Facts and Figures 2023
Department of Innovative Technologies

**SUPSI**

Overview

At SUPSI's Department of Innovative Technologies, innovation and dynamism are core components of daily activities. The institutional mission guides various areas, including academic programs, applied research, and development. Lecturers are committed to developing up-to-date curricula, while research teams collaborate on projects with both local and global partners, striving to train the leading engineers of the future.

Prof. Milena Properzi, PhD
Director of the Department of Innovative Technologies
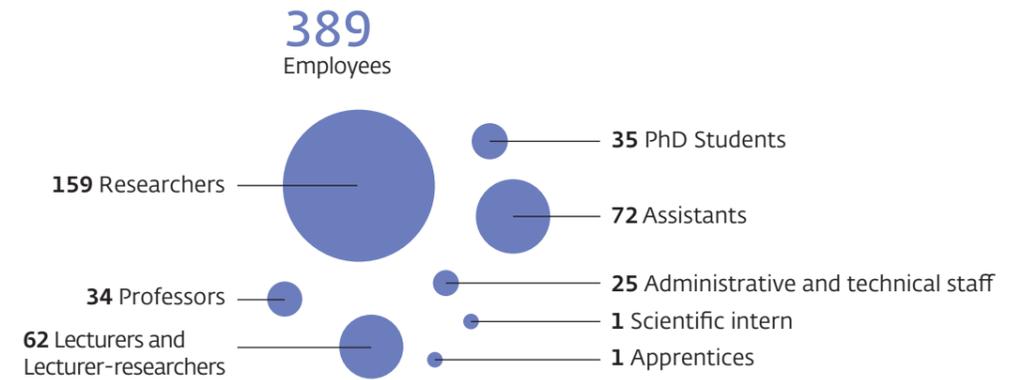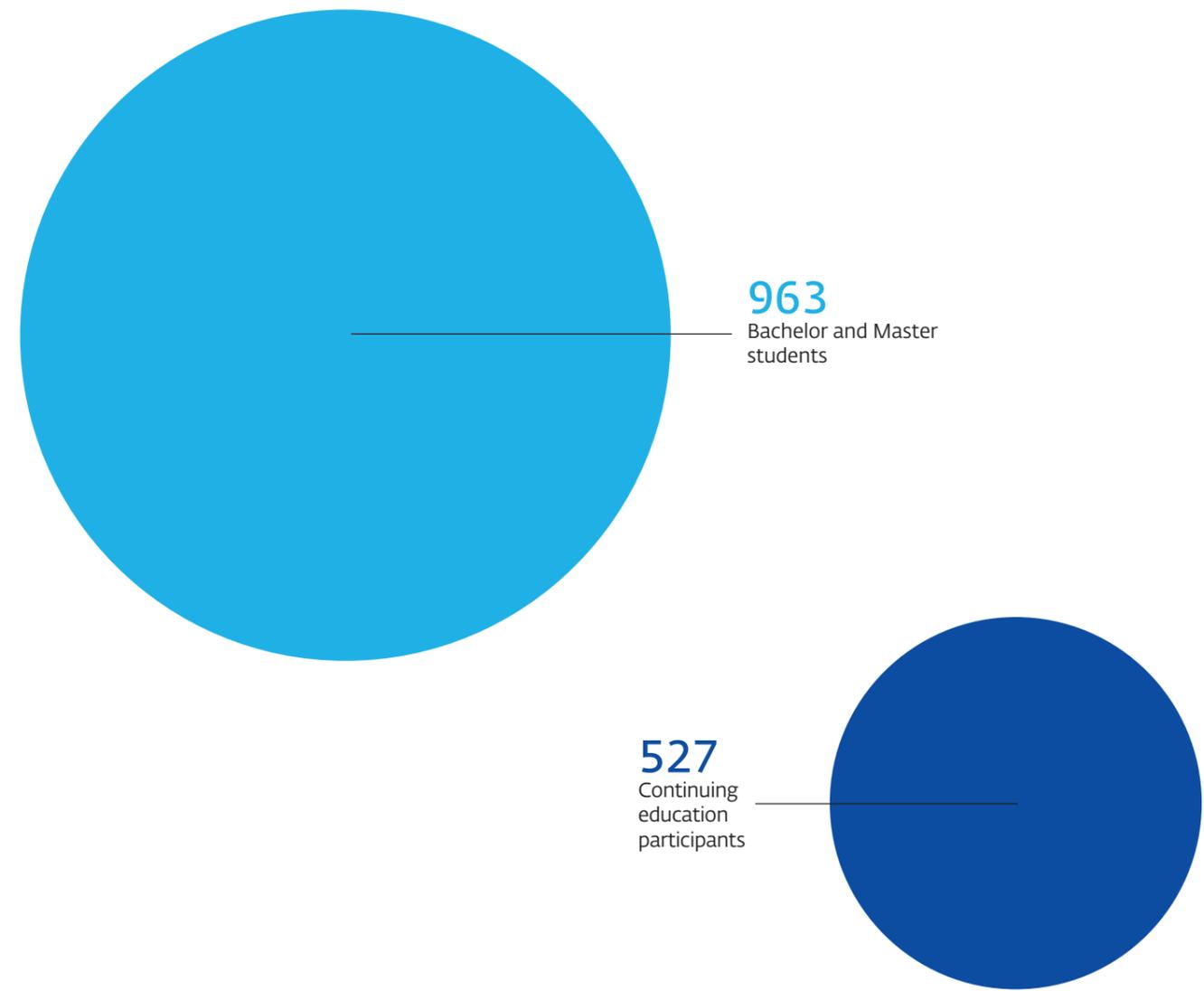
6
Research Institutes

25
Research budget (Mio CHF/year)

20+
Specialised technology laboratories

220+
Research projects

963
Bachelor and Master students

527
Continuing education participants

389
Employees

159 Researchers
35 PhD Students
72 Assistants
34 Professors
25 Administrative and technical staff
62 Lecturers and Lecturer-researchers
1 Scientific intern
1 Apprentices

+71%
Bachelor and Master students

+136%
Continuing education participants

+78%
Academic and scientific staff

Data from 2016/17 to 2023/24.

Undergraduate and Graduate Studies

Head: Prof. Andrea Graf

The Department of Innovative Technologies offers engineering Bachelor's and Master's degree programs recognized at federal and European levels. These programs focus on professional skills, featuring extensive practical activities in the laboratories. Students can also engage in internships, semester projects, and diploma projects in partnership with local companies and institutions.

Bachelor of Science degrees

5

Data Science and Artificial Intelligence
Head: Prof. Francesco Flammini, PhD

Electronic Engineering
Head: Eng. Gianluca Montù

Engineering and Management
Head: Prof. Paolo Pedrazzoli, PhD

Computer Science Engineering
Head: Prof. Sandro Pedrazzini, PhD

Mechanical Engineering
Head: Prof. Walter Amaro

Master of Science degrees

2

Master of Science in Engineering
In collaboration with the other Swiss Universities of Applied Sciences
Head: Prof. Donatella Corti, PhD

EIT Manufacturing Double Degree Master
In collaboration with international universities
Head: Prof. Donatella Corti, PhD

Bachelor of Science degrees

	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total enrolled	**453**	**508**	**542**	**563**	**583**	**666**	**705**	**761**
Full-time	388	445	468	484	507	574	603	668
Parallel to professional activity	65	63	74	79	76	92	102	93

