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İSTANBUL TEKNİK ÜNİVERSİTESİ 1773

ITU Research 2025

Transforming Knowledge into Impact

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ITU for Co-Creation

Alongside human-centered approaches guided by science, digitalization and transformative technologies such as artificial intelligence, universities are entrusted by significant responsibilities in advancing peace, security and sustainable development. Indeed, climate change, increasing energy demand, accelerating technological transformation, and the management of natural resources stand before us as shared responsibility areas that directly affect the common future of humanity. This multidimensional transformation environment shaped by global challenges, makes it imperative to adopt approaches that are grounded in science, centered on trust-based cooperation, and guided by a long-term sense of responsibility.

Drawing strength from its 253-year academic legacy, Istanbul Technical University continues its mission with determination as a responsibility-driven and impact-oriented research university, pursuing an approach that prioritizes generating solutions to global challenges, strengthening interdisciplinary collaboration, and treating societal benefit as an inseparable component of knowledge production. Within this framework, we share with you the work carried out at our university throughout 2025 and the developments that have come to the fore under specific headings.

Established in 2025, our Zero Waste Institute, which addresses environmental sustainability as an institutional responsibility area, develops research, education, and implementation models that promote resource efficiency, circular economy principles, and long-term environmental resilience. The Institute carries out these activities within sustainable collaborations with national and international organizations and civil society stakeholders, primarily the United Nations.

At a time when energy transition has become a critical global issue, the development of clean, secure, and scalable energy technologies remains among the priority focus areas of our university. In alignment with current developments in the nuclear field of our nation, we aim to contribute to the establishment of a holistic nuclear energy ecosystem encompassing advanced technologies such as small modular reactors (SMRs), micro modular reactors (MMRs), and fusion energy. These initiatives are grounded in a responsible approach that addresses nuclear energy risk perceptions through transparency, scientific validation, and human safety.

Prof. Dr. Hasan Mandal
ITU Rector

As a founding member of the European Engineering Learning Innovation and Science Alliance (EELISA) European University, Istanbul Technical University hosted key meetings shaping the “EELISA 3.0” phase, focused on building a more sustainable, integrated, and high-impact European University model across education, research, innovation, and governance. Within this framework, ITU assumed the Rotating Presidency of the EELISA Governing Board, reflecting its commitment to embedding EELISA more strongly into institutional strategies, strengthening the “European engineer” profile of its students, and enhancing collaboration among academic and administrative staff. In parallel, ITU aims to foster high-visibility EELISA Communities that promote cooperation with industry, the public sector, and civil society, while actively contributing to global science diplomacy through the COP31 process in 2026 and by hosting the 2026 WAITRO Summit.

While placing digitalization and artificial intelligence-based technologies at the center of our research and education ecosystem, the studies developed with a focus on green and digital transformation provide tangible contributions in the struggle against climate change. The approach we have adopted in education and research is built upon innovative cooperation models that integrate knowledge production with the training of qualified human resources, while fostering a culture of co-development and co-production.

The on-campus “co-creation and achievement laboratories” support the early-stage participation of our students in research processes and bring industry, the public sector, and academia together within a shared production environment.

In a world where disaster risks are steadily increasing, the responsibility of universities extends beyond knowledge production alone. With this awareness, the Marmara Active Fault Hazard and Risk Application and Research Center (MATAM), established through collaboration between Istanbul Technical University and Türkiye İşbank, has been designed as an interdisciplinary structure spanning from earth sciences to digital technologies. MATAM stands out as an innovative model that continuously monitors risks specific to the Marmara region, processes data through artificial intelligence and high-performance computing infrastructures, and provides decision-support mechanisms for policymakers. The Center constitutes a strong example of a permanent, integrated, and science-based approach to disaster preparedness.

In the field of space, the Space Support Systems Application and Research Center, established through cooperation between Istanbul Technical University and the Turkish Space Agency, presents a pioneering structure that directly responds to the needs of the National Space Program. In addition to satellite production, this Center constitutes a strategic competence area encompassing command-and-control infrastructures of space missions, as well as energy, communication, navigation, and artificial intelligence-supported systems. Strengthened through the support of the Presidency of Strategy and Budget of the Republic of Türkiye, this structure directly contributes to the nation’s operational capacity in the field of space. Additionally, our university aims to make its scientific expertise in space and aerospace fields visible on a global scale and to create new grounds for cooperation during the 77th International Astronautical Congress (IAC) to be held in Türkiye in 2026.

The Central Laboratory Infrastructure Development Projects are supported by the Presidency of Strategy and Budget, the Istanbul Development Agency, and Istanbul Technical University’s Scientific Research Projects Department, aiming to strengthen Türkiye’s research capacity by focusing on artificial intelligence supported computational materials technologies.

This holistic and impact-oriented approach has also been strongly reflected in our university’s international evaluation and ranking results.

Istanbul Technical University has:

- entered the top 300 universities, ranking 298th in the QS World University Rankings category,
- ranked first in Türkiye and 79th worldwide in the QS Engineering and Technology Subject category,
- ranked 60th worldwide in the Times Higher Education Interdisciplinary Science category,
- ranked first in Türkiye and 60th in Europe in EngiRank, and
- ranked first in Türkiye and 25th worldwide in the UI GreenMetric Rankings.

These achievements are the collective outcome of the devoted efforts of the ITU family, as well as the trust-based and sustainable collaborations we have established with you, our valued stakeholders.

This booklet aims to present Istanbul Technical University’s research, development, and innovation-driven activities within a comprehensive framework shaped by an institutional vision grounded in learning together, producing together, and achieving together.

Within this context, the University’s R&D activities carried out across diverse disciplines—together with national and international collaborations and projects prioritizing societal impact—have been brought together. Through this collective perspective, ITU’s science- and technology-based transformation journey is presented in a holistic manner, guided by sustainability, shared responsibility, and common purpose.

I would like to extend my sincere appreciation to all our academics, researchers, students, and stakeholders who contribute to strengthening Istanbul Technical University’s research ecosystem and who have played a role in the realization of this publication. I also wish to express my heartfelt thanks to all team members who prepared this booklet with great dedication, carefully reflecting our institutional memory and shared effort.

The culture of co-creation that defines the ITU family will continue to grow stronger through such collective works and will be carried forward into the future. In this spirit of cooperation and shared responsibility, I wish that 2026 will be a year in which efforts guided by science, centered on humanity, and strengthening a shared understanding of responsibility continue to deepen, and wish you a year filled with health, peace, and success.

Revitalizing Fundamental Textile Knowledge Through European Collaboration

Istanbul Technical University (ITU) is contributing to an Erasmus-funded international project that strengthens adult education in fundamental textile techniques, combining academic expertise, craftsmanship, and Europe's shared cultural heritage within a sustainable learning framework.

The Learning Workshop for Fundamental Textile Techniques project has been awarded €60,000 in funding under the Erasmus KA210-ADU – Small-Scale Partnerships in Adult Education program. The initiative brings together academic research, traditional craftsmanship, and educational innovation to support the long-term transmission of fundamental textile knowledge.

From ITU, the project involves Prof. Dr. Hale Karakaş of the Faculty of Textile Technologies and Design, together with Prof. Dr. Abdülkadir Sezai Saraç, retired faculty member of the Faculty of Science and Letters, Department of Chemistry. Prof. Dr. Saraç is a leading figure in electrochemistry and conductive polymers and is widely regarded as a living representative of the Faculty's academic history, contributing deep institutional memory and interdisciplinary perspective to the project.

The international consortium is led by the Scientific Engineering Union of Textiles, Garment and Leathers (Bulgaria) and includes partners from France, Bulgaria, and Serbia, reflecting a broad European and Mediterranean collaboration. The project will run from September 2025 to February 2027.

The initiative focuses on the conceptual development of a fully equipped learning workshop for fundamental textile techniques, including yarn spinning, weaving, and fabric finishing. A core component of the project is the comparative study of centuries-old European textile practices and existing craft and art workshops.

Particular emphasis is placed on the interaction between practitioners, raw fiber materials, and hand tools, with attention to ergonomic parameters and practical usability. The project will also develop and refine nomenclature lists identifying essential tools and their defining characteristics for each fundamental textile technique.

Expected outcomes include the conceptual design of a textile learning workshop, the development of design documentation for textile apparatus, the publication of a monograph comprising 18 articles documenting textile workshops and museum collections across Europe and the Mediterranean, and the creation of introductory-level curricula to support practical implementation.

By integrating scientific expertise, cultural heritage, and hands-on learning, the project reinforces ITU's role in interdisciplinary, practice-oriented international collaboration while ensuring the sustainable transfer of foundational textile knowledge to future generations.

Strengthening National Defense Technologies Through Next-Generation Laboratories

Istanbul Technical University (ITU) has taken a new strategic step to advance Türkiye's national defense technologies through the establishment of an RF–Microwave Innovative Materials Technologies Laboratory in collaboration with ASELSAN. The initiative reflects a shared vision to align engineering excellence with long-term technological independence.

Istanbul Technical University (ITU) has launched a new collaborative initiative aimed at reinforcing Türkiye's defense and technology ecosystem through next-generation research infrastructure. The RF–Microwave Innovative Materials Technologies Laboratory, established under a protocol signed with ASELSAN, represents a concrete step toward integrating national engineering expertise with strategic technology goals.

Developed within the ASELABS framework, the new laboratory will be the second such facility established at ITU in partnership with ASELSAN. Designed as a hub where academia and industry converge in a meaningful and sustained manner, the laboratory will focus on critical technology areas ranging from radar and electronic warfare systems to advanced RF and microwave-based material solutions. Through these efforts, the collaboration aims to enhance national technological capability while simultaneously strengthening the pipeline of highly qualified human capital.

The laboratory is conceived as a sustainable cooperation model grounded in a culture of shared learning and joint development. The initiative begins with four defined research projects, with the expectation that many more innovative ideas and multidisciplinary projects will emerge from this collaborative structure over time.

Planned to open in the near future, the RF–Microwave Innovative Materials Technologies Laboratory will complement the previously established Underwater, Surface, and Autonomy Technologies Laboratory created in partnership with ASELSAN. Together, these facilities are envisioned as strategic meeting points for advancing technological sovereignty, innovation capacity, and long-term national resilience.

By fostering strong, trust-based collaboration between academia and industry, ITU and ASELSAN reaffirm their commitment to building the future—together, through knowledge, innovation, and shared purpose.

Transforming Food into a Pathway for Health and Well-Being

Prof. Dr. Beraat Özçelik of Istanbul Technical University has been selected for the Mediterranean Science Team 2025 under the MEDNIGHT initiative, in recognition of her pioneering research in food science and nutrition. Her work bridges functional foods, sustainability, and public health, offering inspiration for the next generation of researchers.

Each year, the Mediterranean Researchers' Night (MEDNIGHT) brings together distinguished scientists and academic institutions from across the Mediterranean region, fostering collaboration around shared challenges in sustainability, health, and equality. Within this framework, the Mediterranean Science Team 2025 and the Mediterranean Universities Gender Equality Pioneers (MU-GEP) initiative have highlighted researchers whose work combines scientific excellence with societal impact.

Among the scientists recognized this year is Prof. Dr. Beraat Özçelik, Professor of Food Science and Nutrition at Istanbul Technical University. Prof. Dr. Özçelik is internationally known for her innovative research on functional foods and nutraceuticals, where she integrates natural bioactive components with advanced food processing technologies to develop health-promoting products.

Her research addresses some of today's most pressing public health challenges, including the prevention of chronic diseases and the promotion of sustainable, healthy lifestyles. By re-imagining food not merely as nourishment but as a strategic tool for health and well-being, Prof. Dr. Özçelik's work exemplifies the translational power of food science at the intersection of nutrition, technology, and preventive medicine.

The MEDNIGHT jury praised her contributions for their scientific rigor, societal relevance, and alignment with the Mediterranean region's sustainability and equality goals. This recognition not only underscores Prof. Dr. Özçelik's individual achievements but also reinforces ITU's strong presence on the international research stage, particularly in fields that directly impact quality of life.

Reflecting her scientific vision, Prof. Dr. Özçelik summarizes her approach with a guiding principle:

"Transforming food into a vehicle for health and well-being is the science of the future."

Her selection as part of the Mediterranean Science Team 2025 stands as both a celebration of excellence and a source of inspiration for young researchers seeking to align scientific innovation with social good.

Tracing the Magmatic History of Antarctica's Remote Frontiers

A TÜBİTAK 1001–funded research project investigates the magmatic and tectonic evolution of Nelson Island in Northwest Antarctica. By combining detailed fieldwork with high-precision laboratory analyses, the study sheds new light on subduction-related arc magmatism in one of the least explored regions of the Antarctic Peninsula.

The project "The Petrology and Geochronology of the Nelson Island Magmatism (NW Antarctica)," coordinated by Asst. Prof. Dr. Alp Ünal from ITU Faculty of Mines, focuses on unraveling the magmatic and tectonic evolution of Nelson Island, located within the South Shetland Islands of the Western Antarctic Peninsula. The study aims to clarify the nature, origin, and spatiotemporal development of arc magmatism through an integrated approach that combines systematic field observations with advanced analytical techniques.

Geological fieldwork was carried out during January–February 2023 on the Stansbury Peninsula of Nelson Island, with logistical support from the Czech Antarctic Research Center and field equipment provided by the Polar Research Institute of TÜBİTAK MAM. Over the course of a 14-day Antarctic expedition, volcanic and intrusive rocks were systematically sampled, stratigraphic relationships were documented, and a detailed geological map of the area was produced for the first time.

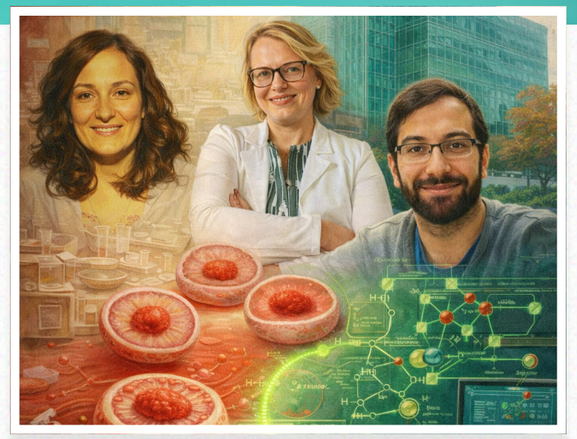
The collected samples encompass a diverse suite of magmatic products, including basaltic lava flows, pyroclastic deposits, and diabase–microgabbro intrusions. These lithologies represent key expressions of subduction-related arc magmatism associated with the Antarctic Peninsula arc system. Despite its tectonic significance, Nelson Island remains one of the least studied islands of the South Shetland archipelago, particularly with respect to precise geochronological constraints and comprehensive geochemical and isotopic characterization.

The ongoing phase of the research, supported by the TÜBİTAK 1001 Grant Program, employs high-precision $^{40}Ar/^{39}Ar$ geochronology, Sr–Nd–Pb isotope geochemistry, major and trace element analyses, mineral chemistry, and detailed petrographic investigations. Together, these datasets will provide critical insights into arc migration processes, mantle–crust interactions, and the temporal and chemical evolution of subduction-related magmatism across the South Shetland Islands.

By bridging challenging polar fieldwork with state-of-the-art laboratory science, this collaborative Turkish–Czech initiative addresses long-standing gaps in Antarctic geoscience literature. At the same time, it strengthens Türkiye's scientific visibility and capacity within the international polar research community, demonstrating how focused exploration at the Earth's margins can illuminate fundamental processes shaping our planet.

Translational Biomedical Innovation Shaping the Future of Cancer Research at ITU

In early 2025, researchers from Istanbul Technical University's Department of Molecular Biology and Genetics advanced the frontiers of cancer research through nationally funded, interdisciplinary projects. Bridging fundamental science with clinical ambition, these initiatives reflect ITU's growing influence in translational biomedical innovation.



