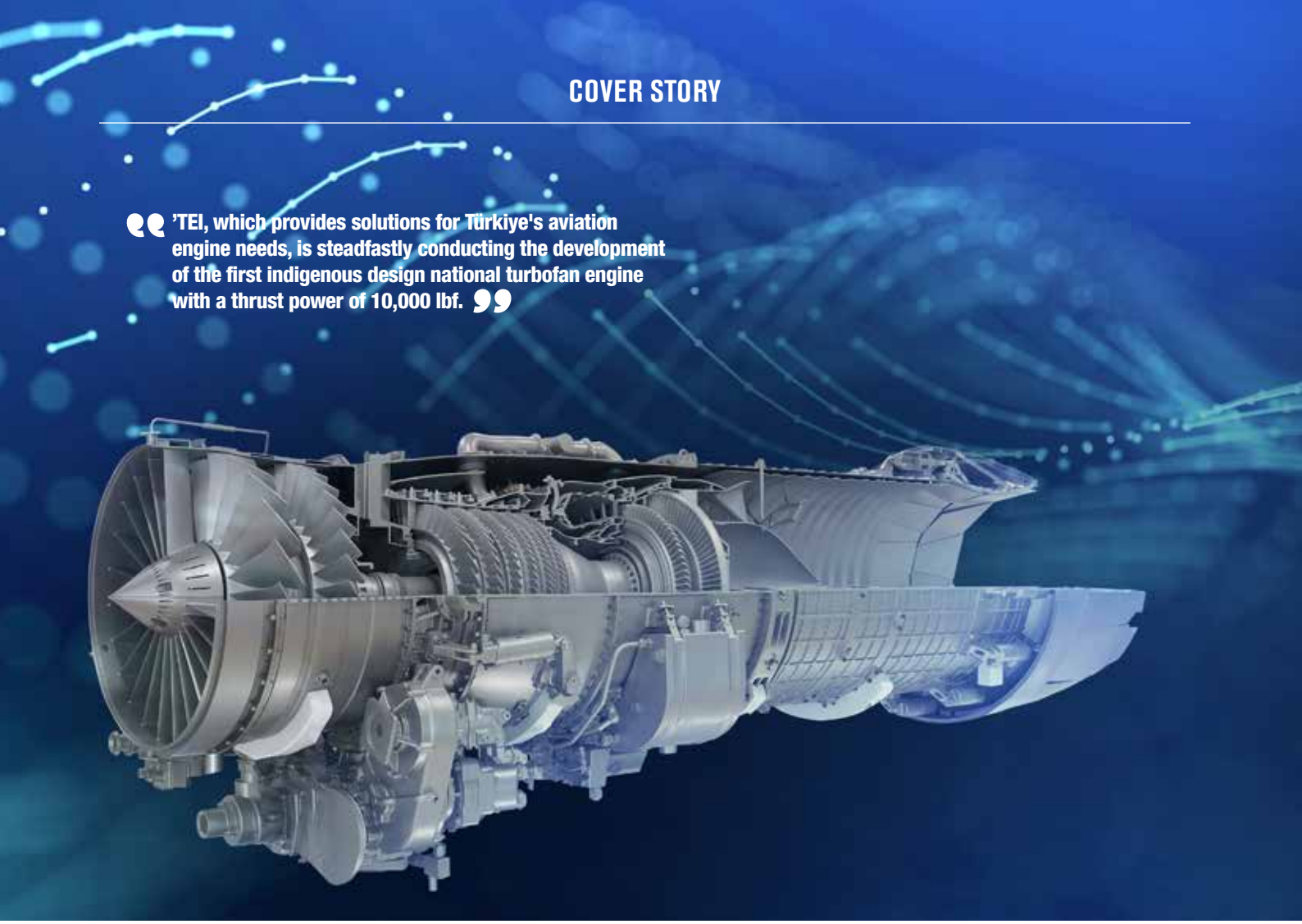
In the engine maintenance field, we successfully completed FAA Part 145 inspections, earning approval for a repair station to perform maintenance on LEAP engine components.

We supported our successful activities in our areas of operation with human resources practices. Just as we have made a tradition of, in 2022 we were once again recognized as the "Employer of the Year" at the "Global Business Excellence Awards," which evaluates the best companies on the international stage. In 2022, we received a total of ten awards, with this prestigious award leading the way. Additionally, we were once again among "Türkiye's Most Popular Companies" from the perspective of students.

I hope that the year 2022, which we have completed with countless successes on behalf of our company, will be a harbinger of our future achievements. I greet you all with respect and affection.

Prof. Mahmut F. Aksit
TEI CEO

”TEI, which provides solutions for Türkiye's aviation engine needs, is steadfastly conducting the development of the first indigenous design national turbofan engine with a thrust power of 10,000 lbf.”



TEI is developing Türkiye’s first domestic turbofan engine, TEI-TF6000, with a dry thrust of approximately 6000 lbf, using its own resources. Additionally, a turbofan engine with approximately 10,000 lbf of thrust, named TEI-TF10000, will be developed by adding an afterburner to the same concept. These turbofan engines and their derivatives developed from the core engine can be used in various national platforms such as manned and unmanned combat aircrafts, business jets, regional passenger aircrafts, civil-military helicopters, attack boats, and power plants.

Simultaneously, with the development of these engines, TEI is advancing in turbofan engine technologies towards the National Combat Aircraft (MMU / TF-X) engine and demonstrating national capability in relatively smaller-scale turbofan engines. In this context, both product and technology development projects provide the opportunity to observe critical technologies to be used in the MMU's engine in advance. Furthermore, the designs, analyses, and software developed by TEI engineering teams are being validated or calibrated.

Türkiye's first national turbofan engine, the TEI-TF6000, was showcased at TEKNOFEST 2022 in Samsun for the first time. The first prototype of this engine, which received significant attention from stakeholders and the public, is targeted to be operated in 2023. The TEI-TF6000 is a turbofan engine with dimensions of 2,250 mm in length, 860 mm in width, and 1,100 mm in height. Its specific fuel consumption value (lbf / lbs.s) is 0.70. The engine features a two-stage fan at the front and two separate air channels at the back, one for bypass air (external air passing by) and the other for air going to the compressor (high-pressure air passing through the high-pressure compressor and heading to the core engine). Similar to the TEI-TS1400 turboshaft engine, it is possible for the TEI-TF6000 to produce a slightly higher thrust than designed. The engine includes a six-stage axial compressor and is of low bypass ratio. It utilizes an axial compressor design. Both fan and compressor stages are manufactured using 'blisk' technology.

In other words, instead of manufacturing wings separately and assabling those on a disk, the disk and blades are produced as a single piece. Additionally, TEI's inertial welding capability for the production of stages close to the combustior was used for the first time in a national engine.

In gas turbine engines, after the compressor stages, the combustor is located. Here, energy is obtained through combustion, which occurs when the air, sucked in and pressurized by the compressor, mixes with injected fuel. The hot exhaust gas generated as a result of combustion then impinges on the blades of the high and low-pressure turbines located immediately behind the combustor. Therefore, the turbine blades must be able to withstand high temperatures and operate at very high temperatures, requiring both cooling and special material technologies. The high-pressure (HP) turbine drives the compressor, while the low-pressure (LP) turbine drives the fan. The air that exits here mixes with bypass air sent from outside the core engine and exits through the exhaust, providing thrust.

The modularly designed TEI-TF6000 turbofan engine includes various subsystems and accessories such as fuel and lubrication systems. These accessories operate by drawing power from a gearbox, similar to many gas turbine engines. The engine is started with a starter generator connected to this gearbox. In the TEI-TF6000 engine, titanium material is used in the front section (fan and compressor stages), while nickel superalloy material and coatings are used in the rear section(combustion chamber and turbine stages).

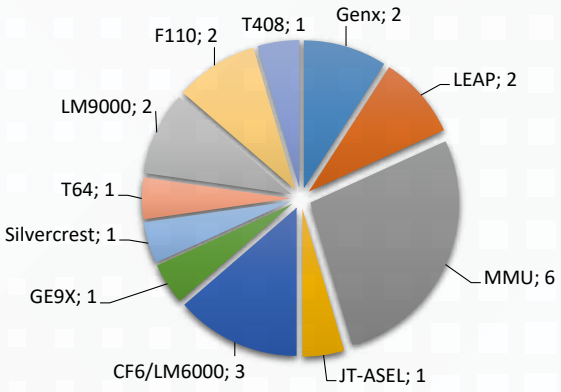
At the very rear of the engine is the exhaust section. An afterburner, which will be installed in this section and provide additional thrust, will be developed and produced for the first time in Türkiye specifically for the TEI-TF10000 engine. Within the scope of the TEI-TF10000 Turbofan Engine Development Project, critical technologies related to an afterburning turbofan engine will be developed nationally for the first time in Türkiye. Additionally, the development of engine accessories and subsystems is also planned. This planning aims to acquire knowledge and experienced human resources both within TEI and the contractor ecosystem.

2022 ACTIVITIES

PART AND MODULE MANUFACTURING

MANUFACTURING OF NEW PARTS (NEW PART INTRODUCTION-NPI)

In 2022, a total of 22 NPI projects were completed and delivered to customers on time. Out of these projects, 12 were for General Electric, 3 for Safran, 6 for TUSAS, and 1 for ASELSAN. Among the completed NPI projects, 8 were related to next-generation commercial engine programs such as GE9x, LM9000, GEnx, and LEAP. With these completed NPI projects, a total of 989 engines across 44 engine groups have been achieved to date.



The distribution of completed NPIs (New Product Introductions) by Engine Group

LEAP PROJECT

As part of the program, a total of 43 different NPI parts and 72 different configurations have been completed to date. In 2022, the NPI project for the Air Duct part and the new configuration project for the Bellcrank part were successfully completed. An agreement was reached with GE Aerospace for the 6 - 10th stage compressor spool part, and NPI activities have commenced. Additionally, a new configuration project for LPT disk parts was initiated with Safran, and a long-term supply agreement was established with the company.

TEI LEAP parts

LM9000 PROJECT

Within the scope of the LM9000 aeroderivative gas turbine project developed by TEI in collaboration with Baker Hughes and GE Aerospace, in 2022, the impingement ring and the 8 - 9 stage spool parts were completed. The NPI project for the 3 - 6 stage spool parts is still in progress.

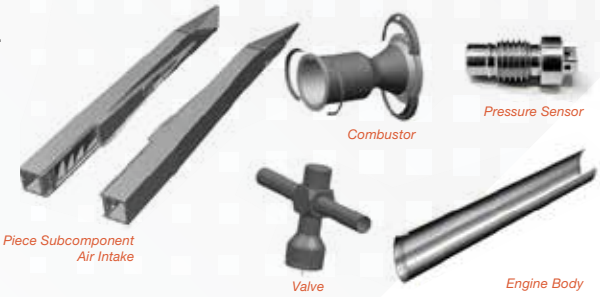
LM9000 parts consist of a total of ***9 different components***

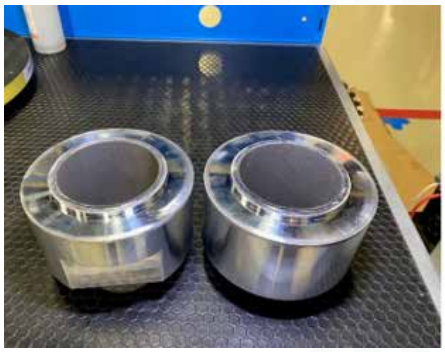
F110 ENGINE REDESIGN PROJECT

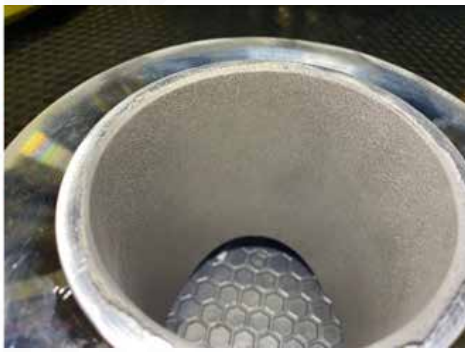
In 2022, concurrent engineering work was carried out with the GEA team for the redesign project of the F110 engine group, known as the F110-GE-132. Within this scope, NPI projects for the LPT 1st stage disk, HPT forward seal, and augmenter duct parts are ongoing.

Additionally, new part production projects were initiated in 2022, which included Electron Beam Welding, Additive Manufacturing, Precision Machining, and Special Processes for airframe and engine body parts. Throughout the year, electron beam welding services were also provided for various customer parts.

TEI F110 Redesign Parts

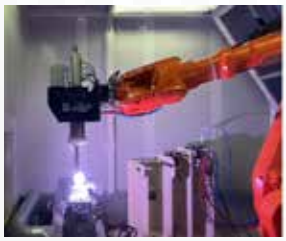






Cylinder Block Thermal Spray Coating

The development studies of the TEI-PD170 engine block's cylinder internal thermal spray coating process have been completed, and suitable metallographic and mechanical test results have been obtained. The processing of coated surfaces with honing has also been successfully developed.



TEI-PD170 Engine Block Thermal Spray Coating

In addition to the ongoing projects, a thermal barrier coating application was developed for the inner diameter of a part to be used as tank ammunition. In the coating process developed for this part, which has a highly complex geometry, an appropriate thickness range was achieved throughout all regions. Advanced cooling systems were uniquely developed and used to ensure that the Al-7075 base material's structure remained intact.

Inner Dimention Thermal Barrier Coating Application

INVESTMENTS

In 2022, commissioning activities were completed for the following investments:

- 1 Horizontal Multi-Purpose Machining Center,
- 1 Profile Projector Device,
- 1 Orbital Welding Workbench,
- 1 Semi-Automatic Sealing Pressure Test Equipment,
- 1 Engine Block Washing and Deburring Machine,
- 1 CFG Workbench,
- 1 Cutting and Polishing Machine,
- 1 Drying Oven,
- 2 Rapid Bakelite Acquisition Devices,
- 1 Microscope,
- 1 Tensile Testing Machine,
- Installation of B700 Metallography Laboratory Workbench and Cabinets,
- 1 Rhytym Workstation and UT Evaluation System,
- 1 Torque Calibrator,
- 1 Rotary Plasma Gun and Hybrid Thermal Spray Coating Machine with Fan Disk Coating Capability (Designed by TEI Special Process Department),
- 2 ACC/Sermetel Coating Curing Ovens,
- 1 Vacuum Heat Treatment Furnace (Owned by Gur Metal Company).

NEW TECHNOLOGIES AND AUTOMATION APPLICATIONS

DIGITAL TRANSFORMATION IN MANUFACTURING / SMART FACTORY PROJECT

In 2022, as part of the Smart Factory Project, the following activities were carried out:

Both the digitization of workshop processes for paperless manufacturing and the process design of necessary applications to enable end-to-end traceability in manufacturing and make decision-making processes data-driven were completed by TEI teams.

Machines in the B1000 building were connected to a common network using Internet of Things (IoT) applications, and operational data began to be collected in a database. Software development activities for the Production Management System (MES), Digital Factory Twin, Digital Quality Management System, Data Analytics, and Reporting applications were completed and uploaded to TEI servers by the project's technology partner, GE Digital.

These applications are currently undergoing field tests, and the system is planned to go live at the B1000 Advanced Manufacturing Technologies Building in 2023.

TEI Digital Transformation Screen Captures

PROJECTS

TEI-TS1400 ACHIEVES 1,572 HORSEPOWER

As part of the Turbo Shaft Engine Development Project initiated by Defense Industry Agency, the TEI-TS1400 engine, planned to power the GOKBEY General Purpose Helicopter, aims to develop a 1400 shaft horsepower turbo shaft engine that is export-independent, national, and civil certified. The project also aims to bring various export-dependant technologies to Türkiye. According to the contract signed between SSB and TEI, the project started in 2017, and the delivery of the first prototype took place on December 5, 2020, in a ceremony attended by our President. As of 2021, imported accessory systems were rapidly developed nationally, including critical accessories such as the national gearbox, oil tank, and pump.

The test cell to be used in the engine tests was also completely designed, developed, and built by TEI engineers and technicians and put into operation. Equipped with national accessory systems such as the national gearbox, oil tank, and pump, the first TEI-TS1400 engine successfully reached the 1400 shaft horsepower maximum takeoff power specified in the project requirements at 40,000 RPM core engine speed and 23,000 RPM shaft output speed during tests conducted in January 2022.

While the manufacturing and testing activities of the national turbo shaft engine continue, the project has reached its highest gas generator speed with the turbo shaft engine in the TEI-TS1400 Turbo Shaft Engine Development Project, achieving a power of up to 1,572 horsepower in tests. As of the end of 2022, 165 hours of engine tests have been conducted, and it is aimed to complete the certification process of the TEI-TS1400 engine in 2025.

The TEI-TS1400 engine

THE 84TH T700-TEI-701D ENGINE HAS BEEN DELIVERED FOR THE GENERAL-PURPOSE HELICOPTER PROJECT

The T700-TEI-701D engine, with a weight of 207 kg, produces a maximum of 2000 shaft horsepower and can operate safely under the most challenging environmental conditions, including desert dust. The turbo shaft engine bearing the nameplate, T700-TEI-701D, is the first helicopter engine manufactured in Türkiye.

The T700-TEI-701D engines will provide power for the T70 General-Purpose Helicopter, which will meet Türkiye's general-purpose helicopter needs for cargo transport, search and rescue, firefighting, air ambulance, and coastal security missions. Turkish industry will play a significant role in meeting domestic needs in both military and civilian sectors.

The General-Purpose Helicopter Program (GMHP) initiated by Defense Industry Agency, with the aim of meeting Türkiye's General-Purpose Helicopter needs using domestic capabilities, has seen the delivery of 84 T700-TEI-701D engines by TEI, with the assembly of 32 engines currently in progress.

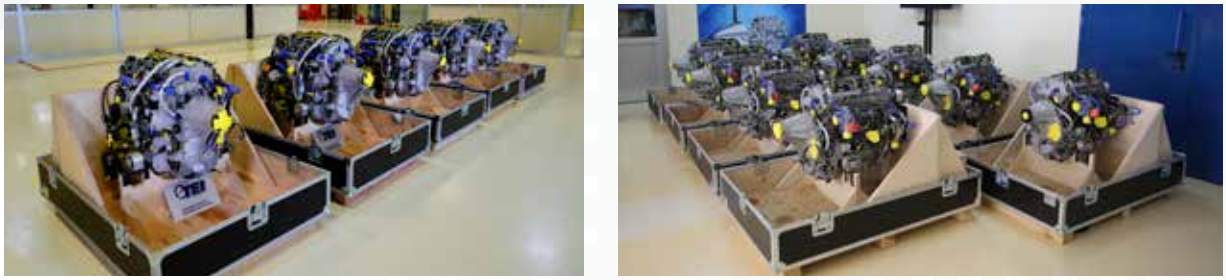
T700-TEI-701D engines

DELIVERY OF 40 TEI-PD170 ENGINES TO TUSAS

Supported by Defence Industry Agency, the TEI-PD170 engine, which was launched in 2013 and first run in 2017, features a two-stage serial turbocharger system. In December 2018, the TEI-PD170 engine made its first flight with the ANKA platform. The TEI-PD170 engine, which can be operated with JP-8 or Jet-A1 fuels, stands

significantly ahead of its competitors with a dry weight of 162 kg. Developed in compliance with civil aviation standards using TEI capabilities, the TEI-PD170 engine holds the title of the world's highest altitude-capable (45,000 ft) serial production turbodiesel engine in its class, thanks to its superior features. The software for the redundant Engine Control System (MKS) of the remarkable engine, notable for its altitude capability and fuel efficiency, was also developed by TEI. Over 10,000 hours of calibration and testing activities were conducted.

In 2022, the assembly of 14 TEI-PD170 engines was completed, marking the delivery of TUSAS's order for 40 engines. With a domestic content rate exceeding 90%, the engine's serial production and delivery continued. Integration of the TEI-PD170 engine with the AKSUNGUR platform was carried out, and platform flights were conducted. Throughout the year, continuous support was provided for the integration of the TEI-PD170 engine with the AKSUNGUR platform, and altitude records were broken during flights, with the AKSUNGUR platform reaching an altitude of 30,000 feet.



TEI-PD170 Engines Awaiting Delivery

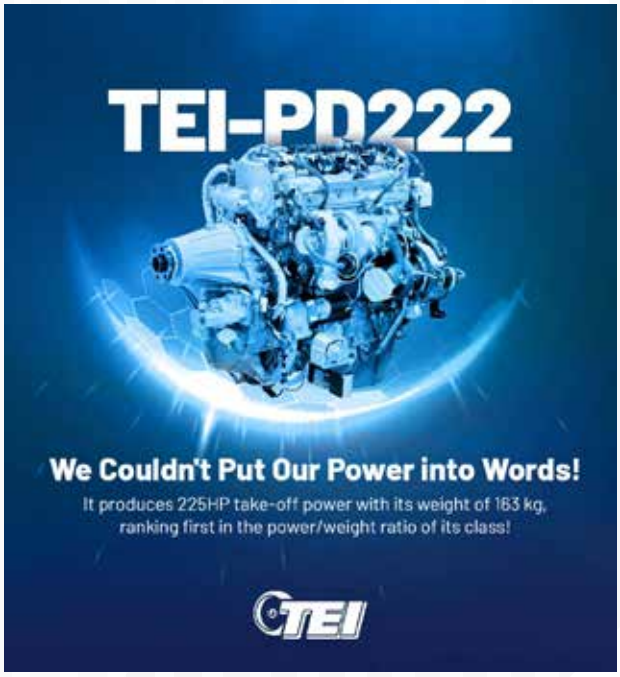
DEVELOPMENTS IN ORIGINAL PISTON ENGINE PROJECTS

TEI-PG50 engine customer deliveries were carried out, and development flights continued. The TEI-PG50 engine, used on the Kargı platform, was employed in a flight that included a radar seeker head for the first time. The TEI-PG50 aviation engine, which is still undergoing development flights, is planned to begin its inventory entry process in the second half of 2023. As part of the TEI-PG50 project, development work for the TEI-PG50S engine, which is still in progress, involved the production of the first prototypes and initial ignition tests. Simultaneously, work on the hardware and software developed specifically for the engine control unit was conducted. Following planned durability tests in the first half of 2023, the engine is expected to be ready by the end of 2023.

A total of 27 flight tests were conducted with the TUSAS AKSUNGUR platform using TEI-PD170 engines, accumulating 73 hours of flight time. Serial production and deliveries of the engines to TUSAS and BAYKAR continue. The first successful start-up of the TEI-PD170 engine was performed on the BAYKAR TB3 platform. A contract was signed with the SSB for the TEI-PD222 engine, officially initiating the project. Work was carried out in collaboration with the SSB to review system requirements. Within the project, design activities were matured, prototype engine production was completed, and durability and performance tests were initiated.

TEI-PD222

Produced by TEI, the TEI-PD222, the most powerful member of the piston aviation engine family, stands out with its 163 kg weight and 225 HP takeoff power, making it the leader in its class in terms of power-to-weight ratio.



BEGINNING MEETING OF UAV ENGINE DEVELOPMENT PROJECT

Under the UAV Engines Development Project signed with the SSB on December 27, 2021, the "Project Kick-off Meeting" was held on February 3, 2022. The meeting was attended by Mesude Kilinc, President of the SSB Engine and Power Transmission Systems Department, and her team, as well as representatives from TUSAS and BAYKAR. Within the scope of the project, 2 new engines, TEI-PD180 and TEI-PD222, will be developed. Thus, following TEI-PD170, the TEI piston engine product family will expand, providing indigenous and national solutions for our country's UAV engines. The project is expected to be completed by the end of 2024.

10,000TH BLISK SALE

TEI, as one of the largest suppliers to the world's largest aviation engine manufacturers, began its involvement in the LEAP engine program in 2016. In this program, TEI recently achieved the milestone of producing and selling the 10,000th blisk (A component used in gas turbine engines, and it represents a compressor disk and blades manufactured as a single piece). The production of blisks requires innovative technologies and advanced manufacturing techniques, and TEI is one of the few aviation companies worldwide with this capability.

FAA PART-145 MAINTENANCE APPROVAL FOR LEAP COMPONENTS

On December 1 - 2, 2022, following a successful FAA Part 145 audit without any findings, TEI earned the authorization to perform maintenance on components of the LEAP engine, which powers the Boeing 737-MAX and Airbus A320neo commercial aircrafts, making it one of the most preferred next-generation commercial engines globally. With the scope of approval issued after the audit, TEI is now authorized to perform maintenance on 19 different components of the LEAP-1A/1B engine, which will be installed on registered aircraft in the United States, following the European Union member states, the United Kingdom, and the EASA Part 145 and UK-CAA Part 145 approvals. This FAA Part 145 approval marks TEI's third civil aviation authority approval.

INDIGENOUS FIXTURE AND INERTIAL SOURCE

TEI, one of the four companies globally with expertise in the inertial welding process, successfully applied the inertial welding process for the first time in indigeneous projects. In this project, equipment design and production, process analysis and layout, and part design where the process was applied were entirely carried out by TEI engineers. Teams from various departments at TEI, including Manufacturing Engineering, Blisk and Advanced Manufacturing Engineering, Engine Dynamics and Structural Engineering, Turbofan Engine Mechanical Systems-1, Indigenous Projects Manufacturing, and Engine Integration, demonstrated dedicated work throughout the process.

An inertia welding is a process in which kinetic energy stored in flywheels is converted into friction and heat in the welding zone. Its advantages include shorter welding times, reduced flash (weld spatter), and a narrower heat-affected zone compared to other welding methods. Material properties are less affected than in other welding processes. It has low power consumption and minimal energy loss, resulting in strong welds. It is a robust, reliable, and repeatable process. The process can be mathematically scaled with pre-determined parameters. It enables the joining of large-scale engine components with high bi-metallic bonding properties and consistent welding quality.

HUMAN RESOURCES PROCESSES

TEI AVIATION ENGINES SCHOOL

In 2022, the second season of the TEI Aviation Engines School was completed with a 15-week program. The number of students doubled compared to the first year, reaching 8,000, and more than 120 university students were reached. The TEI Aviation Engines School, which added significant value to the professional development of students, not only proved its worth but also received a gold award from Stevie MENA in the international arena. Successful graduates from the second term of the Aviation Engines program were hosted at the TEI Eskisehir campus for a full day. After breakfast, a TEI presentation was held, and students had meetings with the recruitment team. The event concluded with a factory tour.

SSB ACADEMY

The program, which began with the opening speech by Assoc. Prof. Cenk Aktas, Defense Industry Academy (SSA), on June 29, continued with a speech by Yeliz Cetinkaya, Vice President of Human Resources and Administrative Affairs at TEI, followed by a TEI Academy presentation. After presentations by academy directors from other defense industry companies, the program concluded with a general evaluation.

THE "Z REPORT PROJECT"

The Z Report Project's first introduction event took place on August 23, 2022. The project aims to increase interaction between young-generation TEI employees and different generations. It focuses on conveying the evolving digital technologies, trends in social media usage, perspectives on social life, and the communication language between generations.

As part of the project, the training processes for mentors and mentees began initially. After completing the training, a project launch was held on September 3, 2022, with the participation of mentors and mentees. Within the scope of the project, mentors and mentees came together and conducted a total of 89 sessions. These sessions led to increased interaction, knowledge transfer, and activities aimed at improving intergenerational communication. The Z Report Project was successfully completed on December 12, 2022, with a high level of satisfaction among mentors and mentees.

DEVELOPMENT ACADEMY EDUCATION PROGRAM

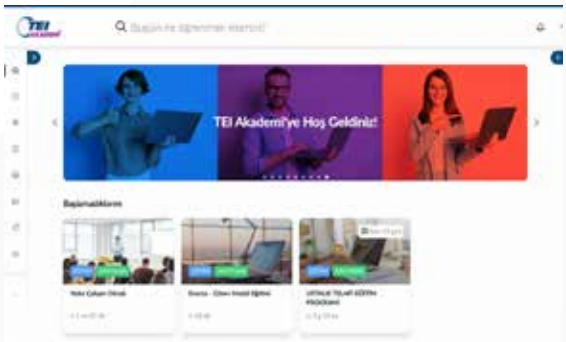
In 2022, a customized Development Academy Training Program was designed based on individual interviews with participants. A total of 109 TEI employees participated in the program this year. The Development Academy Training Program, which is part of leadership development initiatives aimed at developing potential leaders, was successfully completed. Participants expressed their satisfaction with the training, which was tailored to their developmental needs.

BILSEM ACTIVITY

On October 3 - 4, in collaboration with the Ministry of National Education, Defense Industry Academy, and Visionary Young, 20 students who are continuing their education at Eskisehir BİLSEM were hosted at the TEI Eskisehir Campus. During the visit, the students had the opportunity to learn about TEI's activities and operations. Following this, a workshop was conducted in the TEI-TJ90 Engine Workshop, where they had hands-on experience with the disassembly and assembly of an aircraft engine. It was an educational and enjoyable experience for the students. At the end of the visit, all the students received a 3D model of the TEI-TJ90 engine as a gift, marking the completion of their visit to TEI.

LMS SYSTEM RENEWAL

The Digital Education Platform (LMS - Learning Management System) has been launched with a new design to contribute to employees' development journey and provide easy access to personal and professional development training from a single point. The platform is continuously updated with new training content in various fields every month, ensuring that TEI employees can continuously contribute to their development.



THE VISIONARY YOUTH CHILDREN'S WORKSHOP AWARD CERENOMY

As part of the protocol signed Defence Industry Agency of Turkiye and the Ministry of National Education, the Visionary Young Children's Workshop activities were organized a total of 6 times in 2022. The Visionary Young Children's Workshop Ceremony, attended by Prof. Faruk Yigit, the Deputy Chairman of the Defense Industry at the time, and Prof. Petek Askar, the Deputy Minister of National Education at the time, was also attended by Kemal Baldoktu, the President of Human Resources at TEI, Hilal Yildiz Cetin, the Senior Team Leader of Human Resources at TEI, Burak Celebi, the Chief Specialist of Human Resources at TEI, and students from Eskisehir BILSEM.