Master of Science degrees

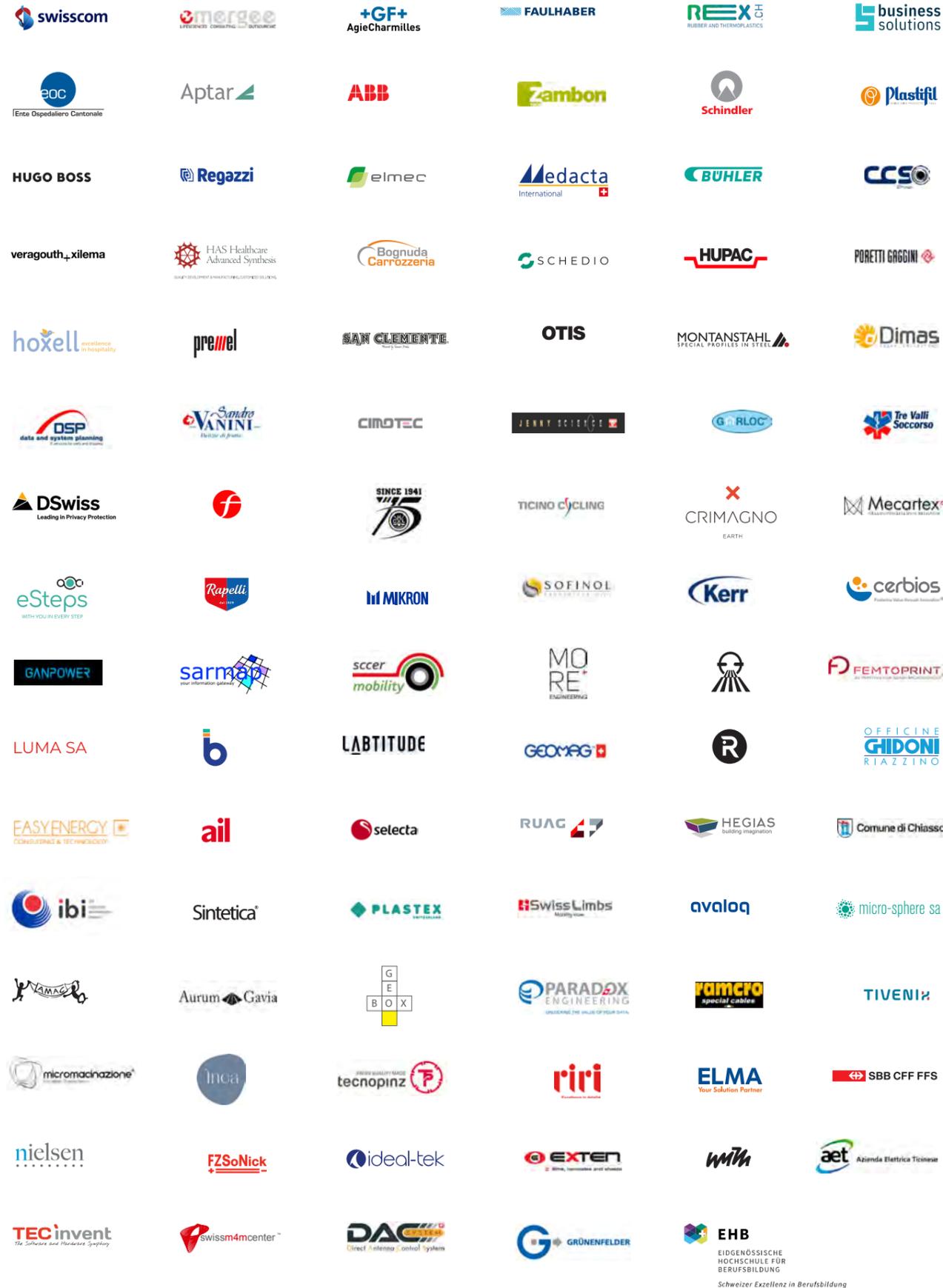|	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total enrolled	**109**	**126**	**137**	**166**	**180**	**215**	**223**	**202**

96

Professors, Lecturer-researchers and Lecturers

# 1:10

Academic staff to students ratio

Theses in collaboration with industry

Every year, more than 80 Bachelor's and Master's theses are conducted in cooperation with local companies and institutions. Some of our partners:

swisscom · emergee · +GF+ AgieCharmilles · FAULHABER · REEX.ch RUBBER AND THERMOPLASTICS · business solutions

eoc Ente Ospedaliero Cantonale · Aptar · ABB · Zambon · Schindler · Plastifil

HUGO BOSS · Regazzi · elmec · Medacta International · BÜHLER · CCSO

veragouth+xilema · HAS Healthcare Advanced Synthesis · Bognuda Carrozzeria · SCHEDIO · HUPAC · PORETTI GAGGINI

hoxell · premel · SAN CLEMENTE · OTIS · MONTANSTAHL SPECIAL PROFILES IN STEEL · Dimas

DSP data and system planning · Sandro VANINI · CIMOTEC · JENNY SCIENCE · GARLOC · Tre Valli Soccorso

DSwiss Leading in Privacy Protection · F · SINCE 1941 · TICINO CYCLING · CRIMAGNO EARTH · Mecartex

eSteps · Rapelli · MIKRON · SOFINOL · Kerr · cerbios

GANPOWER · sarman · sccer mobility · MORE ENGINEERING · · FEMTOPRINT

LUMA SA · b · LABTITUDE · GEOMAG · R · OFFICINE GHIDONI RIAZZINO

EASY ENERGY · ail · selecta · RUAG · HEGIAS · Comune di Chiasso

ibi · Sintetica · PLASTEX · SwissLimbs · avaloq · micro-sphere sa

YAMAGO · Aurum Gavia · GE BOX · PARADOX ENGINEERING · ramcro special cables · TIVENIX

micromacinazione · inca · tecnopinz · riri · ELMA Your Solution Partner · SBB CFF FFS

nielsen · FZSoNick · ideal-tek · EXTEN · wmm · aet Azienda Elettrica Ticinese

TECinvent · swissm4mcenter · DAC · GRÜNENFELDER · EHB EIDGENÖSSISCHE HOCHSCHULE FÜR BERUFSBILDUNG Schweizer Exzellenz in Berufsbildung

Our graduates

Within a year of graduating, the majority of our graduates either find a job or continue their education.

73.2% is employed

25.6% is studying

1.2% is looking for a job
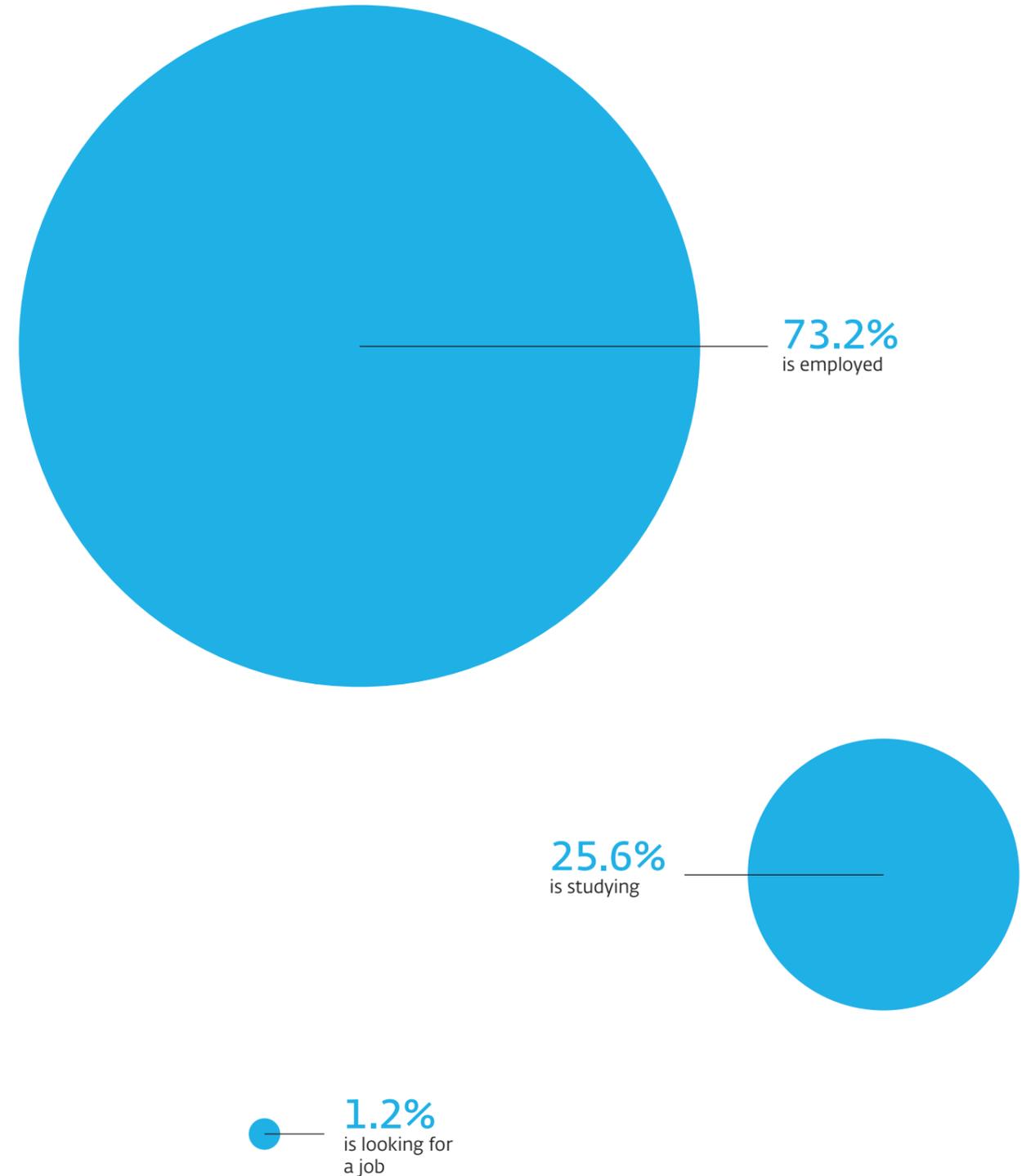
Funding and scholarships

Outstanding students are annually recognized with awards for the best Bachelor's and Master's theses or scholarships for academic support.

Our sponsors:

Argor-Heraeus
BPO Foundation
Leonardo Foundation
Nizzola Foundation
PREMIOSWISSENGINEERINGTICINO Foundation
Reteca Foundation
RUAG Foundation
Rudolf Chaudoire Foundation

Total funding volume (in CHF)

2020/2021
179'073.-

2021/2022
221'630.-

2022/2023
239'829.-

2023/2024
241'750.-

8

Continuing Education

Head: Eng. Antonio Bassi

The Department of Innovative Technologies' Continuing Education offers a broad selection of courses in the areas of: Agile Business, Data Privacy and Cybersecurity, Fashion Innovation, Information Technology and Digitization, Electrical Engineering, Management Engineering, Industrial Engineering and Project Management.

The courses are designed for professionals in engineering and new technologies who seek to remain competitive and responsive to the evolving demands of the market and society.