In 2025, researchers from Istanbul Technical University (ITU) once again affirmed their leadership in translational biomedical science by securing highly competitive support from Türkiye's foremost national funding mechanisms, including the Research University Support Program (ADEP) and the TÜBİTAK 1001 Scientific and Technological Research Projects Support Program. Together, these newly funded projects trace a coherent scientific narrative—one that spans advanced imaging, nanomedicine, molecular targeting, and therapeutic design—anchored in ITU's strategic commitment to interdisciplinary, application-driven research.

At the intersection of imaging and therapy, a flagship project led by Prof. Dr. Ceren Çıracı explores the potential of photoacoustic imaging–guided photothermal therapy for B-cell lymphoma. By combining gold nanoparticle–enhanced photothermal treatment with real-time photoacoustic monitoring, the project seeks to illuminate and eliminate tumor tissue with heightened precision. Drawing expertise from molecular biology, electrical and electronics engineering, control and automation engineering, physics engineering, and clinical medicine, the work exemplifies how convergence across disciplines can transform complex biomedical challenges into tractable solutions.

A complementary ADEP-supported initiative, coordinated by Assist. Prof. Dr. Abdülhalim Kılıç, turns to the microscopic choreography of drug delivery. Through a patented MEMS-based microfluidic platform, the team is pioneering the scalable production of "artificial exosomes"—engineered nanocarriers designed to emulate the targeting efficiency of natural exosomes while overcoming their limitations in consistency and manufacturability. Equipped with chemotherapeutic payloads and tumor-specific ligands, these biomimetic systems point toward a future of more precise, personalized, and less toxic cancer therapies.

Further enriching this translational landscape, Prof. Dr. Gizem Dinler Doğanay received TÜBİTAK-1001 funding for a project that probes the molecular decision points governing cancer cell survival. Focusing on the interaction between Bag-1S and the AAA+ ATPase p97/VCP, key regulators within protein quality control pathways, the project proposes the design of interface-specific peptides to selectively disrupt this interaction. By modulating endoplasmic reticulum–associated degradation without broadly inhibiting essential cellular machinery, the approach aims to weaken cancer cells while minimizing collateral toxicity—an elegant strategy rooted in molecular precision.

Taken together, these projects illustrate how ITU's Molecular Biology and Genetics researchers weave fundamental insight with technological ingenuity. By aligning discovery-driven science with translational intent, they not only expand the boundaries of oncology research but also lay the conceptual and technological foundations for future clinical applications and healthcare innovations.

AIRMOB Advancing Innovative Air Mobility Through European Collaboration

Through its participation in the AIRMOB project, Istanbul Technical University strengthens its international engagement in Innovative Air Mobility. Representing Türkiye as a regional Centre of Vocational Excellence, ITU contributes to shaping Europe's future-oriented aviation skills ecosystem.

Istanbul Technical University (ITU) continues to expand its international activities through active participation in the AIRMOB: Developing Skills and Capabilities for Innovative Air Mobility project, supported under the Erasmus+ ERASMUS-EDU-2024-PEX-CoVE call. Representing Türkiye in the project, the ITU Aviation Institute, in collaboration with the ITU Aerospace Research Center (ITU ARC), serves as one of five regional Centres of Vocational Excellence (CoVE) established across Europe.

The AIRMOB project brings together 21 full partners from Portugal, Spain, Italy, Ireland, and Türkiye and is supported by a total budget of €3.98 million. Coordinated by DBL (Portugal), the 48-month initiative aims to establish a comprehensive education, training, and collaboration framework for the rapidly evolving field of Innovative Air Mobility (IAM), aligned with Europe's digital and green transformation goals.

Activities in Türkiye are carried out under the leadership of Assoc. Prof. Emre Koyuncu, Deputy Director of both the ITU Aviation Institute and ITU ARC, with contributions from Prof. Dr. Hülya Cebeci, Director of the Aviation Institute, and Dr. İpek Ösken. The work focuses on sectoral planning, stakeholder engagement, and aligning national IAM development objectives with European vocational excellence initiatives.

AIRMOB establishes a multi-stakeholder collaboration platform, bringing together vocational education providers, universities, industry representatives, technology developers, and regulatory authorities. Within this framework, the project analyzes competency needs across the IAM ecosystem, develops forward-looking training programs, and prepares new modules and curricula aligned with European Qualifications Framework (EQF) levels, alongside country-specific transformation roadmaps.

As Türkiye's Regio-AIRMOB CoVE leader, the ITU Aviation Institute contributes by mapping the national IAM ecosystem, conducting sectoral analyses, activating key stakeholders, and leading strategic planning activities. The outcomes of these efforts will inform the development of training content and support competency building in areas such as autonomous air mobility systems, sustainable aviation technologies, and intelligent mobility operations.

Through its role in AIRMOB, ITU aims to enhance Türkiye's visibility within Europe's vocational excellence landscape while contributing to the long-term growth, innovation capacity, and transformation of the Innovative Air Mobility sector.

Technology Reshaping Maritime Security

Hosted in Istanbul on 24–25 June 2025, the 5th Maritime Security Conference brought together senior leaders, academics, and experts to examine how emerging technologies are transforming maritime security. The event reinforced international commitment to innovation, interoperability, and strategic foresight at sea.

Maritime Security Centre of Excellence (MARSEC COE) successfully hosted the 5th Maritime Security Conference in Istanbul, Türkiye, under the theme “The Impact of Technology on Maritime Security.” The conference convened 255 participants from 22 countries, including senior military leaders, academics, and maritime security professionals, fostering a high-level forum for dialogue on the evolving maritime domain.

Across two days of sessions, participants explored how technological advancement is reshaping maritime security operations and policy. Discussions addressed both the opportunities enabled by innovation and the challenges associated with rapid technological change, with a focus on autonomous systems, artificial intelligence, cyber resilience, and data-driven maritime situational awareness.

The presence of Admiral Ercüment Tatlıoğlu, PhD, Commander of the Turkish Naval Forces, underscored the importance of national and allied commitment to innovation at sea. His attendance highlighted the strategic value of aligning technological development with operational readiness and collective security objectives.

The conference also benefited from the academic leadership of Prof. Dr. Raul Pedrozo, whose contributions emphasized NATO-wide interoperability, the integration of emerging technologies, and future capability development. These perspectives reinforced the need for coordinated approaches that bridge research, policy, and operational practice.

The 5th Maritime Security Conference reaffirmed MARSEC COE’s role as a hub of maritime knowledge, operational collaboration, and strategic foresight, advancing shared understanding and cooperation in an increasingly complex and technology-driven maritime environment.

Bridging University Expertise with School Science Education

Istanbul Technical University (ITU) hosted a three-day hands-on science education workshop for middle school and high school science teachers from across Istanbul. The program strengthened university–school collaboration by connecting academic expertise with classroom practice.

Istanbul Technical University (ITU) hosted an Applied Science Education Workshop at the Faculty of Science and Letters, welcoming science teachers from Anatolian and Science High Schools as well as middle school science educators representing all 39 districts of Istanbul. Organized in collaboration with the Istanbul Provincial Directorate of National Education, the three-day program brought together physics, chemistry, and biology department heads and teachers for an intensive, practice-oriented learning experience.

The workshop opened with remarks by ITU Rector Prof. Dr. Hasan Mandal, who emphasized the critical role of university–society collaboration in advancing scientific productivity and delivering high-quality education. This was followed by an address from Prof. Dr. Samet Yücel Kadıoğlu, Dean of the Faculty of Science and Letters, who highlighted the workshop’s value in fostering interdisciplinary scientific cooperation.

Extensive preparation by the Faculty Dean’s Office and the Departments of Physics Engineering, Chemistry, and Molecular Biology and Genetics directly shaped the program’s content. Throughout the three days, experienced and actively teaching educators were introduced to ITU’s educational philosophy, its strong emphasis on science communication, and a solution-oriented approach to experimental learning.

On the first day, participants received foundational training in laboratory safety and scientific methodology, delivered by ITU faculty members. From the second day onward, teachers engaged in hands-on experimental sessions within discipline-specific laboratories, where they not only conducted experiments but also observed how university-level laboratory competence is cultivated and transferred to students.

Rather than a one-directional training model, the workshop was designed as a collaborative platform for professional exchange and dialogue between teachers and academics. The program concluded with a closing ceremony attended by Rector Prof. Dr. Hasan Mandal and Istanbul Provincial Director of National Education Assoc. Prof. Dr. Murat Mücahit Yentür, during which certificates were presented to participating educators.

By supporting teachers in carrying more effective, experiment-based approaches into their classrooms, the workshop concluded as a model example of sustainable university–school cooperation, reinforcing ITU’s commitment to impactful science education at every level.

Science at the Frontline of Climate Resilience in Türkiye

Istanbul Technical University's Eurasia Institute of Earth Sciences has entered a strategic partnership with the Ministry of Environment, Urbanization and Climate Change to strengthen Türkiye's resilience to climate change. The collaboration advances science-based solutions for assessing and mitigating climate-driven risks.

Istanbul Technical University Eurasia Institute of Earth Sciences has signed a critical cooperation protocol with the Ministry of Environment, Urbanization and Climate Change, through its General Directorate of Combating Desertification and Erosion (ÇEM). The partnership establishes a scientific framework aimed at enhancing Türkiye's resilience to the escalating impacts of climate change and extreme weather events, with particular emphasis on mass movements and land degradation risks.

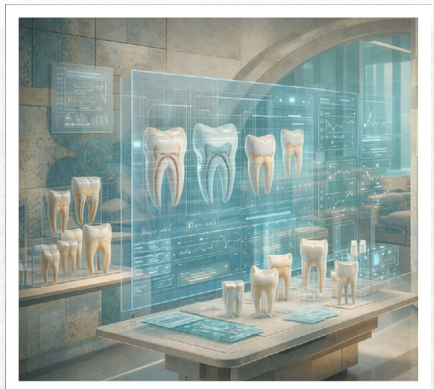
Grounded in interdisciplinary earth system science, the collaboration focuses on translating advanced research into actionable tools for risk assessment, prevention, and adaptation. By integrating geoscientific analysis with policy-relevant outputs, the initiative seeks to support evidence-based decision-making in the face of intensifying climate pressures.

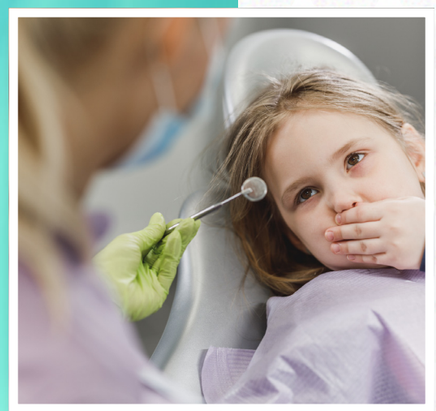
The partnership was formally introduced at the launch event of the Türkiye Desertification Model: Sensitivity and Hazard Maps, hosted by the Gaziantep Metropolitan Municipality. At the event, comprehensive assessments of the country's desertification sensitivity and future risk scenarios were presented using robust scientific methodologies, with significant contributions from the ITU Eurasia Institute of Earth Sciences.

By aligning academic expertise with public institutions, the collaboration exemplifies how science can inform national strategies for climate resilience. Through data-driven mapping, hazard analysis, and long-term risk modeling, the initiative aims to strengthen preparedness and foster sustainable responses to climate-induced challenges across Türkiye.

Augmented Reality Redefining Pediatric Dental Care

A pioneering research project introduces a world-first Augmented Reality (AR) intervention to reduce dental anxiety in children. By integrating immersive yet non-intrusive digital interaction into clinical practice, the approach aims to improve patient comfort while supporting dentists' workflow.





Assoc. Prof. Dr. Gökhan İnce from Istanbul Technical University's Faculty of Computer and Informatics Engineering, Department of Computer Engineering, leads a research project that brings together digital innovation and pediatric healthcare. His research focuses on digital health technologies and human–computer interaction. Supported by Türkiye's leading national research funding agency, the project addresses one of the most persistent challenges in clinical dentistry: dental anxiety, which affects up to 36% of the population and remains a significant barrier to timely and effective oral healthcare—particularly among pediatric patients. Within this framework, the research introduces an innovative Augmented Reality (AR)–based mobile system designed to reduce stress and pain perception during dental procedures, offering a child-centered, technology-driven approach that enhances both patient experience and clinical workflow.

Unlike conventional Virtual Reality (VR) headsets, which may isolate children from their surroundings and interfere with clinical access, or robotic assistants, which are often costly and complex, the AR solution offers a balanced and patient-centered alternative. The system enables children to interact with virtual avatars while remaining visually and cognitively connected to the real clinical environment, preserving communication with the dentist and ensuring procedural safety.

The intervention operates through a three-phase structure. Prior to treatment, children are introduced to dental instruments and procedures through animated avatars, fostering familiarity and reducing anticipatory fear. During treatment, a mounted "virtual stage" provides non-intrusive distraction, minimizing anxiety without obstructing the dentist's workspace. Following the procedure, gamification elements are employed to reinforce positive experiences and sustain engagement.

The effectiveness of the AR intervention will be validated using physiological stress indicators, including salivary cortisol levels and heart rate measurements, and compared with control groups receiving standard care. By grounding the approach in objective biomarkers, the project seeks to demonstrate measurable improvements in patient comfort and emotional regulation.

By reducing anxiety-driven resistance to treatment, the AR system has the potential to ease clinicians' workload and significantly decrease reliance on heavy sedation or general anesthesia for pediatric patients. The project represents a promising intersection of digital health innovation and clinical dentistry, offering a scalable model for more compassionate, efficient, and child-friendly dental care.

ITU Strengthens Global Sustainability Engagement in Istanbul

Istanbul Technical University (ITU) participated in the Global Sustainable Development Congress 2025, hosted for the first time in Türkiye through the collaboration of the Council of Higher Education and Times Higher Education. The congress created a productive environment for high-level dialogue and the development of new international partnerships.

Istanbul Technical University (ITU) took part in the Global Sustainable Development Congress (GSDC 2025), held in Istanbul between 16–19 June 2025. Organized in partnership with the Council of Higher Education (YÖK) and Times Higher Education (THE), the congress brought together more than 5,000 participants from 110 countries, representing universities, governments, industry, and civil society.

The fourth edition of the congress addressed global priorities across a broad thematic spectrum, including sustainable campuses, climate change, socioeconomic equity, artificial intelligence, health, energy, and education. Through plenary sessions, panels, and bilateral meetings, participants explored innovative strategies and collaborative approaches toward achieving the Sustainable Development Goals.

ITU contributed to these discussions by highlighting its research-driven, impact-oriented approach to sustainability. Rector Prof. Dr. Hasan Mandal emphasized the university's 252-year legacy as a leading institution in science and technology, underscoring ITU's responsibility to translate knowledge into societal benefit. He also reflected on the THE Impact Rankings 2025, announced during the congress, where ITU ranked 3rd globally in Quality Education and placed within the top 50 worldwide overall.

Throughout the event, ITU leadership engaged in constructive meetings aimed at strengthening existing collaborations and exploring new opportunities in academic exchange and entrepreneurship. These engagements reinforced ITU's position within trusted international academic networks and its commitment to long-term, sustainable partnerships.

The congress served as a shared platform for collective action, emphasizing that global challenges require cooperation across borders and sectors. With active participation from ITU's Sustainability Office, International Relations Office, and Ranking Coordination Unit, the university's presence at the Turkish Universities Pavilion attracted strong international interest and further enhanced the visibility of its research ecosystem.

Building Seismic Resilience Through Knowledge Exchange

Istanbul Technical University's Disaster Management Institute hosted a two-day international training and practical internship program for academics and public officials from Uzbekistan, strengthening capacity in seismic safety and disaster preparedness through science-based and application-oriented education.