THE ORIENTATION INTRODUCTION EVENT

As part of the "Hybrid Orientation" program, which is regularly organized every month for new employees at TEI, a welcome dinner was organized at the picnic area. Managers attended the event, and team leaders introduced TEI to the new employees, providing an opportunity for them to get acquainted.

THROUGH THE MASTERY COMPENSATION PROGRAM, EMPLOYEES AT TEI HAVE EARNED THE RIGHT TO OBTAIN MASTERY CERTIFICATES

Coordinated in collaboration with Yunus Emre Vocational High School, the Mastery Compensation Program began in June and was completed on December 20, 2022. Approximately 1,180 TEI employees participated in the program. Those who succeeded in the program earned mastery certificates for forklift, electric pallet jack, towing truck, and overhead crane usage.

ISKUR ON-JOB TRAINING PROGRAM

The ISKUR On-Job Training Program, which began with a total of 128 trainees participating in 6 programs in October, November, and December 2022, is ongoing. Throughout the program, trainees continue to receive technical training in their respective fields. It is planned that at least 70% of successful trainees will be employed upon completion of the program in 2023.

VOCATIONAL HIGH SCHOOL INTERNSHIP PROGRAM

Vocational high schools and vocational colleges completed their summer internships in 2022. During the internship program, students were provided with general information about TEI. Various training sessions were organized in different fields to increase students' awareness. Students who participated in the internship also had the opportunity to benefit from Personal Development Training packages.

EDUCATION PROGRAM WITH ESTU

As part of the protocol with Eskisehir Technical University (ESTU), students from the Aircraft Body Engine Maintenance Department of the ESTU Faculty of Space Sciences received both practical and theoretical lessons throughout the fall semester with the HYO 216 program. Examinations and project presentations of the training program, held at the TEI Eskisehir Campus, were conducted under the guidance of TEI instructors, and the program was successfully completed.

BOOST YOUR CAREER SUMMER INTERNSHIP PROGRAM

In the 'Boost Your Career Summer Internship Program,' students in their 3rd and 4th years of university education participated in 20 to 30 working days within TEI's technical and administrative departments. During the program, which took place between June and September, interns were included in specially prepared training programs for them. The mandatory summer internship program, 'Boost Your Career Summer Internship Program,' was completed in 2022 with the participation of 256 students, providing them with an unforgettable internship experience at TEI.

SOURCE OF POWER CAREER CANDIDATE ENGINEERING PROGRAM GRADUATION CEREMONY

The second-term graduation ceremony of the long-term candidate engineering program, where final-year university students enhance their practical skills in TEI's unique engine design, manufacturing, and administrative activities, and take their first steps into the professional world, was held on June 23, 2022. The event, attended by TEI CEO Prof. Mahmut F. Aksit and TEI Vice Presidents, celebrated all candidate engineers who left their mark on the sky within the program, while wishing them success in their career journeys.

TEI PARTICIPATED IN THE GRADUATION CEREMONIES OF ISTANBUL TECHNICAL UNIVERSITY AND MIDDLE EAST TECHNICAL UNIVERSITY

On July 28, 2022, Istanbul Technical University's Faculty of Aeronautics and Astronautics held its undergraduate graduation ceremony, and on August 3, Middle East Technical University's Department of Aerospace Engineering organized its graduation ceremony. During these ceremonies, young talents who graduated with honors from ITU's Aeronautics, Space, and Mechatronics Engineering and METU's Aerospace Engineering departments had the opportunity to meet with TEI's Human Resources team and learn about TEI's recruitment processes and career opportunities.

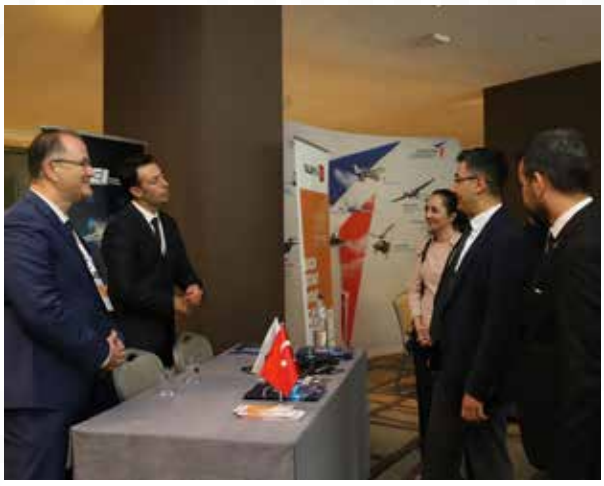
TEI PARTICIPATED IN DOMESTIC AND INTERNATIONAL CBICO EVENTS

In 2022, TEI participated in TalentforBIZ events organized by the Presidency of the Republic of Türkiye, Presidential Human Resources Office (CBICO). These events aimed to support Türkiye in becoming an attractive destination for young people who have studied abroad or live abroad, share career opportunities in Turkish companies, and inform young individuals about Turkish firms. TEI took part in a total of six different events, including three cities in Europe (Rotterdam, London, and Cologne) and three cities in Türkiye (Gaziantep, Izmir, and Bolu).

LONDON, ENGLAND

GAZIANTEP UNIVERSITY

ROTTARDAM, THE NETHERLANDS



EGE UNIVERSITY

COLOGNE, GERMANY

ABANT IZZET BAYSAL UNIVERSITY

UNIVERSITY EVENTS

The TEI Human Resources Team participated in career events at various universities by setting up booths and engaging with students. During these events, students learned about TEI's human resources processes and had the opportunity to ask questions to the human resources team.

2-4 MARCH ITU DEFENSE INDUSTRY TECHNOLOGIES DAYS EVENT

16-17 MARCH HACETTEPE UNIVERSITY HACETTEPE CAREER DAYS EVENT

28-29 MARCH METU CAREER FAIR

5 APRIL ANBEAN DEFENSE INDUSTRY VIRTUAL CAREER FAIR

11 MAY ESKISEHIR OSMANGAZI UNIVERSITY CAREER WEEK

11 MAY YILDIZ TECHNICAL UNIVERSITY DEFENCE INDUSTRY DAYS

11-13 MAY BURSA TECHNICAL UNIVERSITY (BTU) AVIATION AND DEFENSE DAYS BURSA TECHNICAL UNIVERSITY (BTU) ORGANIZED THE AVIATION AND DEFENSE DAY

25 MAY YILDIZ TECHNICAL UNIVERSITY SPRING FEST'22

24-25 MAY ISTANBUL TECHNICAL UNIVERSITY ADDITIVE THINKING CONFERENCE

13-14 OCTOBER SAVTEK DAYS

1-2 JUNE TECHNOPARK ISTANBUL CAREER DAYS

17-18 NOVEMBER METU CAREER FAIR

13-15 SEPTEMBER METU SAVTEK 2022 10TH DEFENSE TECHNOLOGIES CONGRESS

22 DECEMBER MACHINE CHEMICAL MATERIAL DAYS

INTERACTIVE HUMAN RESOURCES SEMINAR

CAREER PLUS ENGINEERING CAMP

ESKISEHIR OSMANGAZI UNIVERSITY EVENT

YILDIZ TECHNICAL UNIVERSITY DEFENSE INDUSTRY TECHNOLOGIES COMMUNITY EVENT

ESKISEHIR OSMANGAZI UNIVERSITY TEI TALK'22 EVENT

ESKISEHIR OSMANGAZI UNIVERSITY TEI TALK'22 EVENT

ESOGU MECHANICAL ENGINEERING FACULTY EVENT

ISTANBUL TECHNICAL UNIVERSITY MAKINISTANBUL EVENT

METU INTERVIEW DAYS

TEI, SCIENCE AND TECHNOLOGY DAYS

SUMMER CAMP EVENT

INTERACTION & DEVELOPMENT CAMP UNIVERSITY STUDENT COMMUNITIES EVENT

YILDIZ TECHNICAL UNIVERSITY MATERIAL DAYS

BILKENT UNIVERSITY INTERVIEW DAYS EVENT

A CONVERSATION WITH STUDENTS FROM SABIHA GOKCEN VOCATIONAL AND TECHNICAL ANATOLIAN HIGH SCHOOL

On March 16th, the TEI Human Resources team met with students from Sabiha Gokcen Vocational and Technical Anatolian High School. During the discussion, questions that the students were curious about were answered, and information was provided about TEI and working life at TEI.

TRAINING

KAMPUSTEIZ! - UNIVERSITY COLLABORATIONS

Collaborative partnerships between universities and TEI aim to combine the resources of both parties and carry out coordinated efforts based on a specific plan. These partnerships are managed by TEI Academy, and they focus on providing services related to undergraduate, graduate, doctoral, and post-doctoral education and research programs. In 2022, partnerships were established with several universities, including Anadolu University, Eskisehir Technical University, Eskisehir Osmangazi University, Istanbul Technical University, Gebze Technical University, Middle East Technical University, and Sabanci University. These collaborations served to increase motivation among university students interested in aviation and provide them with essential knowledge related to the industry. Additionally, a protocol was established with Eskisehir Osmangazi University, where expert TEI technical teams delivered seminar classes to mechanical engineering students over a period of 13 weeks.

EXECUTIVE DEVELOPMENT PROGRAMS

At TEI, separate development programs are conducted for individuals in different positions, including managerial candidates and managers. Within this framework, various training sessions were organized, including the "Point of You Workshop," "Leadership Training," and "Developing Leadership Training." These programs were designed to cater to potential leaders, existing leaders, and managers. The training sessions were carried out throughout the year, providing an enjoyable and informative learning experience for the participants.

PERSONAL DEVELOPMENT TRAININGS

In 2022, the TEI Personal Development Training Catalog featured a range of training topics that were determined based on the opinions of TEI managers, the competencies expected from various job titles, and performance evaluations. The training programs included in this catalog were presented to TEI employees for selection and approval by their managers. During the process of selecting educational institutions for these training programs, extensive benchmark studies were conducted, and current trends were closely monitored to ensure that the programs met TEI's expectations. Furthermore, to diversify TEI's learning experiences and provide different perspectives, the pool of educational institutions was renewed, and training sessions commenced in March. Throughout the year, TEI Academy conducted various training sessions, including Mindfulness, Effective Presentation Techniques, Design Thinking, Negotiation Techniques through Cinema Movies, Schema Therapy, Goal 1 Million, and PRF Impactful Training, among others.

TECHNICAL TRAINING

To ensure the continuous development of TEI employees, various training sessions were provided to employees from different job fields and title groups. Training programs such as AIT&MRO PR, GD&T, NX, PMP, Simulation of Hydraulic Systems, Machining with New Technology Cutting Tools, and Working at Heights were completed.

In addition to technical training, in 2022, TEI also organized Smoking Cessation and Search and Rescue Training for employees. These training sessions were conducted to increase awareness and contribute to the development of the participating employees and were completed with high satisfaction.

TEI BOARD OF DIRECTORS

PROF. MAHMUT F. AKSİT

Prof. Mahmut F. Aksit, who has been serving as the CEO since 2013, also held the position of Chairman of the TEI Board of Directors from 2019 to 2022. As of June 13, 2022, he has assumed the role of a Member of the TEI Board of Directors.

PROF. OSMAN SAIM DINC

Prof. Osman Saim Dinc, TEI Board of Directors Member since March 27, 2017, assumed the role of Chairman of the TEI Board of Directors as of June 13, 2022.

RANDALL HOBSS

We extend our gratitude to Randall Hobbs for his valuable services to our company as a member of the TEI Board of Directors from 2018 to 2022.

DANIEL PATRICK WAUGH

We wish Daniel Patrick Waugh success in his new role as a member of the TEI Board of Directors, starting from December 13, 2022.

VISIT BY FATIH DONMEZ

The former Minister of Energy and Natural Resources of Türkiye and Member of Parliament for Eskisehir, Fatih Donmez, visited TEI as part of a series of programs in Eskisehir. He was accompanied by the Governor of Eskisehir at the time, Erol Ayyildiz, the Deputy Minister at the time, Prof. Seref Kalayci, and their delegation. During the visit to Eskisehir, Fatih Donmez inspected TEI and received a briefing from TEI's CEO, Prof. Mahmut F. Aksit, on TEI's original engine projects, international engine component and module manufacturing capabilities, maintenance and repair activities, and testing infrastructure. After the briefing, Fatih Donmez toured the exhibition area showcasing TEI's indigenous engine projects, its activities, and achievements. He also signed TEI's Guest Book. Donmez received information about TEI's new indigenous engine project, TEI-TF6000, and then participated in the testing of TEI-PD170 and TEI-TS1400 engine projects. He also examined the national test cell created by the TEI team for the testing of the TEI-TS1400 engine. As a token of the visit, TEI's CEO, Prof. Mahmut F. Aksit, presented Fatih Donmez with a handcrafted art piece featuring the design of the TEI-TS1400 turboshaft engine. After the visit, Fatih Donmez praised the TEI team, especially TEI's CEO, Prof. Mahmut Aksit, for their achievements, saying, "I congratulate the entire team who has made us proud with their successes and whose signatures are under these achievements."

MAJOR AGREEMENT BETWEEN TEI AND BOTAS

According to the protocol signed between TEI and BOTAS, TEI will provide engineering support, localization, refurbishment, efficiency improvement, maintenance, and service support to all gas turbines in BOTAS's inventory. TEI and BOTAS began working on the maintenance and repair of a gas turbine used by BOTAS in recent months, and with this agreement, they have expanded their collaboration to include all gas turbines in their inventory. Under the protocol, TEI and BOTAS will also collaborate on gas turbine and natural gas compressor development. The signing ceremony for this agreement took place at the TEI Eskisehir campus and was attended by TEI CEO Prof. Mahmut F. Aksit, BOTAS CEO of the period, Burhan Ozcan, TEI Vice President of Business Development and Sales Ahmet Kain, BOTAS Deputy General Manager M. Talha Pamukcu, and company representatives.

VISIT BY NUMAN KURTULMUS

During his visit to Eskisehir for various programs, the former Deputy Chairman of the AK Party, Prof. Numan Kurtulmus, paid a visit to TEI.
Kurtulmus and his accompanying delegation received information from TEI CEO Prof. Mahmut F. Aksit about Türkiye's indigenous aviation engines in an area designed by TEI like a museum. Kurtulmus had the opportunity to see aviation engines that were designed, developed, operated, and produced in Türkiye while considering the country's national needs. He also examined the manufacturing contributions that TEI offers to the global aviation industry and inspected the parts and modules manufactured by TEI as part of its civilian and military engine programs, where TEI serves as the largest supplier.

COLLABORATION AGREEMENT SIGNED BETWEEN TEI AND ESKISEHIR OSMANGAZI UNIVERSITY

Within the scope of the Undergraduate Education Cooperation Protocol signed between ESOGU and TEI, students studying in the Department of Aeronautical Engineering will be able to do an internship at TEI simultaneously with their university education with the training program to be prepared; the theoretical knowledge they learn during their university education will be reinforced with practical training. ESOGU Aeronautical Engineering Department students will carry out product design and part analysis of engine parts deemed suitable for educational purposes, and will ensure that these parts are produced using Advanced Manufacturing Techniques and Processes.

The cooperation protocol was signed by TEI CEO Prof. Signing with Mahmut F. Aksit, ESOGU Rector of the time, Prof. Kemal Senocak expressed the need for modern aeronautical engineers and said that the cooperation protocol will create an important chance and opportunity for ESOGU aeronautical engineering students. TEI CEO Prof. Mahmut F. Aksit wished that the protocol shall be beneficial for TEI and ESOGU.

COLLABORATION AGREEMENT SIGNED BETWEEN TEI AND SABANCI UNIVERSITY FOR DEVELOPING COMPOSITE ENGINE COMPONENTS

On the 2nd day of the SAHA EXPO Defense & Aerospace Fair, TEI signed an agreement with Sabancı University for the development of composite engine components.

The agreement, signed by TEI CEO Prof. Mahmut F. Aksit and Sabanci University Rector Prof. Yusuf Leblebici, encompasses the "Development of Fan Inner Casing System from Composite Material in Turbofan Engines" project, which will be conducted at the Integrated Manufacturing Technologies Research and Application Center (SU IMC) within Sabancı University. The use of composite material technology in aviation engines allows for lightweight engine design, providing a competitive solution while also offering significant advantages by providing higher strength. The use of composite materials in aviation engines is becoming more widespread thanks to evolving production technologies.

Speaking at the signing ceremony, TEI CEO Prof. Mahmut F. Aksit mentioned that TEI and Sabancı University have been collaborating on various projects, especially in the field of additive manufacturing, for many years.

He noted that the work carried out under this agreement will elevate this collaboration to a higher level. Aksit emphasized that components produced in the aviation industry are very challenging and complex, and through their joint efforts, they have achieved significant results in various projects. Aksit stated, "The development of this system, which will be used in Türkiye's most powerful engine, will be an important step on the path toward more challenging projects."

In his speech at the ceremony, Sabancı University Rector Prof. Yusuf Leblebici highlighted the university's significant and successful work in the field of composite materials and additive manufacturing over the years. He expressed pride in the university's contributions to making Türkiye one of the few countries in the world with a strong presence in this field. Leblebici emphasized that Sabancı University will continue to support TEI's work with its researchers and staff, further strengthening their collaboration.

DEVELOPMENT PARTNERSHIP AGREEMENT SIGNED FOR KOCAK SPEEDOL EQUIVALENT GAS TURBINE OIL

Kocak Speedol and TEI have signed a "Development Partnership Agreement for Equivalent Gas Turbine Oil."

Under this signed partnership agreement, Kocak Speedol will develop oils to be used in TEI's gas turbine engines. During the signing ceremony, which took place on the second day of the SAHA EXPO Defense & Aerospace Fair held at the Istanbul Exhibition Center from October 25th to 28th, TEI's TEI CEO Prof. Mahmut F. Aksit, stated, "In the production of the engines we design, develop, and operate, we prioritize maximum localization, striving to develop all subsystems and even raw materials with national capabilities. In this regard, we attach great importance to collaborations with domestic producers. Our collaboration with Kocak had already begun for our piston engines, and with this agreement, it will be ensured that the oils used in our gas turbine engines are also developed and produced in Türkiye."

Aksit also mentioned that within the scope of their existing collaborations, they use Kocak Speedol Aero Ultra Diesel S170 engine oil in the TEI-PD170 turbodiesel aviation engine. He emphasized that increased collaboration among domestic companies is in the best interest of the country and expressed gratitude to SAHA Istanbul for facilitating such partnership agreements.

TEI HAS SIGNED A CONTRACT WITH THE GENERAL DIRECTORATE OF MILITARY FACTORIES

TEI has signed a 12-month collaboration agreement with the General Directorate of Military Factories (AFGM) at the SAHA EXPO Aviation & Defense Fair. The signing ceremony took place on the second day of SAHA EXPO and was attended by TEI's CEO Prof. Mahmut F. Aksit, AFGM's CEO Imdat Ersoy, and their respective delegations. Under the signed agreement, TEI will provide services to AFGM in the maintenance, repair, testing activities, accident analysis, refurbishment, depot-level maintenance, modification, and on-site repair support of Makila 1A1 engines, which power the Cougar helicopters in the inventory of the Turkish Armed Forces.

Speaking at the signing ceremony, TEI CEO Pro. Mahmut F. Aksit expressed satisfaction with the ongoing collaboration with AFGM, stating, "We have been working together with AFGM for many years. We have been performing maintenance on the Makila 1A1 engines at our Eskisehir facility for a long time. We are delighted with the collaboration that we will continue through this contract." Aksit also emphasized the importance of AFGM's internally developed capabilities and shared some positive news, saying, "Let me also announce something here. Our discussions regarding the production of GE LM2500 engines, which are used in MİLGEM projects, have reached a certain stage in our country. Globally, we are making efforts to acquire the capability to produce this engine under official license. Hopefully, we will sign this agreement together in the near future."

TEI SURPRISES WITH AN ENGINE ANNOUNCEMENT AT THE GENERAL ASSEMBLY

On June 6, 2022, the Board of Directors of the Turkish Armed Forces Foundation (TSKGV) visited TEI. During the facility tour attended by various dignitaries, including the Defense Industry President of the time Prof. Ismail Demir, Secretary-General of the National Security Council Seyfullah Hacimuftuoglu, Governor of Eskisehir of the time Erol Ayyildiz, Deputy Minister of Industry and Technology Hasan Buyukdede, TSKGV Board Member of the period Retired Lieutenant General Umit Dundar and TSKGV Board Member Cenap Asci Cenap Asci, TSKGV Deputy General Manager Sadik Piyade, Chairman of the THK Trusteeship Committee of the period Abdullah Kaya, and their accompanying delegations, TEI's CEO Prof. Mahmut F. Aksit provided information about TEI's ongoing projects.

During the visit, a surprise was presented to the participants: the 1:1 scale model of Türkiye's first national turbofan engine, the TEI-TF6000, which had reached the prototype manufacturing stage after approximately 2 years of design work, was exhibited for the first time.

TEI-TS1400 ACCESSORY GEARBOX (AGB) DELIVERED TO TEI

The second prototype delivery ceremony of the TEI-TS1400 Turboshaft Engine Accessory Gearbox (AGB) for the Gokbey Helicopter took place at the Alp Aviation facilities.

The ceremony was attended by TEI CEO Prof. Mahmut F. Aksit, Alp Aviation CEO Senay Idil, TEI design team managers and engineers, Alp Aviation design unit team managers and engineers, and unit managers who supported the project.

During the ceremony, Senay Idil, the CEO of Alp Aviation, expressed his happiness for designing and producing the gearbox, saying, "Alp Aviation is delighted to deliver the second Accessory Gearbox. We have delivered many products as Alp Aviation, but this product is very different for us. This is because we designed and produced it as a team. In line with Alp Aviation's overall strategy, we realized this product under a completely vertically integrated structure. I thank everyone who contributed to this project." TEI CEO Prof. Mahmut F. Aksit emphasized the importance of AGB production as a significant achievement for Türkiye, stating, "Achieving such a first is a crucial milestone for Türkiye. I thank both the Alp Aviation teams and my team for their support to Alp Aviation's design team in terms of gearbox design. With the effort put forth and the investments made, we have provided Türkiye with this technology. Today, we are experiencing a historic moment for Turkish aviation. We have achieved a very important task. Hopefully, we will continue at the same pace, and after serial production, we will see it flying and performing its tasks effectively. With the efforts made and the investments put in, it will become a flying and operational system for Türkiye.

INTERNATIONAL AEROSPACE AND QUALITY GROUP (IAQG) TÜRKİYE MEETING

The International Aerospace and Quality Group's (IAQG) European sector, EAQG, held its periodical meeting in Türkiye for the first time on March 16-17, 2022. A team of 4 members from TEI, including Turgut Cicek, Vice Prisident of Quality and Manufacturing Engineering; Turgut Avci, Product Quality Manager; Aysin Ozkan, Manager of Manufacturing and Design Organization Quality System and Certification; and Korcan Sever, Technical Leader in Manifacturing and Design Organization Quality System and Certification, participated in the meeting held in Istanbul. The meeting, attended by approximately 40 participants from companies such as Airbus Defence and Space, Leonardo, BAE Systems, Thales, Dassault, Aselsan, TUSAS, both in-person and remotely, reviewed the quality activities carried out in the aerospace, space, and defense industries in 2021 and provided information about the activities planned for 2022.

THE NATIONAL MOBILE TEST CELL HAS BEEN ACTIVATED

TEI has activated Türkiye's first mobile turbofan engine test cell, which has been locally and nationally installed entirely by its own engineers and technicians. Designed to serve various turbofan/turbojet engines, including the TEI-TF6000, this mobile test brake system possesses all the capabilities and features that a built-in test cell can provide and offers testing possibilities under different altitude conditions.

THE NADCAP AUDIT WAS COMPLETED SUCCESSFULLY WITHOUT ANY FINDINGS

In 2022, TEI successfully completed the "Airflow Measurement" and "Three Dimensional Structured Light Systems" (3DSL) special processes under the "NADCAP Measurement and Inspection" audit without any findings.

Inspection processes conducted with next-generation robotic optical measurement systems, including the 3DSL special process, were added to the accreditation scope for the first time. With this development, TEI became the first and only company in Türkiye to hold 3DSL accreditation and the 8th company globally. Among companies providing casting, forging, or measurement services, TEI is the first and only company in its field to achieve this accreditation at a global level.

With its latest accreditation, TEI increased the number of NADCAP accreditations it holds to 45 special processes across 10 different process groups. In the first half of 2022, TEI also successfully completed the NADCAP audits for the Heat Treatment (HT), Welding (WLD), and Nonconventional Machining (NM) process groups, renewing their accreditations.

NADCAP is a conformity assessment program established by both industry and governments to define accreditation requirements, accredit suppliers, and specify operational program requirements by bringing together technically competent experts in their respective fields, managed by industry leaders.

INDUSTRIALIZATION WORKING GROUP MEETING

The 30th Industrialization Working Group meeting, which focused on localizing defense industry needs and determined roadmaps, was held on June 27th at TEI facilities under the coordination of Defense Industry Agency (SSB) Industrialization Department. Experts from SSB, TEI, TUSAS, ASELSAN, Roketsan, Havelsan, FNSS, STM, TÜBİTAK SAGE, MKE, and BMC attended the meeting. The agenda of the meeting, led by SSB Industrialization Department Head of the period Irfan Ozsert and TEI Vice President of Finance and Sourcing Emre Saylan, included discussions on TEI's efforts in localizing the indigenous engine development process and the previous period's evaluation results of the EYDEP program. Following the meeting, a facility tour provided information about TEI's capabilities.

INTERNATIONAL AVIATION THRUST VECTORING CONTROL SYSTEMS CONGRESS

On April 20th, the International Aviation Thrust Vectoring Control Systems Congress was held as part of the Applied Propulsion System Design Engineering Master's Program in Aerospace, Engine, and Space Technologies. The congress was attended by Prof. Osman Saim Dinc, Chairman of the Board of Directors of TEI of the period, Prof. Mahmut F. Aksit, CEO of TEI, and TEI employees.

During the event, TEI showcased various engines including TEI-TS1400, TEI-PD170, TEI-PG50, TEI-TJ300, and TEI-TJ90. TEI employees also conducted a poster exhibition in the congress area. Additionally, during the congress, Technical Leader of the period Alican Kilicaslan, Senior Chief Engineer Bedir Inci, Technical Leader Yasin Okan Kosterit, and Senior Specialist Engineer Hamza Faruk Akkurt delivered presentations.

AFGM AND HBFM TEI GSS WORKSHOP

On December 21, 2022, a workshop was held at TEI's Eskisehir campus, attended by the General Manager of the Military Factories Directorate (AFGM), Brigadier General of the time Tahir Kahan Buyuksarac, the Director of the 1st Air Maintenance Factory (HFGM), Brigadier General Gurhan Ergurhan, and their delegation, along with TEI's Vice President of Business Development and Sales Ahmet Kain, and representatives from the Military Sales Leadership. During the workshop, the existing General Purchase Agreement, the Makila 1A1 contract, and other future-oriented projects between TEI and AFGM were discussed and evaluated.

THE WORLD'S AND TÜRKİYE'S FIRST DEAF ROBOTICS TEAM

The FRC Team 8863, a deaf robotics team, participated in the FIRST Robotics Competition and won a special jury award, making it a pioneering achievement in both the world and Türkiye. The team members, consisting of entrepreneurial high school students, demonstrated the unique power of collaboration and effort.

Mentored by TEI employee Burak Uyanık, FRC Team 8863 is composed of high school students who worked together with team spirit to compete in the FIRST Robotics Competition. In this competition, teams build robots weighing 56 kilograms to complete specific tasks, such as shooting balls or discs into targets, hanging on bars, and balancing robots on balance beams. The teams competed vigorously while adhering to the spirit of sportsmanship.

Established in 2018 by the Ankara Anadolu Sagirlar Sports Club, the deaf robotics team was the first of its kind in the world and Türkiye. Comprising 25 students, the team completed every stage of robot construction, from assembling its iron components to its engines, wheels, and coding. At the Volkswagen Arena Istanbul event of the FIRST Robotics Competition, FRC Team 8863 earned the "Jury Award" in recognition of their exceptional performance, efforts, and dynamics. Burak Uyanik, the team's lead mentor, emphasized the importance of demonstrating that deaf and hearing-impaired individuals can excel in engineering fields, especially since there are very few naturally deaf and hearing-impaired engineers in Türkiye. He expressed his dedication to showing that young deaf and hearing-impaired people can improve the quality of life for their community, prove that they can thrive independently, and make a positive impact on the world.

THE 5S AUDIT CHAMPIONS FOR THE YEAR 2022 HAVE BEEN DETERMINED

The "5S" methodology, derived from the Japanese words that start with "S" and translated into Turkish as "Sort," "Set in order," "Shine," "Standardize," and "Sustain," is a workplace organization system. It is a systematic approach to implementing, managing, and sustaining industrial order, arrangement, and cleanliness within an organization. When used in conjunction with "Visual Workplace," 5S is one of the most effective tools for increasing productivity and preventing losses.

To ensure the continuity of 5S activities, regular 5S audits are conducted by the lean manufacturing team.

I. AUDIT

In 2022, the areas that successfully completed the I, II, and III 5S audits were awarded flags, and these flags were presented to the respective areas by their managers.

ALL WORKSHOP

B200 Workshop

In all workshops, the 3-Star 5S Flag, signifying the 5S Champion, was awarded to the B200 workshop OKUMA workbenches. The 2-Star 5S Flag was awarded to B200 CDP/AFT Seal Cell Inspect, and the 1-Star 5S Flag was awarded to B200 Aft Shaft Cell Inspect.