Certificate of Advanced Studies (CAS)	Diploma of Advanced Studies (DAS)	Master of Advanced Studies (MAS)
29	**1**	**3**

Advanced Short Courses	Tailor-made courses for companies	Webinar
139	**15**	**39**

Participants

	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total	**223**	**310**	**223**	**322**	**525**	**488**	**531**	**527**
CAS, DAS, MAS (10 to 60 ECTS)	167	159	173	265	224	238	287	183
Advanced Short Courses (1 to 9 ECTS)	39	127	17	13	178	166	105	170
Tailor-made courses for companies	17	24	33	44	123	84	139	174

Budget (in CHF)

2018
535'388.-

2019
1'030'356.-

2020
890'236.-

2021
1'311'816.-

2022
1'126'664.-

2023
1'309'973.-

Research and Development

Head: Prof. Federico Bosi, PhD

The Department of Innovative Technologies conducts applied research projects in collaboration with academic and industrial partners at local, national, and international levels.

Research institutes	Ongoing projects*
6	**224**

Research budget (Mio CHF/year)	Third-party funding
25	**77%**

Publications	Patents
150+	**5+**

*Number of projects by funding agency

74 Innosuisse	44 EU/SERI	17 Swiss National Science Foundation (SNSF)	35 Research mandate	34 Other agencies and foundations	20 Internal SUPSI

Geographical distribution of the projects

Ticino **70%**	Switzerland **15%**	Europe **14%**	Non-EU countries **1%**

Research partnership

Universities and research centres: 85 · 103 · 2 — 190

Private and public companies: 169 · 365 — 534

724

Ticino: 95
Other cantons: 74

Main research areas

- 19% Artificial Intelligence
- 19% Computer Science
- 15% Production and Manufacturing Engineering
- 10% Electronic Systems
- 10% MedTech
- 9% Other
- 5% Education
- 5% Robotics
- 5% Energy
- 3% Materials Science
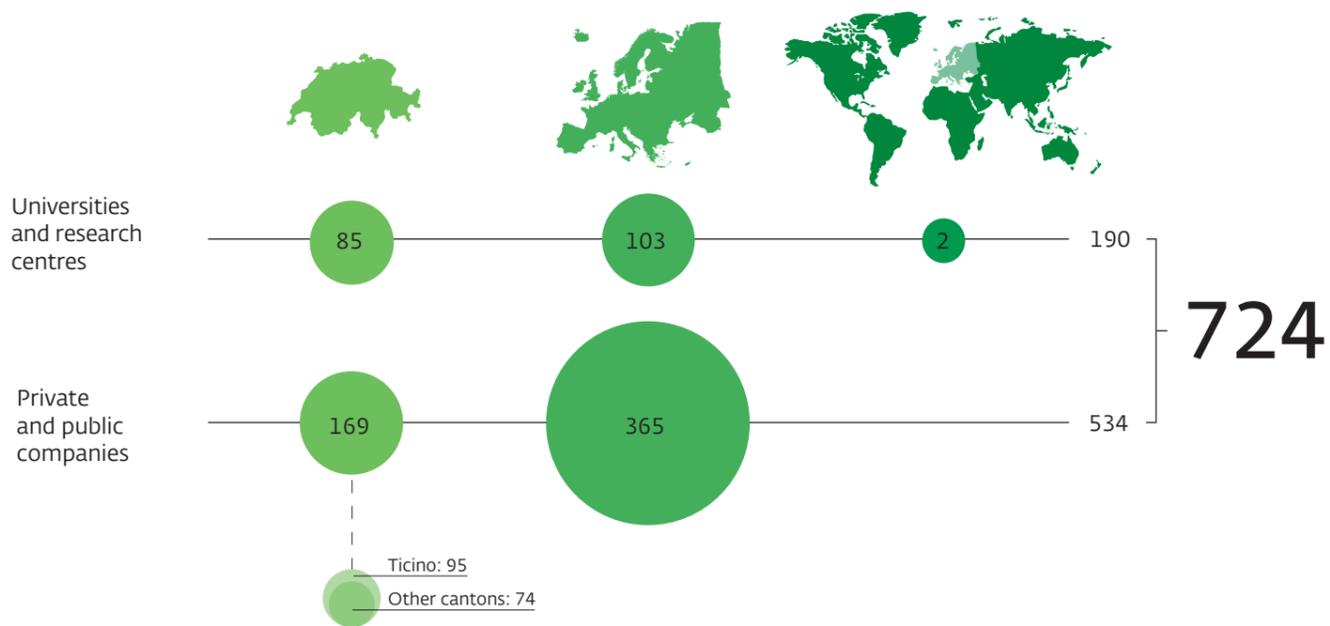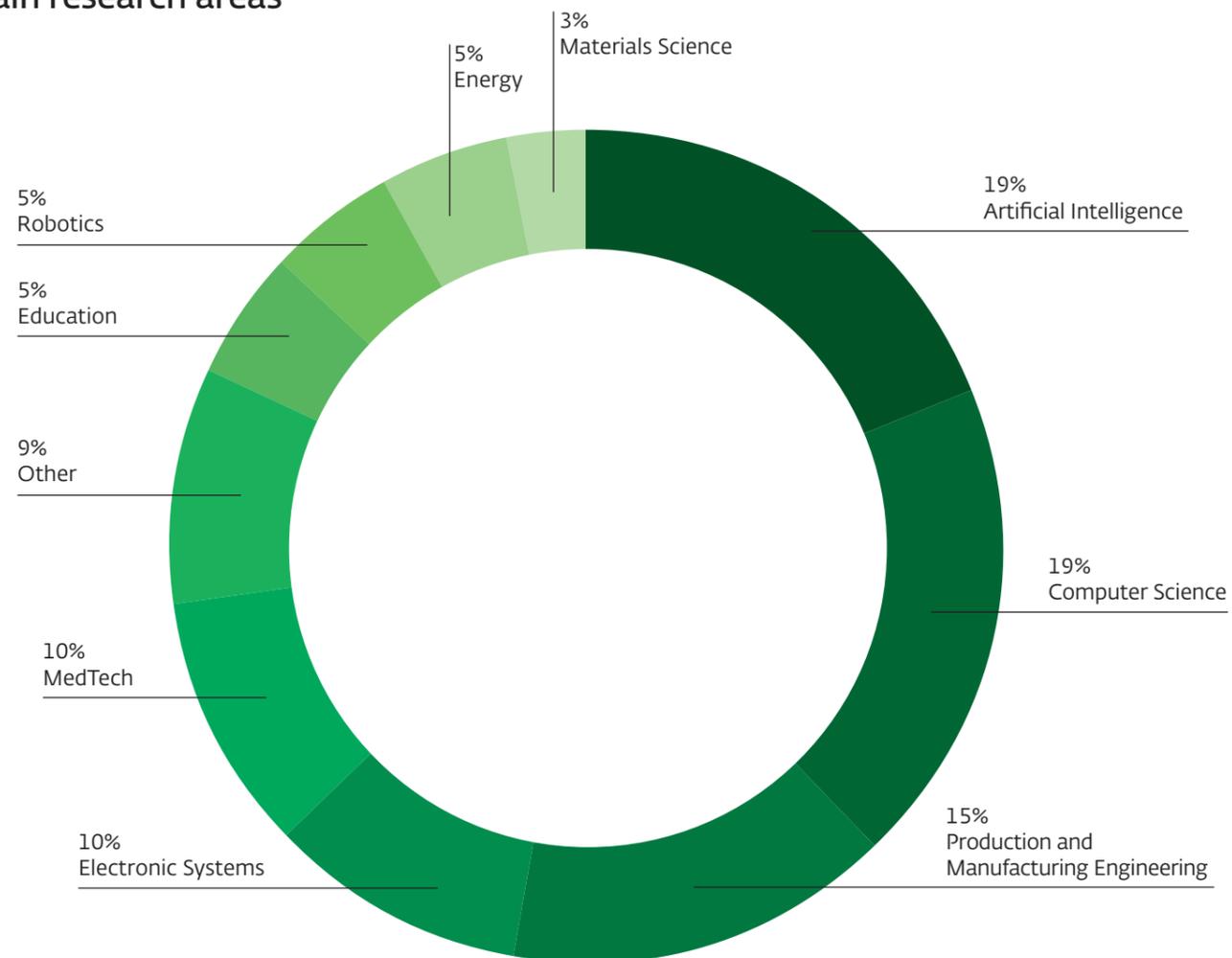
Institutes and research areas

IDSIA USI-SUPSI
Dalle Molle Institute for Artificial Intelligence USI-SUPSI

- Machine learning
- Intelligent control for systems and networks
- Natural language processing and information retrieval
- Computational geometry and computer vision
- Autonomous robotics
- Theory and algorithms

Director:
Prof. Andrea Emilio Rizzoli, PhD

ISEA
Institute of Systems and Applied Electronics

- Digital electronics, microelectronics and bioelectronics
- Analogue and radio frequency electronics, telecoms and imaging systems
- Power and applied energy electronics
- Mechatronic systems
- Precision microtechnical systems
- Applied photonics and optoelectronics

Director:
Prof. Daniele Allegri, PhD

ISIN
Institute of Information Systems and Networking

- Advanced human-machine interaction
- Audiovisual processing and immersive multimedia
- Cloud and distributed systems
- Data engineering, analysis and processing
- Educational technology and open data
- Reliable and secure computer networks

Director:
Prof. Tiziano Leidi, PhD

ISTePS
Institute of Systems and Technologies for Sustainable Production

- Automation, Robotics and Machines
- Sustainable Production Systems

Director:
Prof. Marco Colla

MeDiTech
Institute of Digital Technologies for Personalized Healthcare

- Biomedical Signal Processing
- Digital Health
- Medical Devices

Director:
Prof. Stéphane Meystre, PhD

MEMTi
Institute of Mechanical Engineering and Materials Technology

- Polymer Engineering
- Mechanical Engineering
- Hybrid Materials
- Computational Materials Science
- Thermo-fluid Dynamics

Director:
Prof. Maurizio Barbato, PhD

Our flagship projects

Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI)

Exoskeleton to aid manual worker's back

Many industrial sectors, including aerospace and logistics, rely heavily on manual labor, often performed under non-ergonomic conditions involving the handling of heavy objects. These conditions have raised significant concerns about work-related musculoskeletal disorders, particularly impacting the backs of operators.