A two-day Training and Practical Internship Program on Seismic Safety and Disaster Preparedness was organized by the Disaster Management Institute of Istanbul Technical University (ITU) for a delegation of 40 academics and public officials from Uzbekistan. The program was designed to enhance institutional capacity and national resilience against earthquakes and other natural hazards through an integrated, interdisciplinary approach.

The training opened with foundational scientific sessions covering Earthquake Seismology, Active Tectonics, and Geotechnical Earthquake Engineering, providing participants with the theoretical framework necessary to understand seismic processes and ground behavior. This foundation was complemented by an in-depth exploration of the Fundamentals of Structural Dynamics, a critical discipline for interpreting how structures respond under seismic loading.

Expanding beyond structural performance, the program addressed multi-scale and multi-functional techniques for improving construction and demolition waste, highlighting strategies to reduce the environmental footprint of the construction sector while supporting safer and more sustainable rebuilding practices. Participants also examined Industrial Risk Assessment and the interaction of natural disasters, emphasizing the compound nature of risk in complex urban and industrial environments.

Core engineering principles were further reinforced through sessions on the Earthquake-Resistant Design Philosophy and Experimental Methods in Earthquake Engineering, linking theoretical design concepts with laboratory-based validation and testing practices. These modules underscored the importance of evidence-based engineering decisions in reducing structural vulnerability.

The final segment of the program shifted focus toward societal and infrastructural resilience. Topics included early warning systems, strategies for protecting critical infrastructure, and approaches to building resilient communities capable of accelerating post-disaster recovery. Reflecting emerging global priorities, the program concluded with risk assessment in hydrometeorological disasters, highlighting the growing role of artificial intelligence applications in disaster prediction and management.

Beyond technical instruction, the training served as a platform for reciprocal experience sharing, enabling participants to exchange best practices and institutional perspectives on disaster preparedness between Türkiye and Uzbekistan. The successful completion of the program reaffirmed Uzbekistan's commitment to strengthening disaster resilience, while also demonstrating ITU's role as a regional hub for international cooperation, capacity building, and knowledge transfer in disaster risk reduction.

Constructing Architectural Narratives from Found Materials

Hosted by the ITU Faculty of Architecture, a hands-on workshop invited high school students to explore architectonics, scale, and atmosphere through found electronic scrap. The program emphasized learning-through-making, spatial storytelling, and the embodied experience of architecture.

As part of the itüTA High School Summer Program, hosted by the Faculty of Architecture at Istanbul Technical University between 30 June and 5 July 2025, high school students were introduced to architectural thinking through hands-on design workshops culminating in a public exhibition. Among these, the workshop “Designing Architectural Narratives through Found Scrap Materials: Architectonics, Scale, and Atmosphere,” conducted by Assoc. Prof. Dr. Funda Uz, Res. Assist. Çağdaş Kaya, and Res. Assist. Ayşe Tuğçe Pınar Akın, explored the spatial and narrative potential of discarded electronic components as a medium for architectural inquiry. Using the human body as a primary measure, students investigated architectonics, scale, and atmosphere through cinematic sequencing and the architectural promenade, constructing spaces as experiential narratives shaped by movement, perception, and material engagement. Through the orchestration of light, structure, and material, abstract ideas were translated into spatial expression, emphasizing architecture not as an object but as an embodied, sensory, and process-driven construct, and highlighting the educational value of learning-through-making within an academic architectural environment.

ITU and University of Manchester Launch 3D Printing Initiative to Advance Sustainable Wind Energy

A new international collaboration between Istanbul Technical University and University of Manchester is leveraging 3D printing technologies to develop sustainable wind turbine repair solutions while advancing gender equality in Türkiye’s renewable energy sector.

Istanbul Technical University and the University of Manchester have launched a groundbreaking international research project focused on 3D printing–based innovative repair of recyclable wind turbine blades, supported by the British Council – International Science Partnerships Fund.

The 22-month project, which officially began in January 2025, aims to develop advanced repair methodologies for recyclable composite laminates using 3-D continuous fibre printing technology. By enabling prefabricated repair patches with customizable geometric and mechanical properties, the project seeks to replace conventional, labor-intensive blade repair processes with faster, safer, and more sustainable alternatives.

The collaboration is led by Professor Paul Mativenga of the University of Manchester as Principal Investigator, with Associate Professor Seher Eken of ITU’s Astronautical Engineering Department serving as Co-Principal Investigator. The research team also includes Dr. Akın Atas (University of Manchester), Assistant Professor Oguzcan Inal (ITU, Aeronautical Engineering), and Assistant Professor Kaan Yıldız (ITU Aviation Institute).

The project has secured £79,880 in total funding, with £39,983 allocated to ITU, reflecting the strong institutional commitment to international, impact-driven research partnerships.

Beyond technological innovation, the initiative places a strong emphasis on sustainability, workforce inclusivity, and safety. Compared to traditional repair methods—which require technicians to manually apply and cure multiple composite layers while suspended on turbine blades—3D-printed repair patches can significantly reduce blade downtime and operational risk, particularly in challenging offshore environments.

In addition, the inherent advantages of 3D printing, including reduced physical labor, minimal material waste, and relatively low capital investment, are expected to lower entry barriers and attract individuals from diverse social and economic backgrounds, including underrepresented gender identities, into the wind energy workforce.

These objectives were highlighted during the “3-D printing for Women, Wind and Wealth (3Dfor3W)” event held on May 27, 2025, which featured a 3D printer demonstration following an initial online project meeting. The event underscored the project’s commitment to empowering women in engineering while advancing wind energy technologies and economic value creation.

By combining Türkiye’s favorable investment environment with the United Kingdom’s technological expertise, the ITU–Manchester partnership aims to accelerate collaboration in the offshore wind sector and establish best practices with global relevance. Aligned with Official Development Assistance (ODA) principles, the project contributes to global efforts in climate action, sustainable development, and inclusive innovation.

23 Projects, One ITU: Advancing Impact-Driven Research

Through Türkiye's national research funding system coordinated by the Scientific and Technological Research Council of Türkiye (TÜBİTAK), Istanbul Technical University secured funding for 23 research projects under the ARDEB 1001 Program (2025, 1st Call), reflecting its continued commitment to responsibility- and impact-driven research.

The Scientific and Technological Research Council of Türkiye (TÜBİTAK) is the country's principal public institution responsible for supporting and coordinating research, innovation, and technological development across all scientific disciplines. Among its flagship funding instruments, the ARDEB 1001 Scientific and Technological Research Projects Program supports original, high-quality academic research that contributes to scientific advancement, national priorities, and long-term societal benefit through a rigorous peer-review process.

Within this highly competitive framework, Istanbul Technical University (ITU) achieved a significant milestone in the 2025 1st Call by having 23 projects selected for funding. This result reflects not only scientific merit, but also the effectiveness of ITU's institutional research ecosystem—where structured support mechanisms, interdisciplinary collaboration, and shared academic learning enable research ideas to mature into impactful proposals.

The distribution of supported projects illustrates the breadth of ITU's research capacity. The Faculty of Science and Letters led with six projects, with the Department of Chemistry distinguishing itself through four funded projects. The Faculty of Electrical and Electronics Engineering followed with five projects, while Control and Automation Engineering contributed three projects, collectively demonstrating a balanced and diverse research profile across disciplines.

The funded projects span a wide thematic range, including artificial intelligence, climate sciences, sustainable environmental technologies, nanotechnology, space engineering, and interdisciplinary fields extending from art to urban planning. This diversity underscores ITU's ability to integrate fundamental research with contemporary global challenges and societal needs.

Highlighting this achievement, ITU Rector Prof. Dr. Hasan Mandal emphasized the strong potential of every researcher at ITU to contribute meaningfully to Türkiye's scientific and technological development. Over the past year, this vision has been operationalized through comprehensive workshops, strengthened institutional support structures, and platforms that encourage experience sharing and collective learning.

As part of the Project Coordinators Information and Evaluation Meeting, certificates of appreciation were presented to the coordinators of the 23 funded projects. Beyond recognition, the meeting fostered reflection on project development processes and reinforced a culture of continuous improvement and collaboration.

Ultimately, the 2025 TÜBİTAK–ARDEB 1001 results represent more than numerical success. They stand as a concrete expression of ITU's vision as a "Responsibility- and Impact-Driven Research University," where scientific excellence, interdisciplinary cooperation, and societal value are advanced together in a sustainable and forward-looking research environment.

Strong Start for Projects Supported Under the ITU Platform Project Program

The ITU Platform Project Program, which was launched for the first time in 2025 and accepted applications, with a signing ceremony held at our Ayazağa Campus, marking the official launch of five platforms deemed worthy of support. The platforms stand out for their qualities that strengthen interdisciplinary collaboration within the ITU research ecosystem and support joint production in strategic areas.

The official launch of projects supported under the ITU Platform Project Program was marked by the signing of agreements at a ceremony held at the Süleyman Demirel Cultural Center on January 12. At the ceremony, deans of the faculties involved in the projects, participating academics, and students gathered under the auspices of ITU Rector Prof. Dr. Hasan Mandal.

ITU Rector Prof. Dr. Hasan Mandal expressed his satisfaction with the signing ceremony for the five platforms, noting that the platform projects were inspired by the university's long-standing history. Prof. Dr. Mandal stated that projects carrying the mission of creating value for society from the past to the present embody ITU's vision of being a responsibility and impact-focused research university.

Our Rector emphasized that each platform project brings together ITU's knowledge base with our students and stakeholders. He noted that the platforms have strengthened the culture of interdisciplinary collaboration and laid the foundations for a sustainable research ecosystem. He thanked the platform project leaders, researchers, students, and stakeholders, expressing his hope that the projects would become a success story that adds value to Türkiye.

At the signing ceremony, our academic platform project managers gave presentations. Following the presentations, the agreements were signed to mark the start of the projects.

Each platform was designed as a structure that generates innovation and added value within itself and fosters learning. Students' active participation plays an important role in shaping the platforms. This quality, which enables the expansion of platform projects in terms of scope, further strengthens the impact that the project will generate.

Five platform projects that have secured support for the ITU Platform Project Program, strengthened by university-industry-public sector collaborations, offer opportunities for a total of 74 researchers from 13 different departments at ITU to shape the technologies of the future.

Platform projects eligible for support:

Geohazard Monitoring and Risk Analytics Platform (GeoRiskHub):

GeoRiskHub analyzes climate change-related disaster risks in a dynamic and integrated structure, offering a high-capacity risk ecosystem by evaluating multiple hazard scenarios.

Director: Prof. Dr. Tolga Görüm - Eurasian Institute of Earth Sciences

Electric Energy Generation from Istanbul Bosphorus Currents

The turbine system, which utilizes the currents of the Bosphorus, contributes to sustainable transportation goals by integrating environmentally friendly and low-noise energy production with maritime transport.

Director: Prof. Dr. Uğur Oral Ünal - Department of Naval Architecture and Marine Engineering

IPMED: Integrated Photonics and Microfluidics Early Diagnosis Systems Platform:

IPMED, which combines photonics, microfluidics, and biosensor technologies, offers domestic solutions for the early diagnosis of cancer and other diseases.

Director: Prof. Dr. Levent Trabzon - Department of Mechanical Engineering

E-TEXIOT: E-Textile Suit as an IoT Platform:

The platform, which integrates wearable sensors with IoT infrastructure, develops scalable solutions for healthcare, rehabilitation, and smart living applications.

Director: Assoc. Prof. Dr. Gökhan İnce - Department of Computer Engineering

New Horizons in Integrated Circuit Design, Modeling, and Optimization:

Artificial intelligence, quantum algorithms, and cyber security approaches are producing solutions that will deliver efficiency, security, and high performance in chip design.

Director: Assoc. Prof. Dr. Mustafa Berke Yelten - Department of Electronics and Communication Engineering

A Step by ITU and TUA to Strengthen the National Space Program

At Istanbul Technical University, the Space Support Systems Application and Research Center has been established under a first-of-its-kind organizational model in Türkiye, dedicated to advancing the National Space Program.

Through the collaboration between Istanbul Technical University (ITU) and the Turkish Space Agency (TUA), a concrete and innovative step has been taken toward the realization of Türkiye's space vision. Established with the aim of full administrative integration with the Turkish Space Agency, the Istanbul Technical University Space Support Systems Application and Research Center will directly contribute to strengthening Türkiye's operational capabilities in space.

ITU Rector Prof. Dr. Hasan Mandal emphasized that the Center adopts a pioneering model and made the following statement: "The Center established today represents not only a new research unit, but also the initiation of a new model for university–agency collaboration in our country. Through the integrated structure created with TUA at the administrative level, we will be able to respond to the needs of the National Space Program in a significantly faster and more effective manner. The Center will develop, through national means, the support infrastructure that will serve as the brain and nervous system of missions, and will evolve into a strategic center of competence in this domain."

While numerous universities across Türkiye conduct valuable R&D activities in the space field, the Center established at ITU distinguishes itself through its mission and unique governance structure. Beyond satellite manufacturing, the Center aims to establish a "Command and Control" infrastructure designed to manage the full spectrum of space missions. By focusing on support systems including energy, space weather, communications, navigation, and artificial intelligence it is positioned to assume a strategic role.

The inclusion of three TUA representatives on the Center's seven-member Board of Directors, within the framework of this pioneering model for Türkiye in university–agency collaboration, reflects a permanent and operational partnership that extends beyond project-based cooperation.

The Center's principal areas of activity include:

- Designing, establishing, and operating support systems for space missions.
- Processing data acquired from space and transforming it into real-time, value-added services.
- Producing academic publications at national and international levels, and organizing trainings and workshops.
- Developing sustainable business and service models for the technologies developed.

The Marmara Active Fault Hazard and Risk Application and Research Center (MATAM) Has Been Opened

The opening ceremony of the Marmara Active Fault Hazard and Risk Application and Research Center (MATAM), established through the collaboration between Istanbul Technical University (ITU) and Türkiye İş Bankası, was held on August 13, 2025, at the ITU Ayazağa Campus.

The Istanbul Technical University – Türkiye İş Bankası Marmara Active Fault Hazard and Risk Application and Research Center (MATAM) opened its doors in the building constructed at ITU Ayazağa Campus. The opening ceremony of the center was followed with great interest by participants and media representatives at the Conference Hall of ITU Faculty of Computer and Informatics. As part of the ceremony, a ribbon-cutting was held at MATAM.

ITU Rector Prof. Dr. Hasan Mandal stated that MATAM brings together various fields such as earth sciences, environmental sciences, digital technologies, disaster management, geophysics, geodesy, risk modeling, and engineering around a common goal, forming an interdisciplinary ecosystem. Prof. Dr. Mandal emphasized that MATAM is a collaborative and co-development environment where expert academics in their fields learn from one another, generate knowledge, and transform it. He described MATAM as a development platform where researchers from different disciplines learn from each other, in line with ITU's strategy of learning together. Our Rector highlighted that the center stands out as an innovative model in disaster preparedness. He noted that young researchers at undergraduate, graduate, and doctoral levels will not only meet today's needs but also form a responsible and solution-oriented human resource for effective disaster management in the future.