3-Star 5S Flag: B200 Workshop OKUMA Workbenches

B300 Workshop

B300 Workshop 2-Star 5S Flag winner: B300 Central Inspect 1-Star 5S Flag winner: TP400 Cell Inspect

2-Star 5S Flag: B300 Central Inspect

T200 Workshop

As a result of the audits, T200 Central Inspect became the holder of the 3-Star 5S Flag in the T200 Workshop. T200 Milling Machines earned the 2-Star 5S Flag, and the T200 Technology Development Additive area became the holder of the 1-Star 5S Flag.

3 Yıldız 5S Bayrağı(5S Şampiyonu): T200 Central Inspect

B700 Workshop

B700 Central Inspection and B700 Flow Test Areas were awarded the 3-Star 5S Flag. The 2-Star 5S Flag was earned by the B700 LPC Shaft Deburr Area, and the 1-Star 5S Flag was placed in the LEAP FOS Cell Milling Machines.

3-Star 5S Flag: B700 Flow Test Area

3-Star 5S Flag: B700 Central Inspection Area

B800 Workshop

B800 Prototype Inspect won the 3-Star 5S Flag, while the 2-Star 5S Flag was awarded to B800 Engine Assembly Inspect, and the 1-Star 5S Flag awarded to B800 Clean & FPI Area.

3-Star 5S Flag: B800 Prototype Inspect Area

B1000 Workshop

In the B1000 Workshop, B1000 Shotpeen Area became the 3-Star 5S Flag champion, while B1000 Special Process Quality Area earned the 2-Star 5S Flag, and B1000 Blisk Inspect Area became the owner of the 1-Star 5S Flag.

3-Star 5S Flag: B1000 Shotpeen Area

II. AUDIT

B200 Workshop

B200 OKUMA Workbenches won the 3-Star 5S Flag, making them the B200 champion, while B200 CDP/AFT Seal Cell Milling and Deburring Area earned the 2-Star 5S Flag, and B200 Aft Shaft Cell Inspection Area received the 1-Star 5S Flag.

3-Star 5S Flag (B200 5S Champion): B200 OKUMA Workbenches

B300 Workshop

In the B300 Workshop, the B300 Central Inspection Area received 3 Stars 5S Flag, the B300 Furnace & Alloy Area received 2 Stars 5S Flag and the B300 TP400 Cell Area received 1 Star 5S Flag.

3-Star 5S Flag: B300 Central Inspection Area

B700 Workshop

B700 Shotpeen Area became the champion of the B700 Workshop with the 3-Star 5S Flag, while B700 Flow Test Area earned the 2-Star 5S Flag, and B700 FOS Cell Inspection Area became the 1-Star 5S Flag champion.

3-Star 5S Flag (B700 5S Champion): B700 Shotpeen Area

B800 Workshop

In the B800 Workshop, the 2-Star 5S Flag was awarded to B800 Prototype Inspection Area, and the 1-Star 5S Flag belongs to B800 Clean & FPI Area.

2-Star 5S Flag: B800 Prototype Inspection Area

B1000 Workshop

B1000 LEAP HPT Disk Cell Deburr Area became the champion of the B1000 Workshop with the 3-Star 5S Flag, while the 2-Star 5S Flag was awarded to B1000 LEAP Blisk Cell Deburr and Balance Area, and the 1-Star 5S Flag given to B1000 Special Process Quality Area.

3-Star 5S Flag (B1000 5S Champion): B1000 LEAP HPT Disk Cell Deburr Area

T200 Workshop

T200 Deburr and Clean Area became the holder of the 2-Star 5S Flag in the T200 Workshop, while the 1-Star 5S Flag belongs to T200 Inspection Area.

2-Star 5S Flag: T200 Deburr and Clean Area

III. AUDIT

B200 Workshop

The champion of B200 Workshop and the recipient of the 3-Star 5S Flag is B200 Disk Cell Vertical Lathe Machines, while B200 Shotpeen Area received the 2-Star 5S Flag, and B200 Central Inspection Area was awarded the 1-Star 5S Flag.

3-Star 5S Flag (B200 5S Champion): B200 Disk Cell Vertical Lathe Machines

B300 Workshop

B300 Workshop" achieved the 3-Star 5S Flag and became the 5S champion of 2022 in the B300 Central Inspection Area. The B300 TP400 Cell Inspection Area was awarded the 2-Star 5S Flag, and the B300 Oven and Alloy Area received the 1-Star 5S Flag.

3-Star 5S Flag: B300 Central Inspection Area

B700 Workshop

In the B700 Workshop, the 5S champion with a 3-Star 5S Flag was the B700 Shotpeen Area. The B700 Plasma Area received a 2-Star 5S Flag, and the B700 Flowtest Area was awarded a 1-Star 5S Flag.

3-Star 5S Flag: B700 Shotpeen Area

B800 Workshop

The B800 MRO Central Inspection Area became the 5S champion with a 3-Star 5S Flag in the B800 Workshop. The B800 MRO Depot Area received a 2-Star 5S Flag, and the B800 Prototip Inspection Area earned a 1-Star 5S Flag.

3-Star 5S Flag (B800 5S Champion): B800 MRO Central Inspection Area

B1000 Workshop

In the B1000 Workshop, the 5S champion was the B1000 LEAP HPT Disk Cell Anti Corrosion Coating, which received a 3-Star 5S Flag. The B1000 LEAP Blisk Cell Ultrapolish & VIB Finish Area earned a 2-Star 5S Flag, and the B1000 LEAP Blisk Cell Plasma Area received a 1-Star 5S Flag.

3-Star 5S Flag (B1000 5S Champion): B1000 LEAP HPT Disk Cell Anti Corrosion Coating

T200 Workshop

In the T200 Workshop, the T200 Inspect Area received a 2-Star 5S Flag, and the T200 Multitask Machines Area received a 1-Star 5S Flag.

2-Star 5S Flag: T200 Inspect Area

GLOBAL BUSINESS EXCELLENCE AWARDS

TEI received the "Employer of the Year" award in this platform, where the best in the international arena are evaluated by the "Global Business Excellence Awards" organization. They achieved this award through their approach focused on employee commitment and satisfaction. Additionally, TEI also received a second award in the "People Development" category from the "Global Business Excellence Awards" organization for their Career Candidate Engineering Program, further solidifying their success.

4 AWARDS FROM THE STEVIE AWARDS

TEI was awarded the gold prize in the 'Planning and Implementation Category' at the Stevie Awards for its TEI Aviation Engines School (Stevie MENA), Türkiye's first online education program in its field, which was launched in 2021 with the participation of more than 5,000 students. Additionally, TEI received a bronze award in the same category for its 'Talent Management Strategy (Stevie MENA)' efforts.

TEI was also honored with bronze awards for its internal communication activities in the 'Internal Communication Team of the Year' category at the Stevie Awards for Great Employers and in the category for conducting activities related to employee engagement and motivation at the Stevie Awards IBA.

BRANDON HALL

TEI was awarded the 'Gold Prize' in the 'Best Unique or Innovative Talent Acquisition Program' category at the Human Capital Management program under the 'Brandon Hall Group Excellence Awards,' which is considered one of the most prestigious business awards in the world. TEI received this award for its Aviation Engines School application, which leads the sector by implementing innovative practices in the field of human resources. TEI also won two awards: a 'Silver Prize' in the 'Best Advance in Talent Acquisition Process' category for its Career Candidate Engineering Program.

TEI HAS BEEN SELECTED AS THE COMPANY THAT VALUES ITS FEMALE EMPLOYEES THE MOST FOR THE 6TH CONSECUTIVE TIME BY THE INSTITUTE FOR WOMEN OF AVIATION WORLDWIDE

In 2022, TEI celebrated 'Women's Aviation Week' with two different projects. In the first project, TEI met with 500 female students from 10 different middle schools in Eskisehir through the 'First Steps to the Center of Aviation' project. As part of the project, the female students were shown videos about how airplanes fly, discussions were held about career opportunities in the aviation sector, and THY pilot Elif Coskun gave a talk on 'Being a Female Pilot.' An International Pink Paper Airplane Challenge event was organized with the female students, adding color to the sky with pink airplanes.
The second project, 'Strong Women in Aviation,' took place at the TEI Eskisehir campus. Nearly 300 female TEI employees came together at the event. Additionally, the event included the launch of the 'Empowering Women Empowers All' mentoring program.
TEI's commitment to its female employees and the activities it organized during Women in Aviation Week earned it the iWOAW award for five consecutive years. In 2022, TEI's projects stood out among hundreds of firms from 52 different countries that applied for awards during Women in Aviation Week, earning TEI its 6th iWOAW award.

THE MOST ADMIRED TALENT PROGRAM: CAREER CANDIDATE ENGINEERING PROGRAM AT THE SOURCE OF POWER

TEI's Career Candidate Engineering Program, designed to prepare young talents for the business world, was selected as the 'Most Admired Talent Program' in the 'Aviation and Defense Industry' category in the Top 100 Talent Program 2022, as determined by the votes of young individuals.

TEI WAS CHOSEN AS ONE OF THE MOST POPULAR COMPANIES

With the results of the research conducted with the participation of over 76,000 students from more than 120 universities, TEI has found its place among Türkiye's Most Preferred Companies.

TEI VICE PRESIDENT OF HUMAN RESOURCES AND ADMINISTRATIVE AFFAIRS YELIZ CETINKAYA WAS INCLUDED IN THE TOP 50 CHRO LIST

As a result of the 'Top 50 CHRO' research conducted by BMI Business School Istanbul in collaboration with DataExpert Exceptional Leadership Solutions, evaluating human resources managers from over 1,000 companies in different sectors, Vice President of Human Resources and Administrative Affairs Yeliz Cetinkaya has earned her place among the Top 50 CHROs due to her visionary work and innovative practices.

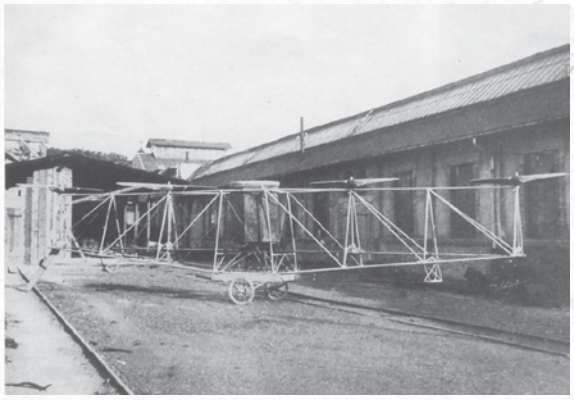
ELECTRIFICATION IN AIRCRAFT PROPULSION SYSTEMS

HISTORICAL PERSPECTIVE

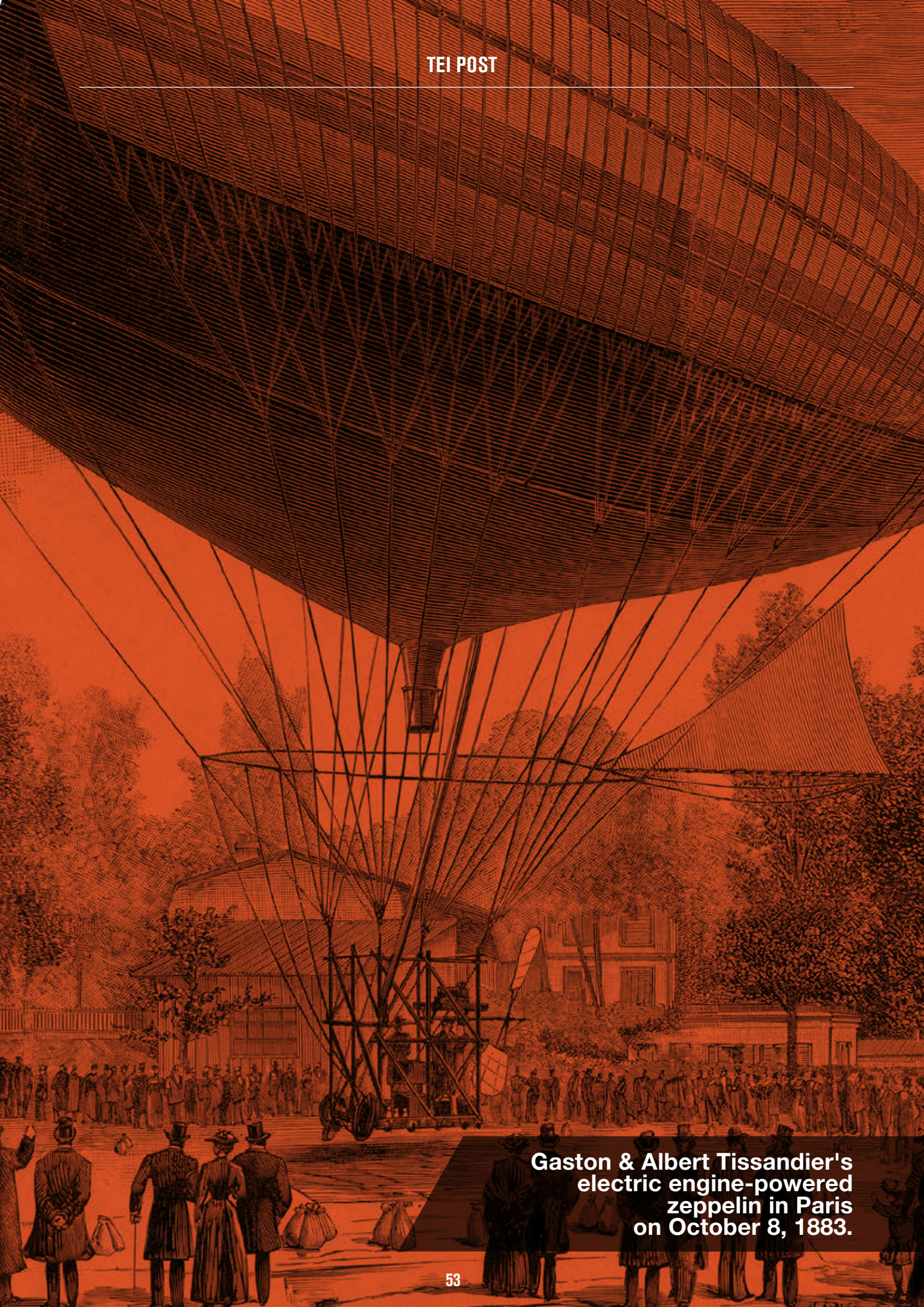
The use of electrical propulsion in aviation began 140 years ago in 1883 when Gaston & Albert Tissandier integrated a 1.5 hp Siemens Engine into their airship. This platform, which had a weight of 1240 kg (MTOW), could travel at a speed of 4.8 km per hour using the electric engine.

To address the issue of hydrogen-filled observation balloons being a danger, Petróczy, Kármán, and Žurovec designed a platform that could perform vertical takeoff and landing (VTOL) and could be considered a pioneer of the multicopter concept. The vehicle was powered by a 142 kW Austro-Daimler electric engine and was supplied with electricity from the ground via cables, and efforts were made to stabilize it.

Unfortunately, significant developments in battery technology, such as weight reduction and low specific fuel consumption (SFC), were not achievable in piston engines and later in turbine engines. Until recently, the use of electric engines in aviation remained largely limited to hobbyist model aircraft.



PKZ-1 designed by Petróczy, Kármán, and Žurovec in Budapest in 1918.



Gaston & Albert Tissandier's electric engine-powered zeppelin in Paris on October 8, 1883.

Fred Militky and Heinz W. Brditschka modified the HB-3 platform to develop the world's first fully electric and manned aircraft, known as the MB-E1 (Militky-Brditschka Elektroflieger No: 1). On October 21, 1973, it conducted its first flight using a Bosch KM77 (10 kW - 13 hp) engine and VARTA brand nickel-cadmium batteries.

Manned, fully electric first aircraft MB-E1 (Photo: Mateusz Śliwka)

The world's first solar-powered unmanned aerial vehicle called Sunrise, developed by the AstroFlight company, which conducted its first flight on November 4, 1974. The aircraft had a maximum takeoff weight (MTOW) of 12 kg and was powered by 450 W-capacity solar panels.
It also mentions the world's first solar-powered manned aircraft, the Gossamer Penguin, designed by Dr. Paul MacCready, the founder of AeroVironment. It was successfully tested on April 7, 1980, with MacCready's 13-year-old son as the pilot. The platform was powered by 541 W solar panels and used the AstroFlight company's Astro-40 electric engine.

Gossamer Penguin, 1980 - California, (Photo: NASA)" provides information about the Gossamer Penguin, which was tested in California in 1980. The photo credit goes to NASA.

In 1997, the Alisport company introduced the Silent Club model, the world's first electric commercial aircraft. The platform had a MTOW of 300 kg and was equipped with a 13 kW electric engine and a 1.4 kWh capacity battery pack.
The BL1E Electra model developed by Electravia is positioned as the world's first registered (with tail number F-WMDJ) electric aircraft. On December 23, 2007, the platform conducted its first 48-minute flight with an 18 kW electric engine and a lithium-polymer battery pack.

Aspres sur Buëch" translates to "BL1E Electra, the first registered electric aircraft, 2007 - Aspres sur Buëch

The Solution F/Chretien Helicopter, designed and produced by Pascal Chretien for Solution F company, conducted its successful test flight as the first fully electric manned helicopter on August 12, 2011. The platform was equipped with two 20 kW Agni Engines electric engines and a lithium-polymer battery pack with an energy density of 160 Wh/kg.

Solution F/Chretien Helicopter, the first electric HELICOPTER (Photo: NASA helicopter, 2011 - Venelles

In the aviation industry, Pipistrel (Slovenia - [Acquired by Textron - 2022]) can be considered a milestone in electrification efforts. The Velis Electro aircraft from Pipistrel was certified by EASA as the world's first electric aircraft in 2020.

Pipistrel Velis Electro

On February 17, 2023, EHang (China) conducted the first fully autonomous flight of its EH216 autonomous air taxi platform in Japan with two passengers on board. The EH216 is powered by 16 electric engines, can reach a maximum speed of 130 km/h, and carry a payload of 220 kg for a distance of 30 km.

EHang EH216

ABOUT LITHIUM

In the 2000s, especially with advancements in lithium-ion battery technology, there has been an acceleration of electrification efforts in the aviation sector (such as air taxis, regional aircraft, hybrid aircraft, etc.). However, the sector still requires batteries with higher energy density than current technology can offer.

Experimental data suggests that when 4th-generation lithium-ion batteries are commercialized, their energy density will increase by 1.5 times and reach a level of 450 Wh/kg. Ongoing experimental studies measure the theoretical energy density of lithium-air batteries at levels of 11,140 Wh/kg. Taking into account the weight of the battery pack, it is estimated that the theoretical energy density for lithium-air batteries could reach 3,500 Wh/kg. Additionally, in order to meet the energy demands for propulsion of these platforms, aviation generator systems using piston/turbine engines (conventional or sustainable fuels) and fuel cells are being developed, with plans to use hybrid technologies for flights.

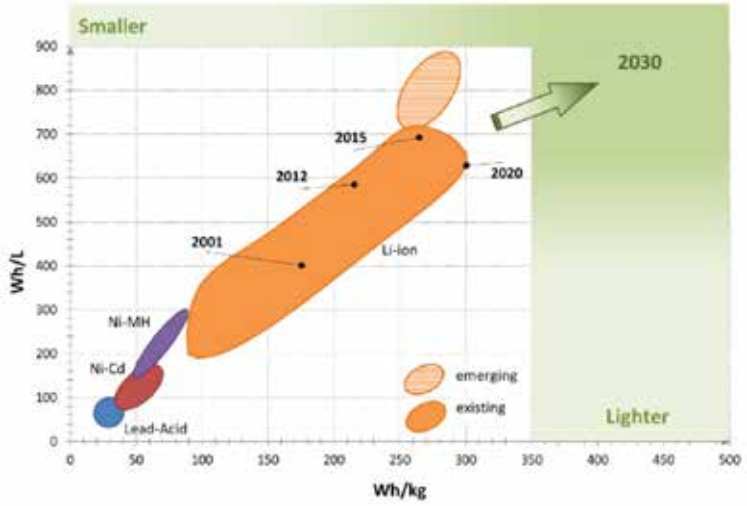


Chart 1: Electric density of batteries (Source: EU - EUR-Lex)

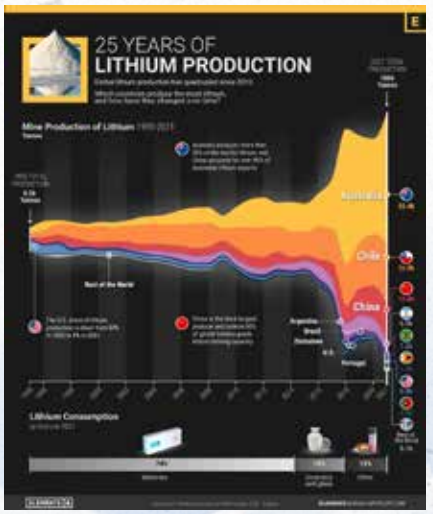
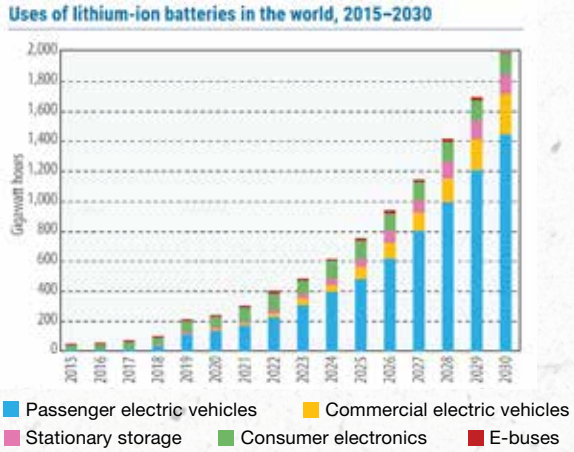


Chart 2: Lithium production between 1995-2021

COUNTRY	2021 PRODUCTION (TONS)	% IN TOTAL
AUSTRALIA	55.416	52,3
CHILE	26.000	24,5
CHINESE	14.000	13,2
ARGENTINA	5.967	5,6
BRAZIL	1.500	1,4
ZIMBABWE	1.200	1,1
PORTUGAL	900	0,9
THE USA	900	0,9
OTHERS	102	0,1
TOTAL	**105.985**	**100**

Table 1: Lithium production of countries in 2021

While China ranks third in global lithium production, it holds a dominant position, accounting for 60% of refined lithium production for lithium batteries. In 2010, only 23% of global lithium production was used in batteries, but by 2021, this figure had risen to 74%.



Source: Wang (2020)

Chart 3: Projection of lithium-ion battery usage areas for the years 2015-2030

ENGINE PROGRAMS AND APPLICATIONS

Today, there are many electric engine programs in use or in the development stage in the aviation sector. Leading companies in the industry, such as GE, Rolls-Royce, Safran, and Honeywell, are investing in and conducting R&D with the support of organizations like Clean Aviation and NASA to advance electric/hybrid propulsion systems and battery technologies.

GE Aerospace, in collaboration with NASA and Boeing, is working on a megawatt-class, multi-kilovolt hybrid propulsion system for single-aisle aircraft. The configuration to be tested on the Saab 340 platform consists of an integrated electric engine and battery pack with the GE CT7-9B turboprop engine. While the turboprop engine is running, it will charge the batteries, and when it is turned off, flight will be sustained by battery-assisted electric engines. At least five flights with the platform are planned to be conducted by 2027.

GE Aerospace, NASA, and Boeing Collaboration on Hybrid Propulsion System

The EU plans to reduce emissions in the aviation sector by 30% by 2035 (compared to 2020) and aims to achieve climate neutrality by 2050. To achieve this goal, they have initiated projects within the scope of technologies for:

- Electric/Hybrid regional aircraft
- Ultra-efficient short and medium-range aircraft
- Enabling hydrogen-powered aircraft (Table 2)

As of November 10, 2021, our country has accepted the Paris Climate Agreement and has also announced a net-zero emissions target by the year 2053.

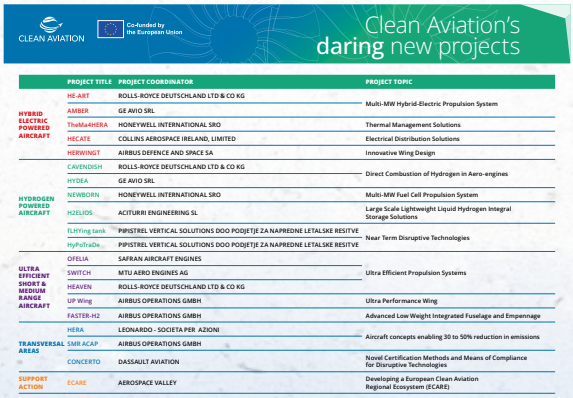


Table 2: Projects and Stakeholders under the EU Clean Aviation Initiative

GE Avio is developing a megawatt-class parallel hybrid propulsion system as part of the Clean Aviation AMBER project. The system consists of an electric engine powered by hydrogen fuel cells and the GE Catalyst turboprop engine. Rolls-Royce, under the Clean Aviation HE-ART project, is working on a hybrid power system. Within this framework, RR AE-2100 turboprop engine has successfully undergone ground tests with hydrogen fuel. Hydrogen-powered aviation engines are part of the Clean Aviation projects, with Rolls-Royce involved in the CAVENDISH project, and GE Avio in the HYDEA project. Efficient and sustainable aviation engine projects include: HEAVEN project by Rolls-Royce with the UltraFan engine program. OFELIA project by CFM, a subsidiary of General Electric, with the RISE engine program. SWITCH project by MTU Aero Engines, working on the next-generation, water-injected, hydrogen-powered hybrid electric engine program.

Graph 4: Clean Aviation Road Map

According to EU reports, it is estimated that by 2050, the number of flights will triple, and if no action is taken, emissions from the aviation sector will double, accounting for 2.8% of global CO2 emissions.

As part of the 2050 climate-neutral goal, it is anticipated that between 2035 and 2050, 40,000 aircraft will be replaced with electric / hybrid / SAF technologies, creating a market with a volume of 5 trillion euros. (Graph 4, Graph 5)

Graph 5: EU Clean Aviation Timeline

Safran Electrical & Power firm has developed ENGINeUS™ electric engine and GENeUS™ electric engine /generator products as part of their electrification efforts. The ENGINeUS™ engine can produce power in the range of 50 – 500 kW and has an energy capacity of 3.5 kW/kg. GENeUS™ can produce 300 kW of power and can also be used as a generator (at 42,000 rpm) thanks to its integration with turbine engines. Safran electric enginers are used to power the VoltAero Cassio 330 (2020), Airbus EcoPulse (2023), Bye Aerospace eFlyer 800 (2024), and Aura Aero ERA (2024) platforms.

ENGINeUS™ 50-100 & 500

GENeUS™ 500

VoltAero Cassio 330

Airbus EcoPulse

Bye Aerospace eFlyer 800

Aura Aero ERA

Siemens has developed aviation electric engines in the low-power class and has successfully conducted flights. The Siemens-Magnus eFusion platform made its first flight in 2018 with the Siemens Sp55D engine, which can generate 72 kW of power.

Siemens-Magnus eFusion

The first electric platform in aviation history used a Siemens engine, but in 2019, the company sold its eAircraft division, which was engaged in electric engines (eAircraft), to Rolls-Royce.

Rolls-Royce produces electric engines, including the Urban Air Mobility (150 kW) and Regional Air Mobility (320 kW) engines, as well as turbo-generators capable of generating up to 1000 kW of electricity.

Turbo-generator applications, in particular, will provide the necessary electrical energy production for aircraft like the APUS i-5, which is designed for longer-distance flights where battery capacity may be insufficient.

The Tecnam P2010 H3PS (Rotax 915 IS + RR electric engine) and Airbus CityAirbus platforms successfully conducted flights with Rolls-Royce engines in 2021. The Tecnam P-VOLT and APUS i-5 (RR turbo-generator + 4 x RR electric engine) platforms are planned to make their first flights in 2023.

Urban Air Mobility

Regional Air Mobility

Turbogenerator System

Tecnam P2010 H3PS

Tecnam P-VOLT

APUS i-5

Airbus CityAirbus

Especially for urban air transportation platforms, Honeywell and DENSO are developing electric engines. Additionally, Honeywell manufactures turbo-generators with capacities of 500 kW (HTS900 turboshaft (600 kW) + 500 kW generator) and 1000 kW (HGT1700 APU + 1000 kW generator) that electrically powered platforms for short and medium-range flights can utilize.

The Lilium platform, an electric VTOL aircraft, made its first flight in 2019 with 36 DENSO & Honeywell electric engines. The Faradair BEHA platform is planned to make its flight in 2026 with a Honeywell turbo-generator configuration [(HTS900 (600 kW) + 500 kW generator)] + Magnix engine.

DENSO – Honeywell

Honeywell Turbogenerator (500 kW)

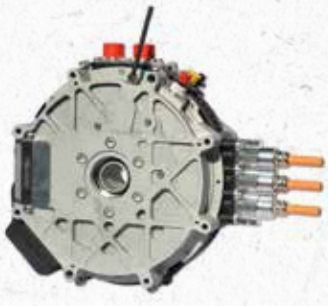
Honeywell Turbogenerator (1000 kW)

Faradair BEHA

Lilium eVTOL

YASA Limited, a company specializing in electric engines for the automotive industry and based in the UK (acquired by Mercedes-Benz in 2019), offers electric engines with capacities of 160 kW and 200 kW. YASA's 400 kW engine configuration was integrated into the Rolls-Royce ACCEL platform, setting a speed record in aviation electrification history by reaching speeds of 622 km/h in 2021.