In response, extensive research efforts have been dedicated to the development and testing of exoskeletal devices. These innovations are designed to provide support and assistance to worker's upper and lower limbs, as well as their backs, using both passive and active solutions. The goal is to reduce strain, improve comfort, and potentially revolutionize the safety and efficiency of manual labor.

The XSPINE project, funded by Eurobench and led by the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI) in collaboration with Politecnico of Milan, University of Bologna, and Polibrixia s.r.l., aims to test and validate a prototype exoskeleton designed to support the back. Developed by IDSIA researchers, the project seeks to enhance working conditions by reducing musculoskeletal risks associated with strenuous activities.

Loris Roveda, Senior Researcher SUPSI at IDSIA, explains, «With this project, our goal is to enhance working conditions for operators by reducing musculoskeletal risks associated with strenuous activities».

The device design employs kinematic modeling of the back to support the operator during tasks. This mechanism tracks the user's movements, providing passive assistance without the use of motors. «Our device offers the advantage of personalized design focused on the user, and it is characterized by scalability and adaptability», Roveda affirms.

Looking forward, the project plans to integrate motors for active assistance and develop intelligent control algorithms to adapt to user behavior and varying work conditions. This innovation promises to transform manual labor safety standards, enhancing both comfort and productivity.

AI combatting the Silent Pandemic of antimicrobial resistance

Antimicrobial resistance (AMR), referred to as «The Silent Pandemic», ranks among the World Health Organization's top ten threats to public health.

This phenomenon arises when bacteria, viruses, or parasites develop resistance to drugs commonly used to treat the diseases they cause. The widespread use of antibiotics in human and veterinary medicine over many years has exacerbated this issue, leading to harmful consequences for the environment.

To address this challenge, the SPEARHEAD project (Swiss Pandemic & AMR - Health Economy Awareness Detect), funded by Innosuisse and led by the University of Basel, has assembled a consortium of research institutes, hospitals, and Swiss industrial partners specializing in medicine, biology, pharmacology, artificial intelligence, and digital communication. Among them, the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI) is tasked with developing AI systems to assist doctors in optimizing antibiotic prescriptions.

Laura Azzimonti, Senior Lecturer-Researcher SUPSI at IDSIA, explains, «Within the project, advanced AI models are employed to predict antibiotic resistance and support doctors in selecting the most appropriate therapy for patients, thereby preventing the inappropriate use of antibiotics. Other research teams at IDSIA are focused on identifying more effective drug molecules for enhancing drug delivery across cell membranes, utilizing simulations and existing data».

Big data forms the cornerstone for the effective operation of artificial intelligence and the quality of solutions it can produce. However, in the medical field, this presents several challenges, particularly concerning privacy protection. «In the case of SPEARHEAD, we utilize cutting-edge federated learning techniques, which enable the integration of diverse data sources while preserving their confidentiality», the researcher elaborates.

Data processing occurs locally within individual hospitals, with only aggregated and anonymized information transmitted to the central server located at IDSIA, ensuring patient privacy. This approach not only fosters collaboration among different hospital facilities but also enhances the development of more precise forecasting methods.

Researchers and hospital staff are also collaborating to address resistance to the adoption of artificial intelligence. The goal is to support the work of medical professionals and improve service quality rather than replace it.

Foto di Marien Duven per Ticino Scienza

Institute of Systems and Applied Electronics (ISEA)

Innovation in Automatic Optical Inspection systems

Within manufacturing chains, each Automatic Optical Inspection system (AOI) fulfills a crucial role in quality control by monitoring manufacturing processes such as board assembly and soldering. Traditional AOI systems often suffer from a high rate of false positives, requiring manual intervention to distinguish real defects from false alarms.

The AOI3DSCAN project, involving the Institute of Systems and Applied Electronics (ISEA), the Institute of Mechanical Engineering and Materials Technology (MEMTi), and Delvitech SA, has led to the development of a groundbreaking optical inspection head. This innovative system consolidates all necessary quality control functions within a single unit across production lines.

ISEA focused on developing acquisition electronics, real-time image processing, and algorithms for 3D reconstruction from 2D images. According to Prof. **Daniele Allegri**, Director of ISEA and project leader, «This project posed continuous challenges, but our multidisciplinary team effectively tackled and resolved them all. The result is a machine where every electronic, optical, and mechanical component is optimized for maximum performance in resolution, speed of acquisition, data transfer, image processing, and 3D reconstruction algorithms, seamlessly integrating with our data analysis systems».

MEMTi contributed to the mechanical design of the optical head and material selection. Delvitech SA spearheaded the software development for analyzing 3D information captured by the new vision system, prototyping, system integration, and deployment on their platforms.

«We are immensely satisfied with the project's outcome. SUPSI's significant contributions were crucial in achieving our goals», remarked **Roberto Gatti**, CEO of Delvitech. «The fully optimized optical head, comprising cameras, telecentric lenses, projectors, and LED lighting systems, synchronized through SUPSI's custom software and hardware, enables Delvitech to deliver unrivaled inspection performance in our market».

This collaborative effort exemplifies the synergy between academia, industry, and research institutes in advancing cutting-edge technology for enhanced manufacturing quality control.

### Innovative landslide-warning sensors

In mountainous and hilly regions, landslides pose significant risks of soil destabilization, endangering lives, animals, and infrastructure. These events, characterized by rapid movements of rock and loose deposits along slopes, are often challenging to predict using traditional methods. Currently, assessing terrain susceptibility to landslides relies primarily on precipitation-related indices, providing broad-scale information across large geographical areas without considering soil saturation levels.

Addressing these limitations, the RASPLAN project has resulted in the development of a compact radiofrequency probe designed to be inserted into boreholes. This probe continuously records soil moisture data at multiple depths. Leveraging specific algorithms based on geological soil models and supported by artificial intelligence, the system can calculate a real-time landslide risk index.

Funded by the Swiss Innovation Agency (Innosuisse), the project involved a consortium of research institutes, governmental bodies, and industrial partners. These included the Institute of Systems and Applied Electronics (ISEA) and the Institute of Earth Sciences (IST) at SUPSI, the Laboratory for Web Science (LWS) at FFHS, the Forestry and Natural Hazards Office of the Canton of Graubünden, and companies GeoAlps Engineering SA and Solexperts AG.

Prof. **Ricardo Monleone**, Scientific Advisor at ISEA, highlighted the interdisciplinary nature of the project: «It was a very interesting project where electronic engineers, computer scientists, and geologists collaborated fruitfully, expanding their horizons and acquiring new knowledge while overcoming various challenges». He also emphasized the logistical difficulties, noting, «The project's test site is situated in a remote location in Val Müstair (GR), practically unreachable for technical interventions during several months of the year. This made it a mission with zero margin for errors».

Upon completion of the project, the system will continue to operate in Valpaschun for several months, providing valuable data to refine models and train neural networks further. This ongoing data collection aims to enhance landslide prediction capabilities and mitigate risks effectively.