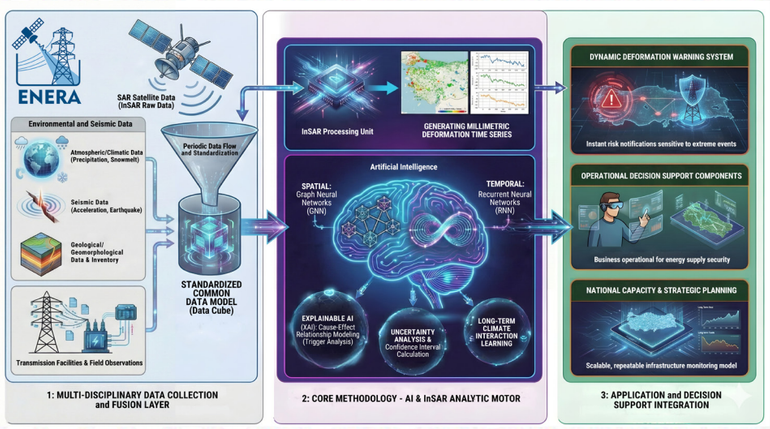
MATAM, which will monitor both land and sea fault lines on a scientific basis and evaluate risks in a dynamic and interactive manner, stands out with its infrastructure capable of collecting data at a micro scale and continuously assessing hazards and risks in a numerical and up-to-date way. Referred to as "Türkiye's Apollo Project" for representing a pioneering, challenging, and transformative step, MATAM aims not only to produce data but also to transform this data into continuously updated risk scenarios, 24/7, by integrating it with emerging technologies.

ITU and TEİAŞ Launch AI-Integrated InSAR Project to Safeguard Türkiye's Energy Transmission Infrastructure

Istanbul Technical University (ITU) and the Ministry of Energy and Natural Resources, Turkish Electricity Transmission Corporation (TEİAŞ) have launched a major research and development initiative titled "Development of an InSAR & AI-Based Deformation Warning System for Energy Transmission Infrastructure (ENERA)", aimed at enhancing the safety, resilience, and continuity of Türkiye's national energy transmission network.

The project focuses on monitoring and mitigating geological and geomorphological hazards—such as landslides, ground subsidence, erosion, and mining-induced deformation—that threaten critical assets including power transmission lines, substations, and switchyards. By integrating advanced satellite remote sensing with state-of-the-art artificial intelligence, ENERA represents a significant step toward proactive, data-driven infrastructure management.

At the core of the project is the use of Interferometric Synthetic Aperture Radar (InSAR) technology, based on long-term data from the European Space Agency's Sentinel 1 satellites, with archives extending back to 2018. This approach enables millimeter-level detection of surface deformation across large, inaccessible areas, without the need for ground-based instrumentation.



Beyond monitoring, ENERA introduces a hybrid and explainable artificial intelligence (XAI) framework that combines Graph Neural Networks (GNNs) and Recurrent Neural Networks (RNNs) to capture both spatial relationships and temporal deformation patterns. By integrating seismic, meteorological, and geological data, the system can distinguish between seasonal ground movements and deformation signals that may indicate emerging structural risk.

The platform is designed as an active decision-support and warning system. Automated workflows generate deformation-based risk maps, uncertainty metrics, and alerts that can be directly integrated into TEİAŞ's operational processes, enabling timely intervention and optimized maintenance planning.

With a total budget of €6 million, the project is coordinated by Professor Tolga Görüm at ITU, Eurasia Institute of Earth Sciences. As Türkiye's first large-scale application of AI-integrated InSAR for energy infrastructure, ENERA establishes a nationally significant R&D capacity and offers a scalable monitoring model applicable to other critical systems such as dams, pipelines, and transportation networks, in line with global climate adaptation and energy security goals.

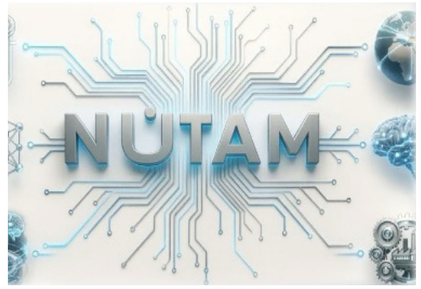
Nuclear Technology Research Center (NÜTAM) foundation is underway!

İTÜ initiated the foundation of Nuclear Technology Research Center (NÜTAM) that will integrate research and development, human resource training, manufacturing, and commercialization processes with a multidisciplinary approach based on cooperation between the public sector, academia, and industry and integration with international platforms within the scope of Turkish Law No. 6550 on the Support of Research Infrastructures in order to enable Türkiye to develop high-tech, sustainable, and safe solutions in the field of nuclear technology.

In line with the national energy policies, the center aims to be a leading research and technology center in the field of nuclear energy that will lead complete independence in nuclear technology, will develop and export technology through interdisciplinary and system-level integrated research and development activities and training of highly qualified human resources.

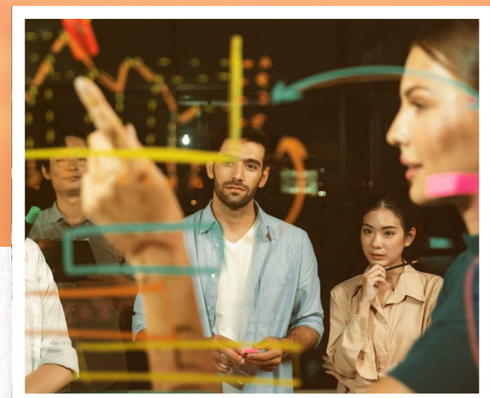
Nuclear technology is an interdisciplinary field where human resources with knowledge and experience in many engineering disciplines must work together. With its education programs, infrastructure in engineering disciplines, and teaching and research staff, İTÜ is the leading institutions in Türkiye. Education and research activities in the field of nuclear energy have been ongoing since 1962. A 250 kW pool-type research reactor was constructed and licensed at the ITU Ayazağa Campus in 1979. The ITU TRIGA Mark II Training and Research Reactor has been actively used for both research, development, and experimental studies and internship-training programs. In addition it has created a suitable environment for the application of techniques such as neutron radiography and neutron activation analysis.

The center is going to focus on five pillars of nuclear technology at its foundation. Nuclear Reactor Design, Nuclear Reactor Materials and Manufacturing, Nuclear Fuel and Waste Management, Nuclear Instrumentation and Control (I&C), and Turbine Island and Equipment Design. With these pillars, the aim of the center are



- Development and construction of a domestic SMR non-fueled prototype.
- Strengthening existing engineering expertise and computational infrastructure to enable domestic design of nuclear power plants.
- Developing Türkiye's nuclear material standards, testing and certification infrastructure, and creating domestic manufacturing capabilities for components.
- Establishing integrated simulation, modeling, and monitoring systems in the field of nuclear fuel cycle and radioactive waste management.
- Development of AI-powered control systems with nuclear I&C and digital twin solutions.
- Sustainable institutionalization of technology and knowledge transfer to industry,
- Contributing to technology exports through the commercialization of products, methods, software, and processes resulting from R&D and innovation activities.

Deep Tech European Venture Builder – De-TECH is a multi-phase European project funded by EIT HEI (European Institute of Innovation and Technology Higher Education Initiative) 2024 Call.



The De-TECH Effect: Accelerating Deep-Tech Innovation and New Venture Creation

Deep Tech European Venture Builder – De-TECH is a multi-phase European project funded by EIT HEI (European Institute of Innovation and Technology Higher Education Initiative) 2024 Call. The project aims to bridge the gap between university research and the market, accelerating the creation, scaling, and long-term sustainability of deep-tech ventures based on advanced technologies such as artificial intelligence, biotechnology, aerospace, and quantum computing, by strengthening collaboration among higher education institutions, industry, and innovation ecosystems across Europe.

Funded under the EIT HEI (European Institute of Innovation and Technology Higher Education Initiative) 2024 Call, the project is part of a €63 million program supporting 47 interdisciplinary projects. De-TECH has a total maximum funding capacity of €1.34 million. Istanbul Technical University (ITU) plays a key role in the consortium, contributing to entrepreneurship and mentoring in mentor training, mentor network development, venture creation, valorization, capacity building, and ecosystem integration for deep tech.

The project was selected in March 2025 following a competitive call process and officially commenced on April 1, 2025. Implementation is structured across three stages: Phase 1 (2025) focuses on program design and pilot implementation; Phase 2 (2026-2027) targets full deployment and scaling, ensuring institutionalization and long-term sustainability.

De-TECH operates across a multi-stage model that includes technology identification, industry. The consortium brings together seven partners across Europe, including four major universities: Universidad Politécnica de Madrid (UPM), Istanbul Teknik Üniversitesi (İTÜ), Estonian Business School (EBS) – Estonia, Leibniz University Hannover (LUH) – Germany, Technoport - Luxembourg - a major tech business incubator,, Effectia - Spain – a science communication consultancy firm, and Istanbul Metropolitan Municipality – Türkiye.

İBB - Türkiye, including leading universities, a consultancy firm, and a metropolitan public authority. By combining research excellence, entrepreneurial education, and real-world industry engagement, De-TECH aims to establish a scalable and sustainable European venture builder model for deep-tech innovation.

In 2025, DeTECH organized and led innovation challenges, a 10-week venture builder competition, comprehensive entrepreneurship and mentoring programs, and AI Education. Hundreds of students, academicians, and non-academic staff have received training, mentoring, and tens of deeptech innovators and startups had the chance to pitch to the consortium ecosystem and investors. 4 ventures have received financial awards, and 3 new deeptech startups have been established with DeTECH support.

Rebuilding with Purpose: Empowering Communities in the Wake of Crisis

The Center for (Post)-Crisis Urban Reconstruction (CURE) is based on a vision for a world in which communities and urban areas devastated by war or disaster can rebuild with dignity, justice, and resilience. Its goal is to become a global catalyst for promoting equitable, inclusive, and robust urban environments.

The Center for (Post)-Crisis Urban Reconstruction (CURE) is based on a vision for a world in which communities and urban areas devastated by war or disaster can rebuild with dignity, justice, and resilience. Our goal is to become a global catalyst for promoting equitable, inclusive, and robust urban environments in crisis and post-crisis contexts. Through innovative recovery and reconstruction approaches, we strive to transform devastation into a catalyst for equity, cultural preservation, and sustainable development—ensuring that every individual and community can flourish in revitalized and reimagined environments.

The establishment of CURE research center represents a critical step in advancing knowledge for post-crisis reconstruction. By generating evidence-based insights, we aim to inform policy, guide reconstruction strategies, and contribute meaningfully to the rebuilding of societies.

CURE's mission is to co-develop knowledge and actionable frameworks that foster resilience, equity, and flourishing in post-crisis societies, particularly in urban contexts. By integrating research, practice, and collaboration across multiple disciplines, we aim to empower communities to rebuild stronger and more inclusively.

In alignment with the United Nations Sustainable Development Goals (SDGs), CURE undertakes the following core activities:

1. Research: Conducting in-depth and applied studies on post-crisis urban recovery and spatial justice.

2. Education: Providing accessible, transformative learning opportunities for diverse groups—ranging from scholars and students to community-based organizations.

3. Consultation: Offering expert guidance and advisory services to communities, governments, and organizations during and after periods of conflict or disaster.

4. Practice: Developing and implementing practical, on-the-ground solutions for rebuilding communities and public spaces.

5. Technical Support: Delivering tools, methodologies, and expertise that facilitate rehabilitation and resilience.

CURE focuses on regions worldwide, including Palestine (Gaza, West Bank, and Jerusalem), the Balkans, Africa, Southeast Asia, and the Middle East. By addressing the critical needs of these areas, CURE aims to foster sustainable, equitable, and resilient urban environments.

Through a holistic, practice-oriented approach to post-crisis urban reconstruction, CURE:

- Integrates multiple disciplines—including architecture, planning, engineering, social sciences, and policy—to offer comprehensive frameworks for rebuilding.
- Emphasizes localized yet scalable solutions, ensuring that strategies are both context-sensitive and adaptable to other conflict-affected areas globally.
- Bridges research and practice through on-the-ground projects, community engagement, and capacity-building programs, thus moving beyond theoretical understanding to practical implementation.
- Prioritizes social justice and resilience in reconstruction processes, aiming to foster inclusive and equitable urban environments post-crisis.

Science With Society: **ITU's Approach to Public Engagement and Shared Knowledge**

At Istanbul Technical University, scientific knowledge is not only generated for society, but increasingly developed with society—through dialogue, participation, and shared learning.

In a world shaped by climate change, rapid digitalization, and emerging global risks, universities are being called upon to rethink how science is produced and communicated. At Istanbul Technical University (ITU), one of Türkiye's leading research universities, this shift has led to a growing emphasis on public engagement, science communication, and collaborative knowledge production that connects academic research with everyday life.

Rather than viewing science as a closed activity confined to laboratories and academic journals, ITU increasingly approaches science as a social process—one that benefits from interaction with citizens, students, and diverse communities. This perspective aligns with a broader global transformation in higher education, where universities are expected not only to advance scientific excellence, but also to contribute actively to societal understanding, trust, and resilience.

From "Science for Society" to "Science with Society"

In Türkiye, public discussions around science and technology are often framed through the distinction between science for society and science with society. The former emphasizes expert-driven solutions developed within academia and later delivered to the public. While this model has historically enabled major scientific and technological advances, it can sometimes overlook social priorities, ethical concerns, or lived experiences.

The latter approach—science with society—embraces participation, dialogue, and co-creation. At ITU, this understanding increasingly informs both research and education. Complex challenges such as climate change, artificial intelligence, sustainable cities, or disaster resilience require not only technical expertise, but also social insight, public dialogue, and interdisciplinary collaboration. By involving society earlier in research and learning processes, universities can produce knowledge that is both scientifically robust and socially meaningful.

Opening Science to the Public

A key component of ITU's science–society engagement is the creation of open, accessible spaces where scientific topics can be discussed beyond academic settings. One such initiative is Science Café (Bilim Kafe), a public science conversation format coordinated nationally in Türkiye to bring researchers and citizens together in informal venues such as libraries and cultural centers.

In Istanbul, ITU has actively contributed to Science Café events focusing on contemporary topics such as artificial intelligence. These gatherings allow researchers, students, and members of the public to engage in direct conversation—asking questions, sharing perspectives, and exploring how emerging technologies shape daily life. By hosting scientific discussions in familiar public spaces, ITU helps demystify complex ideas and encourages broader participation in scientific dialogue.

Engaging with Youth and Future Innovators

Public engagement becomes particularly impactful when it reaches young audiences. In Türkiye, large-scale science and technology festivals—such as TEKNOFEST, a national event celebrating innovation, engineering, and entrepreneurship—play an important role in connecting youth with science. ITU's active presence in these environments reflects its commitment to inspiring future scientists, engineers, and creative thinkers.

Through interactive talks, demonstrations, and team-based projects, ITU researchers and students engage directly with young participants, emphasizing that science and technology are not distant disciplines, but fields shaped by curiosity, collaboration, and creativity. Discussions around artificial intelligence, space technologies, and engineering design highlight those future skills will increasingly cut across traditional disciplinary boundaries—spanning engineering, social sciences, health, and the arts alike.

Universities as Civic and Educational Actors

ITU's approach to science with society is also embedded in its educational philosophy. New-generation university education increasingly integrates societal challenges into curricula through interdisciplinary courses, project-based learning, and collaborations with public institutions and civil society organizations. Students are encouraged to apply scientific knowledge to real-world problems, developing not only technical expertise but also communication skills, ethical awareness, and social responsibility.

This model positions the university as a civic actor—one that contributes to public understanding and collective problem-solving. By aligning research and education with societal priorities, ITU strengthens the relevance and impact of academic work while preparing graduates to navigate complex professional and social environments.

Dialogue, Trust, and Responsible Innovation

In rapidly evolving fields such as artificial intelligence or biotechnology, scientific progress must be accompanied by public dialogue and ethical reflection. At ITU, science communication activities aim to foster two-way interaction, where researchers listen as much as they explain. This dialogue-based approach helps build trust, encourages transparency, and supports responsible innovation.

Public talks, interactive workshops, and community-oriented science events enable citizens to engage with scientific developments that directly affect their lives. At the same time, researchers gain insight into public concerns and expectations, allowing research agendas to better reflect societal values.