Rolls-Royce ACCEL

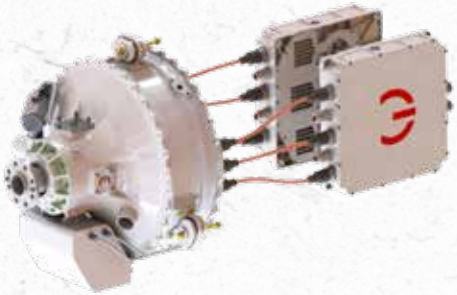


YASA P400

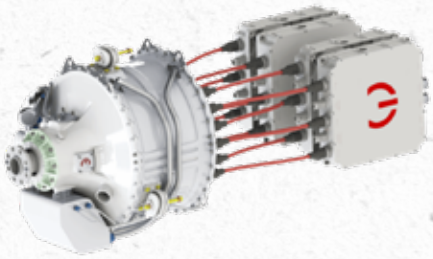
YASA P750

Magnix Aero, founded in Australia in 2009 and currently based in the United States, manufactures the Magni 350 (350 kW) and Magni 650 (650 kW) engines. Many aircraft platforms have successfully used Magnix engines in their propulsion systems, including Harbour Air eBeaver (2019), Cessna 208 E-Caravan (2020), Eviation Alice (2022), Robinson R44 (helicopter) (2022), and DHC 8-Q300 (2 x P&W PW123 (Hydrogen) + 2 x Magni650 engine configuration) (March 2023).

Additionally, the Faradair BEHA platform is planning its first flight in 2026 with a configuration that includes a Magnix engine and Honeywell Turbo-Generator (HTS900 (600 kW) + 500 kWe generator).



magni350



magni650

Harbour Air eBeaver

Cessna 208 E-Caravan

Cessna 208 E-Caravan

Cessna 208 E-Caravan

DHC 8-Q300

ZeroAvia (UK - USA), a pioneer company specializing in electric engines powered by green hydrogen-based fuel cells, stands out in the development and production of these engines. The company has engine programs with capacities of 600 kW and up to MW level, with more than a thousand engine orders. The Dornier 228 platform is expected to make its first flight with two ZA600 (600 kW) engines in 2023, followed by commercial flights in 2025. ZeroAvia aims to conduct flights with a 40 - 80 passenger capacity platform in 2026, a 100 - 200 passenger capacity platform in 2030, a 200 passenger capacity platform in 2035, and a platform with over 200 passengers in 2040.

Dornier 228

Platform with 40-80 Passanger Capacity

Emrax Engine, a company based in Slovenia, produces 5 different electric engines: EMRAX 188 (60 kW), EMRAX 208 (86 kW), EMRAX 228 (124 kW), EMRAX 268 (210 kW), and EMRAX 348 (400 kW). These engines can achieve doubled power and torque values by using two integrated engines of the same model without the need for a new engine design. EMRAX engines are used in fully electric or hybrid propulsion systems for air, land, and sea vehicles.

EMRAX Motor

Pipistrel Taurus Electro

Smesh Strom Motorcycle

Nessmann Boote

Wright Electric (USA) company develops MW class aviation electric engines and produces 2 MW capacity Testing of the engines continues at FAA facilities. The company will cover more than 1500 km in 2026. Company aims to ensure zero emission for 100 passenger capacity aircrafts on short flights of approximately 1 hour.

Wright Spirit with BAe 146 platform in 2023 plans to fly 1 x Wright Engine + 3 x Honeywell ALF 502R-5, 2 x Wright Engine + 2 x Honeywell ALF in 2024 502R-5 and with 4 Wright Engines in 2025.

Wright Motor

PLATFORM PICTURES

Wright Spirit BAe 146

In the field of aviation electrification, significant advancements are expected to occur in the coming years, driven by developments in battery technology, fuel cells, piston / turbine engine generators, and electric engines. Currently, there are aviation electric engine development projects ranging from 50 kW to 5,000 kW. However, in alignment with the 2050 climate-neutral target, there is an inevitable need for the development of more efficient, lighter, and higher-power capacity engines.

While lithium-based batteries, especially lithium-air versions, are currently in the experimental stage, they are anticipated to be significantly more efficient than today's lithium batteries when commercialized, thanks to their high energy density.

Alongside innovations in battery technologies, the use of turbo-generators and fuel cells can enhance the flight range and payload capacity of electric platforms. In this context, advancements in hydrogen technologies, particularly green hydrogen production, transportation, and storage, are of paramount importance. Overall, the aviation industry is poised for substantial acceleration in the development of electrification technologies, with the goal of reducing carbon emissions and achieving more environmentally friendly flight options.

ABBREVIATIONS

MTOW	Maximum Take-Off Weight
VTOL	Vertical Take-Off and Landing
SFC	Specific Fuel Consumption
SAF	Sustainable Avitation Fuel
EASA	European Union Aviation Safety Agency
FAA	Federal Aviation Administration
GH2	Green Hydrogen

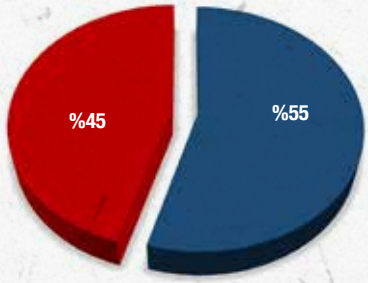
WHO IS OMER SIMSEK?

Omer Simsek, born in 1982 in Konya, Türkiye, completed his undergraduate education in 2010 with a degree in Mechanical Engineering from Gazi University. In the same year, he also obtained a degree in Business Administration from Anadolu University. In 2015, he completed his undergraduate education in Sociology from Anadolu University as well. In 2013, he finished his master's degree in Mechanical Engineering from Gazi University. Since 2019, he has been working as a Senior Engineer in the Business Development Department.

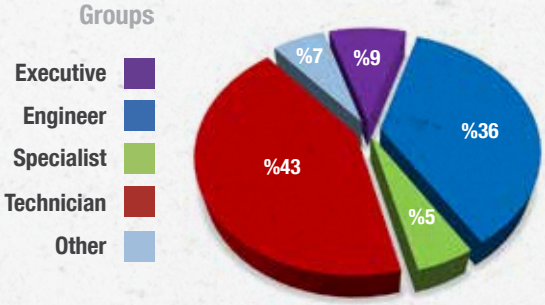
STATISTICS ON TEI'S EMPLOYEES

Employee distribution as of December 31, 2022;

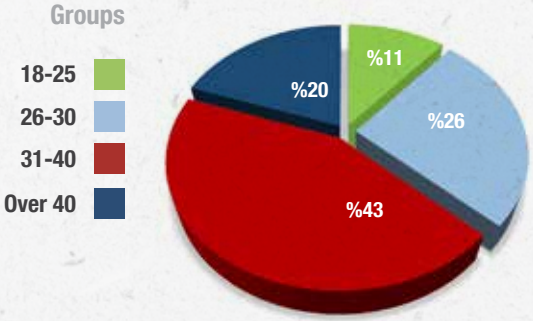
Breakdown of White Collar And Blue Collar Employees



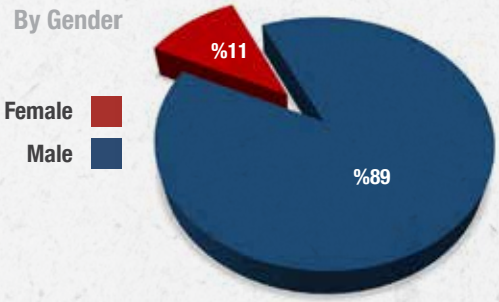
By Title Groups



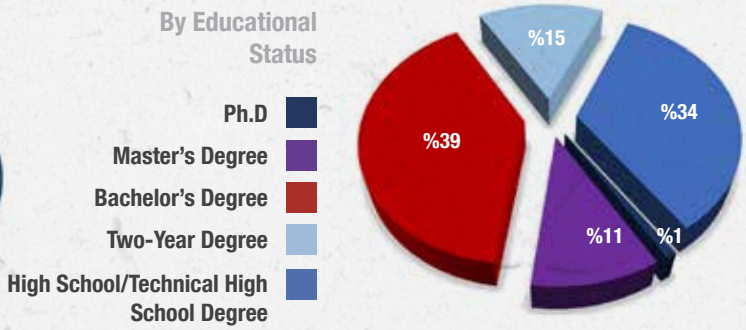
By Age Groups



By Gender



By Educational Status



NEW APPOINTMENTS IN OUR COMPANY
BETWEEN 01.01.2022 - 31.12.2022

Ahmet Findik
was appointed as the Vice President of Engineering on November 01, 2022.

Ahmet Kain
was appointed as the Vice President of Sales and Marketing on November 01, 2022.

Fatos Bahar Cekyay
was appointed as the Vice President of Product Management on November 01, 2022.

Ibrahim Emre Saylan
was appointed as the Vice President of Finance and Procurement on November 01, 2022.

Murat Ilker Celik
was appointed as the Vice President of Service and Product Support on November 01, 2022.

Murat Karamahmutoglu
was appointed as the Vice President of Manufacturing on November 01, 2022.

Turgut Cicek
was appointed as the Vice President of Quality and Manufacturing Engineering on November 01, 2022.

Yeliz Cetinkaya
was appointed as the Vice President of Human Resources and Administrative Affairs on November 01, 2022.

Mehmet Erkan Emek
was appointed as the Director of Turbofan Engine Design at the Engineering Vice Presidency on November 01, 2022.

Ali Tuna Kirgiz
was appointed as the Director of Turboshaft Engine Design at the Engineering Vice Presidency on December 23, 2022.

Emin Tuzlu
was appointed as the Director of System Engineering Group at the Engineering Vice Presidency on December 23, 2022. Currently working as the Director of the System Engineering.

Ercan Arican
was appointed as the Program Manager of Turbofan Engines at the Product Management Vice Presidency on December 23, 2022.

Kubra Coskun
was appointed as the Technical Leader at the Construction and Specifications Leadership On March 1, 2022.

Orkun Cezmi
was appointed as the Workshop Chief at the Assembly Maintenance Engineering and Quality Directorate on March 1, 2022.

Ugur Ari
was appointed as the Workshop Chief at the Manufacturing Directorate on March 1, 2022.

Aydin Sami
was appointed as the Senior Technical Leader at the Manufacturing Engineering Leadership on April 1, 2022.

Melek Canbulat
was appointed as the Technical Leader at the Material and Planning Leadership on April 1, 2022. Currently working as Senior Technical Leader in Material Planning and Shipping Directorate.

Murat Cevirgen
was appointed as the Senior Team Leader at the Mechanical Systems Leadership on April 1, 2022.

Yusuf Onder Yavuz
was appointed as the Technical Leader at the Wiring Systems Leadership on April 1, 2022.

Coskun Tunca
was appointed as the Senior Technical Leader within the Assembly Prototype and Quality Leadership on May 1, 2022. Currently, he serves as the Senior Technical Leader at the Prototype Assembly - Piston Engines Leadership.

Gulhan Kayir Kozandagi
was appointed as the Technical Leader at the Turbojet & Turbofan Engines Directorate on May 1, 2022.

Hakan Tunca
was appointed as the Chief Engineer at the Chief Engineering Office on May 1, 2022.

Metin Celik
was appointed as the Workshop Chief at the Assembly Maintenance Planning and Operations Directorate on May 1, 2022.

Sinan Inanli
was appointed as the Senior Chief Engineer at the Chief Engineering Office on May 1, 2022. Currently working as Director of Tests Systems Design Directorate.

Armagan Demir
was appointed as the Technical Leader at the Special Process Directorate on June 1, 2022.

Tugba Leblebici
was appointed as the Senior Technical Leader at the Directorate of Electrical, Electronic, Control, and Embedded Systems on June 1, 2022. Currently working as Senior Team Leader in Directorate of Electrical, Electronic, Control, and Embedded Systems.

Yusuf Oksas
was appointed as the Senior Technical Leader at the Directorate of Indgenous Projects Manufacturing Engineering on June 1, 2022.

Dincer Gulcelebi
was appointed as the Senior Administrative Leader at the Directorate of Financial Affairs on July 1, 2022.

Oktay Cevik
was appointed as the Technical Leader at the Directorate of Performance and Operational Excellence on July 1, 2022.

Yucel Saygin
was appointed as the Technical Leader at the Directorate of Performance and Operational Excellence on July 1, 2022.

Umit Er
was appointed as the Workshop Chief at the Manufacturing Directorate on August 1, 2022.

Alican Kilicaslan
was appointed as the Technical Leader at the Turbojet & Turbofan Engines Directorate on October 1, 2022.

Gokhan Sarikinaci
was appointed as the Technical Leader at the Material Planning and Inventory Directorate on October 1, 2022.

Metin Izmirli
was appointed as the Technical Leader within the Turbojet & Turbofan Engines Directorate on October 1, 2022. Currently working as Senior Technical Leader in Mechanical Systems Directorate.

Murat Alkan
was appointed as the Technical Leader at the Turbojet & Turbofan Engines Directorate on October 1, 2022. Currently working as Senior Technical Leader in Mechanical Systems Directorate.

Murat Uzun
was appointed as the Technical Leader at the Test Directorate on October 1, 2022.

Mucahit Dilekcan
was appointed as the Technical Leader at the Turbojet & Turbofan Engines Directorate on October 1, 2022.

Atakan Ondogan
was appointed as the Technical Leader at the Directorate of Electrical, Electronics, Control, and Embedded Systems on November 1, 2022.

Emre Gerceker
was appointed as the Technical Leader at the Directorate of Electrical, Electronics, Control, and Embedded Systems on November 1, 2022.

Mahmut Orbay Inac
was appointed as the Senior Technical Leader at the Directorate of Information Technologies on November 1, 2022.

Riza Kayihan
was appointed as the Technical Leader at the Directorate of Piston Engines on November 1, 2022.

Teoman Ozmen
was appointed as the Senior Team Leader at the Directorate of Integrated Logistics Support on November 1, 2022.

Gorkem Madenoglu
was appointed as the Technical Leader at the Directorate of Turbojet & Turbofan Engines on December 1, 2022.

2022
SERVICE PLAQUES

The 2022 Service Plaque and Employee Awards Ceremony took place at the General Directorate level. During the ceremony, employees who completed their 5th, 10th, 15th, 20th, 25th, and 35th years of service were presented with service plaques. Additionally, employees who were selected among the candidates submitted to the Employee Awards Committees throughout the year were honored with Employee Awards.

EMPLOYEES CELEBRATING 35TH YEAR OF SERVICE

- Ayhan Alpay

EMPLOYEES CELEBRATING 25TH YEAR OF SERVICE

- Ahmet Abidin Gurdal
- Hakan Kirazli
- Ismail Ayvaz
- Ismail Dunca
- Kemal Erturk
- Mahir Tug
- Melih Gursoy
- Mesut Uzun
- Nihat Mert
- Omer Bayramoglu
- Taha Serdar Tuzer
- Turgut Avci
- Yasemin Arikan
- Yucel Eskiler
- Yuksel Yildiz

EMPLOYEES CELEBRATING 20TH YEAR OF SERVICE

- Altug Piskin
- Bahri Sen
- Hakan Afsar
- İlhan Sari
- Ozkan Yakar

EMPLOYEES CELEBRATING 15TH YEAR OF SERVICE

- Abdullah Cenk Isik
- Abdullah Vardar
- Ahmet Dogru
- Ahmet Hikmet Erenoglu
- Ahmet Sarikaya
- Alper Solmaz
- Ayhan Gursoy
- Ayhan Ozturk
- Beynur Urkmez
- Cem Cetin
- Cenk Serefhan
- Ceyhun Golcuk
- Durmus Ozyurt
- Ekrem Yudar
- Emre Bilgicer
- Ender Akdogan
- Engin Okuyan
- Erhan Hakal
- Erhan Sakrak
- Erhan Yagli
- Erman Ozkan
- Ersen Altintas
- Eyüb Sentuna
- Fatih Baser
- Fatih Gokbulut
- Fatih Tektas
- Ferhat Unver
- Gokhan Kupluk
- Guzin Bagci
- Halil Hanli
- Halil Kilic
- Halil Unlu
- Halime Ozkaya
- Hamza Demiralay
- Ilhan Yilmaz
- Kadir Baydar
- Kemal Engin Uysal
- Mehmet Cimen
- Mehmet Emre Karpuz
- Mehmet Komurcu
- Muhammet Ozkara
- Murat Erkara
- Murat Karaduman
- Musa Akkol
- Mustafa Sarikaya
- Muzaffer Sahinkus
- Nadir Aydin
- Necmettin Gunar
- Nil Akcoray Ozkan
- Omer Faruk Ozkan
- Onder Suluklu
- Ozgur Acaray
- Secil Songuler
- Semih Ozturk
- Serhat Ustun
- Serkan Keser
- Sinan Orcen
- Tolga Ozgonul
- Ugur Aksay
- Ugur Ozel
- Ulas Bicer
- Yasemin Eren

EMPLOYEES CELEBRATING 10TH YEAR OF SERVICE

- Adem Tayyar
- Adem Ulker
- Ahmet Ergut
- Ahmet Tuna
- Ali Ihsan Guney
- Ali Ihsan Yazaydin
- Ali Kemal Aldanmaz
- Ali Riza Arku
- Ali Tamer
- Ali Tetik
- Arif Erman Sengil
- Atakan Ismet Ispir
- Atilla Yildiz
- Ayhan Inam
- Ayhan Ozer
- Baris Timurlenk
- Beynur Yurtsever
- Bilal Ceylan
- Burak Deniz
- Bulent Dinc
- Busra Yildirim
- Cem Tunc
- Cihan Yalcın
- Coskun Tunca
- Caglar Dengiz

- Cagrı Nart
- Cetin Enser
- Dilek Yagci
- Dincer Gülcelebi
- Doruk Kocer
- Ece Canan Karabastik
- Ekrem Ilgin
- Emin Dereli
- Emrah Demircan
- Emrah Durmaz
- Emre Ayaz
- Emre Cam
- Emre Dalak
- Emre Gülec
- Ender Duran
- Eray Ayas
- Ercan Ozturk
- Erdoğan Keles
- Erhan Coskun
- Ersen Yesil
- Ersin Ozkan
- Ertan Cam
- Evren Kiran
- Fatih Bayraktar
- Fatih Karakas
- Fatih Yesil
- Furkan Bilgic
- Gokhan Tunc
- Goksel Altunay
- Goksel Oren
- Gorkem Degirmen Biricik
- Gozde Ergun Agdaci
- Gulhan Ozmen
- Hakan Arabaci
- Hakan Dogu
- Hakan Okmen
- Halil Ekdi
- Halil Er
- Halil Ibrahim Boztas
- Hasan Saritas
- Hayrettin Sonmezer
- Hilal Yıldız Cetin
- Himmet Emre Aktas
- Huseyin Cayir
- Huseyin Sogutonu
- Ibrahim Alper Dincer
- Ihsan Mizrak
- Ilker Bozsoy
- Ilker Yuruk
- Irfan Yilmaz
- Iskender Akpinar
- Ismail Gulgun
- Ismail Kurt
- Izzet Aydin
- Kaya Yavuz
- Kemal Uyarli
- Levent Godek
- Levent Ulker
- Mahmut Tuncol
- Mecit Danisman
- Mecit Gulec
- Mehmet Oguz Turgut
- Mehmet Urus
- Mehmet Ulker
- Mehmet Yakar
- Melih Cengiz
- Melih Erim
- Meral Ozer Goz
- Mesut Baskaya
- Metin Mehel
- Metin Özturk
- Murat Koksal
- Murat Tanir
- Murat Usluer
- Musa Yavuz
- Mustafa Agic
- Mustafa Celik
- Mustafa Ekincek
- Mustafa Guler
- Mustafa Gur
- Mustafa Sengun
- Mustafa Turan
- Mustafa Ustuncu
- Muzaffer Caliskan
- Muzaffer Mutlu
- Nilgun Demiroglu
- Onur Temiz
- Orcun Kor
- Osman Mutlu
- Omer Ecevitoglu
- Omer Semih Kinik
- Omur Cavdar
- Ozgur Unsar
- Ozkan Asik
- Ozlem Kasap
- Recep Koca
- Remzi Ozkan
- Remzi Yaz
- Resul Dumlukaya
- Ridvan Ozturk
- Sabri Ozkan
- Samet Bilir
- Samet Kocak
- Sedat Caisir
- Sedat Dikmen
- Sefa Ortakci
- Selahaddin Kinyas
- Selami Erisen
- Selcuk Ozparca
- Selen Bayar Yildirim
- Semih Koseoglu
- Semih Sivrikaya
- Sercan Gunes
- Serhat Esme
- Serkan Gence
- Serkan Kinden
- Serkan Kokdamar
- Sertac Erturk
- Sinan Guresci
- Sinan Inanli
- Soner Oren
- Suleyman Karakas
- Senol Uygun
- Taner Bacak
- Tayfun Yavuzbayir
- Tugrul Akbulut
- Ufuk Bayrak
- Ufuk Gunaydin
- Ufuk Uluturk
- Ugur Sengun
- Vildan Arat
- Volkan Gurakan
- Vural Ayva
- Yalcin Bayraktar
- Yasin Ozhuner
- Yasin Yilmaz
- Yetkin Kocak
- Yunus Durmazkeser
- Yunus Emre Kılıc
- Yunus Yalin
- Yusuf Soner Ciftci
- Yusuf Simsek

EMPLOYEES CELEBRATING 5TH YEAR OF SERVICE

- Abdi Baturay Gokceyrek
- Abdullah Ali Ozcan
- Abdullah Sonayaz

- Adil Kilis
- Ahmet Alperen Cetin
- Ahmet Alptekin
- Ahmet Arslan
- Ahmet Basdogan
- Ahmet Bodur
- Ahmet Bugra Dagligil
- Ahmet Delidag
- Ahmet Kaan Zayim
- Ahmet Keskin
- Ahmet Okur
- Ahmet Onur Sahin
- Ahmet Yaylaci
- Akin Aldemir
- Alattin Cetin
- Ali Atak
- Ali Ay
- Ali Bahadir Karademir
- Ali Can Budak
- Ali Demir
- Ali Ensar Ozcan
- Ali Fırat Dinler
- Ali Onur Can
- Ali Osman Turkoglu
- Ali Tumkaya
- Ali Uysal
- Alican Ergen
- Alican Kilic
- Alparslan Gundogan
- Alper Unlu
- Anil Bayraktar
- Anil Uzer
- Arda Luleci
- Arif Dergec
- Arif Eroglu
- Asaf Yener
- Atakan Sonmez
- Atila İyisever
- Aydın Er
- Aykut Tayfun Sen
- Ayse Hale Kara
- Bahadir Akbaba
- Baris Pehlivanogullari
- Bayram Battal
- Beytullah Nur Okcan
- Buket Parlak
- Burak Celebi
- Burak Gulecin
- Burak Sahin
- Burak Var
- Burcu Duru
- Burc Güleç
- Bulent Atici
- Bunyamin Atar
- Cafer Karaca
- Can Balci
- Caner Dokel
- Caner Kucukmasa
- Caner Turkoglu
- Cemre Atalay
- Ceren Salman Karadag
- Coskun Akkaya
- Cagatay Ozturk
- Cagdas Sen
- Cagdas Tinmaz
- Denizgun Dag Demir
- Dincer Atci
- Duran Basaran
- Duygu Nur Oflaz
- Ebubekir Enes Batuk
- Ebubekir Karacaoglu
- Eda Mat
- Elif Ucarcan
- Emin Bahar
- Emir Can Yildirim
- Emrah Gullu
- Emrah Uzunay
- Emre Ayan
- Emre Aytan
- Emre Burak Kocakaya
- Emre Can Cicek
- Emre Cavdar
- Emre Egemen
- Emre Erarslan
- Emre Gokoglu
- Emre Kaya
- Emre Orakoglu
- Ender Yurtsever
- Enes Cakmak
- Enes Duraklar
- Engin Dogan
- Engin Karanfil
- Engin Kusan
- Eray Ildiz
- Erdem Kiran
- Erdi Sanli
- Erdogan Abagunay
- Eren Erturk
- Erhan Altintas
- Erkan Cevik
- Erman Uzmez
- Ersin Akis
- Ersin Askin
- Ethem Akipek
- Ezgi Gökce Cankal
- Ezgi Kilic
- Faruk Senyuz
- Fatih Aydın
- Fatih Gunaydin
- Fatih Kircali
- Fatih Yardimci
- Ferdi Akin
- Ferdi Kok
- Ferdi Ozdongul
- Ferhat Uzunoglu
- Fethi Karatas
- Firat Ceylan
- Filiz Ozcan
- Furkan Ugur
- Gamze Gulenc
- Gokhan Cay
- Gokhan Celik
- Gokhan Kalender
- Gokhan Parlak
- Gokhan Sakartepe
- Goktug Horuz
- Gorkem Eldemir
- Gorkem Gokce
- Gulden Gocer Cil
- Gulhan Kayır Kozandagi
- Guney Mert Bilgin
- Gurbuz Arican
- Gurkan Sarikaya
- Hakan Mustafa Comertel
- Halil Coskun Uysal
- Halil Emre Cebesoy
- Hamza Turhan
- Hande Akbas
- Hande Ozcan Uzun
- Harun Koksal
- Harun Mevlut Sari
- Hasan Efecan
- Hasan San
- Hatice Karaca
- Huseyin Ciftkardas
- Huseyin Eron
- Huseyin Tetik
- Ibrahim Aldemir
- Ibrahim Asci
- Ibrahim Cam

- Ibrahim Istekli
- Ibrahim Kaplan
- Ibrahim Seymen
- Ibrahim Tongul
- Ibrahim Yildirim
- Ihsan Eralp
- Ihsan Yesildağ
- Ilhami Uret
- Ilker Demiray
- Ilker Saban Cakalli
- Irem Buse Akbay
- Ismail Ozben
- Ismail Yagci
- Kaan Kalfaoglu
- Kadir Aktas
- Kadir Gocmen
- Kadir Goksel
- Kadir Tufekci
- Kemal Alper Uyan
- Kemal Buyukkamber
- Kerem Ozdemir
- Keziban Guler
- Kubilay Ozdemir
- Kursad Alpargu
- Mahmut Naci Ugur
- Mehmet Ali Akar
- Mehmet Can Kuru
- Mehmet Emin Bal
- Mehmet Uysal
- Melih Can Uzun
- Melih Cihan Yenigun
- Melih Efe
- Melikcan Ozgur
- Meltem Karaalioglu
- Meral Uslu
- Mert Gulsen
- Mertcan Mut
- Merve Kumas Ergin
- Mesut Pehlivanoglu
- Metin Onder
- Muhammed Baybars Gokcan
- Muhammed Dogan
- Muhammed Seyhan
- Muhammet Akgul
- Muhammet Emre Badem
- Murat Cirkin
- Murat Kucuktopcu
- Murat Uzun
- Mustafa Boyacı
- Mustafa Doncu
- Mustafa Guncan
- Mustafa Ozmen
- Mustafa Tutuncu
- Muzaffer Kaya
- Necati Durmaz
- Numan Yasar
- Nur Dilara Kilic
- Oguzhan Koseoglu
- Okan Ersahan
- Okan Erdil Uluturk
- Oktay Cevik
- Olcay Sari
- Onur Kakilli
- Onur Ozsanag
- Onur Sevim
- Onur Topcinar
- Onur Yaldir
- Onurcan Gul
- Onurcan Potas
- Orhan Demirkapu
- Orkun Kekec
- Osman Serkan Gokce
- Osman Yavuz
- Ozan Alican
- Omer Burak Unsal
- Omer Duran
- Omer Faruk Guven
- Omur Madankaya
- Ozkan Orhan
- Pelin Buyukburgaz
- Ramazan Yildirim
- Rasit Kunduz
- Recep Nazikgul
- Revzanur Karagul
- Saffet Bilge
- Salim Isik
- Samet Akbulut
- Sefa Yasar
- Selimcan Demir
- Semih Avcun
- Senar Yetkin
- Sercan Alcay
- Sercan Uzuntas
- Serdar Ozdemir
- Serhan Kuran
- Serhat Guner
- Serkan Atik
- Serkan Karan
- Serkan Onay
- Serkan Ulukut
- Serkan Yavuz
- Sezer Unal
- Sinan Bayir
- Sinan Duzyol
- Sinan Geyve
- Suat Yuksel
- Suleyman Akkaya
- Suleyman Cinar
- Sahin Cankes
- Sahin Orhan
- Sahin Oysal
- Sebnem Zehra Aydogan
- Sevket Ertekin
- Seyma Ersoy Atman
- Tayfun Isikli
- Tulay Yelken
- Ulku Uzan
- Umit Caliskan
- Veysel Egemen Agakay
- Volkan Elma
- Volkan Kocaogullar
- Volkan Padir
- Volkan Tepekaya
- Yahya Serkan Catal
- Yasin Cam
- Yasin Saylak
- Yasin Tohumcu
- Yasin Uslu
- Yasin Yalcin
- Yasar Aydogmus
- Yesim Nur Gulcan
- Yilmaz Aksahin
- Yusuf Balat
- Yusuf Cetin
- Yusuf Delil
- Yusuf Karali
- Yusuf Sancak
- Yucel Beki
- Yucel Saygin
- Zeki Demircan
- Zeliha Guler
- Zeynel Gungor
- Zeynep Bahar
- Ziya Bolu

VISITS TO OUR COMPANY FROM VARIOUS INSTITUTIONS CONTINUED INTENSIVELY THROUGHOUT THE YEAR.