Institute of Information Systems and Networking (ISIN)
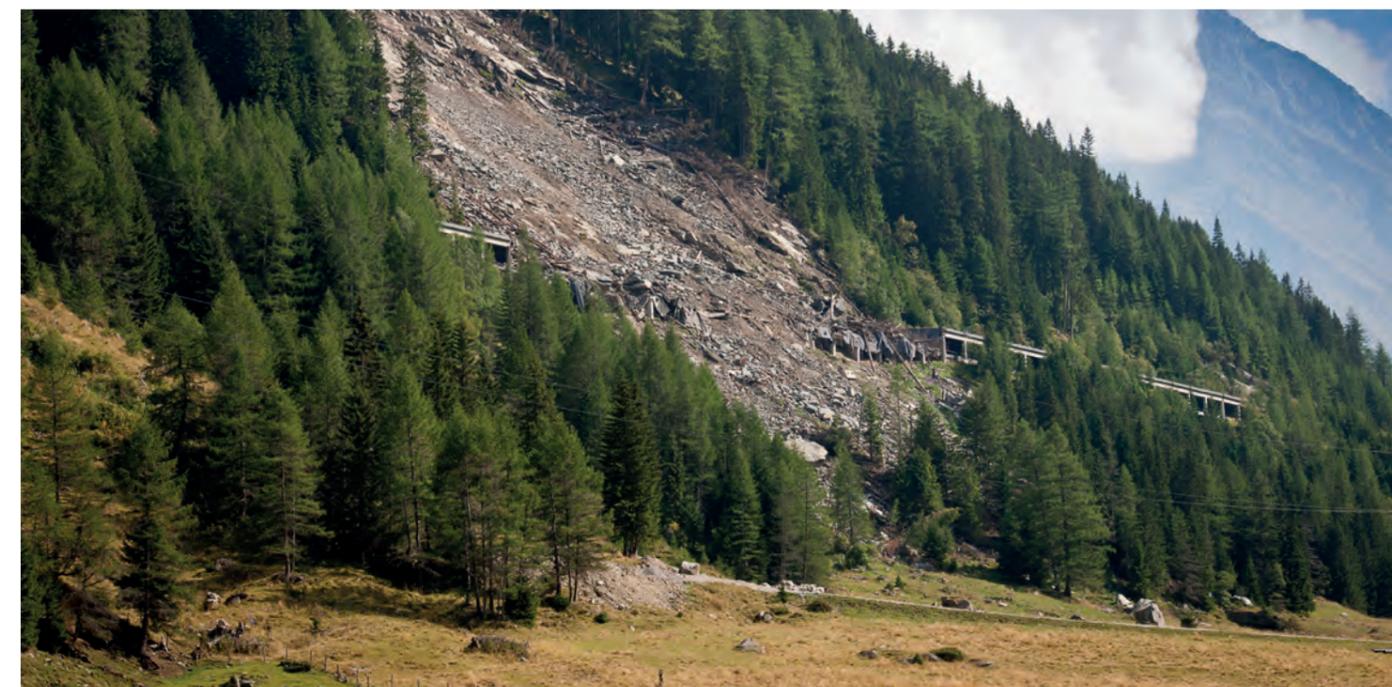
New advances in digital screening for autism

Autism spectrum disorder (ASD) affects approximately 1 in 59 children, making it one of the most prevalent neurodevelopmental disorders. However, current methodological approaches do not allow for a precise quantitative assessment of ASD symptoms in children.

Therefore, the project Digital Phenotyping of Autism Spectrum Disorders in Children, funded by the Swiss National Science Foundation (SNSF), aims to develop tools for digital phenotyping and automated screening of ASD using computer vision and Internet of Things (IoT) technologies.

«The technology developed during the project allows us to quantitatively observe and analyze the development of fine motor skills in children, their repetitiveness, play behavior, and the distribution of attention towards individual objects and the surrounding space, by observing them during autonomous play experiences. The analyzed play behavior, being a visible expression of the child's neurological development, will allow us to identify early signs of neurodevelopmental disorders and support ASD diagnosis», explains **Michela Papandrea**, Senior Lecturer-Researcher at the Institute of Information Systems and Networking (ISIN).

The technologies used allow for a multimodal approach that supports the gold standard methodologies currently used for ASD diagnosis. Specifically, during the project, the main focus is on the analysis of inertial data related to the movement of toys explored and used by the child during free play sessions and ADOS diagnosis sessions, the positioning of toys in 3D space, the child's gaze during interactions with experts in ASD assessment and the surrounding environment, body movement, and physical exploration of space.

These analyses, within the project, are conducted longitudinally to identify significant factors in ASD identification. This will enable the creation of a product at the end of the research project that facilitates early diagnosis of ASD by introducing an AI-based process that allows for large-scale screening of young children. Consequently, the generated product will provide a quantitative characterization associated with ASD diagnosis, allowing for precise therapeutic intervention tailored to the different manifestations of the disorder.

A virtual agent revolutionizing hotel booking management

During the pandemic crisis, the hospitality industry rapidly embraced automated solutions to handle customer relationships, substituting traditional human interactions with innovative processes.

Leading the Closed-domain Task-oriented Conversational Agents with Embedded Intelligence (TACO) project, the Institute of Information Systems and Networking (ISIN) developed a text-based virtual assistant tailored for seamless integration into any hotel environment. This virtual agent interprets customer messages, discerns their intent, and initiates conversations to gather specific booking details. For instance, upon receiving a message like «I would like to stay at your hotel, «the agent identifies the intention to book a room and prompts for details such as the stay period and the number of guests. It adeptly understands natural language and converts contextual information into structured data; for example, interpreting «I am coming tomorrow» to schedule the appropriate date.

Funded by the Swiss Innovation Agency (Innosuisse) and developed in collaboration with TellTheHotel and WellD, the project has resulted in an application available in four languages (Italian, English, German, and French), encompassing 40 intents and managing 12 conversation flows. Currently operational across numerous establishments, the application delivers tailored responses for each hotel and enables customizable replies.

«The project posed significant challenges, from mastering nuances in natural language across four languages to designing a user-friendly system adaptable for every hotel», notes **Massimo Coluzzi**, Lecturer-Researcher at ISIN. «Yet, leveraging cutting-edge Natural Language Processing techniques and advanced Cloud architectures was both challenging and rewarding in making the application versatile».

«We highly value SUPSI's expertise and dedication in advancing our chatbot project for the hospitality sector», remarks **Aldo Polledro**, CEO of TellTheHotel. «Their collaboration has provided us with invaluable insights into AI technologies, significantly enhancing our product. We eagerly anticipate future developments and collaborations».

This virtual agent represents a pioneering solution in enhancing customer service efficiency and personalization within the hotel industry, poised to drive further advancements in AI-driven guest interactions.

Institute of Systems and Technologies for Sustainable Production (ISTePS)

The core of human-robot interaction

Across various sectors, companies are increasingly utilizing artificial intelligence (AI) and digital technologies to boost operational efficiency and streamline processes. However, the implementation of these advanced technologies is complex and demanding, requiring specific expertise and know-how from operators and professionals involved.

The Fluently project, headed by the Automation, Robotics, and Machine Laboratory (ARM) in collaboration with an international consortium of 22 academic and industrial partners, aims to develop a novel AI-driven wearable device. This device will enable industrial robots to interpret human language, gestures, and emotions, transforming them into actionable instructions to enhance worker well-being.
The project focuses on three demanding industrial domains: the disassembly and recycling of batteries for e-bikes and electric vehicles, inspection and assembly processes in the aerospace sector, and the refurbishment of complex industrial parts using laser machining.

«Fluently's transformative capability lies in facilitating human-robot collaboration akin to human teamwork», explains **Oliver Avram**, Lecturer-Researcher at the ARM Laboratory and scientific-technical coordinator of the project. «Central to this is how both parties interact through implicit and explicit signals, adjusting their intensity according to the task at hand».

In addition to developing an intelligent interface for effective human-machine cooperation, the project has established the RoboGym—a training facility where humans and robots can refine their interactions and optimize industrial processes. Located at the Department of Innovative Technologies with support from industrial partner Fanuc, the RoboGym has begun training activities across its four robot stations. This initiative not only enhances the skills of students, researchers, and company employees but also fosters greater awareness and sensitivity to AI and robotics.

«Critical human competencies for interacting with AI technologies include collaboration, creativity, adaptability, critical thinking, and emotional intelligence», concludes the researcher. «Through shared training experiences, humans and robots develop mutual understanding, learn effective collaboration, and establish personalized team dynamics».

The Fluently project thus not only advances technological capabilities in AI-driven human-robot interaction but also cultivates essential skills crucial for the evolving labor market landscape.

AI and IIOT for enhanced injection moulding optimization

The REDETERMINE project, led by the Institute of Systems and Technologies for Sustainable Production (ISTePS), in collaboration with the Institute of Information Systems and Networking (ISIN), INTERROLL SA, and Koord Sarl, aims to revolutionize the engineering polymers selection, testing, and validation processes in the plastic injection moulding industry.

Employing cutting-edge artificial intelligence (AI) techniques and Industrial Internet of Things (IIOT), REDETERMINE is developing a decision support platform to expedite product design and development. This platform optimizes the selection of technopolymers and enhances testing and verification processes. Funded by the Swiss Innovation Agency (Innosuisse), the project enhances operational efficiency and introduces a new paradigm in plastic injection moulding—paving the way for reconfigurable production processes resilient to supply chain fluctuations.
The Mini-Factory within the Department of Innovative Technologies serves as the hub for designing, developing, and testing these systems. It boasts a state-of-the-art IIOT production facility dedicated to studying and implementing Industry 4.0 concepts.

Throughout its development, REDETERMINE has achieved several key milestones: firstly, the creation of a robust data model for accurate material and process parameter selection; secondly, the design of a bespoke testing machine for acquiring crucial component parameters; and thirdly, the development of AI algorithms to support decision-making by designers and process engineers.

«The significant innovation of REDETERMINE lies in its capacity to accelerate and optimize the validation of new technopolymers, notably reducing test cycles and refining process parameters», explains **Matteo Confalonieri**, Lecturer-researcher at ISTePS and project leader.

«Participation in REDETERMINE has enabled the integration of AI logic directly into our production processes, marking a pivotal advancement in resource optimization, waste reduction, and the incorporation of sustainable materials», emphasizes **Roberto Villa**, Head of Research and Development at INTERROLL SA.

In summary, REDETERMINE represents a substantial stride towards enhancing resilience and sustainability within the plastics industry through advanced technological integration.

Institute of Digital Technologies for Personalized Healthcare (MeDiTech)

AI for Brugada Syndrome Diagnosis

Brugada syndrome, a genetic disorder that disrupts heart rhythm and primarily affects young men, significantly increases the risk of sudden cardiac death.