> ***By creating spaces for dialogue, ITU strengthens trust between academia and society, ensuring that scientific progress is both responsible and socially grounded.***

Towards a Shared Scientific Future

As global challenges become more interconnected, the relationship between science and society grows increasingly important. Istanbul Technical University's commitment to public engagement reflects a broader vision of research universities as bridges—connecting knowledge production with social understanding and collective learning.
By opening science to dialogue, participation, and shared ownership, ITU demonstrates that scientific excellence and societal impact are not competing goals, but complementary ones. In this model, science advances most effectively not in isolation, but together with the communities it seeks to serve.

by Res. Asst. Dr. Burak Korkmaz

EELISA European University Charts Future at ITU

The EELISA "Grand Meetings" were held at Istanbul Technical University (ITU) Süleyman Demirel Cultural Center, bringing together administrators, academic and administrative representatives, and students from partner universities to mark the launch of "EELISA 3.0." Over 130 participants attended, engaging in governance, research, student leadership, and innovation-focused panels and meetings.

From November 18–19, the Governing Board set the alliance's long-term strategic direction. Following EELISA's six-month rotating chairship tradition, ITU Rector Prof. Dr. Hasan Mandal took over as Chair from Université PSL and ENPC (France). Prof. Dr. Mandal highlighted ITU's goal to strengthen EELISA within institutional strategies, empower students, enhance staff collaboration, and build socially visible, mission-oriented EELISA communities.

As part of EELISA's expansion, the University of São Paulo (USP, Brazil) and the Technical University of Moldova (UTM, Moldova) joined as Co-Partner Adherents. ITU signed MoUs with both institutions to promote student and staff mobility, and research, development, and innovation collaborations. The Governing Board also began evaluating criteria for EELISA's transition to legal entity status to reinforce governance.

EELISA 2.0's progress over the past two years was reviewed, including innovation initiatives and sustainability strategies shaping the 3.0 period. The "Framework for Institutionalization, Staff Incentives, Engagement and Recognition" was submitted for approval to strengthen staff participation and recognition. Support for an Erasmus Mundus joint degree and integrated European education model was also discussed.

The Executive Board assessed progress in its fifth year, reviewed digital campus, lifelong learning, joint pedagogy, and community initiatives, and clarified success indicators and next-period goals. Staff Representatives focused on increasing engagement, recognition, and institutionalization, while preparing for Erasmus+ staff exchanges and task programs.

The Student Council evaluated proposals to enhance its sustainability and effectiveness, including local office structures, mentoring, recognition mechanisms, and career programs. The first Student-Led Bootcamp encouraged interdisciplinary student teams to develop innovative solutions to real-world challenges. Over 60 students produced prototypes, business models, and proposals to strengthen institutionalized student leadership across EELISA.

These meetings laid the groundwork for EELISA's continued development as a sustainable, integrated, and impactful European University, advancing education, research, innovation, and governance across the alliance.

Bridging Academia and Industry: An AI-Powered Platform for Autonomous Material Microstructure Analysis

AI-Powered Autonomous Material Microstructure Analysis Platform project establishes an artificial intelligence–driven framework for predicting the mechanical properties of Spheroidal Graphite (SG) and Gray Cast Iron by combining materials science with advanced computer vision and machine learning techniques.

The platform analyzes microstructural data obtained from Scanning Electron Microscopy (SEM), optical microscopy, and standardized laboratory tests, enabling rapid and high-fidelity characterization of both the metallic matrix and graphite morphology. By automating feature extraction and analysis, the system replaces time-consuming, operator-dependent testing procedures with objective, reproducible, and data-driven evaluations.

In industrial sectors such as automotive and construction, traditional material characterization methods are often costly, slow, and sensitive to human bias. As production cycles accelerate and quality requirements become more stringent, there is a growing need for faster and more reliable approaches to assess material performance. This project directly addresses this need by introducing an AI-supported platform that enhances efficiency while improving consistency and traceability in material evaluation.

The project builds on a strong and reliable data foundation generated in a controlled experimental environment. This controlled development phase provides robustness and scientific validity before the platform expands to incorporate large-scale industrial data.

The platform is being developed through a strong interdisciplinary collaboration between the ITU Artificial Intelligence and Data Science Research and Application Center (ITU AI) and ITU MME.

- The ITU Artificial Intelligence and Data Science Research and Application Center leads the development of artificial intelligence models, database infrastructure, and the web-based platform.

- The ITU Metallurgy and Materials Engineering Department contributes deep domain

This close integration of disciplines enables the translation of complex microstructural information into actionable mechanical property predictions.

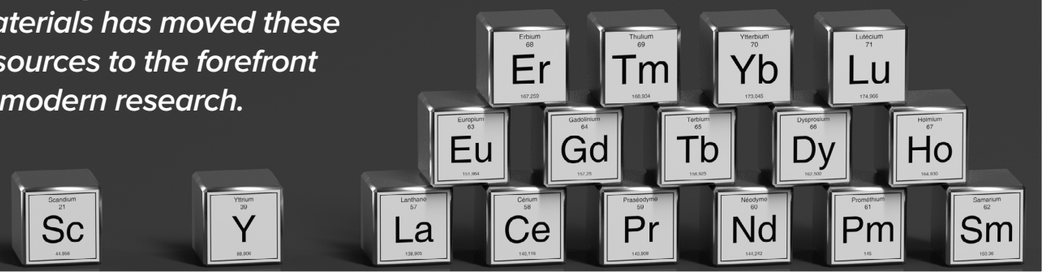
Industrial accessibility is a central design principle of the platform. Through a web-based interface, industry professionals can input material data and rapidly obtain analysis results, supporting informed decision-making across production and quality control processes. At the same time, the systematic digitization of microstructural and experimental data ensures the preservation and transfer of accumulated material knowledge to future generations.

The Turkish Foundry Association (TÜDOKSAD) plays a key role in bridging academia and industry by supporting pilot applications and validating project outputs in real production environments. These collaborations strengthen the platform's readiness for broader industrial adoption and create a pathway for extending the AI infrastructure to other metal systems. In doing so, the project contributes to increasing the global competitiveness and technological capacity of the manufacturing industry.

While the current focus centers on predicting and classifying the mechanical properties of SG and Gray Cast Iron, the project is conceived as a long-term foundation for intelligent material design. In its next phase, the platform advances from prediction toward generative optimization, leveraging generative artificial intelligence to recommend chemical compositions, cooling rates, and heat treatment strategies that achieve targeted mechanical outcomes. This shift from analysis to intelligent decision support marks a significant step toward more efficient, adaptive, and innovation-driven industrial production.

Pioneering an Integrated Rare Earth Infrastructure: **From Bastnasite Ore to High-Value End Products**

In recent years, the rapidly growing demand for next-generation and critical metals/ materials has moved these resources to the forefront of modern research.



Rare Earth Elements (REEs), a cornerstone of present and future technologies, play a critical role across a wide range of applications, from the energy transition to defense, electronics, and medical technologies. REEs comprise 17 metallic elements that occur together in nature and are notoriously difficult to separate due to their highly similar chemical properties.

Aligned with our University's strategic objectives on continuous development and research infrastructure strengthening, the Rectorate has prepared the interdisciplinary project entitled "Establishment of an Integrated Pilot-Scale Production Infrastructure for Strategic and Critical Rare Earth Metals, Compounds, and End Products from Domestic Resources." This initiative aims to establish a fully integrated, pilot-scale production infrastructure to transform the high reserve at the Eskişehir Bastnasite deposit into high value-added oxide, salt, and metal products. REE production processes are inherently multi-stage, complex, and highly knowledge-intensive. Within this framework, an integrated technology chain will be developed, encompassing ore preparation, hydrometallurgy, solvometallurgy, solvent extraction, and molten-salt electrolysis.

The project targets >90% process yield for critical REEs, high-purity product streams, and an infrastructure at TRL-6 level to enable transition toward industrial scale, thereby contributing to the development of domestic and national technological capabilities.

Expected Outputs and Contributions:

• Monitoring global developments to define the key, needs-driven dynamics in the REE field for Türkiye; to strengthen national mining and metallurgical strategies through R&D and innovation; and to contribute to national security.

• Recognizing Türkiye's REE ore resources as a major opportunity for the country's technological and strategic transformation goals. In this context, efficient processing of the ore should be considered not only an economic opportunity but also a strategic investment for geopolitical independence. In line with the National Energy and Mining Policy and the Strategy for Effective Management of Subsurface Resources, the project will support the effective utilization of domestic raw-material resources, domestic production of high value-added products, and the reduction of external dependence on critical raw materials.

• Enabling the sustainable production of REE concentrates with high grade and low impurity levels through ore preparation routes that are economically, environmentally, and technically viable; and, based on generated data, proposing a holistic beneficiation flowsheet for the recovery of REEs, barite, and fluorite.

• Defining tailored and original process details suitable for Türkiye's REE concentrates, and establishing a technically robust basis for scale-up and further technology development.

On the Road to Türkiye's Energy Independence

Calls for platform projects in nuclear technologies and special call for general research projects have launched.

In line with national energy and research policies, two strategically prioritized research calls in the field of nuclear technologies are being brought together with our University's strong research ecosystem. In today's world, where energy has become a strategic necessity at the intersection of climate, economy, technology, and geopolitics, the 2026 Call for Platform Projects in Nuclear Technologies aims to support scientifically and technologically qualified, interdisciplinary platform projects that place our University's research units with strong infrastructure at the center. Through this call, we place great importance on strengthening societal impact, benefit, and sustainable development outcomes.

This call offers a broad thematic framework covering Small Modular Reactor (SMR) and Generation IV (Gen-IV) reactor designs, reactor safety, digital twin and artificial intelligence applications, as well as advanced materials, fuel, and nuclear waste management. Within this scope, platform projects with high scientific depth and technological competence will be implemented with a total support budget of 10,000,000 TL.

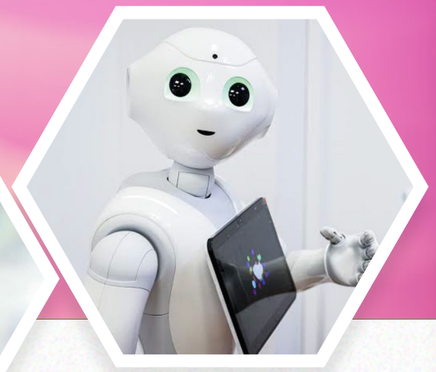
Through our other call, the Special Call for General Research Projects (ÖÇGAP), we aim to strengthen our University's scientific capacity in strategically prioritized areas of nuclear technologies.

Under the theme "Strategically Prioritized Research Topics in Nuclear Technologies," this call, to be conducted by our Scientific Research Projects (BAP) Unit, will support multidisciplinary projects with high scientific output potential, with an upper funding limit of 1,000,000 TL.

As ITU, we host Türkiye's first and only university research reactor; we support projects aligned with the 2053 net-zero emissions target by undertaking the academic coordination of the Nuclear Technology Development Park, and we equip our students with competencies in the nuclear field through our innovative minor programs.

SMR studies, which align with the "development of a domestic modular nuclear reactor" objective stated in the 2030 Industry and Technology Strategy, clearly demonstrate the strategic importance of these calls.

Through the Nuclear Technopark, which will be established in the near future, ITU will provide academic leadership for these projects and resolutely support Türkiye's goal of becoming a country that produces knowledge and technology in nuclear technologies, in line with the National Technology Initiative.



Since its establishment, Istanbul Technical University (ITU) has consistently undertaken responsible actions aimed at protecting the environment and generating positive societal impact. The outcomes of this integrated sustainability approach are clearly reflected in international rankings.

Commitment to a Sustainable World

Building on this long-standing commitment, the ITU Green Campus project was launched in 2013 and has continuously expanded through a wide range of practices and initiatives. To further consolidate and institutionalize these efforts, the Sustainability Office was established in 2021. The Office's mission is to integrate sustainability as a core principle across education, research, and governance, while its vision is to embed sustainability values throughout all ITU units, positioning the University as both a national and global role model. In line with these objectives, the Sustainability Office actively contributes to the achievement of the United Nations' 17 Sustainable Development Goals (SDGs) and supports Türkiye's national zero-waste policy.

In the UI GreenMetric World University Rankings established in 2010 under the initiative of the University of Indonesia ITU's Ayazağa Campus ranked 25th worldwide, 15th in Europe, and first in Türkiye for the ninth consecutive year in 2025 among 1,745 campuses from 105 countries. This strong performance serves as a tangible indicator of ITU's achievements in energy and water efficiency, waste management, green transportation, and environmentally friendly campus policies.

Complementing its campus-based initiatives, ITU advances sustainability through education and research aligned with the SDGs. In this context, the 100% English-taught Sustainability MSc (with thesis), launched in the 2023–2024 academic year, aims to train highly qualified experts in sustainable development and sustainability management. With its interdisciplinary structure encompassing engineering, architecture, and social sciences, the program responds to industry demand for skilled professionals while strengthening university–industry collaboration. Receiving an average of 100 applications per term, the program currently hosts 64 students from 21 different universities and 23 academic disciplines, fostering a diverse and dynamic learning environment.

ITU's sustainability-driven impact is also recognized at the global level. In the Times Higher Education (THE) Impact Rankings 2025, ITU ranked 48th among 2,318 universities worldwide and achieved 3rd place globally in SDG 4, Quality Education. Furthermore, by ranking within the top 100 in eight different SDGs, ITU has reaffirmed its vision as a research university focused on responsibility, inclusiveness, and measurable societal impact.

Beyond graduate education, ITU continues to broaden sustainability literacy across its academic ecosystem. With the launch of the Sustainability Master's Program in 2023–2024, students are encouraged to strengthen the link between academia and industry through interdisciplinary, solution-oriented theses. In addition, ITU has introduced a Sustainability Minor Program the first of its kind which goes beyond conventional diploma education by equipping students with the competencies needed to anticipate future challenges and develop solutions that address both present and emerging sustainability needs.

Istanbul Technical University's Incubation Center, ITU Çekirdek, Is the World's Best*

Built on Istanbul Technical University's 250+ years of academic background, ITU ARI Teknokent operates as a globally connected entrepreneurship and technology ecosystem. Bringing together technology companies, startups, researchers, investors, and international partners, it enables ideas developed in Türkiye to scale beyond borders. At the heart of this ecosystem stands ITU Çekirdek Incubation Center—ranked #1 worldwide by UBI Global in 2023 among 1,895 incubators and accelerators—setting a global benchmark for university-driven entrepreneurship.

Founded in 2002, ITU ARI Teknokent has been one of Türkiye's leading technology development zones and plays a critical role in the country's innovation and entrepreneurship ecosystem. From its early years, its focus has been clear: to help technology companies and startups grow by connecting academic knowledge with sector expertise and global markets.

At ITU ARI Teknokent, technology is not regarded as a sole purpose. What matters is impact—new products, sustainable companies, qualified employment, and international competitiveness. This perspective shapes how the ecosystem is designed and how its programs, collaborations, and long-term priorities are structured.

ITU ARI Teknokent with Numbers

Today, ITU ARI Teknokent hosts 400 resident technology companies, employing more than 8,100 professionals across sectors ranging from software and deep tech to advanced manufacturing. To date, over 6,100 R&D projects have been completed within the ecosystem.

Companies operating in the technopark have generated USD 11.9 billion in total turnover and achieved USD 1.3 billion in exports, demonstrating strong global reach and high value-added production.

At the core of the ITU ARI Teknokent ecosystem stands ITU Çekirdek Incubation Center, supporting startups from idea stage to global scale. To date, 5,500+ startups have been supported through ITU Çekirdek programs, with 2,100+ incorporated as companies. These startups have reached a total valuation of USD 3.5 billion, attracted USD 320 million in investment, and created more than 13,000 jobs.

The program is further strengthened by a 500+ mentor network, bringing together expertise from industry and academia.