VISIT OF DEPUTY GOVERNOR OF ESKISEHIR OF THE PERIOD ISMAIL SOYKAN
13.01.2022

VISIT OF THE SUPREME BOARD OF JUDGES AND PROSECUTORS
01.02.2022

VISIT OF TR MOTOR
10.02.2022

VISIT OF THE GENERAL DIRECTOR OF MILITARY FACTORIES IMDAT ERSOY
04.03.2022

VISIT OF THE GENERAL DIRECTOR OF GUR METAL, BEGUM YARDIMCI
08.04.2022

VISIT OF HONEYWELL TURKIYE, ISRAEL, AND CENTRAL ASIA GENERAL MANAGER UYGAR DOYURAN AND HIS DELEGATION
16.04.2022

VISIT OF THE CHIEF PUBLIC AUDITOR SEREF MALKOC
21.03.2022

VISIT OF THE GENERAL DIRECTOR OF TURKISH TECHNIC, MIKAIL AKBULUT
30.03.2022

VISIT OF THE MOROCCAN MILITARY DELEGATION
30.03.2022

VISIT OF DIRECTOR OF THE KORDSA INTEGRATED MANUFACTURING TECHNOLOGIES RESEARCH AND APPLICATION CENTER, DEVREM OZAYDIN
30.03.2022

VISIT OF BURSA TECHNICAL UNIVERSITY
01.04.022

VISIT OF COMMANDER OF ESKISEHIR PROVINCIAL GENDARMERIE OF THE PERIOD, COLONEL ERCAN ATASOY
05.04.2022

VISIT OF THE GE MARINE, GE AVIATION TÜRKİYE DELEGATION
22.04.2022

VISIT OF REGIONAL BUSINESS DEVELOPMENT AND SALES DIRECTOR OF GE MARINE FOR EUROPE, MIDDLE EAST, AND AFRICA OF THE PERIOD, STEVE ROGERS
22.04.2022

VISIT OF THE SINGAPORE DELEGATION
28.04.2022

VISIT OF THE KAYSERI CHAMBER OF MECHANICAL ENGINEERS
07.06.2022

VISIT OF THE PRESIDENT OF KONYA CHAMBER OF INDUSTRY AND THE DELEGATION
08.06.2022

VISIT OF THE QATAR DELEGATION
09.06.2022

VISIT OF THE REPUBLIC OF SOUTH AFRICA ARMSCOR DELEGATION
15.06.2022

VISIT OF THE PAKISTAN AIR FORCE COMMAND DELEGATION
15.06.2022

VISIT BY KENNETH DOWIE MUIR
16.06.2022

VISIT OF THE UKRAINE DELEGATION
27.06.2022

VISIT OF THE GE DELEGATION
30.06.2022

VISIT OF ALP AVIATION
30.06.2022

VISIT OF THE BAYKAR TECHNICAL TEAM
21.07.2022

VISIT OF COMMANDER OF THE 1ST MAIN JET BASE, BRIGADIER GENERAL DOGAN EROGLU
27.07.2022

VISIT OF THE MALAYSIA DELEGATION
27.07.2022

VISIT OF THE DENIZLI MACHINERY MANUFACTURERS ASSOCIATION
29.07.2022

VISIT OF THE RECTORS FROM ITU - ESOGU - AZERBAIJAN
30.07.2022

VISIT OF THE PROVINCIAL DIRECTOR OF NATIONAL EDUCATION, PERVIN TORE, OF THE PERIOD
01.08.2022

VISIT OF TR MOTOR AND THE UKRAINE DELEGATION
02-03-05.08.2022

VISIT OF AIR FORCE COMMANDER YUSUF ERGE
11.08.2022

VISIT OF THE GREENLEAF COMPANY
13.08.2022

VISIT OF SASAD GENERAL SECRETARY OF THE PERIOD, DR. R. RUSEN KOMURCU
19.08.2022

VISIT OF THE AMBASSADOR OF IVORY COAST
16.09.2022

VISIT OF KENNAMETAL
27.09.2022

VISIT OF THE BOTAS DELEGATION
28.09.2022

VISIT OF AVIATION ENGINEERING SCHOOL GRADUATES
28.09.2022

VISIT OF THE CHIEF PHYSICIAN OF ESKISEHIR CITY HOSPITAL, MD. YASAR BILDIRICI
30.09.2022

VISIT OF THE DEPUTY GOVERNOR OF ESKISEHIR, SALIH ALTUN
30.09.2022

VISIT OF SSB - GE
04.10.2022

VISIT OF TUSAS NATIONAL FIGHTER DEPUTY GENERAL MANAGER
13.10.2022

VISIT OF THE PRESIDENT OF THE BOARD OF DIRECTORS OF DENIZLI ORGANIZED INDUSTRIAL ZONE, ABDULKADIR USLU, AND HIS DELEGATION
20.10.2022

VISIT OF GE
31.10.2022

VISIT OF STUDENTS FROM GEBZE TECHNICAL UNIVERSITY
02.11.2022

VISIT OF UKRANIAN DELEGATION
03.11.2022

VISIT OF THE CHIEF PUBLIC PROSECUTOR ALI YELDAN
04.11.2022

VISIT OF STUDENTS FROM METU AEROSPACE ENGINEERING
09.11.2022

VISIT OF MEMBER OF THE PRESIDENCY SECURITY AND FOREIGN POLICIES, MESUT HAKKI CASIN
16.11.2022

VISIT OF PROVINCIAL POLICE CHIEF IN ESKİSEHİR, YAMAN AGIRLAR
21.11.2022

VISIT OF BOEHLERIT
24.11.2022

VISIT TO THE SOUTH AFRICAN DENEL COMPANY
15.12.2022

VISIT OF IHL
16.12.2022

VISIT OF REPRESENTATIVES FROM TUSAS AND ITS SUBSIDIARIES
20.12.2022

VISIT OF THE BOTAS DELEGATION
29.12.2022

MALAYSIA FAIR

TEI participated in the Defence Services Asia (DSA) 2022 Exhibition in Kuala Lumpur, the capital of Malaysia, which took place from March 28 to 31, 2022.

During the DSA 2022 fair, which has significant potential in the Far East market, TEI engaged in discussions with local companies operating in the Far East region. TEI also hosted visitors at its booth. Napadej Dhupatemiya, the Commander of the Royal Thai Air Force of the period; Pilot Major General Casim bin Muhammed el-Menai, the Commander of the Qatar Emiri Air Force; and officials from the Oman Ministry of Defence visited TEI booth to gather information about various projects. Minister of the Interior Affairs of the Period, Hamzah Zainudin also visited TEI booth.

In addition to international visitors, Türkiye's Ambassador to Malaysia at the time, Merve Safa Kavakci, and the Chief of the General Staff of the Turkish Gendarmerie, General Arif Cetin, visited TEI booth. Then AK Party Member of Parliament from Istanbul, Ravza Kavakci Kan and Deputy Chairman of Defense Industry Agency at the time, Celal Sami Tufekci also received updates on TEI's latest projects.

FARNBOROUGH INTERNATIONAL AIRSHOW

Between July 18 and 22, TEI participated in the Farnborough Airshow, one of the world's most important aviation exhibitions, held in the capital of the United Kingdom, London. TEI showcased its indigenous products, including the TEI-PD170, TEI-PG50, TEI-TS1400, and TEI-TJ300 engines at the exhibition.

TEKNOFEST AZERBAIJAN

TEKNOFEST, which was organized outside of Türkiye's borders for the first time in 2022, took place in Baku, Azerbaijan, between the dates May 26 to 29. TEI booth attracted significant attention from Azerbaijani youth and the public.

Students studying in Azerbaijan not only learned about TEI but also received information about TEI Aviation Engines School from the Human Resources team.

The festival, which lasted for 4 days, was attended by President Recep Tayyip Erdogan and Azerbaijani President Ilham Aliyev. TEI CEO Prof. Mahmut F. Aksit accompanied the presidents in their festival programs.

During the festival, Ismail Demir, the head of the Defense Industry at the time, received information about the latest developments in the TEI-TS1400 engine when he visited the TEI booth. Adil Karaismailoglu, the Minister of Transport and Infrastructure at the time, was also among the names who visited the TEI booth.

TEKNOFEST SAMSUN

In its 5th year with great enthusiasm and excitement, TEI participated in the festival held in Samsun, showcasing its capabilities in various fields, especially in national aviation engines, in a 300-square-meter booth. TEI also conveyed to participants the progress that our country has made in this field.

Every year, within the scope of TEKNOFEST, TEI organizes the Jet Engine Design Competition, where the winners received their awards. Additionally, during the festival, which took place from August 30 to September 4 at Samsun Carsamba Airport, TEI conducted taxi demonstrations with the TEI-TJ90 Turbojet Engine.

TÜRKİYE'S FIRST TURBOFAN ENGINE DEBUTS AT TEKNOFEST FOR THE FIRST TIME

Visitors to the TEI booth had the opportunity to examine the national aviation engines that TEI has contributed to our country. TEI also showcased Türkiye's first national turbofan engine, TEI-TF6000, for the first time at TEKNOFEST.

ISTANBUL AIRSHOW

The Source of Power TEI participated in the Istanbul Airshow held at Ataturk Airport from October 6th to 8th. In its 13th edition this year, the International Civil Aviation and Airport Exhibition and Aviation Industry Supply Chain Platform, Istanbul Airshow, featured TEI showcasing its indigenous products, TEI-TF6000 and TEI-TS1400. Additionally, at the fair where TEI participated jointly with GE, TEI introduced Türkiye's first domestically produced helicopter engine, the T700-TEI-701D, produced in Eskisehir under a GE license.

Throughout the event, which saw the participation of over 100 different companies, TEI conducted numerous bilateral meetings to explore new business opportunities in the Eurasian market.

ESKISEHIR INDUSTRY FAIR

Eskisehir, Türkiye's aviation hub, hosted the Eskisehir Industry Fair from October 18th to 21st. Many companies from the aviation, defense, and machinery industries were present at the fair, ready to explore new business opportunities.

TEI, which designs, develops, operates, and manufactures Türkiye's national aviation engines, presented its products to visitors at the Eskisehir Industry Fair. Participants who visited the TEI booth had the opportunity to examine various engines, including the TEI-TF6000 turbofan engine, TEI-TS1400 turboshaft engine, TEI-PD170 turbodiesel aviation engine, TEI-TJ300, TEI-TJ90, TEI-TJ60, TEI-TJ30 turbojet engines, and TEI-PG50 two-stroke gasoline aviation engine.

TEI aims for maximum domestic production in all areas of operation and collaborates with numerous subcontractors, evaluated new business partnership opportunities with various manufacturing companies throughout the fair.

SAHA EXPO FUARI

TEI showcased its indigenous products at SAHA EXPO. SAXA EXPO, one of Türkiye's largest aviation and defense industry events, was held at the Istanbul Fair Center from October 25th to 28th, featuring participation from over 1000 companies from more than 50 countries.

At the fair, TEI exhibited a range of engines, including the TEI-TF6000 turbofan engine, TEI-TS1400 turboshaft engine, TEI-PD170 turbodiesel aviation engine, TEI-TJ300, TEI-TJ90, TEI-TJ60, TEI-TJ30 turbojet engines, TEI-PG50 two-stroke gasoline aviation engine, and the T700-TEI-701D turboshaft engine. Alongside these engines, TEI also showcased the most complex aviation engine component manufactured in Türkiye using the additive manufacturing method, which is considered the future of manufacturing technology.

In addition to its physical presence at SAHA EXPO, organized by SAHA Istanbul, Europe's largest industrial cluster, TEI also engaged with visitors in the Metaverse universe from November 1, 2022, to February 1, 2023. This allowed interested individuals who couldn't physically attend the fair to have the opportunity to examine Türkiye's first national aviation engines developed by TEI.

IDEAS FAIR

TEI exhibited its indigenous products at IDEAS 2022, which took place in Pakistan, a friendly and brotherly country.

During the first two days of IDEAS 2022, held in Karachi, Pakistan, from November 15th to 18th, visitors showed strong interest in TEI's booth. At the fair, TEI showcased Türkiye's first national helicopter engine, TEI-TS1400, Türkiye's first national turbodiesel aviation engine, TEI-PD170, Türkiye's first two-stroke aviation engine, TEI-PG50, and TEI-TJ90 and TEI-TJ60 turbojet engines. In addition to its indigenous engines, TEI also exhibited the subsystems it has developed for its indigenous engines. Visitors had the opportunity to see the alternator and central power unit used in the TEI-PD170 turbodiesel aviation engine.

Throughout the event, which hosted numerous bilateral meetings, TEI closely monitored export opportunities in Pakistan and the region.

INDUSTRIAL COLLABORATION DAYS IN DEFENSE AND AVIATION

TEI continued its important steps toward localization and nationalization in the defense and aviation industry by participating in the Industrial Collaboration Days in Defense and Aviation (ICDDA) held in Ankara from October 12th to 14th. TEI, the leading company in our country's aviation engines, engaged in numerous bilateral meetings during the event, where manufacturers, SMEs, and subcontracting companies in the defense and aviation sector assessed new business opportunities. During the event, which saw the participation of over 1000 attendees, TEI's Vice President of Finance and Sourcing, Emre Saylan, served as a speaker at the conference titled "The Future of Global Aerospace and Space Supply Chains.

TÜRKİYE INNOVATION WEEK

Between December 12th and 13th, TEI made a significant impact at Türkiye's most comprehensive innovation event, Türkiye Innovation Week, held at the Istanbul Halic Congress Center. The event featured the launch of the TEI-TF10000 engine, designed by TEI.

The TEI-TF10000 engine, designed as a military turbofan engine, is intended to be used in combat unmanned systems in the KIZILELMA class, fast attack boats, power plants, and regional passenger aircrafts. It represents a crucial technological achievement and demonstration for TEI and Türkiye in the journey towards the National Combat Aircraft's engine. This engine, with different configurations derived from its core, can also provide propulsion solutions for heavy-class helicopters like ATAK-2. The real size mock-up of the engine, capable of producing 10,000 pounds of thrust when combined with the afterburner module added to the TEI-TF6000, was showcased for the first time at the event.

The opening ceremony of the event was attended by President Recep Tayyip Erdogan, and during the ceremony, the Türkiye Innovation Leaders Awards were presented. TEI was honored with the "Strategic Partner" award. This year's event, held under the theme of "The New Century of Innovation," included a panel discussion titled "Rising Star of the Defense Industry: Türkiye," in which TEI's CEO Prof. Mahmut F. Aksit, participated along with other prominent figures from the industry.

THE PLACE WHERE DESIGN MEETS EXPERIENCE

BOGAZICI DEFENSE INDUSTRY SUMMIT

TEI participated in the Bogazici Defense Industry Summit organized by Bogazici University Engineering Society (ENSO) on January 8th and 9th. During the summit, Senior Technical Leader Serhat Tabanli provided students with information on Electrical & Electronic Systems in Aviation Propulsion Systems. On the second day of the summit, Senior Group Leader for Recruitment, Sibel Piskin, informed students about TEI and human resources practices.

5TH DEFENSE INDUSTRY SUMMIT

The 5th Defense Industry Summit, sponsored by TEI and organized annually by Marmara University, took place on May 10 - 11, 2022, in Istanbul. Anıl Uzer, a Senior Engineer from TEI, participated in the event and delivered a presentation providing insights into TEI's position in the global aviation and defense industry, key aviation materials and processes, current industry practices, and TEI's status in these applications.

BURSA TECHNICAL UNIVERSITY CONFERENCE

On May 15th, TEI's CEO Prof. Mahmut F. Aksit, met with university students in Bursa. During the event attended by students from Bursa Technical University and Uludag University, Prof. Mahmut F. Aksit shared TEI's journey in developing national aviation engines.

ADDITIVE MANUFACTURING CONFERENCE

TEI showcased its capabilities in additive manufacturing at the conference held on October 6-8. During AMC TÜRKİYE 2022, TEI employees answered questions from both companies working in additive manufacturing and curious students interested in TEI. Articles prepared by TEI's additive manufacturing team were presented at the conference. On the second day of the event, Guray Akbulut, the Technology Programs Manager, delivered a presentation introducing TEI to the participants.

FUTURE'S SOFTWARE DEVELOPERS EVENT

The team leaders from the Electrical - Electronic Control and Embedded Systems Directorate and the Technology Programs Directorate, along with the Software Development, Software Verification, and Engine Design Tools Development teams, met with students from the Computer Engineering and Electrical - Electronics Engineering departments of Ihsan Dogramacı Bilkent and TOBB ETU Universities. During these meetings, TEI teams shared information about career opportunities and software activities at TEI and answered the students' questions.

ESOGU MATERIALS SCIENCE CLUB MATERIALS CLUB 2ND MATERIALS DAYS

The 2nd Materials Days event organized by the Eskisehir Osmangazi University Materials Science Club took place on December 25, 2022. During the event, presentations were given by Senior Specialist Engineer Hamdi Ayture and Senior Engineer Remzi Gomek on Special Processes, Laboratory Work, and Material and Process Development practices implemented at TEI.

TEKNOPARK ISTANBUL COMPANY MEETINGS

On November 24th, Senior Technical Leader Emre Dilektasli from the MGMY - MPGM unit participated in the Teknopark Istanbul Company Meetings - Advanced Materials Technologies event. He shared information about TEI's capabilities in advanced materials, superalloys, coating materials, and ceramic matrix composites technology areas. During the event, one-on-one meetings were conducted with participating companies to discuss potential collaborations and partnerships.

BTK ACADEMY CAREER SUMMIT

The BTK Academy Career Summit 22', held on December 14-15, 2022, at the BTK Central Campus, saw the participation of over 2500 visitors along with leading organizations in the defense industry, telecommunications, and e-commerce sectors. During the summit, experienced executives shared their career stories in 9 panels with 36 panelists, engaging in one-on-one discussions with young attendees. The enthusiasm and excitement of the youth were clearly visible throughout the event.

After TEI's CEO Prof. Mahmut F. Aksit's speech at the intersection of technology, Yeliz Cetinkaya, Vice President of Human Resources and Administrative Affairs, provided career advice and insights into TEI's human resources practices, while Emre Saylan, Vice President of Finance and Sourcing, shared information about TEI's cybersecurity practices.

TEI IS 37 YEARS OLD

TEI, its 37th anniversary was celebrated with various events, marking 37 successful years of achievements in all areas of its operations since its establishment. As part of the commemoration of the 37th anniversary within the company, employees participated in a special photograph session and an online quiz. TEI's CEO, Prof Mahmut F. Aksit, made a statement about the significance of the day, saying, "I would like to thank all our valuable colleagues for their significant contributions to the successes we have achieved in the past 37 years, especially with our indigenous engine projects. I wish for many more achievements together with the TEI family, the source of power".

WOMEN EMPOWERING THE POWER MENTORSHIP PROGRAM

The mentorship program, which is part of the Career Candidate Engineering Program at Source of Power, has started to help female students take a stronger steps in their career journeys. In this journey guided by female TEI managers, students empowered their careers through technical and personal development, benefiting from mentorship and support.

R&D DESIGN TALK EVENT

The first TEI Design Talks event, themed "Principles (ILK(E)LER)," was organized through the collaboration of TEI Engineering Deputy General Management Operations Leadership, the Communication Committee, and Corporate Communications Leadership. The event took place on March 22nd at Eskisehir Technical University and involved the participation of TEI's R&D teams. Employees from Eskisehir Ankara, and Istanbul campuses also had the opportunity to come together. The event began with a presentation titled "From 6 Sigma to Pide" by Umut Karahan, the Director of Engine Dynamics and Structural Engineering. It continued with a talk titled "Two Stubborn Goats" by Senior Team Leader Kursad Alpargu and concluded with a presentation titled "Codes of Our Childhood" by Senior Technical Leader Fatih Oztoprak. Following these presentations, Vice President of Engineering Ahmet Findik delivered a speech, and then plaques and certificates for trees planted in the on speakers' behalf were presented.

TEI CEO PROF. MAHMUT F. AKSIT, CAME TOGETHER WITH EMPLOYEES

TEI CEO Prof. Mahmut F. Aksit came together with over 2200 employees at the TEI Eskisehir Campus on April 6th. Employees from the Ankara, Istanbul, and Gebze offices also followed the event through live streaming. Following this meeting, the TEI Management Excellence Awards Ceremony took place. After the employees who had achieved outstanding success were awarded plaques, a group photograph was taken with all the employees, concluding the event.

EXECUTIVE OUTSTANDING ACHIEVEMENT AND EXECUTIVE PROJECT OUTSTANDING ACHIEVEMENT AWARD CEREMONY

Localizing Thermal Spray Coating Studies

Emin Tuzlu, Selcuk Kilicarslan, Emre Unlu, Erdem Kuscu, Murat Eksi, Rabia Gunay, Dincer Tali, Emre Dilektasli, Nafiz Cagri Sahin, Ece Canan Karabastik, Vefa Saka, Onur Kakilli, Kenan Kara, Baris Bilal, Altintas Goktug Kobak, Alper Kocak

The use of Additive Manufacturing-Oriented Design Philosophy in Indigenous Engine Projects and Technology Development Projects

Guray Akbulut, Baris Pehlivanogullari

TEI Aviation Engines School

Ilker Basol, Mustafa Kemal Baldoktu, Emin Tuzlu, Sinan Sal, Buket Topel, Mehmet Karakis, Emin Nadir Kacar, Guray Akbulut, Kerem Gundogan, Mehmet Ali Aktas, Nuri Koray Orbay, Ozgur Unsar, Rabia Gunay, Sinan Inanli, Tamer Sertoglu, Ahmet Basdogan, Coskun Tunca, Senay Dortkasli, Ezgi Ayten Cetin Dincer, Denizgun Dag Demir, Fatih Oztoprak, Hakan Mutluay, Hilal Yildiz Cetin, Himmet Emre Aktas, Mehmet Oguz Turgut, Selin Bulbul, Ersen Altintas, Gokhan Aran, Erinc Erdem, Ceylan Kubilay Erdem, Serkan Kinden, Guney Mert Bilgin, Cansinem Tuzemen Gundogan, Refika Ceren Kocacoglu Birgul Ay, Burak Celebi, Sedat Can Dogu, Burcu Uydurucu, Erkan Balk, Zeynep Urulu

TEI-TJ300 Speed Record Test

Selcuk Kilicarslan, Sinan Sal, Bora Yildirim, Buket Topel, Mehmet Erkan Emek, Mehmet Karakis, Ahmet Ozsahin, Erdem Kuscu, Guray Akbulut, Gurcan Tore, Huseyin Bayraktar, Kerem Gundogan, Nadide Ebru Bozkurt, Necati Emir, Nuri Koray Orbay, Ozgur Unsar, Rabia Gunay, Suleyman Caner Songuler, Suleyman Tasci, Turgut Avci

CTS800/TS1400 Engine Test Cell Design, Installation, and Correlation Processes

Gursel Boz, Mehmet Karakis, Alper Unlu, Eren Akcay, Ahmet Basdogan, Gulsah Arar Dursun, Murat Uzun, Muhittin Arslan, Hasan Ali Cetinel, Ozgur Mert Serbest, Sefa Sanbay, Vedat Aras, Onur Ozturk, Adem Yilmaz, Muhammed Abdulmuttalip Deniz, Osman Abdullah Ozcelik, Adnan Sen, Ferudun Kuscu

Aubert & Duval - Supply Chain Recovery/Development and New Business Opportunities

Selcuk Kilicarslan, Buket Topel, Mecit Ozgur Yaman, Ahmet Akan, Gurcan Tore, Huseyin Bayraktar, Selahaddin Kinyas, , Suleyman Tasci, Turgut Avci, Emrah Gokce Caglar, Emre Durdu, Hakan Yaman, Levent Inal, Melek Canbulat, Onur Ersay Us, Tayfun Yavuzbayir, Ersen Altintas, Fahri Ersoy Orhan, Furkan Utku Yazan, Hamdi Ayture

CTS800/TS1400 Engine Test Cell Design, Installation, and Correlation Processes

Kerem Gundogan, Safiye Canset Mercan, Safak Kaya, Ugur Akdogan

23RD APRIL "MY DREAM FUTURE"

PAINTING EXHIBITION

As part of the April 23 National Sovereignty and Children's Day celebrations, TEI organized a painting competition called "Hayalimdeki Gelecek" (My Dream Future) for the children of TEI employees.

With the participation of 120 TEI children to the competition aimed to share children's excitement of April 23. All children who participated in the April 23 Drawing Competition received gifts suitable for their age groups.



























Meyra




RONGE

































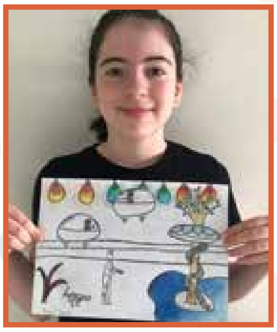








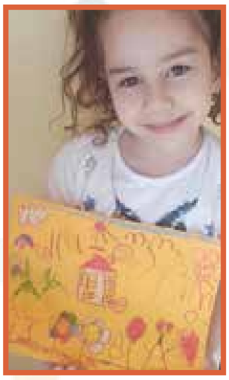
NEW YORK
STREET

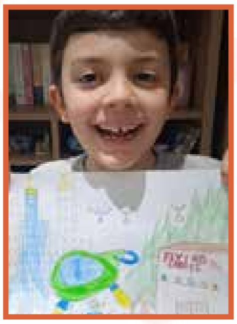



















"My Dream Future"

TEI SPRING TOURNAMENT

The traditional TEI Spring Tournament, held every year, was completed this year with great enthusiasm and the participation of nearly 1500 TEI employees in various branches such as basketball, billiards, bowling, darts, football, photography, running, table tennis, chess, tennis, and volleyball over a period of 7 weeks. The employees who achieved top rankings were presented with their trophies during a ceremony held at the TEI Traditional Family Picnic.

The champions in various categories are, Basketball Tournament TS1453 team, Billiards Tournament Turgut Avci, Bowling Tournament Testers Team, Darts Tournament Hakan Mutluay, Football Tournament Turbofan & Turbojet Team, Photography Contest Fatih Karakas, Running Tournament (1 round) Metin Ozturk, Running Tournament (2 rounds and 4 rounds) Mehmet Esat Ozmen, Table Tennis Women's Tournament Seyda Yasar Capa, Table Tennis Men's Tournament Omer Sarac, Table Tennis Mixed Doubles Tournament Omer Sarac and Vasvidin Gore, Chess Tournament Ozgur Kalyoncuoglu, Tennis Women's Tournament Ayris Karadurmus, Tennis Men's Tournament Ahmet Ozsahin, Volleyball Tournament R&D Supply Team.


TEI

2022 TEI SUMMER SCHOOL

The TEI Summer School, held for TEI children, took place in person for the first time after the pandemic from June 20 to July 1, 2022. The TEI Summer School 2022 had over 200 children participating and featured 12 different sports and art activities, including basketball, football, volleyball, drama, charcoal drawing, glass art, ceramics, roller skating, painting, street games, and obstacle courses.


TEI 2022
YAZ OKULU
Turbosaft Grubu

2022 TRADITIONAL *Family Picnic*

After the pandemic, the Traditional Family Picnic was held for the first time with over 6000 participants, including employees and their families, on Sunday, September 25th. The picnic area featured food and beverage stalls, and more than 20 different fun activities were organized for children, teenagers, and all participants, making it an enjoyable day for the TEI family.

In addition to the activities, attendees had the exciting opportunity to witness a taxi demonstration with the TEI-TJ90 turbojet engine in operation, allowing them to see a jet engine in action. Employees also visited the Engine Adventure Museum Area, where families had the chance to see TEI's indigenous engines, manufacturing contributions to the global aviation industry, and capabilities in areas such as quality, maintenance, repair, revision, assembly, and overhaul firsthand. Additionally, those attending the TEI Traditional Family Picnic had the opportunity to inspect the Indigenous and National First Turbofan Mobile Test Cell on-site.

During the event, awards were presented to the winners of the Traditional Spring Tournament, and a surprise gift drawing called the "37 Special Gifts for 37 Years" was held to commemorate the 37th anniversary of the company's founding.

MOMENTUM INTERNAL TRAINER SCHOOL EVENT

TEI, maintaining its principles of continuous improvement and lifelong learning, organized an event on November 24th, Teachers' Day, to celebrate the company's in-house trainers. Approximately 200 TEI employees, who served as trainers for 70,000 out of the total 136,000 hours of training conducted by TEI, gathered at the TEI Social Facility. TEI CEO Prof. Mahmut F. Aksit, during his participation in the event, expressed his gratitude to all trainers, saying, "You are spreading the knowledge that both our company and our country need. I congratulate all of you on Teachers' Day." The event concluded with the presentation of gifts prepared for in-house trainers.

INTERNATIONAL DAY OF DISABLED PERSONS

On December 3rd, as part of World Disabled Persons Day, a meal event was organized at TEI. During the meal event, plans for improvements that have been made at TEI and those that are planned for the future were shared.

ONLINE QUIZZES

In 2022, TEI organized online quizzes on 9 different topics with active participation from employees. The topics of the quizzes included Milestones, 5S, Information Security Management Systems, Inventors, Occupational Health and Safety, Environment, Glossary of Power, Türkiye and World Capitals. Employees who achieved top rankings in the quizzes were rewarded.

DESK CALENDAR PHOTOGRAPH CONTEST

TEI desk calendars for 2023 featured photographs taken by TEI employees. These photographs included campus landscapes, snapshots of campus life, and pictures of our adorable campus friends. Employees whose photos were selected for the calendar were presented with gifts.

Nur Polat

Hande Akbas

Onder Tutu

Emre Dalak

Mehmet Akif Kaplan

Sedat Can Dogu

Hande Yaman Sensoz

Tugce Coskuntuna Dasdemir

Erkan Balk

Adnan Sen

Emre Ozeren

Hasan Tuysuz

A DELICIOUS BREAK

In 2022, TEI organized 9 different "A Taste of a Break" events, featuring fruity, chocolaty and milk desserts, healthy snacks, seasonal beverages, and tart varieties. During these events, employees who posted the distributed products on their social media, participated in a drawing and received prizes.

SOCIAL CLUB ACTIVITIES

TEI Social Clubs, which were established in 2021 and contribute positively to the work-life balance of employees, organized more than 35 different events in 2022 in the fields of sports, arts, environment, and culture with the voluntary participation of employees of 18 social clubs.

FISHING CLUB

The TEI Fishing Club organized events on June 26 Sunday, 2022, in Gemlik, on October 7, 2022, in Karasu, and on November 27, 2022, in Gemlik.