Diagnosing the condition is often challenging due to its subtle and variable clinical symptoms. Traditionally, clinicians rely on electrocardiogram (ECG) features, particularly ventricular abnormalities, as key indicators. However, recent research highlights the importance of atrial abnormalities, expanding diagnostic avenues.

The Biomedical Signal Processing (BSP) research group at the Institute of Digital Technologies for Personalized Healthcare (MeDiTech), led by Francesca Faraci, collaborated with the Cardiocentro Ticino Institute of the Ente Ospedaliero Cantonale (EOC) to develop innovative solutions. Their breakthrough includes an AI system designed to detect atrial abnormalities, offering alternative diagnoses for Brugada syndrome and broadening diagnostic capabilities.

PhD students **Beatrice Zanchi** and **Giuliana Monachino** from MeDiTech state, «We employed advanced generative techniques to augment datasets specific to Brugada syndrome ECGs. This approach mitigates data scarcity due to the condition's rarity and explores novel validation methodologies for synthetic datasets».

These generative techniques not only enrich existing datasets but also expand AI applications into areas previously limited by data constraints, which is crucial in cardiology for enhancing diagnostic precision and preventing serious complications.

This study challenges traditional approaches to Brugada syndrome diagnosis, opening new pathways for innovative diagnostic methods that enable earlier detection and intervention. These advancements promise to improve clinical management and enhance patients' quality of life through cutting-edge technologies.
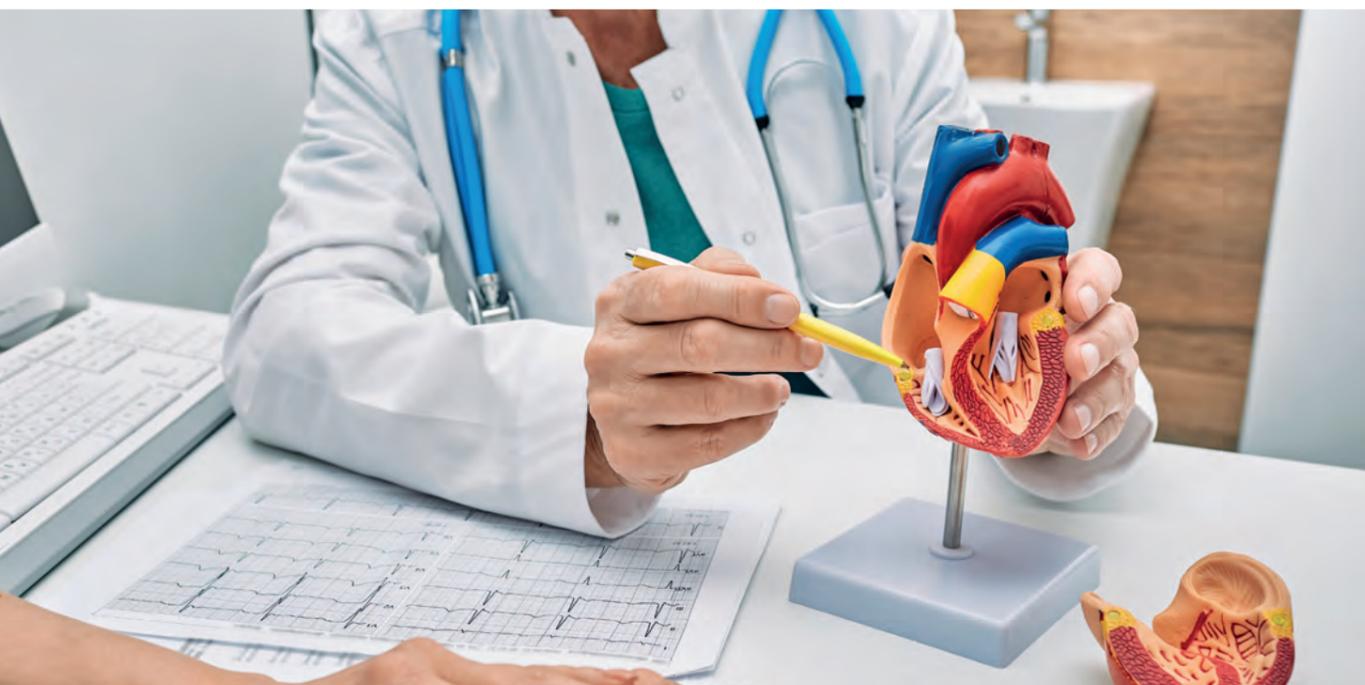
Workplace Stress Identification and Prevention

Burnout, classified by the World Health Organization (WHO) as an occupational phenomenon, manifests through feelings of exhaustion, increased mental distance or cynicism towards work, and reduced professional efficacy. In Switzerland, this issue costs companies an estimated CHF 195 per employee per month.

In response, the Resilient AG startup has focused on burnout prevention by developing a system comprising a mobile application called Resilient Client and a smartwatch.

Through the project «Identification of Risks and Prevention of Work-Related Stress Disorders» (WRSD), funded by the Swiss Innovation Agency (Innosuisse), the goal is to enhance the current system using a multimodal model tailored to each individual. This model integrates data from various sources, including physiological metrics (e.g., heart rate, sleep patterns), contextual factors (e.g., working conditions, commute, smartphone usage), behavioral insights (e.g., changes in habits, significant events), and individual characteristics (e.g., personality, demographics).

The project involves collaboration with the Institute of Information Systems and Networking (ISIN) which is developing a mobile app compatible with major platforms to collect data from wearable devices and contextual smartphone usage information.

Furthermore, in collaboration with experts from the Psy-bern clinic, the Natural Language Processing research group at the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI) is developing a conversational interface (CI) that acts as a mental coach within the Resilient App. This interface monitors and prevents work-related stress while educating users on effective stress management techniques.

These innovations from Resilient Client provide personalized feedback based on user profiles and collected data, fostering greater awareness and motivation for preventing work-related stress. Currently, the application is undergoing a feasibility study at Philip Morris Products (PMP) locations in Bologna and Lausanne.

Institute of Mechanical Engineering and Materials Technology (MEMTi)

Synthetic Fuels Research Takes Off

In September 2023, the European Parliament enacted legislation to support the adoption of sustainable aviation fuels, aiming for these fuels to constitute 70% of consumption by 2050. In response, the research consortium re.Fuel (Renewable Fuels and Chemicals for Switzerland), spearheaded by the Federal Laboratories for Materials Testing and Research (Empa), is committed to driving down the costs of sustainable fuels and chemical intermediates. Their focus includes enhancing the efficiency, selectivity, and flexibility of production facilities.

The Institute of Mechanical Engineering and Materials Technology (MEMTi) contributes significantly to the consortium. The Thermo-Fluid Dynamics Laboratory simulates reactors for methanol production, while the Computational Materials Science Laboratory addresses catalysts in the methanol-to-olefins process.

Prof. **Maurizio Barbato**, Director of MEMTi, emphasizes the suitability of synthetic fuels for aviation, shipping, and heavy transport sectors. Current global aviation fuel consumption stands at approximately 375 billion liters annually, with a Swiss company targeting production of 50 billion liters annually by 2040. Barbato believes that achieving the EU's target of 34% sustainable fuel consumption is feasible with multiple producers entering the market.

Historically, synthetic fuel production, introduced in 1925 from coal and water, faced challenges from conventional oil extraction and refining. However, rising awareness of fossil fuel sustainability concerns is now driving industrial-scale production of e-fuels with a zero-carbon footprint.

Barbato underscores the complexities involved in fuel synthesis, including managing high-pressure reactions, temperature control, and optimizing yields while minimizing energy costs. The consortium aims to enhance process efficiency and scalability for industrial deployment.

Looking ahead, Professor Barbato advocates for leveraging all available technologies to transition away from fossil fuels. While electric mobility suits private transport, he sees e-fuels and hydrogen as more promising for freight transport, long-distance travel by air and sea. Research should continue across all sectors, from battery technology to hydrogen production via electrolysis, to enhance overall energy efficiency.

In summary, the pursuit of synthetic fuels represents a critical step towards a sustainable energy future, necessitating continued innovation and collaboration across technological domains.

Sustainable innovation for products and food

In 2021, the International Committee of the Red Cross (ICRC), the World Food Programme (WFP), and the United Nations High Commissioner for Refugees (UNHCR) initiated a collaborative project aimed at exploring alternative and innovative solutions to polypropylene bags used for packaging food and relief items.

These three humanitarian organizations, deeply involved in procuring and distributing essential goods to some of the world's most vulnerable and marginalized communities, supply millions of tons of food and non-food products globally.

The Polymer Materials Engineering Laboratory at the Institute of Mechanical Engineering and Materials Technology (MEMTi) is actively participating in the project titled «Alternatives to PP Bags». Funded by Innovation Norway and led by the ICRC, this initiative seeks to address the environmental impact of packaging by applying eco-design principles to identify and develop potential substitutes. The materials developed must meet specific criteria, including capacity (5 to 90 kg) and quality standards such as resistance to UV rays and pests.

Under the leadership of Prof. **Andrea Castrovinci**, the research group collaborated closely with GiottoIndustrial Networking SA, a Swiss competence center specializing in technical textiles based in Ticino. This partnership enabled the development of a viable solution that meets all project-defined criteria.