As a result of ITU Çekirdek's performance and outcomes, it was recognized as the world's top university business incubator by UBI Global in 2023. The evaluation was conducted based on 21 key performance indicators, including economic impact, post-graduation performance, and access to finance—confirming the strength, consistency, and global relevance of the model developed at Istanbul Technical University.

A Phenomenal Success in Türkiye's Investment Ecosystem

In just the past two years, startups graduated from İTÜ Çekirdek have secured an impressive $135 million across 170 investment rounds—a remarkable milestone for the ecosystem.

These extraordinary startup successes and investments are celebrated every year at one of the ecosystem's most prestigious gatherings, İTÜ Çekirdek's Big Bang Startup Challenge, where the year's achievements take center stage in truly grand fashion.

Building on this strong track record, ITU ARI Teknokent launched its investment fund, ARI FON, in 2025, with a total target size of USD 25 million, aiming to invest in 50 high-growth-potential startups over five years.

** Ranked #1 by UBI Global in 2023 among 1,895 incubators and accelerators from 94 countries*

Success Built on Strong Partnerships and Focused Programs

ITU Çekirdek supports startups across all sectors. However, it believes that sustainable impact is created through strategic focus. Rather than spreading resources too thin, ITU ARI Teknokent deepens its impact by concentrating on selected verticals and building long-term, international collaborations.

Since 2015, automotive and mobility technologies have been supported in collaboration with OİB (Automotive Exporters Association of Türkiye). Since 2019, innovative energy technologies have been fostered through partnerships with EPDK (Energy Market Regulatory Authority) and ELDER (Association of Electricity Distribution System Operators).

As of 2025, this sectoral approach has expanded further through new vertical programs:

- Fintech, sustainability, and AI-focused HUBrica, in partnership with Halkbank, one of Türkiye's largest state-owned banks
- Medtech programs under the Lifetech Clustering, in collaboration with Medipol University and İSEK (Istanbul Health Industry Cluster); AzLAB, developed with AstraZeneca

In 2026, new programs were launched with TOGG, Türkiye's national electric vehicle manufacturer (focused on AI and digital health), and TTGV (Türkiye Technology Development Foundation) (focused on climate and clean technologies), reinforcing alignment with global technology trends.

Global Reach, Built-In

Global reach is not a phase for ITU ARI Teknokent—it is embedded in how the ecosystem is built.

Through INNOGATE Always on, ITU ARI Teknokent's international acceleration mechanism, startups gain sustained access to customers, partners, and investors in strategically important markets such as the United Kingdom, Germany, France, the Netherlands, the United States, and the UAE.

This global positioning is further reinforced through European Union–funded projects and international innovation networks. Initiatives such as WeRin, DTECH-4ENT, EELISA, FAIR FASHION, and SEEDBridge enable cross-border collaboration, shared innovation agendas, and long-term knowledge exchange.

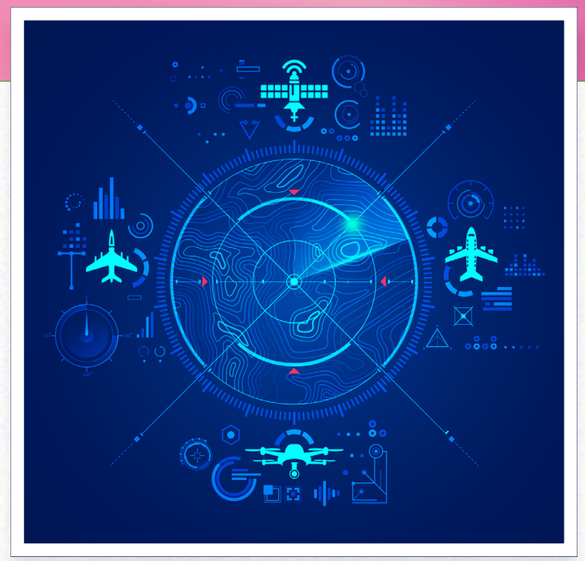
Within this structure, globalization is not only about helping companies expand abroad—it is also about bringing global knowledge, networks, and opportunities into Türkiye's innovation ecosystem. ITU ARI Teknokent's ITU SEED program is designed for startups coming from abroad; to date, it has received applications from 97 countries, positioning ITU ARI Teknokent as a global hub for startups worldwide.

Together, these capabilities establish ITU ARI Teknokent as a globally connected innovation and entrepreneurship platform, shaped by Istanbul Technical University's academic strength. With ITU's academic strength and talent pipeline at its foundation, ITU ARI Teknokent continues to transform research into technology, technology into value, and local potential into global impact, contributing to Türkiye's position in the international innovation landscape.

INNOGATE | Always on
7 Countries

ITUSEED | ACCELERATOR FOR INTERNATIONAL STARTUPS
97 Countries

Bridging Engineering Education and Strategic Defense Systems



Istanbul Technical University has launched the Defense Technologies Minor Program, bringing together academic theory and the strategic realities of the defense sector. Open to students from all engineering disciplines, the program offers a multidisciplinary perspective on complex defense systems.

Launched under ITU's Innovative Minor Programs initiative and led by Prof. Dr. İbrahim Özkol, the Defense Technologies Minor Program brings together the Aviation Institute and the Faculty of Aeronautics and Astronautics to expand the horizons of engineering education beyond single-discipline boundaries. Open to students from all engineering departments, the program reflects the collaborative and system-driven nature of contemporary defense projects, where technological solutions emerge from the integration of multiple fields rather than isolated expertise. Its guiding aim is to enable students to see the "big picture" of defense technologies—how complex systems are conceptualized, designed, tested, and ultimately deployed within strategic, operational, and institutional contexts.

The curriculum has been designed to balance theoretical depth with application-oriented insight. Students begin with foundational domains such as policy frameworks and applied mathematics before progressing toward specialized technical subjects including Aircraft Power Systems, RF Communication for Unmanned Aerial Systems, Guidance and Navigation, and Embedded Systems. By bringing these diverse areas into dialogue, the program emphasizes system-level thinking, helping students understand how subsystems interact, constrain one another, and collectively define overall performance. Extending learning beyond the classroom, weekly seminar series host senior executives and technical leaders from the defense industry, offering students first-hand exposure to current technological challenges, sectoral priorities, and real-world decision-making processes. Through this sustained interaction between academia and industry, the program equips graduates not only with technical competence, but also with an operational understanding of the defense ecosystem—preparing them to contribute meaningfully to national defense initiatives from the very beginning of their professional careers.

Istanbul Technical University (ITU) is actively developing a comprehensive ecosystem for quantum technologies, focusing on the transition from theoretical research to industrial application. By integrating academic expertise with technical infrastructure, ITU aims to contribute to Türkiye's capacity in the field of next-generation computing.

Pioneering the Quantum Frontier

A key component of this initiative is the Quantum Systems Research Center and Production Facility, currently being established on the Ayazağa Campus. This facility is designed to support the development of quantum computing services, with a specific focus on hardware. A primary objective of the center's roadmap is the design and fabrication of Türkiye's first domestic quantum processor by 2030. Beyond hardware development, the infrastructure will provide a platform for research in quantum artificial intelligence and data security, preparing students and researchers for roles in the global technology sector.

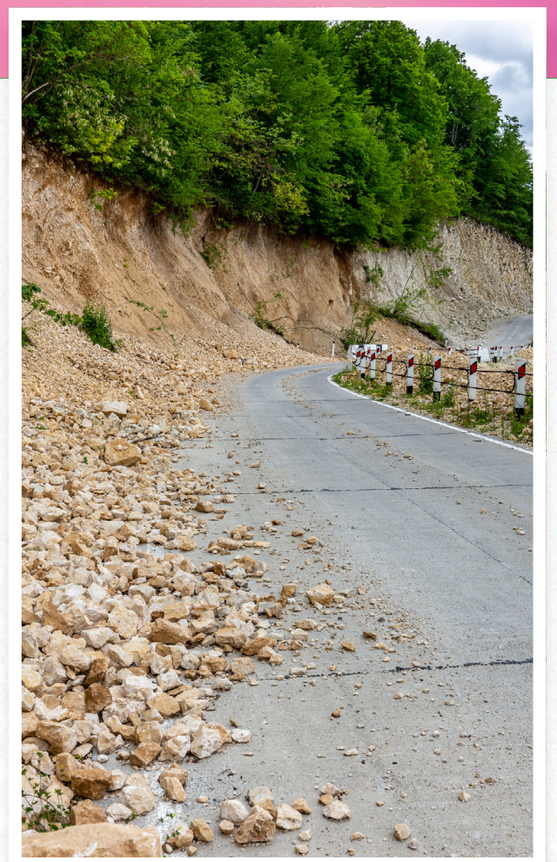
ITU's educational framework has also been updated to reflect these technological shifts. The university has introduced a Quantum Technologies Minor Program, which utilizes a "co-learning laboratory" model. This approach emphasizes project-based learning, allowing students to work within an integrated R&D environment alongside industry professionals.

To support these objectives, ITU has formalized a collaboration with ComPro and Q&Co Quantum Computing Technology. This partnership, signed by Rector Prof. Dr. Hasan Mandal and industry representatives, creates a framework for aligning ITU's research in nuclear and quantum sciences with commercial expertise. The collaboration is intended to streamline the pathway from laboratory research to functional technology, focusing on the development of domestic hardware and sustainable innovation.

Advancing Landslide Risk Intelligence Through Integrated Earth System Science

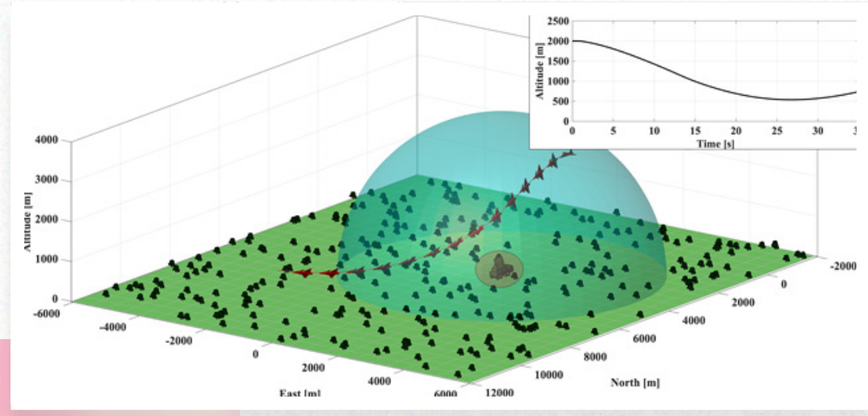
The TERALAND Project — Terrain Risk Assessment for Landslide Detection and Simulation, coordinated by Prof. Dr. Ömer Lütfi Şen with the Eurasia Institute of Earth Sciences as a project partner, has been awarded funding under an internationally oriented program supported by Türkiye's leading national research funding agency (TÜBİTAK) through its 1071 / IraSME framework. The project responds to the growing challenge of slope-related hazards—including landslides, debris flows, and rockfalls—whose frequency and severity are intensifying due to climate change, extreme precipitation events, and rapid urbanization. By addressing the limitations of conventional disaster prediction and management approaches, TERALAND seeks to establish a holistic, science-driven decision-support system for monitoring, understanding, and managing landslide risk in steep and high-risk terrains.

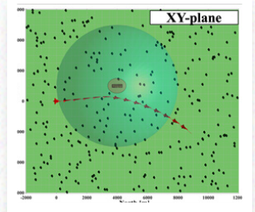
At its core, TERALAND integrates satellite-based Earth observation, climate projections, artificial intelligence, and physics-based modeling within a unified analytical framework. Structured around six interconnected work packages, the project combines AI-driven landslide susceptibility mapping, climate-trigger and extreme event analysis, and high-resolution physics-based simulations to model landslide initiation, propagation, and runout under different scenarios. These outputs are further linked to dynamic risk and socio-economic impact assessments, enabling the identification of exposed infrastructure and populations, as well as quantitative estimates of potential damage. The system will be validated through field-based pilot implementations in Türkiye and Germany, and will deliver an operational early-warning module supported by real-time meteorological data. By explicitly incorporating climate change scenarios into both short-term warning and long-term planning, TERALAND represents a significant step toward forward-looking, integrated landslide risk governance across preparedness, response, and recovery phases.

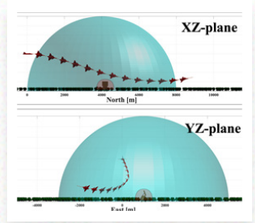


The TERALAND Project, coordinated by Prof. Dr. Ömer Lütfi Şen with the Eurasia Institute of Earth Sciences as a partner, has been awarded competitive funding under a national program supported by Türkiye's leading research funding agency. The project aims to develop an integrated decision-support system for landslide risk assessment and early warning in high-risk terrains.

Radar Evasion Strategies for Non-Stealth Aircraft







Researchers from the ITU Aviation Institute introduced a novel control-based approach enabling non-stealth aircraft to autonomously generate radar-evasive maneuvers, expanding low-observability operations beyond traditionally stealth-designed platforms.

In 2025, researchers from the Istanbul Technical University (ITU) Aviation Institute published an innovative study in Aerospace (MDPI) addressing a critical operational limitation in contemporary air combat and surveillance environments: the vulnerability of non-stealth aircraft to radar detection. The study, authored by Çağrı Ege Altunkaya, Akın Çatak, Fatih Erol, and Mustafa Demir, under the supervision of Assoc. Prof. Dr. Emre Koyuncu and Prof. Dr. İbrahim Özkol, proposes a maneuver-based solution that shifts the focus from platform design to intelligent control strategies.

Titled "Stealth-Maneuver Generation for Non-Stealth Aircraft: A Control Barrier Function Approach," the research introduces a novel framework based on Control Barrier Functions (CBFs) to systematically relate aircraft control inputs to radar cross-section (RCS) behavior. Through this approach, control commands are autonomously generated to ensure that the aircraft's RCS remains below a predefined detectability threshold. Owing to the sensitive nature of radar data, the researchers constructed a dedicated RCS database for a reference F-16 aircraft using advanced geometric modeling and analytical techniques, enabling realistic yet secure simulation studies.

Simulation results demonstrate that the proposed method effectively maintains radar visibility below critical limits across a wide range of engagement scenarios. By enabling non-stealth platforms to dynamically adapt their maneuvers in response to radar threats, the study highlights a promising pathway for enhancing survivability without requiring costly structural modifications. These findings position CBF-based maneuver generation as a flexible and scalable tool for future air operations, offering new opportunities for low-observability mission concepts in both manned and unmanned aerial systems.

Showcasing Space Science and Systems Engineering on a Global Stage

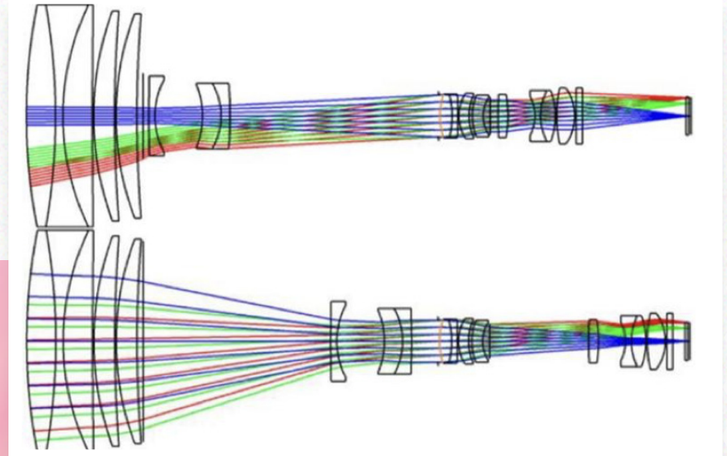
Istanbul Technical University (ITU) participated prominently in the International Astronautical Congress (IAC) 2025, one of the world's most prestigious and comprehensive gatherings in the space sector, held between 29 September and 3 October 2025 in Sydney, Australia. Hosted under the Türkiye Pavilion, coordinated by Türkiye's national space authorities and leading industrial stakeholders, ITU welcomed international visitors at its stand and represented the university's long-standing commitment to global collaboration in space science and technology. ITU was represented by Prof. Dr. Burak Berk Üstündağ (Computer Engineering), Prof. Dr. Melike Nikbay (Space Engineering), and Res. Assist. Barış Beynek (Space Engineering), highlighting the university's interdisciplinary academic strength at the intersection of computation, engineering, and space systems.