BASKETBALL CLUB

The basketball tournament organized by the TEI Basketball Club, which attracted a high level of interest from TEI employees, concluded. The final match between TEIBULLS and Minik Panterler was fiercely contested, with TEIBULLS emerging as the tournament champions. TEI Harlem and Eskisehir Turbojet teams earned the 3rd and 4th positions. TEIBULLS lifted the championship trophy at the end of the tournament.

BILLIARD CLUB

The TEI Billiards Club has completed a 3-Cushion Billiards Tournament with 3 balls, which lasted for 8 weeks and featured the participation of 20 club members.

ENVIRONMENT CLUB

The TEI Environment Club organized a walk on Sunday, targeting the "81 Billion Steps in 81 Provinces" initiative as part of the Ministry's Environment Week. The walk took place in Bozuyuk, Kozpinar village, and it was joined by Eskisehir Outdoor Sport (EOS) Club as well.

A total of 32 participants walked a total of 926,990 steps, showing their support for the national goal, and they also collected waste within the forest area.

YOGA CLUB

The TEI Yoga Club organized a Yoga Camp in Sapanca, lasting for 2 nights and 3 days. TEI members who love yoga had the opportunity to disconnect from the hustle and bustle of life, immerse themselves in nature, and practice "Yin Yoga" in a natural setting under the guidance of a yoga instructor. The TEI Yoga Club continues to their weekly yoga classes with the guidance of a professional yoga instructor, in July and August.

MARINE AND SAILING CLUB

Four members of the TEI Marine and Sailing Club embarked on their sailing journey by completing their basic sailing training at the Istanbul Marmara Yacht Club. They continued their basic sailing training throughout the year.

FOOTBALL CLUB

A total of 300 people participated in the TEI Indoor Soccer Tournament organized by the TEI Football Club in two different groups. The champion of Group A was Jet Montaj, while the champion of Group B was Kalite Gucu.

In the TEI Super Cup final match between these two teams, Jet Montaj emerged as the winner, becoming the champion of the TEI Indoor Soccer Tournament and the holder of the Super Cup.

RUNNING CLUB

The TEI Running Club, emphasizing a healthy lifestyle and the motto "Get Active," participated in the 17th International Antalya Marathon, Runtalya 2022, in March. 11 members of the TEI Running Club participated in the 10 km race, and 4 members ran in the 21 km race. In the corporate category of the 10 km race, TEI Running Club ranked 7th out of 85 companies. On August 13th Sunday, during the Eskisehir Half Marathon, the TEI Running Club secured 2nd place in the 10 km corporate category.

TABLE TENNIS CLUB

The TEI Table Tennis Club, participating in the Eskisehir Inter-Corporate Table Tennis Tournament, won 2 trophies and earned the right to participate in the Turkish Championship held in Elazıg from June 11th to 13th, 2022, with the TEI Power and TEI Turbofan teams. In a tournament featuring 70 different organizations, the TEI Power team ranked 9th.

MOTORCYCLE CLUB

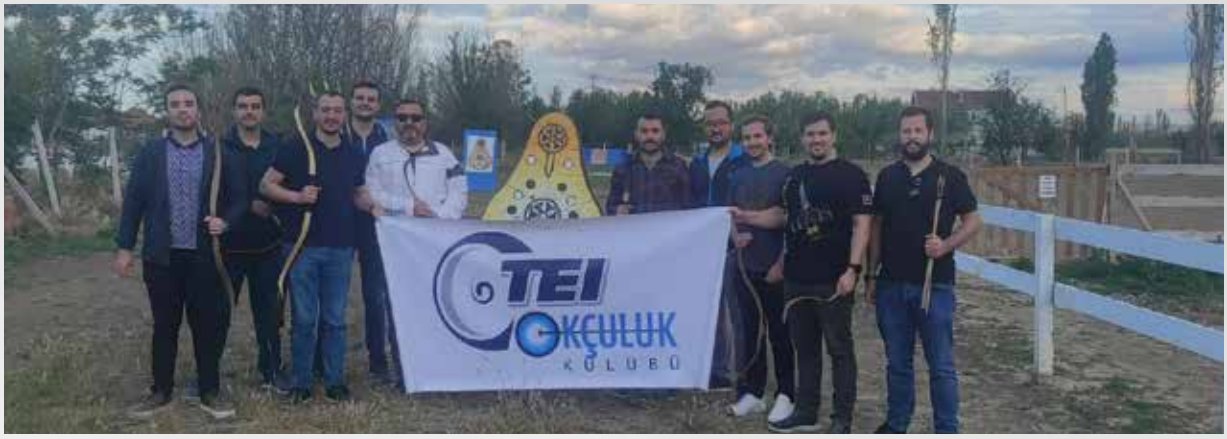
The TEI Motorcycle Club members continued to develop their riding skills throughout the year, focusing on internationally recognized and accepted riding techniques. In this context, they received theoretical training in June and indoor and on-road riding training in August.

MUSIC CLUB

The TEI Music Club is getting ready to dust off ears with their regular rehearsals. Members continued their studio rehearsals in 2022 and expanded their repertoire.

ARCHERY CLUB

The TEI Archery Club completed their traditional archery basic training in June, inheriting a sport from our ancestors, and continued their traditional archery training throughout the year.



SCUBA DIVING CLUB

The TEI Scuba Diving Club took another step towards exploring the underwater world by conducting diving training in Bodrum and Seferihisar in June.

In August, a team of 20 people conducted diving training in Dalyan. After completing their practical training, the participants will receive their 1-star diver certification.

TENNIS CLUB

The TEI Tennis Club continued to keep their rackets active throughout the year with their training sessions on the tennis courts and the training they received in August.

OHS SAFE EMPLOYEE AWARD

TEI organized the Occupational Health and Safety Safe Worker program every three months with the aim of preventing work accidents and occupational diseases and promoting positive and safe behaviors to become a habit. Employees who showed the most sensitivity to working in accordance with occupational health and safety rules were recognized with a thank-you letter and an award from the management, in order to support the continuous improvement of occupational health and safety.

Ahmet Tuna, Ozkan Can Turker, Yavuz Cinar, and Ahmet Karga were awarded. They received their awards from Vice President of Human Resources and Administrative Affairs Yeliz Cetinkaya and Facilities and Security Manager Ender Dur.

OCCUPATIONAL HEALTH AND SAFETY WEEK CELEBRATED WITH ACTIVITIES

The Occupational Health and Safety Week of 2022 was celebrated with various activities aimed at increasing awareness and consciousness about occupational health and safety, just like every year.

OHS SLOGAN COMPETITION

This year, the 6th Occupational Health and Safety Slogan Competition was held, and Kemal Alaattin Yucel won with the slogan "Our Goal is Global Leadership in Aviation, Our Priority is Occupational Health and Safety" out of 274 slogans.

OHS ONLINE QUIZ

A total of 790 employees participated in the online OHS knowledge quiz, which highlighted knowledge and awareness of occupational health and safety. The top 15 participants then competed in an in-person quiz, which was organized for the first time this year after the pandemic. After a fierce competition, Kutlay Kalmaz became the first-place winner, followed by Ezgi Didem Cayhan in second place, and Soner Oren in third place.

VIRTUAL REALITY BASED OCCUPATIONAL SAFETY APPLICATION

This year, during Occupational Health and Safety Week, an innovative approach was taken with a Virtual Reality (VR)-Based Occupational Safety Application. The aim was to create a more engaging and enjoyable experience for employees through the use of new tools in occupational health and safety. The team that organized the Virtual Reality (VR) event and achieved success, the Bahadir Takim, was awarded for their efforts.

TEI SUBSIDIARY-INDUSTRY COMPANIES OHS REPRESENTATIVES MEETING

During Occupational Health and Safety Week, a meeting with suppliers in the automotive industry was organized. Representatives of Occupational Health and Safety discussed the continuous improvement of Occupational Health and Safety practices during the meeting held at TEI. The event concluded with a field tour, and participating companies included Aycan Aviation, Derin Aviation, Akbey Aviation, Truva Mold Machinery, and Numerik Machine.

2022 OHS PRACTICES

In 2022, TEI successfully completed programs aimed at maintaining a safe working environment and the well-being of its employees. In 2023, TEI will continue to prioritize Occupational Health and Safety and increase awareness through new projects with the motto "Our Goal is Global Leadership in Aviation, Our Priority is Occupational Health and Safety".

CELEBRATING ITS 37TH ANNIVERSARY, TEI DONATED LOVE BUNDLES

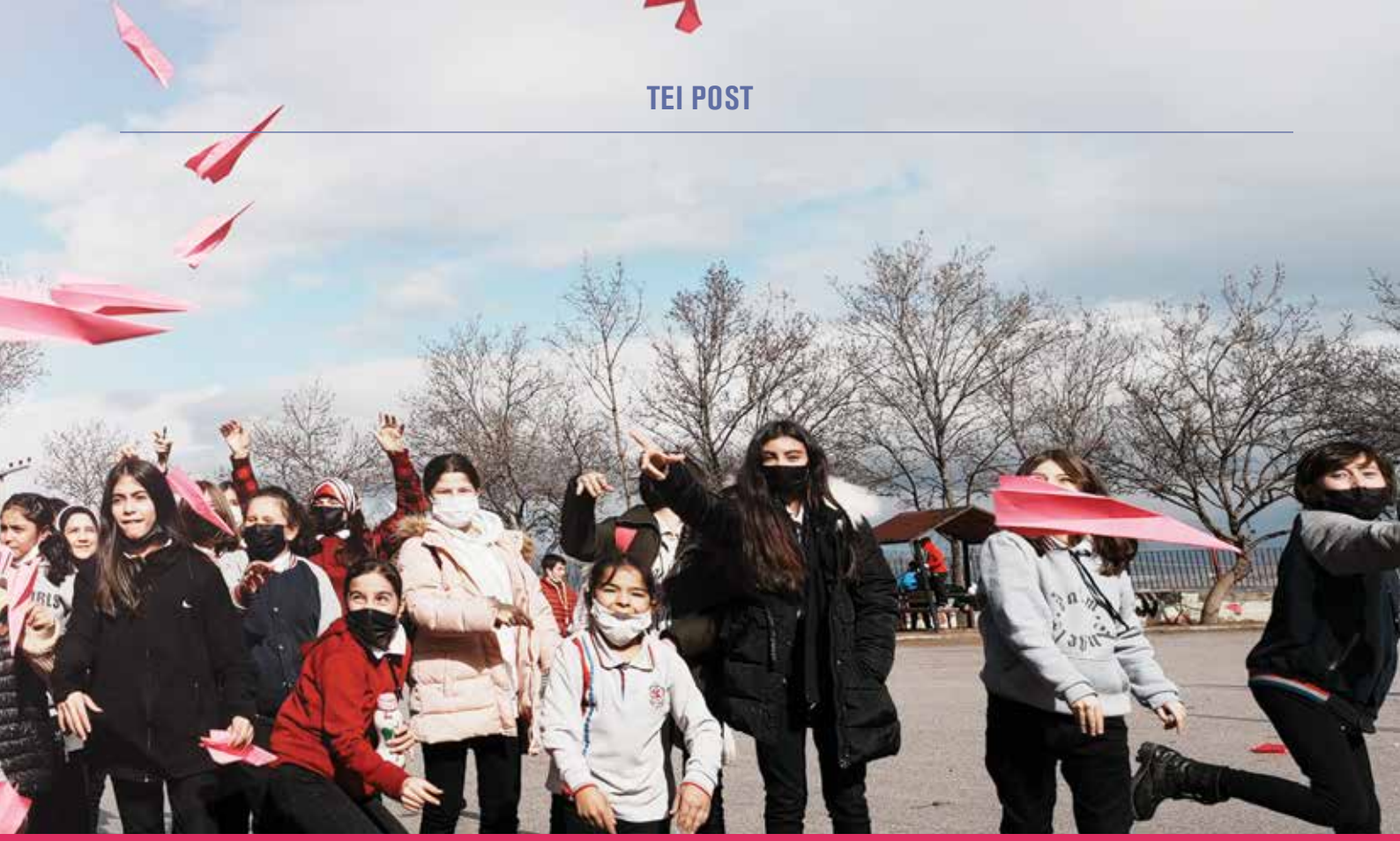
Since 2016, TEI has continued a tradition of celebrating its birthday on January 25th by sharing its joy with babies born on the same day in Eskisehir. TEI brings happiness to these families by giving them gifts. In its 37th year, TEI donated love bundles to the Turkish Red Crescent Eskisehir Branch, which were then distributed as gifts to mothers who gave birth at the Eskisehir City Hospital and the Eskisehir Osmangazi University Health, Application, and Research Hospital.

WOMEN IN AVIATION WEEK

On March 8th, as is the anniversary of the first licensed female pilot in 1910, Women in Aviation Week is celebrated during the week that includes March 8th. As part of Women in Aviation Week, TEI organized the "First Steps to the Center of Aviation" project to inform and raise awareness among girls about aviation.

As part of the project, visits were made to 10 middle schools determined in collaboration with the Eskisehir Directorate of National Education, reaching a total of 500 female students. During these meetings, educational materials prepared with the support of TUBITAK were used to provide information about the aviation sector and TEI. Elif Coskun, a Boeing 737 pilot at Turkish Airlines, and Sibel Piskin, a Senior Group Leader at TEI, introduced the students to the professions of piloting and engineering. They emphasized the importance of gender equality in aviation and answered the students' questions about aviation. The event was met with great interest from the female students, and it concluded with a paper airplane-making activity where pink airplanes were flown and colored in the sky.

Female employees from various departments at TEI shared messages with the female students, which included encouraging words and advice for their future colleagues. The First Steps to the Center of Aviation event also featured special gifts for the students.




TEI
Dünya Havacı Kadınlar Haftası


HAYATTA

HEALTHY ACTIVITY HABITS FOR CHILDREN IN OCCUPATIONAL HEALTH AND SAFETY WEEK

In order to contribute to laying the foundations of safety and health habits that children will carry throughout their lives, TEI visited Kirka Ataturk Primary School in Eskisehir. During the visit, various activities and workshops related to personal protective equipment and health safety signs were conducted. Additionally, practical fire extinguishing exercises and interactive OHS training sessions were carried out. The school principal and teachers of Kirka Ataturk Primary School were thanked for their support in educating children about the future importance of being conscious about safety and health. This initiative aims to raise awareness among children about the importance of safety and health practices. It also includes distributing coloring books on occupational health and safety topics, along with crayons, as gifts to the students.

VARIOUS ACTIVITIES WERE ORGANIZED TO RAISE ENVIRONMENTAL AWARENESS ON ENVIRONMENT WEEK FROM JUNE 1 TO JUNE 7

Continuing to make a name for itself through its social responsibility activities, TEI organized various events during the period of June 1-7 for Türkiye's Environment Week and June 5-11 for World Environment Week to raise environmental awareness and promote environmental consciousness.

WASTE COLLECTING ACTIVITY

On June 8, 2022, a "Waste Collecting Event" was organized in the Kocakir Forests located on Eskisehir - Seyitgazi road. Waste materials found within the Kocakir Forests and along the roadside were collected.

TEI COMPOST PROMOTION AND APPLICATION EVENT

On June 9 Thursday, 2022, a Compost Introduction and Application Event with the participation of nearly 100 students was held at the ETI Maden Isletmeleri Elementary School.

After providing theoretical training to 3rd and 4th-grade students, compost bins were practically prepared using organic waste from TEI's cafeteria and soil. After distributing gifts to the students as a memory of the day, a group photo was taken to conclude the event.

TREE PLANTING EVENT

TEI employees organized a "Tree Planting Event" on June 10th as part of Environmental Week to increase the existing green areas and the number of trees at the Eskisehir Campus.

RECYCLE FACILITY TO ESKISEHIR CUMHURIYET HIGH SCHOOL HAS BEEN CREATED

TEI has expanded its sustainability and recycling activities beyond its own premises to include various locations in Eskisehir. They have established a recycling area at Eskisehir Cumhuriyet Anatolian High School's garden as part of the Zero Waste Project to promote a culture of recycling.

BLOOD DONATION EVENT

TEI, under the slogan "A drop of blood means a life!" organized a blood donation event. As part of the protocol signed with the Turkish Red Crescent in 2016, TEI regularly conducts blood donation campaigns. This year, with the participation of over 90 employees, TEI organized a blood donation event during the Red Crescent Week. On November 1st, TEI employees at the Eskisehir Campus were informed by Red Crescent staff in a vehicle, underwent health checks, and then proceeded to donate blood.

VISIT OF THE MOST SENIOR TEACHER

TEI celebrated Teachers' Day with various activities. As part of this tradition, TEI visited the most senior teacher in Eskisehir on Teachers' Day this year. The event was organized in coordination with the Eskisehir Provincial Directorate of National Education, and Omer Yapar, the principal of Istiklâl Primary School, who has been in the teaching profession for 45 years was visited. The event was attended by the then Provincial Director of National Education in Eskisehir, Pervin Tore, TEI's Vice President of Human Resources and Administrative Affairs, Yeliz Cetinkaya, officials from the Provincial Directorate of National Education, TEI employees, and other teachers.

ESOGU SIVRIHISAR VOCATIONAL HIGH SCHOOL COMPUTER GRANT

TEI, emphasizing its commitment to education in its social responsibility activities, has established a computer laboratory at Eskisehir Osmangazi University (ESOGU) Sivrihisar Vocational School.

This laboratory, which includes 25 desktop computers and network equipment, was inaugurated on November 28th. The opening ceremony was attended by ESOGU Rector Prof. Kamil Colak, Sivrihisar District Governor Huseyin Sayin, Sivrihisar Mayor Hamid Yuzugullu, TEI CEO Prof. Mahmut F. Aksit, ESOGU Deputy Rectors Prof. Ramazan Erdag and Prof. Hakan Demiral, School Director Prof. Murat Olgun, District Mufti Mustafa Budak, District Director of National Education Erdogan Bozkurt, and other guests.

In his speech at the ceremony, ESOGU Rector Prof. Colak said “I express my gratitude to TEI, one of the city's significant institutions, for their support to the institution and education. We added an important laboratory to their school that would contribute significantly to their students”. TEI CEO Prof. Mahmut F. Aksit, emphasizing their commitment to education, stated, "We provide various forms of support to many educational institutions at different levels. We have also provided ESOGU Sivrihisar Vocational School with a computer laboratory. I wish it brings success and prosperity”.

9TH INTELLIGENCE WORKSHOP FROM TEI OPENED IN INONU KUMBET YENIKOY PRIMARY SCHOOL

As part of the "Intelligence Workshops Project," which was initiated in 2016 and has become a tradition, TEI established its 9th Intelligence Workshop at Inonu Kumbet Yenikoy Primary School.

This project is carried out in coordination with Eskisehir Provincial Directorate of National Education, and TEI, with the contributions of its employees, provided various educational materials and intelligence games to the school. Additionally, a play field was created in the school's courtyard.

HAYME HATUN MATHEMATICS LABORATORY

TEI has added another support to its contributions to education. TEI established a Mathematics Laboratory at the Sultandere Village Life Center in Eskisehir. This laboratory, established in coordination with the Eskisehir Provincial Directorate of National Education, will be used for mathematics learning and various mathematical activities for preschool and primary school children.

The inauguration ceremony took place in Sultandere and was attended by the then Minister of National Education, Mahmut Ozer, who visited Eskisehir for a series of visits. TEI's CEO Prof. Mahmut F. Aksit, and TEI executives were also present at the ceremony. Over the years, TEI has been involved in various social responsibility projects in collaboration with the Provincial Directorate of National Education, including libraries, intelligence workshops, internship programs, visits to the most senior teachers, and Women in Aviation Week activities, demonstrating its commitment to education.

ESKISEHIR SEYITGAZI (CEVIZLI – KUMBET PRIMARY SCHOOLS) CLOTHING SUPPORT

Continuing its support in the field of education, TEI, within the framework of its Village Schools Support Project, provided winter supplies for 130 students attending Seyitgazi Cevizli Elementary School and Middle School, and Kumbet Sehit Ekrem Saygi Elementary School and Middle School.

TEI PROVIDED LIBRARY SUPPORT TO MEHMET ALI YASIN ELEMENTARY SCHOOL THROUGH THE TEI LIBRARY PROJECT

TEI initiated the "TEI My Library Project" with the aim of contributing to students' education, and in this context, Mehmet Ali Yasin Primary School was selected as the project school by Eskisehir Provincial Directorate of National Education.

As part of the project, TEI provided support in painting the walls of the classroom where the library would be established, acquiring bookshelves, tables, chairs, bean bag chairs, and the reading books designated by Eskisehir Provincial Directorate of National Education.

SAMSUN PRIVATE KUZEY GOKTURK VOCATIONAL HIGH SCHOOL GRANT

TEI provided measurement devices as a grant to the Private Kuzey Gokturk Vocational and Technical Anatolian High School located in Samsun to support education.

ISTANBUL KARTAL LUTFI KIRDAR CITY HOSPITAL GRANT

TEI donated laptop computers and medical equipment to support the activities at Istanbul Kartal MD. Lutfi Kirdar City Hospital.

TEI IS THE GOLD SPONSOR OF THE ROBOTICS CODING COMPETITION

TEI provided support as a gold sponsor for the Robotics Coding Competition initiated under the coordination of the Eskisehir Governorship in 2020. The materials acquired as part of the project were delivered to middle schools and high schools affiliated with the Provincial Directorate of National Education in a ceremony held at the governorship.

SPECIAL ATHLETES BASKETBALL NATIONAL TEAM SPONSORSHIP

TEI sponsored the Special Athletes Basketball National Team, which operates under the Türkiye Special Athletes Sports Federation Presidency, to support them during their preparation camps for the World Championship.

ASSESSMENT OF ADDITIVE MANUFACTURING SURFACES

USING X-RAY COMPUTED TOMOGRAPHY

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Abstract
Surface characterization becomes an important practice in industry as the nature of metal additive manufacturing (AM) process offers varying resultant surfaces based on different process parameters and geometries. Integrating of X-ray computed tomography (XCT) technology into the characterization of AM surfaces by solving its' challenges will be a significant leap, especially for internal surfaces. In this paper, data of various AM surfaces obtained using a coherence scanning interferometry is compared with surfaces extracted from XCT measurements. Effects of specimen material and surface characteristics on evaluating different areal surface parameters using XCT are discussed.

Keywords: X-ray computed tomography (XCT); Surface roughness; Additive manufacturing (AM); Laser Powder Bed Fusion (LPBF)

1. Introduction

Laser powder bed fusion (LPBF) is an additive manufacturing (AM) technique where metal particles are fused layer by layer utilizing laser beam as high thermal energy. Layer-wise fabrication of components offers significant freedom on part design and leads an innovative approach to manufacturing industry that cannot be offered by conventional methods. This technology therefore gains considerable attention by enabling production of intricate geometries, internal part features, thin structures and rapid fabrication without a need for tooling or molds. Moreover, LPBF techniques take place in different industries such as automotive, biomedical and as well as the aerospace where high quality final part is aimed. However, LPBF has some drawbacks that need to be managed in order to expand the applications with improved material properties. For instance, residual stresses induced by high cooling rate of melted material resulted in warping or curling, poor surface quality and geometrical deviation [1]. LPBF part surface properties highly depend on AM process variables, inclination angle of surfaces, geometry and location on building platform [2]. LPBFed parts must fulfill design specifications and standards to comply with high quality part expectation. Surface characterization is therefore a critical factor for these parts prior to industrial applications. Highly irregular and unpredictable surfaces of LPBFed parts are challenging to define using conventional characterization methods. This irregularity consists of different surface features including roughness, waviness, surface geometrical distortion, globules, surface pores, laser tracks and spatters [3]. These elements present different characteristics such as overly deep or highly steep regions on 3D surface topography. In this perspective, the framework of LPBF part surface characterization; from gathering surface raw data to detailed analysis and parametrization must be conducted wisely by taking into account these diverse LPBF surface elements.

Surface analysis of AM parts generally performed by mapping the surface in various ways and then computing texture parameters. Surface texture parameters are well-defined by international standards. The ISO 4287 [4] arithmetic mean deviation (Ra) is a profile based surface characterization parameter. The ISO 25178-2 [5] arithmetic mean height of the scale-limited surface (Sa) is an area based surface characterization parameter. Surface characterization for industrial applications mostly done by using ISO 4287 Ra parameter. However, ISO 25178-2 Sa areal parameter is becoming widely accepted as a surface texture parameter in AM industry [6]. Sa, areal parameter presents more insight on irregular surfaces of AM parts as it takes into account the whole analyzed areal topography not only a line profile.

Different optical, non-optical and contact methods of measurement technologies are being employed to obtain surface data. Some common optical technologies used in surface characterization are Coherence Scanning Interferometry (CSI), Confocal Microscopy (CM), Focus Variation (FV), optical microscopy and Scanning Electron Microscopy (SEM) [6]. All these methods need a comprehensive understanding while used for surface characterization. CSI technique is developed to characterize low roughness surfaces such as optical surfaces, however with recent advancements, it is being utilized in AM to measure high slope or low reflectance features [7,8]. CSI technology offers comparably higher number of non-measured points compared to other technologies. Thompson et al. performed a comparison study on CM, CSI, FV and XCT technologies for characterization of LPBF surfaces and concluded that the investigation of aligned topographies is critical to understand behavior of different methods for obtaining texture parameters [9]. Another frequently used AM surface characterization method is FV, in which sharp changes are captured on the surface slope and can be utilized for rough surfaces. Newton et al. studied the effects of FV method parameters on measuring surfaces of different AM materials such as magnification, vertical resolution, lateral resolution and illumination type [10].

Another surface measurement technology is X-ray computed tomography (XCT), which is a non-destructive inspection technology enabling dimensional and material quality control for both inner and outer part geometry. It has been widely utilized in AM industry due to unique capability of internal features characterization [11]. XCT gains significant attention by allowing inspection of internal features and their surface characteristics, without using a destructive procedure, despite the limitations of accuracy, repeatability, resolution and uncertainty [11]. There are many studies conducted regarding its usage in surface characterization [7, 12-16]. Reconstruction of XCT data, resolution, sample material and machine features are some factors affecting the XCT measurement. 2D images obtained from XCT scan, are combined to form the 3D volume that is later converted into a surface. There are several methods used for surface determination from XCT data [17]. Methods work on determining the surface from gray value distribution by separating the material from the background peak on gray value histogram. In this sense, Townsend et al. concluded that using local iterative surface determination provides the most accurate results for computing surface texture parameters [18]. Liu et al. also claimed the local iterative surface determination method

is more suitable for surface reconstruction than ISO 50 method and improved voxel size provides more details in surface texture [18]. XCT presents various voxel sizes with different magnifications; therefore, resolution of final surface texture is highly dependent on the voxel size, which should be carefully selected for characterization to include typical features of AM surfaces [20].

While analyzing the surfaces and obtaining texture parameters, the post-processing of acquired data is an essential step. Even if different measurement technologies offer comparable results, the areal topography characterization may be affected essentially from the post-processing of surface data that includes filtration of roughness, waviness phenomena and removal of the form [7]. The separation condition is a wavelength threshold, called cut-off. The long wavelengths are distributed to the waviness and the short wavelengths are distributed to roughness through filtering. The linear Gaussian filter is the most widely used standard filtering technique in industry [21]. ISO 25178-3 defines the conditions of nesting index (cut-off) for areal filtering [22]. The final surface and texture parameters depend both on type of the filter and cut-off value as part of separation and post-processing procedure [23]. XCT is capable of detecting re-entrant and undercut features present in AM surfaces. While post-processing the XCT data to evaluate surface texture parameters, those features may present errors as height data at those feature points may have multiple elevation values. These possible errors could be eliminated by applying mesh correction procedure [24], which was not applied in this study.

The accuracy and uncertainty calculation for surface characterization of both XCT and optical methods are complex phenomena with many affecting variables such as scanning, filtering parameters and parameter calculations. There are limited work in literature for these concepts. Both uncertainty calculation and standardization need noteworthy attention for traceability of measurement procedure [25]. Also, another subject that may contribute to measurement uncertainty is noise in XCT measurements. Rodríguez-Sánchez et al. reviewed different noise factors such as scan settings, scanned object, Xray detector, image reconstruction algorithm and data postprocessing in XCT measurement [26]. Evaluation of measurement noise and uncertainty are out of scope of this study.

In this study, 3 samples from Inconel 718 material and 3 samples from Ti6Al4V ELI with differing surface roughness are manufactured. Sample surfaces were measured using both XCT and CSI methods. Obtained surface data is postprocessed, filtered and parametrized. A comparison of different surface characterization methods utilizing different materials in the field of AM is intended. This study also aims to contribute to literature of relatively new XCT methodology on AM surface texture measurement.

2.Materials and Methods

2.1. Sampling and Fabrication

Test samples used in this study are solid cubes with 5 × 5 × 5 mm dimensions. They were designed considering both XCT process limitations and CSI field of view. The test surface was chosen to be top flat surface of samples, which is the orthogonal plane to build direction in LPBF machine.

Inconel 718 and Ti6Al4V ELI (extra-low interstitial) materials were used for sample manufacturing. Inconel 718 material is chosen due to higher material density compared to Ti6Al4V ELI. Material density is an affecting factor because of the X-ray absorption mechanics in XCT measurement.

Total six samples of Inconel 718 and Ti6Al4V ELI material were measured. For both materials, three different samples represent different level of surface roughness values from lower Sa to higher Sa, which is generated by modification of LPBF process inputs. Thus, an investigation of different set of surface roughness formed by LPBF is intended. Inconel 718 samples were fabricated using EOS M290 LPBF machine equipped with 400 W Yb-fiber laser whilst Ti6Al4V ELI samples produced using Concept Laser M2 Machine.

Inconel 718 samples are denominated as IN718-1, IN718-2 and IN718-3 respectively from low roughness to high roughness. Ti6Al4V ELI samples are labelled as TI64-1, TI64- 2 and TI64-3 respectively from low roughness to higher one.