The research focused particularly on jute fabric, a plant-derived fiber with mechanical properties comparable to polypropylene but less resistant to water and susceptible to microorganism attacks like fungi and bacteria. To enhance jute's performance as a substitute for polypropylene, researchers developed a treatment using the Layer by Layer (LbL) approach. This technique involves applying a solution designed to reinforce the vegetable fiber and improve its characteristics. Specifically, the LbL method was utilized to incorporate an antibacterial agent, silver nitrate, and a hydrophobic polymeric precursor into the coating, thereby reducing water interaction with the fiber.

This innovative approach not only enhances the durability and functionality of jute-based packaging but also promotes sustainability by reducing reliance on synthetic materials. It represents a significant step forward in addressing environmental challenges associated with packaging in humanitarian aid and beyond.

Awards and prizes

Best Bachelor's theses

TalenThesis Award

Matthias Berchtold
Computer Science Engineering

Modelli di Machine Learning efficienti in termini di risorse e interpretabili per l'identificazione di testo generato da Chat GPT

Christian Pala
Data Science and Artificial Intelligence

Distilled Chat GPT, a survey

Davide Zepponi
Engineering and Management

Hidden Gems for Private Equity Firms: an Analytical Framework for Target Detection

John Steele
Electronic Engineering

Convertitore DC-DC Interleaved

Lorenzo Pongelli
Mechanical Engineering

Sensore di forza per macchine di assemblaggio semiconduttori

RUAG Innovation Award

Giovanni Cutuli
Mechanical Engineering

Caratterizzazione numerica delle prestazioni di uno scambiatore di calore ad immersione innovativo per applicazioni ad alta temperatura

Best Master's theses

Fondazione Nizzola Award

From the left: Andrea Marino, Daniele Duzzi, Lorenzo Bazzolo

1st prize
Daniele Duzzi
MSE Civil Engineering

Strategy for the Sustainable Management of Bridges: Territorial Considerations on Integrating Environmental and Socio-Economic Impacts into Decision-Making Processes

2st prize
Lorenzo Bazzolo
MSE Medical Engineering

Test bench for in vitro preclinical testing and evaluation of endovascular prosthesis

3st prize
Andrea Marino
MSE Mechanical Engineering

Reduced gravity experiment on particle entrainment by flowing water

Argor-Heraeus Award

Ex-aequo:
Giulia Elena Delamotte
MSE Energy & Environment

Microbially Induced Boosted Calcium Carbonate Precipitation

Claudio Capuzzimati
MSE Business Engineering

Sustainability journey in Montanstahl AG: laying the foundations for responsible sustainable development

Our outstanding research

8 DTI researchers among the top 2% in Stanford's World Ranking

Each year, Stanford University publishes a ranking of the top 2 percent of the most cited scientists across various disciplines. The 2023 ranking includes eight researchers from the Department of Innovative Technologies, active at the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI) and at the Institute of Digital Technologies for Personalized Healthcare (MeDiTech): Prof. **Giorgio Corani**, Prof. **Francesco Flammini**, Prof. **Alessandro Giusti**, Prof. **Monaldo Mastrolilli**, **Loris Roveda**, **Marco Scutari**, Prof. **Marco Zaffalon**, and Prof. **Stéphane Meystre**.

Shane Legg Featured in Time Magazine's 100 Most Influential People in AI

Shane Legg, co-founder of DeepMind and former PhD student at IDSIA USI-SUPSI, has been selected by Time editors as one of the 100 most influential people in artificial intelligence.

Learning Technology Awards to AI Digital Role Play Skill Gym platform

The platform was recognized as the world's best emerging technology for training. Its enhancement was supported by the Boost project (Boosting the SkillGym user experience with advanced natural language understanding), conducted by the Institute of Information Systems and Networks (ISIN), the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI), and Lifelike SA.

In 2021, the platform had already received the *Global Edtech Startup Award* (GESA), the most prestigious award in the field of Edtech.

Quality of life Award to REMIT project

The Dalle Molle Foundation for Quality of Life grants the *Quality of Life Award* to research projects that leverage science and technology to benefit people. The REMIT (Remotely-assisted Enhanced Mirror Therapy) project, conducted by the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI), utilizes virtual reality and an exoskeleton to enhance mirror therapy for recovering lost hand function. This project was developed by **Antonio Paolillo**, **Gabriele Abbate**, and Prof. **Alessandro Giusti** from IDSIA, along with **Luca Randazzo**, Co-founder and CEO of Emovo Care.

More than 190 media mentions

The Department of Innovative Technologies and its research institutes frequently attract media attention. In 2023, the Department notably contributed to the production of several media specials, including:
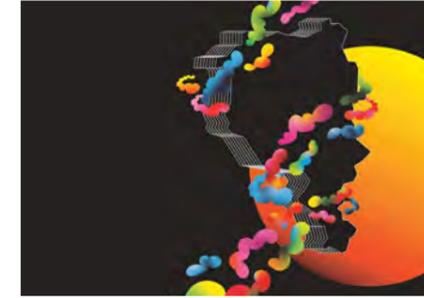
Uomini e robot: la ricerca DTI - Il Giardino di Albert RSI
(in Italian only)

L'elettronica è di casa alla SUPSI (e qui guarda al futuro) - Corriere del Ticino
(in Italian only)

Major events and conferences

8° Voxxed Days Ticino
January 20

Open Day
February 3

Swiss Operational Research Days
June 22-23

Welcome Day
September 15

Continuing Education Graduation Ceremony
September 25

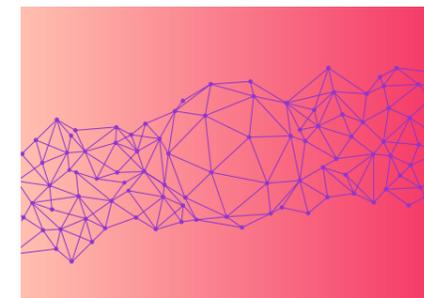**35 Year Anniversary of IDSIA USI-SUPSI**
September 27

Master of Science Graduation Ceremony
October 15

Project Management Forum
October 23-24

Explainable AI in medicine
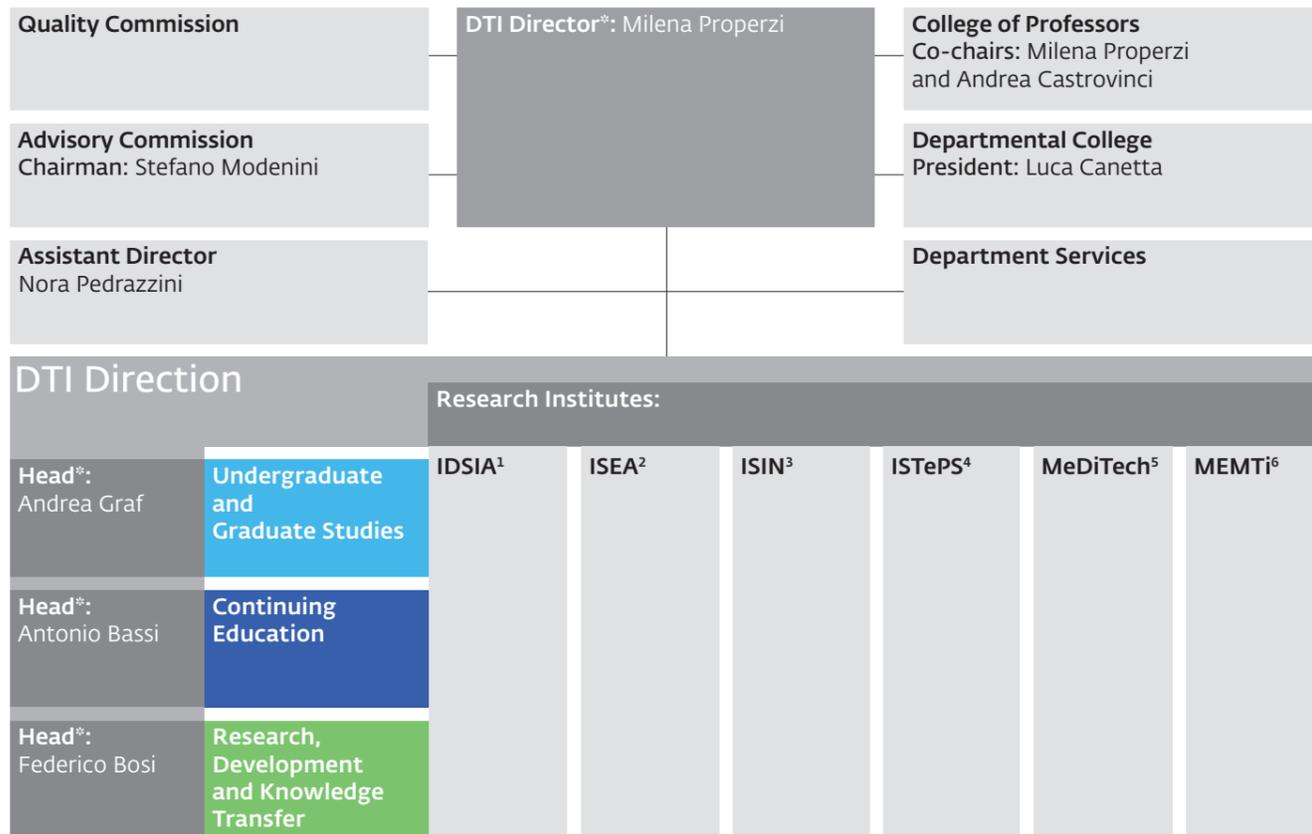November 2-3

Swiss Digital Days Ticino - NextGen
November 6

Swiss Digital Days Ticino - #herHACK
November 7

Bachelor of Science Graduation Cerimony
November 25

Organisation Chart

Quality Commission	DTI Director*: Milena Properzi	College of Professors Co-chairs: Milena Properzi and Andrea Castrovinci
Advisory Commission Chairman: Stefano Modenini		Departmental College President: Luca Canetta
Assistant Director Nora Pedrazzini		Department Services