At the congress, ITU presented the work of its flagship research units operating within the Faculty of Aeronautics and Astronautics. The Space Systems Design and Test Laboratory (ITU-USTTL) attracted strong interest with its pioneering activities in satellite system design, integration, testing, and orbital operations.

Complementing this expertise, the Aerospace Multidisciplinary Design Optimization Laboratory (AeroMDO Lab) showcased research applying multidisciplinary optimization, artificial intelligence, and reliability-based design approaches to satellite and rocket-engine systems. In addition, the Space Support Systems Application and Research Center (UZDES)—established within ITU and operating in close coordination with Türkiye's national space program—was introduced as a key contributor to the country's space ambitions. Through its presence at IAC 2025, ITU reaffirmed its role as a research-driven, internationally engaged institution advancing space science, engineering, and systems-level innovation.

Istanbul Technical University took part in the International Astronautical Congress (IAC) 2025 in Sydney, presenting its advanced research capacity in space systems, satellite technologies, and multidisciplinary aerospace design within the Türkiye Pavilion.

Deep Learning–Enhanced Fiber Bundle Fluorescence Microscopy for Compact Imaging Systems



Invited research presented by ITU demonstrates how custom-designed high-NA fiber bundles, combined with deep learning–based image enhancement, can overcome physical limitations in fluorescence microscopy and enable portable, high-resolution imaging solutions.

At the 2025 International Conference on Light and Light-Based Technologies (ICLLT), Asst. Prof. Dr. Berna Morova from the Department of Physics Engineering at Istanbul Technical University delivered an invited talk presenting recent advances in fiber bundle–based fluorescence microscopy. Her work addresses a longstanding challenge in biomedical imaging: achieving high-quality fluorescence images in confined or hard-to-access environments using compact and flexible optical systems.

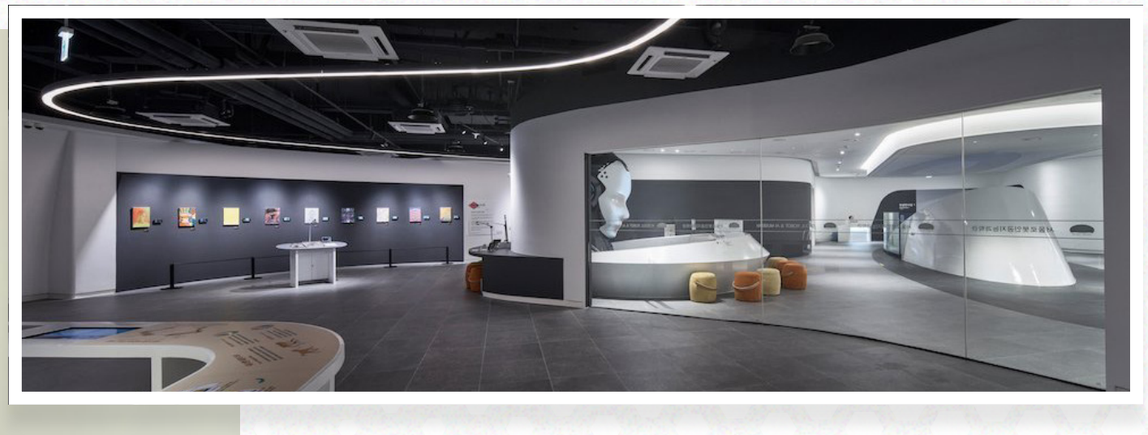
The research focuses on the development of custom optical fiber bundles fabricated via the stack-and-draw method using thermally matched, tailor-made glass compositions. These fibers achieve high numerical apertures (up to 0.61), significantly improving light-collection efficiency and image sharpness. Seven distinct fiber bundle architectures were designed, manufactured, and experimentally evaluated through brightfield and fluorescence imaging of biological and patterned samples. The results revealed that bundles with moderately increased core diameters and spacing provided superior contrast and spatial fidelity, offering valuable design insights for future fiber-based imaging platforms.

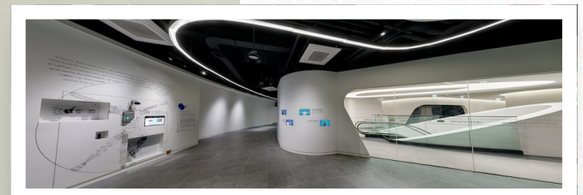
To transcend the inherent physical limitations of fiber bundle imaging, the study introduced a deep learning–based image enhancement strategy. A convolutional neural network was trained to transform standard widefield fluorescence images into high-contrast outputs comparable to those obtained with advanced structured illumination microscopy—without requiring additional optical hardware. Quantitative analysis showed a substantial improvement in the contrast-to-mean ratio (σ/μ), demonstrating the potential of artificial intelligence to elevate imaging performance through software alone. This hybrid approach—combining custom photonic design with AI-driven processing—opens new pathways for portable, cost-effective, and high-resolution fluorescence imaging, with promising applications in biomedical diagnostics, compact endoscopy, and future real-time live-tissue imaging systems.

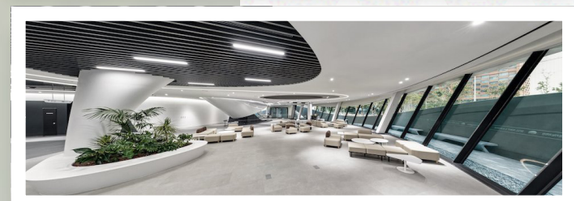
A Global Architectural Landmark at the Intersection of Robotics and Artificial Intelligence

Designed by ITU Faculty of Architecture alumna Melike Altınışık, the Seoul Robot and Artificial Intelligence Museum (RAIM)—the world's first museum dedicated exclusively to robotics and AI—has received the Gold Award in the Cultural Buildings category at the Grand Prix du Design Paris, marking a major international recognition for contemporary architectural innovation.

Designed by Melike Altınışık, a graduate of the Faculty of Architecture at Istanbul Technical University, the Seoul Robot and Artificial Intelligence Museum (RAIM) has been awarded the Gold Award in the Cultural Buildings category at the Grand Prix du Design Paris, an international design competition organized in collaboration with the Institut Français du Design. The project has also been shortlisted as a finalist for the World Architecture Festival (WAF), to be held in Miami in November 2025. Selected as the winning entry of an international competition in 2018, RAIM was realized between 2019 and 2024 through a collaboration between MAA – Melike Altınışık Architects and WITHWORKS Architects & Engineers, and officially opened to the public in Seoul on 20 August 2024. Conceived as the world's first museum dedicated entirely to robotics and artificial intelligence, RAIM has emerged as a pioneering cultural landmark aligned with the ambitions of the Fourth Industrial Revolution.







Architecturally, RAIM articulates a distinctive design language that fuses advanced computational design, smart construction methodologies, and immersive spatial storytelling. Its non-directional, fluid, spherical form operates not merely as an enclosure, but as an integral component of the museum's narrative—mirroring the dynamism, adaptability, and intelligence of the technologies it houses. The building was realized through Building Information Modeling (BIM), off-site construction, digital fabrication, and robot-assisted manufacturing, enabling the precise execution of its complex geometries. Inside, the visitor experience unfolds as a spatial sequence: from robot-guided entrances and public ground-floor spaces to a central vertical exhibition tunnel that dissolves the boundary between the physical and digital realms. Envisioned as a living exhibition, RAIM integrates architecture, robotics, and AI into a continuous dialogue, positioning the museum not only as a venue for display, but as a catalyst for innovation, public engagement, and interdisciplinary exchange within Seoul's rapidly evolving AI ecosystem.

Ranked Among the World's Top 300

Istanbul Technical University (ITU) has achieved its best-ever result in the QS World University Rankings (WUR) 2026, climbing 28 places to secure 298th position globally. Despite the inclusion of 112 additional institutions this year, ITU now stands within the top 20% of universities worldwide, a significant leap from the top 30% just a year ago.

This upward trajectory is driven by ITU's surging global reputation. The university rose 21 places in Employer Reputation (ranking 91st worldwide) and 22 places in Academic Reputation (ranking 305th). Furthermore, ITU climbed 81 places in the Citations per Faculty metric, reflecting its growing scientific impact as it has been classified as a "very high" research-intensity institution by QS WUR. Our global community also continues to diversify, with ITU now hosting students from approximately 85 different nations.

Türkiye's Leader in Engineering and Technology

ITU continues to cement its position as the premier institution for technical education. In the 2025 QS World University Rankings by Subject, ITU rose to 79th place globally in "Engineering and Technology," ranking 1st in Türkiye.

Our university showed improvement in all evaluated subject areas, appearing in 21 different fields, the highest number in ITU's history. Most notably, ITU is now the most-ranked Turkish university in the global top 100, with three subjects achieving top-tier positions:

- **Petroleum Engineering: 40th**
- **Mining/Mineral Engineering: 44th**
- **Architecture/Built Environment: 51–100 range**

Beyond its engineering core, ITU showed remarkable growth across all broad faculty areas, with significant climbs in Natural Sciences (182nd), Arts and Humanities (239th), and Social Sciences and Management (308th). These results reaffirm ITU's vision of combining technical expertise with a holistic academic impact.

According to the EngiRank 2025 results, Istanbul Technical University (ITU) has secured its position as the number-one engineering institution in Türkiye. Ranking 60th overall across Europe, ITU distinguished itself by placing in the European Top 50 in four of the seven engineering subjects evaluated.

The #1 Engineering University in Türkiye, 60th in Europe

The importance of this achievement is underscored by CESAER, the leading association of science and technology universities in Europe, which recognizes EngiRank as a vital indicator for higher education policy. As the sole Turkish member of CESAER, ITU continues to represent national excellence within this elite European framework.

In the data-driven EngiRank 2025 (European Ranking of Engineering Programs), ITU topped the list of 16 Turkish universities in the ranking. Among 239 evaluated European universities, ITU's 60th-place finish highlights its robust standing in the continental academic landscape.

ITU's performance was particularly dominant in specialized fields, showcasing a superior competitive profile. On a European scale, our university ranked:

- **17th in Environmental Engineering**
- **30th in Civil Engineering**
- **32nd in Materials Engineering**

Beyond these core strengths, ITU demonstrated a well-rounded and balanced interdisciplinary profile. The university achieved notable success in several other categories, ranking 41st in Medical Engineering, 51st in Electrical, Electronic and Information Engineering, 51st in Chemical Engineering, and 55th in Mechanical Engineering. This consistent performance across diverse sectors reflects ITU's comprehensive approach to technical education.

Furthermore, ITU's commitment to global challenges was validated by its rankings of 31st in Multidisciplinarity and 44th in Contribution to the Sustainable Development Goals (SDGs).

In EngiRank 2025, ITU has made its community proud through its strategic balance of research and innovation. With an interdisciplinary focus and a strong presence in Environmental, Civil, and Materials Engineering, ITU is poised to further elevate its global standing in the coming years, driven by its intensified efforts in innovation and European Union projects.

Istanbul Technical University (ITU) continues to solidify its status as a global powerhouse in sustainability. According to the 2025 Times Higher Education (THE) Impact Rankings, which evaluate universities worldwide based on the UN Sustainable Development Goals (SDGs), ITU has broken into the top 50 globally, securing the 48th spot among 2,318 institutions with an outstanding overall score of 92.6.

Driving Impact and Leading the Way in “Quality Education”

ITU’s commitment to a sustainable future is reflected in its top-100 placement for eight different SDGs. Most notably, ITU has achieved a world-class ranking of 3rd in SDG 4: Quality Education. Our university also ranks in the top 50 for four other key areas:

Decent Work and Economic Growth (SDG 8): 23rd

Industry, Innovation, and Infrastructure (SDG 9): 31st

Clean Water and Sanitation (SDG 6): 42nd

Life on Land (SDG 15): 44th

ITU’s upward trajectory in the Quality Education category marks a significant global achievement. By prioritizing open science and sustainability, the university has climbed from 48th place in 2021 to 18th, 10th, 5th, and finally 3rd globally in 2025. This success is underpinned by the ITU Libraries’ open science initiatives and the ITU Academic Archive Commission, which ensure that high-quality education remains accessible, equitable, and inclusive.

ITU is not just teaching sustainability; it is institutionalizing it. We are home to Türkiye’s first and only Sustainability Master of Science Program. Launched in the 2023-2024 academic year, this interdisciplinary program attracts students from diverse fields to tackle challenges in circular economies, resilient cities, and climate change. Moreover, the Innovative Minor Programs launched in seven different areas including “Sustainability” in 2025. And recently, the Zero Waste Institute has also been established at ITU. It aims to serve as an international center of scientific excellence and attraction, being one of Türkiye’s first academic structures in the field of zero waste and environmental sustainability.

Furthermore, recognizing the critical role of the Polar Regions in global climate health, ITU has launched a specialized Master’s Program in Polar Research. As the first Turkish university in the University of the Arctic (UArctic) network, ITU offers a unique multidisciplinary platform for those looking to lead at the frontiers of environmental science.

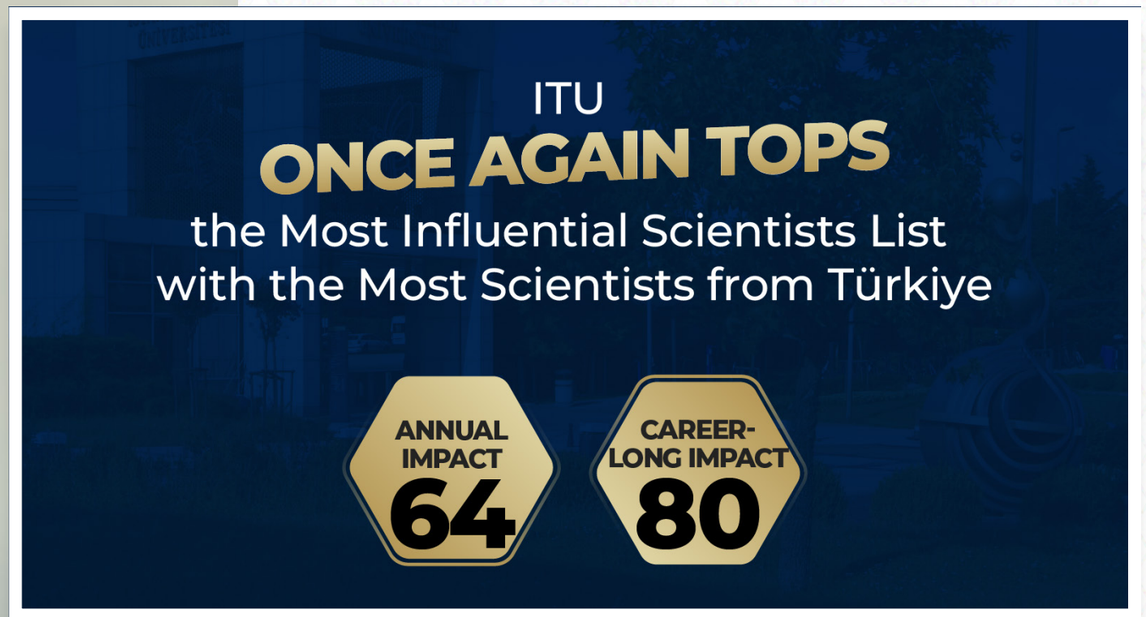
Türkiye’s Leader in the World’s Top 2% Scientists

In the 2024 World’s Most Influential Scientists list, compiled by Stanford University in collaboration with Elsevier, Istanbul Technical University (ITU) leads the nation with the highest number of faculty members recognized in both the “Career-Long Impact” and “Annual Impact” categories.