2.2. X-ray computed tomography

XCT measurements were conducted using RX Solutions Easytom 230 computed tomography system. Measurements were performed on polymer fixture with samples facing upwards from the top surface. Five consecutive measurements were carried out employing exactly same parameters without moving sample. Main elements of XCT measurement are shown in Table 1. Frame averaging was also used during the acquisition of XCT images. Samples were placed as close as possible to x-ray source in order to achieve the highest magnification. Calculated voxel size is 8.5 µm.

The reconstruction of XCT images into the 3D volume was performed using a local software by applying a beam hardening correction factor. Any noise filter were not applied during reconstruction.

Table 1. XCT measurement parameters.

Scan Parameters	Worth
Acquisition Parameters	Value
Voltage	230 kV
Current	36 µA
Projections	2 mm Copper
Voxel Size	1440
Calculated Voxel Size	8.5 μm^3

2.3. Interferometer

CSI measurements were done using Polytec TopMap Pro.Surf profilometer. Used system is a white-light interferometry (WLI), which is an alternative term to CSI according to ISO 25178-604 [27], based on optical profilometer. The system is equipped with telecentric optics. The system's measuring point spacing is 14.3 µm, numerical aperture (NA) is 0.04 and optical resolution is 8.4 µm according to manufacturer's datasheet. Five consecutive measurements were performed without using area stitching and without moving sample to prevent uncertainty effect it may present. Raw data were transferred to surface reporting and analysis software for further post-processing.

2.4. Data analysis

Following the reconstruction of the XCT data, 3D volume of surface was processed using Volume Graphics VGStudio Max 3.2 software. Advanced surface determination option was applied each sample for obtaining full sample volume and was adapted by starting contour of surface based on local gray values. The automatic selection of threshold value for both the background and material distribution by detecting maximums of the histogram peaks was applied. The local iterative method was used for the material definition.

Subsequently reconstructed surfaces aligned to sample top plane, which was cut from the volume. Surfaces were converted into meshes using the grid based approach without any simplification for more accurate analysis.

Meshes were then transferred into the surface analysis software. Hereafter, the steps for analysis are same for both CSI and XCT surfaces.

Geometrical form was removed from measured profiles by polynomial approximation of 1st order in order to eliminate any effects of the sample warping. Then, a Gaussian 0.8 x 0.8 mm L-filter nesting index and 2.5 µm S-filter cut-off were applied to obtain the roughness surfaces per ISO 25178-2. Surface ends were removed before obtaining the texture parameters by 1 cutoff length, to eliminate the effects of edge build-up of samples.

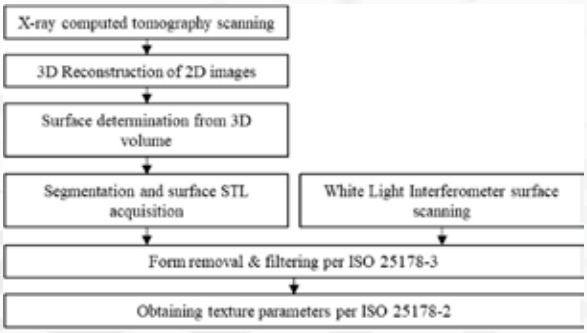

Fig. 1. Surface data analysis workflow for both XCT and CSI measurements.

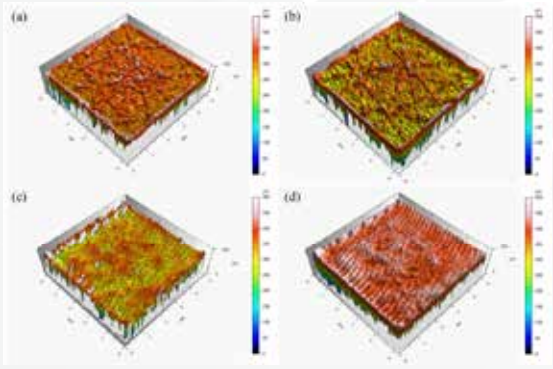

Fig. 2. (a) IN718-1 CSI measurement 3D surface; (b) IN718-1 XCT measurement 3D surface; (c) TI64-2 CSI measurement 3D surface; (d) TI64-2 XCT measurement 3D surface color maps.

Resulted area size for computing all texture parameters is4.2 x 4.2 mm. At last, surface texture parameters per ISO 25178-2 were obtained.

3. Results and Discussion

This study was done to investigate the possibility of using XCT in the surface characterization of AM parts and to compare the XCT surface measurements with CSI surface measurements.

Fig. 2 shows the 3D surface color maps of one XCT and CSI measurement for two types of material. 3D color maps show edge effect formation on AM samples. However the edges were not included in the calculation of texture parameters. CSI surfaces present non-measured points due to severe sharp changes on the surface and low CSI method NA. XCT surfaces capture all surface information, as the method is not affected from abrupt changes on the surface. Both methods have different resolutions, therefore the color maps have differences visually even though color scales are same. XCT results have more smooth shapes compared to CSI surfaces. AM process effects such as laser tracks, spatters and scan paths are visible and distinguishable with fine details in XCT measurements.

However, sharpness of these features are smoothed, which may cause lower roughness values.

Table 2. XCT measurement results

Sample	Sa/µm	Sq/µm	Sku
IN718-1	27.73	40.00	6.32
IN718-2	39.97	53.87	4.39
IN718-3	42.57	54.60	3.49
TI64-1	6.81	9.45	7.92
TI64-2	12.07	15.63	4.41
TI64-3	14.93	18.70	3.34

Table 3. CSI measurement results

Sample	Sa/µm	Sq/µm	Sku
IN718-1	30.00	43.02	8.44
IN718-2	40.94	55.88	4.64
IN718-3	39.64	50.60	3.39
TI64-1	7.90	11.40	13.58
TI64-2	13.40	17.94	6.26
TI64-3	16.62	21.84	4.99

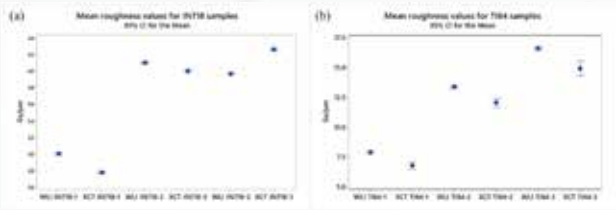

Fig. 3. CSI and XCT measurements mean roughness (Sa) values comparison for samples; (a) Inconel 718; (b) Ti6Al4V ELI.

Sa, arithmetical mean height of surface; Sq, root mean square height of surface and Sku, kurtosis of height distribution ISO 25178-2 parameters are obtained. Table 2 shows XCT mean measurement results while Table 3 shows CSI mean measurement results. All texture parameters are computed using the same filtering parameters.

Results show that Sa values are comparable and maximum difference between XCT and CSI measurements is 13% while maximum difference of Sq values between XCT and CSI measurements is 17%. For Ti6Al4V ELI material, differences between texture parameters seem to be larger. This is due to XCT measurement parameters for both samples are similar even though X-ray attenuation of sample materials is different. Most differing parameter is Sku parameter, which measure the sharpness of roughness profile. Sku values higher than value of 3 shows that the height distribution on the profile is sharper. All samples and different measurement methods present a Sku value higher than 3. The maximum difference between different measurement methods for Sku values is 41%. Outliers and sharp changes in the surface affect this parameter. The surface slope measuring capability of CSI method is related with NA of the system. Low NA value presents data voids on the surface where significant slope is exhibited. These voids can be spotted in Fig. 2 when compared with XCT surfaces. Care should be given to use Sku parameter, as it does not bear resemblance to other parameters for comparison of different methods.

Mean roughness, Sa, values for both materials are compared in Figure 3. Figure 3 shows the mean measurement results with 95% confidence interval of five consecutive measurements for each method. Except one

sample, CSI results are higher than that of XCT. This is expected as the visual color maps show smoother representation of XCT results. XCT measurements of Ti6Al4V ELI samples show higher standard deviation compared to Inconel 718 and CSI method. Even though XCT parameters should be adjusted for various materials due to material density differences, this study utilized same XCT parameters in order to study the comparison between materials.

4. Conclusions

The effects of XCT and CSI surface measurement methods on LBPF surface parameters were investigated in this study. Surface parametrization workflow was applied in both XCT and CSI measurements for comparison. Three samples from each material, Inconel 718 and Ti6Al4V, with different surface roughness are manufactured. These sample surfaces were measured through XCT and CSI methods. Obtained surface data is post-processed, filtered and parametrized according to the surface characterization standards.

- XCT mean roughness, Sa values are comparable to that of CSI.
- XCT is more capable of visually representing the surface smoother as it enables all surface features to be measured. CSI has more non-measured points compared to XCT. CSI measurement is affected by sharp and abrupt changes on the surface.
- CSI measurements presents higher mean roughness values compared to XCT.
- Different materials show different comparison results with CSI. Considering XCT measurement, special care should be given to determining measurement parameters for different materials.

Further work will be necessary for investigating the possibility of integrating XCT measurement into the complex functional AM parts, as the XCT still have limitations regarding the sample material density and geometry. Surface characterization of internal features and freeform features using XCT will also need to be investigated.

Acknowledgements

Authors would like to gratefully acknowledge TUSAS Engine Industries (TEI) for all support throughout the current study.

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CHARACTERIZATION OF METAL POWDER REUSED MULTIPLE TIMES FOR LASER POWDER BED FUSION

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Abstract

Laser Powder Bed Fusion (L-PBF) enables the manufacturing of highly complex parts with less material consumption for being used in various industrial applications. Metal powders are commonly used as feedstock material and the powder can be reused several times. Especially in aerospace applications, the reused powder characteristics are quite important in terms of traceability over the part quality since the aerospace industry requires high-quality and reliable end-use parts. In this study, Alloy 718 metal powder, which is generally utilized in high-temperature applications in gas turbine engines due to their good creep and corrosion resistance, were characterized over a 20 series of L-PBF build cycles. The powder characterization was performed in order to investigate the flow behavior of powder reused multiple times by using several methods such as powder rheology, particle size distribution (PSD), and quantitative morphology analysis along with apparent and tap density measurements. The results showed that no major and meaningful difference was seen among 20 times reused powder in terms of PSD and their morphology whereas there is a prominent difference seen by density measurements and with shear cell measurements by powder rheology. These methods revealed that reusing powder causes worse flowability trend.

Keywords: Laser powder bed fusion, powder reuse, powder characterization, powder rheology, particle size distribution and morphology.

1. Introduction

Unlike the conventional manufacturing methods, Laser Powder Bed Fusion (L-PBF) allows parts to be manufactured with less material loss by reusing un-melted powder [1, 2].
Powder can be reused in several build cycles without significant change in chemistry or powder physical characteristics. However, after a number of reuse cycles, one of the main powder characteristics which is powder flowability starts to change with affecting the powder spreadability in L-PBF process. The final part quality decreases when the powder is not spreaded homogeneously throughout the build plate [1,3]. Since the aerospace industry requires high-quality and reliable end-use parts, the characteristics of powder that is used in the L-PBF process need to be traceable and interpretable well [4]. In aerospace industry, Alloy 718 is commonly used in high-temperature applications such as gas turbine engine because of its good creep and corrosion resistance [5]. Therefore, understanding and defining the Alloy 718 reused powder characteristics play an important role for this industry.

On the other hand, defining and understanding reused powder characteristics for L-PBF process is a complex phenomenon and also challenging. [3, 6, 7]. Recently, several studies on reusing powder in L-PBF for different materials have been investigated. For instance, Yi et al. studied on powder characteristics of reused Inconel 718 powder. They revealed that with increasing number in powder reusing the powder particle size increases [2].
Just as Yi et al., Ardila et al. studied on reusing Inconel 718 powder. They reused the powder up to 14 cycle and characterized the powder by doing particle size distribution analysis. Similar to Yi et al.'s results, Ardila et al. showed that particle size distribution after several production cycles was similar, with the exception of a small amount of particle aggregation in bigger particle sizes [5]. Moghimian et al. researched on the reusability of titanium, nickel and aluminum alloys in order to give some insights on reused powder characteristics [4]. Cordova et al. used different characterization methods such as particle size distribution, morphology, density, chemical composition and rheological analysis to reveal the effects of powder reuse for Inconel 718, Ti6Al4V, AlSi10Mg and Scalmalloy materials [7]. Cordova et al. reused AlSi10Mg powder 6 times, Ti6Al4V powder 11 times and Inconel 718 powder 38 times. However, contrary to other studies, in Cordova et. Al.'s study, Inconel 718 powder was rejuvenated with virgin powder for each cycle. Gruber et al. [8] also studied on the characterization of 20 times reused Inconel 718 powder by analyzing morphology, flowability, and physico-chemical behavior. One of the main outcomes of this study showed that virgin powder had worse flowability than reused powder. Nguyen et al. [9] reused Inconel 718 powder 10 times and showed that reused powder had lower flowability than virgin powder, as opposed to Gruber et al. [8] and Yi et al. [2]'s results. Since there are contradictory results in the literature and powder handling procedures vary from user to user, exploring of powder characteristics requires more attention.

In this study, Alloy 718 powder was featured over 20 series of L-PBF build cycles. The powder characterization was performed in order to investigate the flow behavior of multiple times reused powders applying several methods such as powder rheology analysis with both shear and powder cell, particle size distribution (PSD), quantitative morphology analysis and Hausner Ratio calculation. This study aimed to help users to explore the reused powder characteristics by using different methods with novel approaches.

2. Materials and Methods

2.1. Powder handling, sampling and manufacturing

As a feedstock material, gas atomized Alloy 718 (UNS N07718) powder from Oerlikon Metco was used. The Powder was characterized over 20 series of L-PBF built cycles. L-PBF process was performed in EOS M400 system equipped with single yttrium fiber laser under argon atmosphere. Each build cycle was produced using the same build job as given Fig 1. The 65,7 J/mm3 volumetric energy density was used for the process. The direction of gas flow in process chamber was opposed to scanning direction of build parts. Powder handling and sampling was carried by the same operator with the same procedures. The virgin powder was loaded to start the first process and no rejuvenation was made on the reused powders for the rest of the 19 cycles. Powder batch samples, which is to be characterized, were collected from 63 µm mesh-sized sieving after each build process was completed. For each cycle, 200g of powder was collected for characterization purposes.

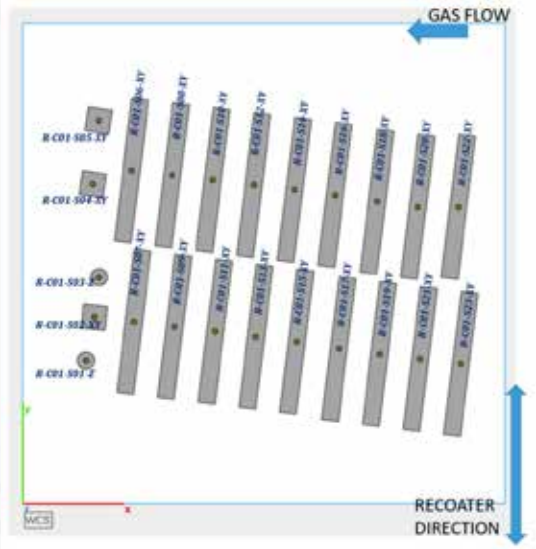

Fig 1. Build plate plan produced in each reuse job

2.2. Powder Characterization

The powders were analyzed using various powder characterization methods as shown in Table 1.

Table 1. Characterization plan of the presented study

Characterization Method	Characteristics	Standard
Particle Size Distribution (PSD): Laser Diffraction (LD) + Dynamic Image Analysis (DIA)	Particle Size	ASTM B 822, ISO 13320
	Morphology	ISO 13322-2
Density measurements and Hausner Ratio calculation	Apparent Density&Bulk density	ASTM B212, ASTM B417
	Tap Density	ASTM B527
	Hausner Ratio	n/a
Powder Rheology: Powder cell + Shear Cell	Powder cohesion behavior	n/a
	Powder shear behavior	n/a

The particle size distribution analysis was carried out using Microtrac FlowSync and Malvern Mastersizer Hydro 2000G. Both of these devices used wet operation with water with 1.33 Refractive Index (RI) as a dispersant. Besides, 1.98 of RI was used for Alloy 718 particle in both devices. The main reason of using two different device was to validate the particle size results.

The powder morphology analysis was employed by using Microtrac FlowSync which has Dynamic Image Analysis (DIA) capability. Powder morphologies of each reuse cycles was compared with each other according to quantitative morphological analysis shown in Table 2. The morphological calculations are mathematically defined in the software of device. The particles were filtered by 0.5, 0.7 and 0.9 values and accordingly the percentage of particle volume were compared with each other.

Table 2. Quantitative morphological analysis parameters

Morphological Parameters		Description
Shape	Sphericity (4πarea/ Perimeter)	changes from “0” to “1”. “1” describes the perfectly spherical particle.
	W-L aspect ratio (Area/CHull Area)	changes from “0” to “1”. “1” describes the perfectly spherical particle.
Surface Roughness	Solidity (Area/CHull Area)	changes from “0” to “1”. “1” describes the perfectly smooth particle.

The apparent density measurement was done according to ASTM B212 standard by using flow measurement kit supplied from LPW Technology. The tap density measurement was done in accordance with ASTM B527 standard by performing a tap density tester supplied from Torontech. The volume defined on a cup of 25 cm^3 was recorded after 3000 taps. According to apparent and tap density results of powders, hausner ratio was calculated as in (1).

$$Hausner\ ratio = \frac{Tap\ density}{Apparent\ density} \quad (1)$$

The rheological analysis of powders was carried out using Anton Paar MCR 702 MultiDrive system with the equipment of powder flow cell and shear cell.
The powder shear cell equipment was employed for the measurement of Coefficient of flowability (ffc) which is a function of major principal stress (σ1) and unconfined yield strength (σc) as defined in (2) [3].

$$ffc = \frac{\sigma 1}{\sigma c} \quad (2)$$

The measuring system was a large shear system of PSC43 having 18.9 ml volume. Shear cell measurement was started with gathering pre-shear stress measurements under multiple repetitions of 3 kPA, 6 kPA and 9 kPa normal stresses and their reduced stresses. After that, yield focus analysis was carried out using Mohr-Coulomb model by the rheometer device and flow function was obtained accordingly. 1st, 5th, 10th, 15th and 20th reuse cycles were measured three times in order to make a clear assessment on the results.

The powder cohesion strength was analyzed using powder flow cell. Two-blade stirrer ST36-2V-10/PFC was used as a measuring stirrer. For the powder measurement preparation, the powder memory was erased by the pressure drop method applying fluidization process at 2,5 l/min at the first stage. Then, powder cohesion strengths were calculated by recording torque signals. Cohesion strength results were defined from average of the last 20 data points. The same amount of material which is 170g was analyzed for 1st , 5th, 10th, 15th and 20th reuse cycles.

3. Results and Discussion

3.1. Particle Size Distribution and Powder Morphology

Fig. 1 a) and b) present the PSD curves of different reuse cycles using Microtrac Sync and Malvern Mastersizer 2000G, respectively. The results describe that reusing powder causes shifting PSD curves both left and right side by decreasing the peak of curve. This shows that not only agglomerated particles increase but also a small size of particles caused by spattering or soot increases.

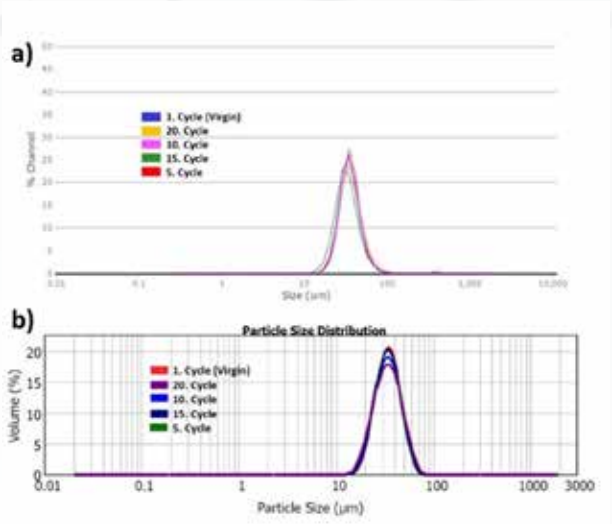

Fig. 2 PSD curves of reuse cycles a) acquired by Microtrac Sync and b) acquired by Malvern Mastersizer 2000G.

Table 3 shows the median particle size (D50) and span of the same cycles using different PSD devices. It can be seen that the width and span tendency of PSD increase with reusing numbers. This also points out that the agglomerated and small sized particles increase due to spattering or sooting in the powder bed.

Table 3. Median particle size (D50) and span of the same cycles using different PSD devices.interval of the same cycles using devices.

Particle Size Distribution				
Reuse Cycle	D_{50} (Microtrac Sync)	D_{50} (Malvern Mastersizer 2000G)	Width (Microtrac Sync) =(d84-d16)	Span (Malvern Mastersizer 2000G) =(d90-d10)/d50)
1.	33,51	34,35	18,14	0,746
5.	34,91	33,62	18	0,759
10.	34,82	33,82	19,28	0,811
15.	31,30	34,14	19,22	0,761
20.	35,34	33,93	21,44	0,865

In quantitative morphology analysis, all reuse cycles were measured via Microtrac Sync. However, it was seen that the particle count was an important parameter that effects the results. For this reason, only the reuse cycles with roughly the same particle count were considered for measurements. Table 4 shows the different filtration of particle sphericity for the 9th and 20th time reused of powders. This describes that by reusing powder, the sphericity of particles tends to decrease from %86.18 to %83.82 when considering the sphericity value bigger than 0.9. The trend was the same all the other morphological parameters given in Table 2. However, there was also seen that the controversial results exist in comparison to the reuse of 3rd and 17th. Therefore, quantitative powder morphology analysis by dynamic image analyzer (DIA) needs to be investigated in detail by comparing and validating via scanning electron microscope analysis.

Table 4. Quantitative sphericity analysis of powder batches by dynamic image analyzer method

Sphericity			
Reuse Cycle	Particle Count	Filter	Passing Volume (%)
3.	61451	>0.5	100
		>0.7	99.06
		>0.9	**84.25**
9.	57747	>0.5	100
		>0.7	99.06
		>0.9	**86.18**
17.	61551	>0.5	100
		>0.7	98.71
		>0.9	**85.39**
20.	55344	>0.5	100
		>0.7	98.91
		>0.9	**83.82**

3.2. Powder density measurements and Hausner Ratio

The apparent and tap density measurements were carried out for over 18 cycles. With the increase in reuse times, there was no significant and meaningful changes in apparent densities whereas the tap densities increased from 5.07 g/cm3 (virgin) to 5.26 g/cm3 (18th cycle). This increasing trend in tap densities of reused powder can be seen in Gruber et al and Yi et al.'s studies [7,9] that point out changes in powder packing and powder morphology.

Hauser ratio calculation was done and accordingly flow behaviour was determined based upon Kaleem et al.'s study [10] for the cycles as shown in Fig 2. It is clearly seen that the trend of hausner ratio increases with powder reusing number and thus, the flowability of powders becomes worse.

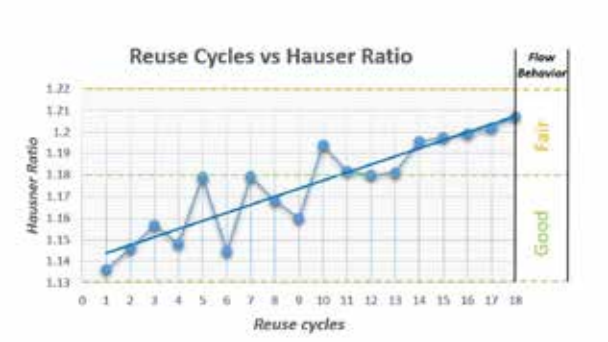

Fig 3. Hausner ratio and flow behavior of reuse cycles

3.3. Powder rheology

Rheological tests were carried out to determine the coefficient of flowability (ffc) and powder cohesion strengths for 1st, 5th, 10th, 15th and 20th reusing cycles. Fig. 3 demonstrates the ffc and flow behavior under 9 kPA normal stress, which was determined according to the Mohr-coulomb principle by the rheometer device. The relationship between ffc and powder flowability can be classified as "free-flowing" (ffc >10), "easy-flowing" (4<ffc<10), "cohesive" (2 < ffc<4) and "very cohesive" and "not-flowing" (ffc < 2) [11]. The results in shear test measurement show that powder flowability trend decreases with powder reusing increases.

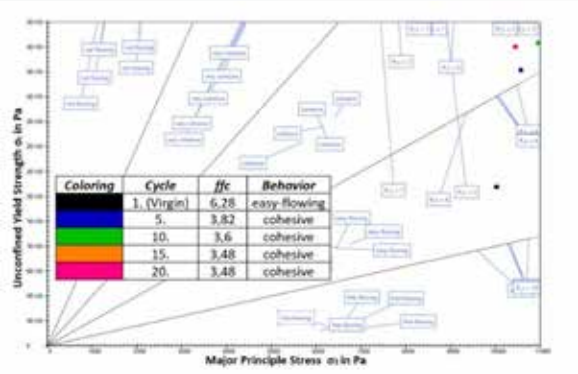

Fig 4. Shear cell measurements and flow function behaviors of Cohesion strength measurements of 1st, 5th, 10th, 15th and 20th reuse cycles.

Figure 4 points out the results of cohesion strength tests performed for 1st, 5th, 10th, 15th and 20th reuse cycles by powder cell equipment of reometer device. The correlation between the reuse cycles was not clearly and meaningly seen in these measurements. The main reason of this can be the measured powder amount which is 170g equals to below 40 ml in powder cell. This powder amount may not be enough to predict the powder cohesion strength reliably since the blade stirrer surfaces need to be fully covered with powder before measurement.

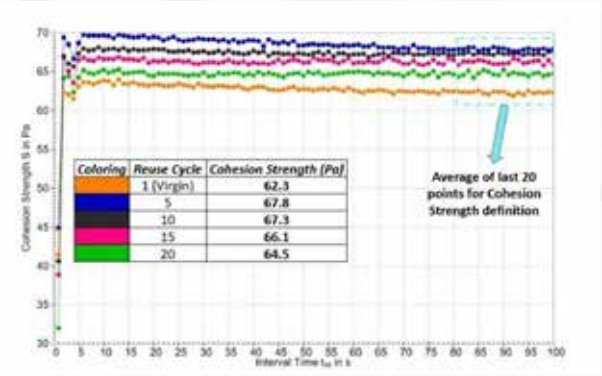

Fig 5. Cohesion strength measurements of 1st, 5th, 10th, 15th and 20th reuse cycles.

4. Conclusions

In the present paper, we explored the effect of powder reuse for Alloy 718 produced with the L-PBF method by characterizing powder reuse cycles via PSD and morphology analysis, powder density measurements and powder rheology. The following conclusions can be drawn from the present study:

1. Powder reuse causes shifting PSD curves both left and right side by decreasing the median size of the curve. This shows that not only agglomerated particles increase but also a small size of particles caused by spattering or soot increases. The trend of width or span of the PSD curve is also increasing due to the abovementioned phenomenon.

2. Quantitative morphology analysis by DIA requires detailing investigation in order to define the powder characteristics. Furthermore, the particle count plays an important role to compare the reuse cycles.

3. Tap and apparent powder density measurements revealed that the trend of hausner ratio increases with reusing powder. This result shows that the flowability of powders becomes worse with reusing number of the powder increases.

4. Powder shear cell measurements by rheometer show that the powder flowability trend via defining flow functions decreases with increasing reusing of powder.

5. In the powder cohesion strength measurement by rheometer, there was not seen a meaningful and clear correlation between the reuse cycles. Additional tests with different amounts of materials are required to evaluate the reused powder characteristics.

The future work will continue with performing additional build cycles with the same powder batch. Furthermore, different powder characterization methods will be used such as a scanning electron microscope for the evaluation on morphological analysis for a better understanding of reused powder characteristics. Moreover, the influence of reused powder on chemical composition, microstructure, and mechanical properties including fatigue behavior, is an ongoing study.

Acknowledgments

This study was done with the financial supports of TUSAS Engine Industries, Inc.

Author's statement

Conflict of interest: Authors state no conflict of interest. Informed consent: Informed consent has been obtained from all individuals included in this study. Ethical approval: The research related to human use complies with all the relevant national regulations, institutional policies and was performed in accordance with the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee.

SPORTS
CULTURE

The years spent watching sports competitions from a young age, where competition and friendship merged regardless of where or with whom, with the taste of enjoyable moments in the world of sports. These years, filled with the wonders of sports and the stories within, were crowned by a quiz show that combined entertainment and knowledge: 'Cok Biliyorsun'. The show, which showcased my quirky knowledge of sports, not only captivated the viewers on the Socrates YouTube channel but also often left them in awe. In this article, I will narrate the story of how my love for sports began and how this passion bore fruit through a competition.

My story essentially revolves around the idea that a passion cherished since childhood can lead to remarkable outcomes when nurtured consistently. The values I held dear and learned early on included teamwork and how to stand firm as an individual during challenging times that existed since my very first memories, which is more than a temporary pleasure. The story goes as far back as learning to read and write using the names of players from my favorite football team in 1995. Like many sports enthusiasts in our country, football was the starting point for this hobby. The milestone that I refer to as the gateway to the wider world was the Olympics. For me, sports means 'Olympics', because it is an organization which brings together all world and nations together and affect a curious child directly. The Olympic stage is a unique place where you can witness firsthand the embodiment of virtues such as participating and competing even when you know you cannot win, showing appreciation for the person who bests you, the essence of hard work, and dedicating oneself to a cause. In fact, it was these very behaviors that not only ignited my passion for sports but also shaped my character.

The path that my love for sports took me on, by the time we reached the year 2022, turned out to be a completely unexpected journey. It led me to a place I never imagined. Watching Türkiye's best sports broadcast of 'Cok Biliyorsun', a sports knowledge competition, on Socrates Dergi's YouTube channel was the moment I said to myself, 'I should be here.' I did not hesitate to apply, and when my application was accepted, I became a part of this sports knowledge competition. After acing all 13 questions in the first competition, breaking records, and essentially defining the limits of the competition, I was rewarded with personalized questions tailored for me. The amusing moments that arose during the recordings, thanks to my correct answers to these questions, added some wonderful memories to my life. The questions covered a wide range of topics, from the 1936 Olympics to beach volleyball players, from sports in cinema to famous TV series actors' sporting endeavors during their youth, and some were genuinely challenging. Throughout the season, with 32 contestants participating in this journey, I secured five victories, becoming the first-season champion of the competition. For me, 'Cok Biliyorsun' was more than just a competition; it introduced me to wonderful people, prioritized the joy of participation over winning, and allowed me to showcase the sports culture and ethics I have been trying to promote over the years. It was like a dear friend to whom I owe a lot. It is a friend who helped me gather beautiful memories and brings a smile to my face when I look back. At this point, I want to express my gratitude once again to my friends from TEI, who supported me throughout this journey. Thank you for being with me from day one, for following the process alongside me, and for standing by my side. You are greatly appreciated.

In our country, sports is often associated with winning, success is commodified as an end goal, and the enjoyment of the process is forgotten. I hope that as a society, we can change our perspective on sports and what it brings. Coding the idea that sports is an enjoyable hobby, similar to cultural and artistic activities that enrich our minds, into our lives, and integrating the beautiful concept of sportsmanship into all aspects of our lives will, I believe, be beneficial in raising better generations. The most important thing to remember, in my opinion, is this: Success is not the goal; success is a byproduct of hard work. What truly matters is how much you enjoy the journey and how much you can add to yourself along the way. Stay with sports, have fun.

WHO IS ALI BAHAR?

Ali Bahar, born in Canakkale in 1990, graduated from Istanbul Technical University with a degree in Mechanical Engineering in 2012. Since 2021, he has been working as a Secondary Air System Senior Design Engineer at Turbosaft Compressor Directorate.

NAPLES STYLE PIZZA

FIRST ENCOUNTER WITH DOUGH

I have always had an interest in food and cooking, and there are examples of this in childhood stories my family tells. Before I even turned one, I apparently grabbed a spicy Adana kebab from my father's hand and finished it. When I was two, I attempted to make a cake using food and cleaning supplies I found in the kitchen. Anyway, while I am open to trying all sorts of things when it comes to food, Mediterranean cuisine holds a special place in my heart. These are the kitchens along the coast of the sea that stretches from Tarifa in the west to Antakya in the east! Due to their proximity in latitude and sharing the same sea, the settlements in this region have very similar climates. This similarity not only affects the sea and agricultural products but undoubtedly also leads to similarities in human behavior and cultural developments. While eating food is wonderful, things can change when it comes to cooking. Although I enjoy making many things from scratch, working with dough used to be one of the few things I avoided. That is, until the Covid-19 pandemic forced us to stay home in 2019.

Dough and dough at the end of the bulk fermentation process gluten network within | My sourdough Corona

FLOUR, WATER, YEAST, SALT AND PASSION

My sourdough, Corona, was born. She came into the world due to the Coronavirus pandemic, and because Corona is also a feminine name, it seemed like the ideal name for the sourdough starter symbolizing fertility.
I was nurturing her day by day, preparing her for my first attempt at making bread. Kneading the dough and being able to control it, as I had seen in the tutorials, turned out to be quite challenging. Dealing with dough was not as enjoyable as I had thought. Over time, I improved at applying the techniques taught in the tutorials and became better at handling the dough. With carefully chosen wheat flours, sourdough starter, Corona, and by pushing the limits of my oven, I had made my first bread. The smell of a bread oven filled the entire house. It was truly a unique experience for me. I had not thought before that bread, with the right components, could be a complete meal on its own. Now that I had learned to deal with dough, I could try making different dishes. A few attempts with lahmacun and simit, and finally, pizza.

Three different cross-sections of bread to represent my progress in learning how to make bread | My sourdough whole wheat bread.

As it is evident, the most crucial component of Neapolitan pizza is the dough. The parameters that affect the dough create a vast possibility space: hydration level of the dough, type of yeast, quantity of yeast and salt, ambient temperature, humidity, fermentation method, and fermentation duration. To summarize the fundamental requirements of Neapolitan pizza, we can say it includes flour, water, yeast, salt, and passion.

One of the pizzas I made in my home oven

AMATEUR PIZZA MOVEMENT: HIDDEN ACTIVE OVEN

Traditional Neapolitan pizza is cooked in wood-fired ovens operating at temperatures between 400-500°C and is ready in a short time, typically 60-90 seconds. This quick cooking process helps the dough retain its moisture and elasticity. However, when amateurs attempt to make Neapolitan pizza at home, they often face challenges. Most home ovens have a maximum temperature of around 280°C, which extends the cooking time for the pizza dough to around 7-9 minutes. As a result, the dough becomes crispier because it loses more moisture. Another challenge is the increased thermal imbalance between the dough and the toppings. While the dough takes 7-9 minutes to cook, the mozzarella cheese on a Margherita pizza, for instance, requires a much shorter time to melt. If you place the dough with all the toppings in the oven simultaneously, your dough will be ready before the mozzarella cheese has melted, and your tomato sauce might have dried out. To overcome these challenges, you need to employ multi-stage cooking methods. One of these methods is as follows:

- Start by spreading crushed tomatoes over your dough and place it in the oven. During this phase, the dough's edges will rise and take on its initial shape.
- Remove the dough from the oven and add the remaining toppings before placing it back in the oven. This way, you achieve a balanced cooking result in homecooking.
- At this stage, one of the techniques I developed was using a torch to quickly cook the edges, helping them brown and creating a faux leopard spot pattern on the crust.

One of the Margherita I made with a portable pizza oven. I used purple basil instead of sweet basil and used pesto.

From a Margarita pizza experiment in which I used the portable oven with wood fire. | A pizza ready to go in the oven

2022 PIZZA OLYMPICS

AVPN organizes pizza competitions in various categories with participants from different countries. I was surprised by Japan's success in past years' pizza olympics, where they won multiple categories. It was a clear indication of how successful pizza has become as a global food.

I became aware of a pizza competition organized by AVPN on one of their social media platforms and decided to participate by uploading a few photographs. However, it wasn't until 2022 that I learned about the international pizza competition, the Pizza Olympics, held by this organization. Unlike previous years, this year, they were introducing an Amateur category in the Olympic tournament, and I was thrilled when I found out about it. I immediately applied for the competition, and once my registration was accepted, I received an email with the competition rules. To my surprise, the prefermentation technique I had been practicing for months was not allowed according to the competition rules. They only allowed traditional methods, and the hydration level was limited to 60%. With less than a month left until the competition, I needed to work on perfecting this recipe. I came up with an emergency action plan and started a pizza diet – I had to make at least 3 pizzas a day for practice, cutting out as many other meals as possible. This allowed me to refine the dough recipe, improve my dough stretching skills, and get used to the dynamics of the oven with the Neapolitan slap technique. In the final week leading up to the competition, I also began experimenting with AVPN approved flours. Then, the day of the competition arrived, and I loaded my prepared dough into the car and set off from Eskisehir.

While performing in the preliminaries

Doing warm-up laps before the competition

The Olympic preliminary rounds were held in Istanbul, hosted by Ozgur Kilinclar and Nappo Pizza. I arrived at the competition venue a bit early and was greeted by the incredibly long, never-ending pizza counter and the massive Neapolitan pizza oven. What was interesting was that they were still serving customers until the competition hour, and the Nappo pizza chefs who were participating in the competition were busy stretching pizza dough at the counter. The entire restaurant seemed to tremble with the resounding slaps of Neapolitan pizza dough! I was trying to alleviate my nervousness by reminding myself that I was participating in the amateur category. Finally, when the restaurant closed, I took the opportunity to prepare a Margherita pizza at this counter and put it in the oven. But everything was at least 3 times bigger than the tools I had in my own kitchen; the pizza peel was much longer, the oven was much larger, and it took time to walk from one end of the counter to the other. Anyway, this warm-up round was definitely beneficial for me! The jury for the competition consisted of chefs Ozgur Kilinclar, Cihan Kipcak, and Salvatore de Rinaldi. Additionally, Antonio Pace, the founding president of AVPN, was among the spectators. I managed to represent Türkiye in Naples at the Olympics by performing well in both the written exam and the practical part! In the professional category, Bulut Senol, Mert Ongun, and Inan Ezginer earned the right to represent Türkiye in Naples. This year, the Pizza Olympics would feature 6 different categories: Real Neapolitan Pizza, Pizza for Gourmets, Fried Pizza, Mastunicola, Napoli Calzonesi, and Amateurs. By the way, Mastunicola pizza is known as the first real pizza in Neapolitan traditions and is even referred to as the mother of Margherita. Fried pizza, on the other hand, is a cooking technique that Italians developed as an alternative during World War II when their ovens were destroyed.

Without any prior plans, I decided to plan my trip to Naples for the finals. In July, Naples was quite hot and humid, which meant I would need to use less yeast, but how much less? Anyway, since I arrived a couple of days early, I had the chance to visit many famous Naples pizza restaurants, watch the pizzaiolos at work, and taste their pizzas. One of them was the De Rinaldi restaurant, which is run by the Italian chef Salvatore de Rinaldi's family and was part of the preliminary jury. During my visit, I had the chance to meet and have a conversation with Christiano, who would be chosen as the first in the Real Neapolitan Pizza category this year. The Rinaldi family runs one of the few AVPN approved restaurants in Naples that work with sourdough, which was particularly interesting to me as I was keen on making pizza with sourdough.

During the one-week-long Olympics, I had the opportunity to meet many people. Antonio Pascarella and Vincenzo Viscusi, who had become famous with their Malati di Pizza account by sharing pizza videos, were also there. Antonio was among my competitors in the amateur category and would win the bronze medal.

Vincenzo was there to support Antonio. I had a conversation with them about their journey to becoming pizza influencers and their experiences. Then came the time for the amateur category competition. The first day was dough preparation day. I participated in the competition with my sourdough, Corona. I guess I had some difficulty adjusting the yeast amount for the climate in Naples because when it was time to make pizza the next day, my dough balls had over-fermented. As a result, the first dough ball tore when I was shaping it, and I only managed to take a pizza out of the oven on my second and last attempt. However, both the jury and I were not very satisfied with the result due to over-fermentation. In the end, we competed as 20 amateur pizza enthusiasts from around the world in the amateur finals, and I did not have a chance to place. We said our goodbyes, hoping to meet again at the next Olympics. On the other hand, Bulut Senol, who represented Türkiye in the finals, did an excellent job in the Pizza for Gourmets category and won first place, earning a gold medal.

KORAY RECOMMENDS

• For those interested in Neapolitan pizza and wanting to learn more, here are some names to consider: Davide Civitiello, Vito Iacopelli, Malati di Pizza, Vincenzo Viscusi, Salim Gafayri and Zorbey Sevinc.

• For those interested in making Neapolitan pizza but does not want to work with dough, NeoNappo products and Metro Chef Neapolitan pizza base

• Where you can eat Neapolitan style pizza: Nappo Pizza (Istanbul & Izmir), Stüdyo Pizza (Ankara), Mozz (Ankara), and Teho Restaurant (Eskisehir).

WHO IS KORAY SEVINC?

Born in Bursa in 1988, Koray Sevinc graduated from the Department of Mechanical Engineering at Ege University in 2010 and completed his master's program in Turbomachinery and Propulsion Research at von Karman Institute in 2016. Since 2016, he has been working as an Aerodynamic Engineer (Senior Technical Leader) in the Turbofan M.T.D. Aerothermal Design Department.

NAPLES-STYLE MARGHERITA PIZZA RECIPE

Here are the ingredients and dough preparation steps for 4 pizzas:

For the Dough:

- 600 grams of 00 grade pizza flour or baklava flour
- 390 grams of drinking water
- 0.3 grams of fresh yeast
- 17.5 grams of sea salt

For the Toppings:

- 400 grams of canned summer tomatoes
- 3 pieces of 125-gram mozzarella cheese balls
- 20-30 large basil leaves
- Cold-pressed extra virgin olive oil

Dough Preparation:

In a bowl, mix the water and salt.
Add one-third of the flour and stir until you have a homogeneous mixture. In a small bowl, take 1-2 tablespoons of the prepared water and salt mixture. Dissolve the fresh yeast in this mixture and then return it to the main mixture.
Slowly add the remaining flour while kneading the dough for about 10 minutes. Then, cover it in a closed container and let it rest at room temperature (approximately 21°C) for 60 minutes.
Divide the dough into 4 equal-weight portions and place them in a closed container. The dough balls will be ready to be baked after 12 hours.

Baking Instructions:

- Preheat your oven to the maximum temperature and place your tray on the top rack.
- Allow a minimum of 30 minutes for your oven to fully preheat.
- Take one of the dough balls and place it on the work surface, using a bit of semolina or flour to prevent sticking.
- Press the dough from the center outward to form a disc with a diameter of approximately 30 cm.
- Spread the canned tomatoes onto the dough, leaving a border of about 1-2 cm around the edges.
- Drizzle a bit of olive oil in a spiral motion over the toppings.
- Transfer the pizza onto parchment paper or use a peel to place it on the preheated tray in the oven. After 4 minutes, when the edges have puffed up, remove the pizza from the oven.
- Add the basil leaves and thinly sliced mozzarella cheese in a spiral pattern to the center, leaving the edges exposed.
- Drizzle more olive oil in a spiral pattern, then return the pizza to the oven.
- Your pizza will be ready in approximately 3-4 minutes.

Enjoy your meal!

KAFKA'S CITY PRAGUE

I think anyone visiting Prague, one of the most beautiful cities in Central Europe and known as Kafka's city, will love it. With its unique architecture, breathtaking views, rich history, and local cuisine, it attracts tourists from all over the world. I recommend heading straight to the banks of the Vltava River as soon as you arrive in Prague. Watching the sunset while dining on boats on the river is one of the most enchanting activities you can do. If you are wondering if there is anything interesting from a historical perspective, I can tell you that there is a significant historical presence, such as Czechoslovakia, which was a large reality. You can notice traces of the history of this country, which was in the midst of World War II, in many parts of the city. Old Town Square, the city's oldest and most important square, has a 14th century appearance and has been on the UNESCO World Heritage Sites list since 1991. Old Town Square also houses many historical buildings, such as St. Nicholas Church and the Virgin Mary Column.

If you have 4-5 days, you can explore most of the must-visit places in the city and get to know Prague well. Since we did not want to spend our entire honeymoon in one city, we allocated 3 days for Prague, so our travela was a bit rushed. Even though exploring the city does not take much time because it is not very large, if we had more time, we would have discovered many more places.

So, when is the best time to visit Prague? It depends on your personal preference and your tolerance for various weather conditions. In terms of weather, if you visit Prague during the summer, you might experience scorching daytime heat and chilly evenings. Therefore, I believe the best times to visit Prague are during the spring (April - May) and the fall (September - October). We were there in October, and even though the season was relatively cool, it did not affect the crowds. Prague is a very touristy city, so we still found ourselves in the midst of a large crowd while exploring.

When it comes to the places to visit in Prague, "Old Town" is undoubtedly the heart of Prague and a must-visit place. It's the most touristy area in Prague, and key attractions there are the Astronomical Clock and Tyn Church. However, I recommend being cautious with your valuables while watching the impressive show of the Astronomical Clock every hour. It is easy to get distracted by the spectacle and not notice if something is taken from your pocket or bag.

Another iconic place on our list of places to visit is Charles Bridge. There used to be another bridge here in the 1300s, but it was destroyed by a flood, leading to the construction of Charles Bridge in 1402. Today, it still stands in all its glory. The bridge offers both a stunning view of Prague and 30 sculptures that are works of art in themselves. It's definitely worth seeing. Within walking distance from the bridge, you can easily reach Prague Castle, an important symbol of Czech history built in the 9th century. When you reach the castle, you will be rewarded with a breathtaking view. If you head down the road towards Kafka Museum, which is across the bridge, you'll come across a path leading downhill. This spot is right on the banks of the Vltava River and is known as the Charles Bridge View Point. It is a good place to photograph the bridge and be attacked by the resident gooses by the river.

Kafka Museum, built in the memory of Franz Kafka since Prague is his birthtown, located on the banks of the Vltava River in Prague, is one of the most visited cultural spots in the city. Divided into two sections, "Existential Space" and "Imaginary Topography," the museum reflects Kafka's inner world and traces his life. If you have read Kafka's "Letters to Milena," you will find the original letters displayed in the museum, along with various mechanical artworks. Another remarkable Kafka-related attraction in Prague is Kafka's Kinetic Statue, which is definitely worth seeing.

Speaking briefly about Prague's cuisine within Czech cuisine, I can say that it is characterized by being calorie-rich, featuring a lot of meat and potatoes, and often on the oily side. I believe this is influenced by the Czech cuisine's interaction with Germany, Austria, and Hungary. I recommend trying some of the Prague dishes, such as Goulash adapted from Hungary to suit Czech tastes, Kulajda, a hearty vegetable soup, Svickova Na Smatane, an unusual beef dish, and Nakladany Hermelin, a dish made with cheese. Prague also offers a variety of snacks, including sweet treats like Trdelnik, fried cheese dish Smažený Sýr, grilled sausage sandwich Grilované Klobásy, open sandwiches known as Chkebíčky, and potato pancakes called Bramboraky. They are all delicious and filling.

Finally, Prague is a magnificent city that will leave you wondering why you haven not visited sooner, making you not want to leave once you are there, and enticing you to come back again. I recommend that everyone go and see this incredible city, and I assure you that you'll return home with unforgettable memories.

WHO IS HAZAL KARASOY SAAT?

Hazal Karasoy Saat was born in Antalya in 1992. She began her career in Human Resources in 2020 and has been serving as the Employer Brand Leader in the Human Resources department since 2023.

OUR INNER WORLD
AND HAPPINESS

Prof. Acar Baltas

For the past twenty years, I have primarily focused my leadership and management studies on values and the meaning of life. This is because I believe that short leadership or management skills training sessions that provide participants with "do this, don't do that" recipes ultimately fall short, and this "outside-in" approach isn not very effective. I believe that such programs confirm the Anatolian wisdom that says “pushed advice goes forty steps”.

TRANSFORMATION AND AWARENESS

Through the books I have read, the writings I have written, and the work I have done with various groups, I have come to believe that being a good manager, leader, or a good person happens "from the inside out" rather than "from the outside in." During these endeavors, I noticed the importance of two aspects. Firstly, the vast majority of participants are not aware of what their true values are. Secondly, almost none of the participants can express the purpose of their existence in life in a single sentence. The commonly expressed phrase by participants, "to be happy and successful," is not only a vague and general description but also reflects a self-serving worldview. The primary reason for personal insatiability is the impossibility of these goals ever being realized.

Values form the basis of our behaviors. Values stand in the way of personal pleasure and self-interest, and they can be an obstacle to an organization's profitability. Now, let's play a game together. Define five values for yourself and arrange them in order of importance. Then, identify two behavioral indicators for each value. For example, if honesty (truthfulness, ethics, integrity) is defined as a value, provide behavioral indicators such as "speaking the truth in all situations (even if it harms me)" or "not speaking negatively about absent individuals" as examples.

Next, assess how closely your behaviors align with these definitions. Many people who perform such an evaluation will realize that their behaviors do not always align with their declarations. If you find yourself among them, try to align your behaviors with the values you have expressed. However, remember that this may require paying a price. By living in alignment with your values, you will experience a deep inner sense of peace because claiming to have a value requires paying a price or being willing to pay the price for it.

REASON FOR EXISTENCE

The next step is to define your purpose in life with a single sentence. This purpose can be as humble as "to raise children who will be beneficial to society" or as ambitious as "to create a work that will leave a lasting impact on society." However, this purpose should empower you, provide a sense of meaning, and guide a portion of your daily activities when you wake up each morning.

When a person's values and abilities merge with their passion, they begin to work and live not to be the best in the world but to be a good person for the world. This means that our character is as valuable as our competencies.

If a person in life is not serving a purpose beyond themselves and only focuses on what they will gain, they are bound to feel dissatisfaction and emptiness. This is because the justice scale within a person operates in a self-centered manner. In all their relationships with their children, spouse, neighbor, or boss, they tend to perceive themselves as giving more and receiving less. Therefore, the feeling of being a debtor does not leave peace in a person. People who come to the world not only to "take" but also to "give" add a spiritual dimension to their inner world. The "what is in it for me?" mentality dictated by the Anglo-Saxon worldview, as mentioned earlier, constantly fuels the feeling of being a debtor in individuals.

People who experience this feeling, even if they define high values such as "truth, family, ethics" among their values, live by either completely forgetting it or often violating these values by saying "but" and inevitably become part of a hypocritical life.

One of the most important aspects of Turkish society's values is "children." However, many parents in their professional lives believe that buying more "things" for their children will make them happier rather than spending more "specialized time" with them. For example, they go on vacation with friends who have children of the same age and cannot use the opportunity to spend very valuable "specialized time" with them without time pressure. Therefore, our recommendation to young parents is to spend their holidays only with their children, listen to them without time pressure, and instill their defined family values to them during "problem-free times."

An important part of a person's inner journey is the steps they take to deepen their relationships with others. Remembering the birthdays of people around them, writing cards consisting of unique adjectives and sentences about why they are important to them, and asking themselves how they made the other person feel after each interaction can be a good start to improve in this direction.

CONCLUSION

People who excessively prioritize themselves often fail to make others feel good in their presence. Therefore, thinking about the feelings and impression we leave behind is a suitable starting point for becoming a better person in the world. Perhaps the most important thing in life is not to be mistaken about our loved ones.

SPINE HEALTH AND ERGONOMICS

SPECIALIST MD ALPER ALABULUT - BRAIN AND NEUROSURGERY

Ergonomics is a branch of science that aims to create living and working environments that are suitable for human behavioral and biological characteristics. It focuses on making work and workspaces more suitable for humans.
The spine is one of the most commonly affected areas of the body in terms of health due to the modern work life of people in society, and various diseases can often arise from routine work activities such as sitting in an office chair or heavy lifting. Therefore, applying ergonomic principles to a worker's work environment can help prevent spine-related illnesses and maintain spinal health.

Two typical situations often lead to the deterioration of spinal health in people during their work lives:

1. Spinal diseases that cause pain as a result of normal activities and the requirements of the job at the workplace (without accidents or trauma). Incorrect use of body mechanics (such as sitting for hours in an office chair), prolonged activity, repetitive movements, prolonged standing, and fatigue are the most significant contributors to these diseases.

2. Unexpected events during the task affecting spinal health (including accidents and trauma). Examples include improper lifting of a load, falls, or heavy objects falling on the spine during work. These accidents can affect the neck, back, and other joints of the body, potentially causing damage to spinal ligaments, muscles, or soft tissues.

ERGONOMICS IN BUSINESS LIFE

There are some basic ergonomic guidelines that can help prevent spinal disorders in employees:
• A job description based on the forces present in a specific work environment, the time spent on the task, and the biomechanics (defining human movement and sitting posture on an office chair) used in the task should be developed.
• A working principle should be established that regulates body posture and allows for anatomically correct movement to minimize the forces that muscles, connective tissues, bones, and joints may be exposed to due to the nature of the job.
• Methods to preserve fitness and flexibility should be developed, and a power reserve should be created for the individual.

WHAT IS HARMFUL TO SPINE HEALTH IN WORKING LIFE?

1. Prolonged static posture or sitting is harmful. A healthy body can tolerate staying in a specific position for only about 20 minutes. Therefore, individuals working in conditions that require a fixed posture may begin to develop spinal disorders after some time. Remaining in the same position reduces the flexibility of soft tissues outside the bones (especially muscles and connective tissues) over time. Subsequently, various spinal disorders occur due to increased energy on the spine, leading to neck, back, waist, arm, and / or leg pain.

2. In contrast to desk jobs, the spine and joints of employees exposed to continuous movement at the limits of body anatomy can develop serious joint disorders suddenly. In these types of jobs, individuals are often exposed to loads that are lifted from the ground, raised overhead, heavy, or involve twisting and bending movements while carrying.

3. Fatigue and stress resulting from days of sitting at a desk, work intensity, or lack of sleep can lead a person to move less skillfully, increasing the likelihood of being involved in an accident or making inappropriate movements. In the workplace, long working hours and the presence of mobbing can also lead to the development of bad habits and dietary habits that are contrary to our muscle and bone tissue.

WHAT COMPLAINTS ARE APPLIED TO THE HOSPITAL?

The most common complaints are neck pain (67%) and back pain (62%). Additionally, arm and leg pain is also frequently observed. In 48% of individuals, regular weight gain has been noted.

WHAT DO WE DO FOR A HEALTHY WORK LIFE?

In a survey conducted for office workers, the rate of employees taking regular work breaks was 24%, while the rate of people or organizations creating an ergonomic working environment in their workplace remained at 22%. While 64% of the employees stated that they exercise or do sports, even if not regularly, only 44% have periodic health examinations. Smoking (42%), alcohol (53%) and sleep problems (24%) were also found to be significant.

WHICH DISEASES ARE MOST COMMON?

Cervical spondylosis (60%) and cervical herniation (30%), lumbar spondylosis (50%) and lumbar herniation (35%), kyphosis, fibromyalgia, carpal tunnel syndrome, osteoarthritis, and tendinitis are commonly diagnosed conditions.

ERGONOMICS AT THE DESK, STANDING OR DRIVING POSITION IN WORK

Our posture is crucial both at home and in the workplace. Posture-friendly techniques are a valuable component in preventing or managing neck, back, or lumbar pain during any activity. Incorrect posture while standing for extended periods, sitting in an office chair, or driving a car are common causes of spinal issues.

Posture for Jobs that Require Standing:

When standing, it İs important to maintain the anatomical curves of the spine. Here's what you can do:
- Keep your head directly over your shoulders (i.e., "chest out, head back").
- Try to keep your shoulders as level with your hips as possible.
- Periodically engage your abdominal muscles.
- Slightly separate your legs, positioning one foot slightly in front of the other, and slightly bend the knee of the other leg to balance your hip.
- If you need to stand on a hard surface at work, it's best to wear supportive and orthopedic shoes. To reduce pressure on your spine while standing, you can use a support rail, wall, or box to prop up one of your feet. This standing posture may require some practice. Remember to change your legs and positions every 20 minutes.

Sitting Posture for Desk Jobs:

Our posture is important when sitting in office chairs or at a workstation. Many of us spend hours in front of a computer, which can lead to back or neck pain. Many of these aches can be prevented by applying the following:
- Create an ergonomic workspace by adjusting the office chair, computer, and desk to be user-friendly.
- Change your sitting posture in the chair. Many people sit forward on their chairs and lean forward to look at the computer screen. You can provide lumbar and back support by sitting fully in the chair and keeping your head-neck area upright.
- If you're sitting in one place for a long time, take stretch breaks and short walks.

Additionally, an ergonomic workspace can be achieved by positioning the computer screen at the right place and height, adjusting the hands and feet correctly, and choosing the right type of office chair.

- Adjust the chair's seat so that the working surface is at "elbow height." The back of your legs should easily pass a clenched fist from behind and in front of the chair's edge to prevent excessive pressure on the back of your legs and swelling of your feet. The chair's backrest should provide mild lumbar support, pushing slightly forward. If these adjustments cannot be made with the existing office chair, consider a different brand or type of chair.

• Adjust the height of the computer screen. Sit in the newly adjusted chair as described earlier. Close both of your eyes and then open them slowly. The initial focus point of your gaze when you open your eyes is where the middle of the computer screen should be placed. If needed, the screen can be elevated using books or a stand.

Posture During Commuting to and from Work:

Regardless of the duration of your commute to work, your sitting position while driving or traveling can contribute to spinal issues. Similar to those who sit in an office chair for hours, long-distance commuters (one hour or more each way) may experience adverse effects on their spine during these journeys.

First and foremost, it's essential to sit with your knees at hip-level height. To support the inward curve of the lower back, you can use a rolled-up towel or lumbar support. Drivers are advised to adjust their seats to a comfortable distance from the steering wheel, allowing easy access to it. Stretching out can increase pressure on the spine, but sitting too close can increase the risk of injury from the car's airbag.

Carrying Materials and Weight in a Spine-Friendly Manner:

When carrying weight and needing to turn or bend, always keep the load in front of you, and rotate your shoulders, hips, and feet as if using your body as a mold. This is because the spine and hip joints are anatomically insufficient for twisting and bending movements. Therefore, avoiding these movements while carrying heavy loads is essential.

• Keep the load as close to your center of gravity as possible. For long and narrow objects, it is safer to carry them on one shoulder.
• When carrying multiple objects simultaneously, you should evenly distribute the weight if reasonably possible.
• Sometimes, you may need to push or pull objects while carrying weight. Pushing is generally easier on the spine than pulling. To initiate a push, it is important to use your arms and legs evenly. If you need to pull, avoid bending at the waist.
• In some cases, you may need to carry very heavy loads on your back. When this is necessary, it can be a viable method, but it is important to distribute the weight to your legs, preventing excessive strain and bending of the back.

Implementing these techniques both at work and at home will help protect your spine.

WHAT ELSE SHOULD WE DO BESIDES ERGONOMICS?

- Engaging in regular daily movement and exercise.
- Achieving and maintaining an ideal weight range.
- Eating a diet that supports muscle and bone health.
- Not smoking.
- Reducing stress.

BETWEEN THE DATES
JANUARY 1 - DECEMBER 31, 2022

OUR RETIRED *employees*

- Muzaffer Celik, serving as an Expert Technician, retired on February 17, 2022.
- Nazif Gumus, serving as the Chief Technician, retired on July 25, 2022.

We wish them happiness in their lives from now on

TS1400

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