The 2024 rankings highlight the depth and breadth of our faculty members’ contributions. This underscores the university’s commitment to fostering an interdisciplinary research culture that translates scientific discovery into real-world solutions.

- **Annual Impact:** 64 ITU researchers earned a spot on this year’s list. Among them, two rank in the global top 100, 19 in the top 500, and 33 in the top 1,000 within their respective fields.
- **Career-Long Impact:** Demonstrating sustained academic excellence, 80 ITU scientists, including ITU Rector Prof. Dr. Hasan Mandal, were recognized for their lifelong contributions. This includes four researchers in the global top 100, 20 in the top 500, and 38 in the top 1,000.

By consistently placing at the top of these global benchmarks, ITU reaffirms its role as a hub for innovation and a vital contributor to the international scientific community.



Interdisciplinary Archaeology: Integrating Computational Sciences

Istanbul Technical University (ITU) is advancing a distinctive model for archaeological research that emphasizes interdisciplinary collaboration and computational analysis.

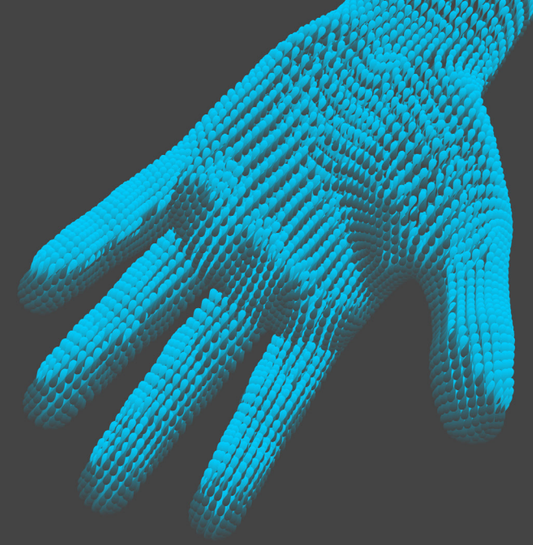
The cornerstone of this effort is the Hacımusalar Mound excavation in Antalya, led by Prof. Dr. Bülent Arıkan. This project functions as an international field school where undergraduate and graduate students from the U.S., Canada, and Europe work alongside Turkish peers. The program integrates diverse disciplines, including geomatics, geophysics, architecture, and game design, to study human-environment interactions. This approach not only reconstructs settlement chronologies but also explores historical responses to climate challenges, such as drought, to inform contemporary agricultural solutions.

The evolution of archaeology at ITU began within the Eurasia Institute of Earth Sciences, focusing on the standardization of digital archaeological data. This matured into the Geoanthropology graduate program, which offers English-language instruction centered on analytical thinking and Earth system sciences. By applying computational methods—such as simulation and spatial modeling—to datasets generated at Hacımusalar Mound, ITU researchers contribute to high-impact international journals and collaborative projects funded by TÜBİTAK.

ITU's success stems from its ability to treat archaeology as a multifaceted social and technical science. By bridging the gap between field excavation and laboratory analysis, the university provides a rigorous environment for researchers interested in the intersection of heritage, technology, and environmental change.

Although the university does not house a degree-granting undergraduate archaeology department, its strategic focus on data digitization and modeling has placed it among the top research institutions in the field, ranking 1st in Türkiye and 245th globally according to 2025 URAP data.

The "thermally activated textile-based exoskeleton" developed under the ERC-supported TEXWEAROTS Project has been published in Advanced Science, one of the most prestigious journals in the field.



A Study Combining Knitting Technology and Robotics Engineering at ITU

This work brought together knitting technology and robotic engineering to develop a completely wireless, lightweight, and energy-efficient system that supports human movement. Thanks to its textile-based structure, the device integrates naturally with the human hand and can provide 270° of movement in 12 seconds using only 10.8 W of energy. Additionally, it operates at a low temperature of 48°C, offering safe and long-term usage capabilities.

From seamless knitting to smart robotic movements

The system developed as part of the research combines heating, sensing, and actuation functions within the same structure thanks to conductive threads embedded in a specially designed mesh structure. This enables the system to provide rehabilitation support for individuals with limited manual dexterity and also be used in industrial robots for object grasping and transport tasks.

Demonstrating significantly superior performance compared to traditional actuators in terms of energy efficiency, flexibility, and durability, this new design has the potential to set a new standard in soft robotic systems.

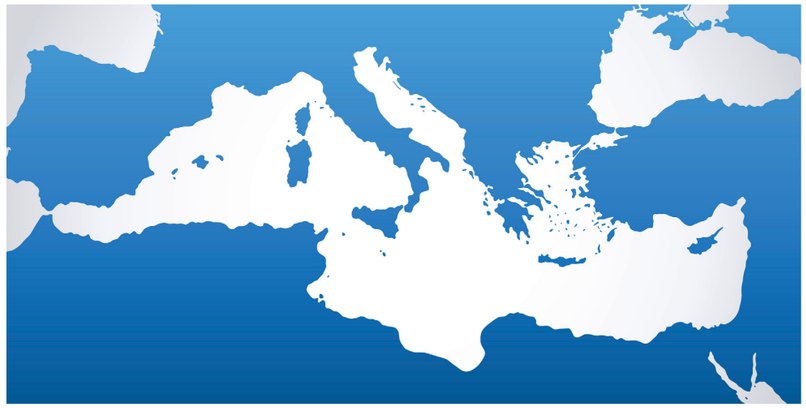
Scope: ERC-Supported TEXWEAROTS Project

This study was conducted as part of the TEXWEAROTS Project, supported by the European Research Council (ERC) under the European Union's Horizon Europe Program.

The project, led by Prof. Dr. Özgür Atalay, a faculty member at the ITU Faculty of Textile Technologies and Design, aims to develop next-generation wearable soft robotic solutions by integrating textile technologies with sensors, actuators, and energy systems.

Drought May Increase in the Mediterranean Even If Rainfall Does Not Decline in the Future

A comprehensive study conducted by an international research team including Assoc. Prof. Dr. İsmail Dabanlı of ITU examined climate dynamics and precipitation patterns in the Mediterranean region. The article was published in Nature, one of the world's most prestigious scientific journals.



The scientific study published in Nature, co-authored by Assoc. Prof. Dr. İsmail Dabanlı, a faculty member of the ITU Department of Civil Engineering, addresses how precipitation in the Mediterranean has changed from the past to the present, what may occur in the future, and the impacts of these changes on the region. The study determined that atmospheric dynamics exert a more dominant influence on Mediterranean precipitation than human-induced effects.

Research helping resolve contradictions regarding precipitation and drought in the Mediterranean

The research team including Assoc. Prof. Dr. Dabanlı examined a 150-year period from 1871 to 2020. The study utilized the most comprehensive dataset for the region, compiled from more than 23,000 stations across 27 countries. Although precipitation increased in some decades and decreased in others, it was found to have generally remained at the same level overall. This appears to be more closely linked to natural movements in the atmosphere (atmospheric dynamics). Moreover, these findings are consistent with the latest climate simulations, CMIP6 (Coupled Model Intercomparison Project Phase 6). Both the new study and CMIP6 indicate that there has been no prevailing long-term precipitation trend in the region in the past.

Even if precipitation does not decline, the region is becoming drier. As global warming increases air temperatures, water in soils and vegetation evaporates more rapidly. The research team states that air temperatures will continue to rise and that this drying will intensify. Furthermore, new climate models also suggest that precipitation may decrease slightly in the future. If this occurs, available water resources in the Mediterranean could decline substantially. Therefore, a clear understanding of the impacts of both precipitation and temperature in the Mediterranean is essential for effective regional planning and for the region's environmental and agricultural future.

A Hidden Warning Beneath the Marmara Sea

A research team led by Istanbul Technical University (ITU) has published the first and most comprehensive assessment of the Mw 6.3 earthquake that struck the Marmara Sea on April 23, 2025.

The study, appearing in the Journal of Seismology, provides critical data on the Main Marmara Fault (MMF)—a major segment of the North Anatolian Fault system that has remained largely quiescent since 1766.

Led by Prof. Dr. Tuncay Taymaz and a team from ITU, the research utilized advanced rupture modeling and high-precision aftershock relocation to evaluate the event's impact on regional seismic hazards. The findings suggest the earthquake occurred within a sensitive transition zone between a "locked" fault segment and a neighboring "creeping" section. Globally, such zones are recognized as areas where moderate earthquakes can indicate the initiation of larger ruptures.

One of the study's most significant observations is the rapid eastward migration of seismicity. Using the HypoDD relocation framework, the team tracked 590 aftershocks that advanced approximately 20 km toward the locked Kumburgaz segment within the first 24 hours. This migration signals a critical stress transfer toward a fault section widely regarded as a critical seismic gap due to its long-term strain accumulation.

Interestingly, this eastward progression terminated abruptly at a high shear-wave velocity (high-Vs) anomaly—a dense crustal volume capable of sustaining high stress without immediate failure. Furthermore, the aftershocks clustered around the periphery of the main rupture rather than within the slip area itself. This pattern is frequently observed in the preparatory stages of larger seismic events, suggesting that the 2025 Silivri–Kumburgaz earthquake may serve as a significant signal for the mechanical state of the faults south of Istanbul.

A Thermodynamic Perspective on Potential Life in Icy Ocean Worlds

Searching for life in the solar system often leads researchers to “icy ocean worlds”—moons like Jupiter’s Europa and Ganymede, or Saturn’s Enceladus and Titan. While these moons harbor vast subsurface oceans, the question remains: is the chemistry within them actually hospitable to life?

A recent study led by Dr. Seda Işık, an Istanbul Technical University (ITU) doctoral graduate, in collaboration with NASA’s Jet Propulsion Laboratory (JPL) and the Max Planck Institute, has provided a thermodynamic map for this search. Published as a “Planetary Science Highlight” by NASA/JPL, the research examines whether the Citric Acid Cycle (TCA/Krebs cycle)—the metabolic engine of terrestrial life—could function under the extreme conditions of these alien oceans.

By applying advanced thermodynamic modeling, the team discovered a significant chemical hurdle. While certain metabolic intermediates like citrate and succinate could theoretically form in these environments, other essential compounds, such as fumarate and oxaloacetate, appeared thermodynamically unfavorable. This indicates a potential “energy bottleneck,” suggesting that for life to sustain a complete metabolic cycle in these oceans, it would require a specific, external energy input.

Intriguingly, the researchers found a parallel to this bottleneck here on Earth. Similar chemical constraints exist at the Lost City Hydrothermal Field in the Atlantic Ocean—a site famous for hosting life in extreme, high-pH conditions. This comparison suggests that while the chemistry on icy moons is challenging, it is not necessarily a dead end.

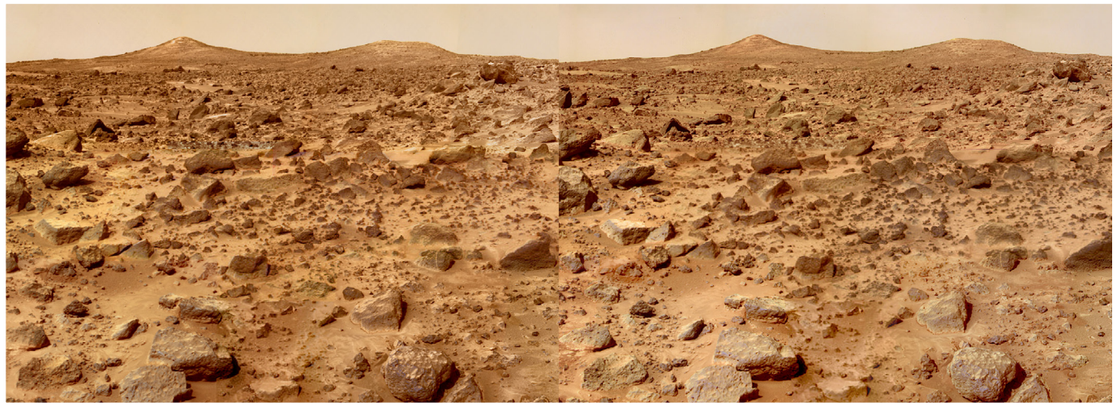
The study also confirmed that simple organic molecules like pyruvate and acetate remain stable under these icy-world conditions, providing a potential prebiotic foundation for life. These findings, supported by data from NASA’s Cassini mission, offer a vital framework for upcoming exploration.

As the ESA’s JUICE mission and NASA’s Europa Clipper and Dragonfly missions head toward these distant moons, Dr. Işık’s research provides the geochemical “key” needed to interpret the atmospheric and oceanic data they send back. By understanding the thermodynamic limits of these worlds, scientists are better equipped to recognize the chemical signatures of life—or the precursors that lead to it—in the farthest reaches of our solar system.

Dr. Işık completed her doctoral study under the supervision of Assoc. Prof. Dr. Nazlı Olğun Kıyak.

Türkiye’s Rocks as a Blueprint for Planetary Missions

As space agencies prepare for the next frontier of Red Planet exploration, the search for life is increasingly relying on “analog” sites here on Earth. A new international project, led by Prof. Dr. Nurgül Balcı of the Istanbul Technical University Geomicrobiology-Biogeochemistry Laboratory (ITU-GBL), is turning the geological landscape of southern Türkiye into a primary laboratory for future Mars missions.



In collaboration with University College London’s Mullard Space Science Laboratory (UCL-MSSL) and the University of Mainz, researchers are analyzing the spectral and geochemical signatures of Turkish carbonates. The goal is to build a first-of-its-kind planetary and geochemical catalog that mirrors the conditions found on Mars.

What sets this study apart is its direct link to the ExoMars 2028 mission. UCL-MSSL is part of the team developing the PanCam (Panoramic Camera) for the Rosalind Franklin Rover. By performing PanCam-calibrated spectral analyses on Earth-bound rocks, the project allows scientists to “tune” their instruments before they ever leave the launchpad. These studies, combined with magnesium isotope and biotrace analysis at ITU-GBL, will help interpret Mars’ water history, past climate, and potential habitability.

The implications extend far beyond academic research. The resulting catalog will serve as a foundational resource for the Turkish Space Agency (TUA), providing the essential data needed to calibrate future domestic planetary missions. By identifying how biological traces are preserved in specific minerals on Earth, the team is essentially creating a field guide for recognizing life on other worlds.

As the ExoMars rover prepares to hunt for signs of ancient life in 2028, the data gathered from the carbonate-rich terrains of southern Türkiye may provide the critical context needed to turn a pixelated image from millions of miles away into a groundbreaking scientific discovery.

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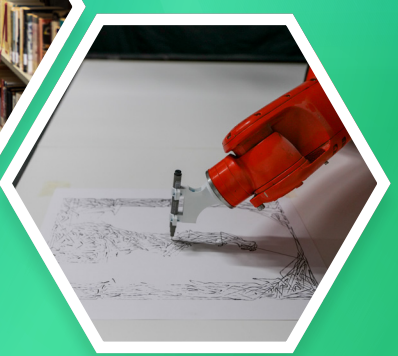

Editorial Direction: Prof. Dr. Lütfiye Durak Ata
(Vice-Rector for Research)

Contributors: Res. Asst. Dr. Burak Korkmaz,
Lecturer Dr. Başak Keskin, Cüneyt Altındaş, Gökçen Akça,
Fatih Çünkioğlu

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ITU Research 2025

Transforming Knowledge into Impact

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