DTI Direction

		Research Institutes:					
Head*: Andrea Graf	Undergraduate and Graduate Studies	IDSIA[1]	ISEA[2]	ISIN[3]	ISTePS[4]	MeDiTech[5]	MEMTi[6]
Head*: Antonio Bassi	Continuing Education						
Head*: Federico Bosi	Research, Development and Knowledge Transfer						

[1]Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI)
Director*: Andrea Emilio Rizzoli

[2]Institute of Systems and Applied Electronics (ISEA)
Director*: Daniele Allegri

[3]Institute of Information Systems and Networking (ISIN)
Director*: Tiziano Leidi

[4]Institute of Systems and Technologies for Sustainable Production (ISTePS)
Director*: Marco Colla

[5]Institute of Digital Technologies for Personalized Healthcare (MeDiTech)
Director*: Stéphane Meystre

[6]Institute of Mechanical Engineering and Materials Technology (MEMTi)
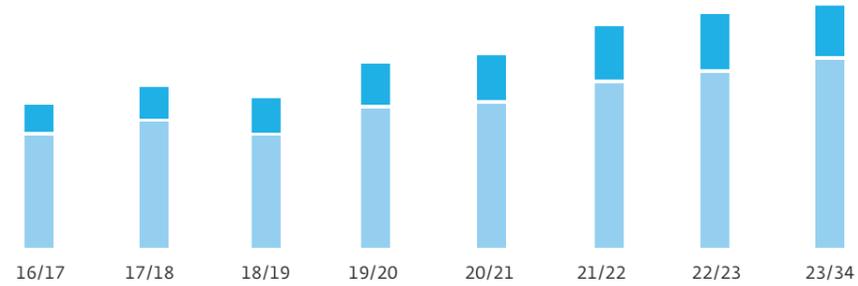Director*: Maurizio Barbato

*Members of DTI Departmental Management Board
Organisation Chart, December 31, 2023
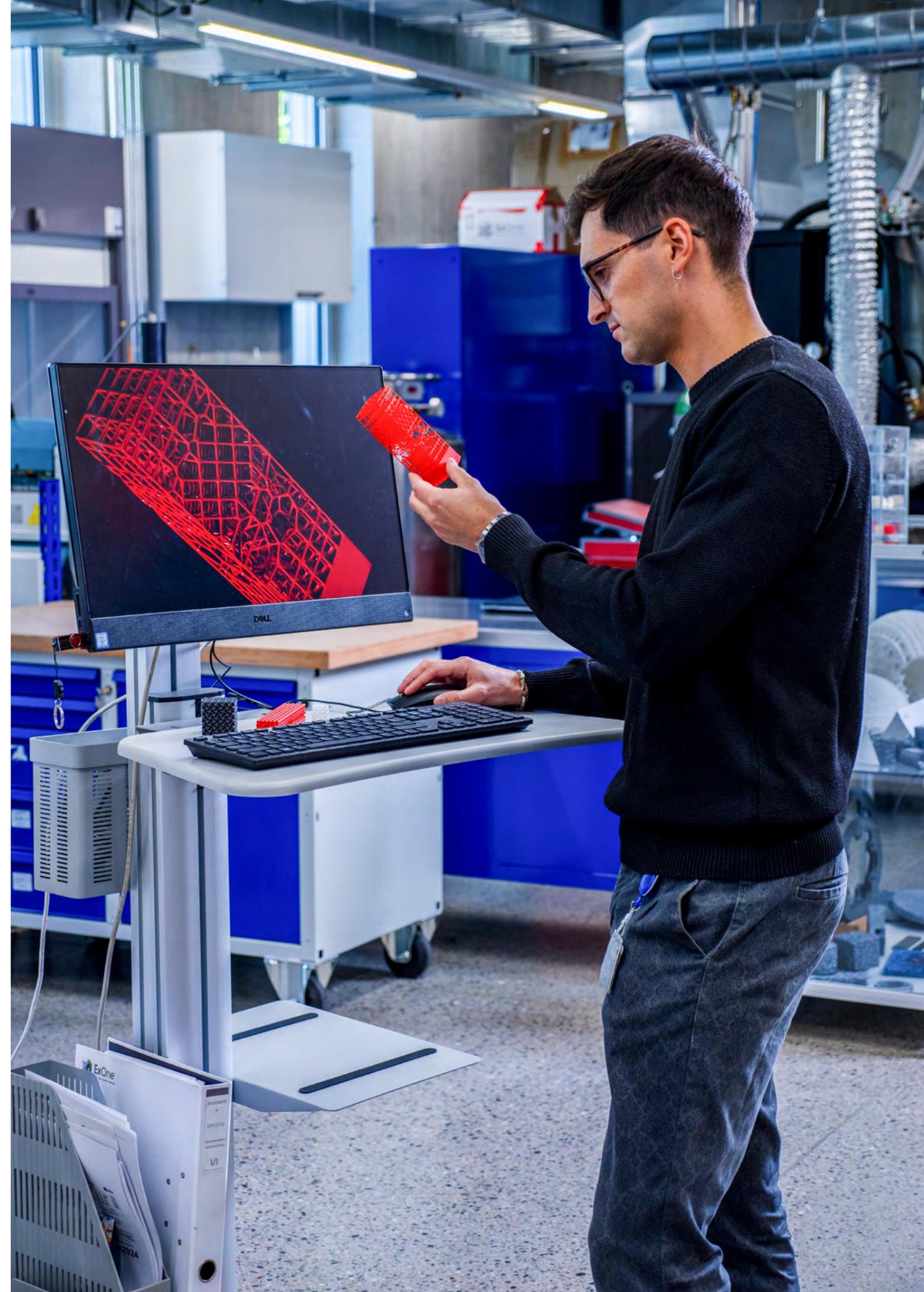
At a glance

Undergraduate and Graduate Studies

Total enrolled	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Bachelor	453	508	542	563	583	666	705	761
Master	109	126	137	166	180	215	223	202

Continuing Education

Total participants	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
CAS, DAS, MAS	167	159	173	265	224	238	287	183
Short Advanced Studies	39	127	17	13	178	166	105	170
Tailor-made courses for companies	17	24	33	44	123	84	139	174
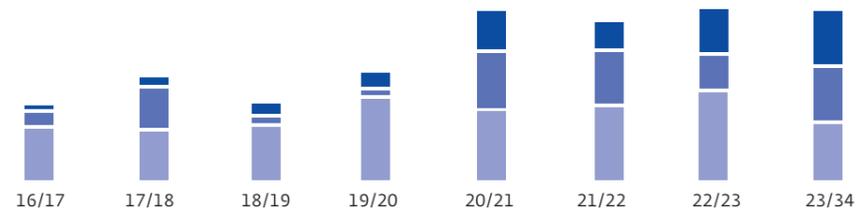
Research and Development

	2016	2017	2018	2019	2020	2021	2022	2023
Initiated Research Projects	61	55	65	68	82	88	110	122
Budget (Mio CHF)	16.4	16	15.7	17.9	19.2	22	23.5	25
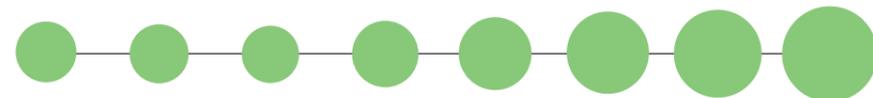
Employees

	2016	2017	2018	2019	2020	2021	2022	2023
Total	270	275	279	317	350	361	371	389

Undergraduate and Graduate Studies

Bachelor of Science
- Data Science and Artificial Intelligence
- Electronic Engineering
- Engineering and Management
- Computer Science Engineering
- Mechanical Engineering

Master of Science
- Engineering (MSE)
- EIT Manufacturing Double Degree

Department of Innovative Technologies

Research and Development
MEMTi, MeDiTech, ISTePS, ISIN, ISEA, IDSIA

Continuing Education
MAS, DAS, CAS
- Business Agile
- Data Privacy and Cybersecurity
- Fashion Innovation
- Information Technology and Digitization
- Industrial Engineering
- Project Management

IDSIA USI-SUPSI   Dalle Molle Institute for Artificial Intelligence USI-SUPSI
ISEA   Institute of Systems and Applied Electronics
ISIN   Institute of Information Systems and Networking
ISTePS   Institute of Systems and Technologies for Sustainable Production
MeDiTech   Institute of Digital Technologies for Personalized Healthcare
MEMTi   Institute of Mechanical Engineering and Materials Technology

MAS   Master of Advanced Studies
DAS   Diploma of Advanced Studies
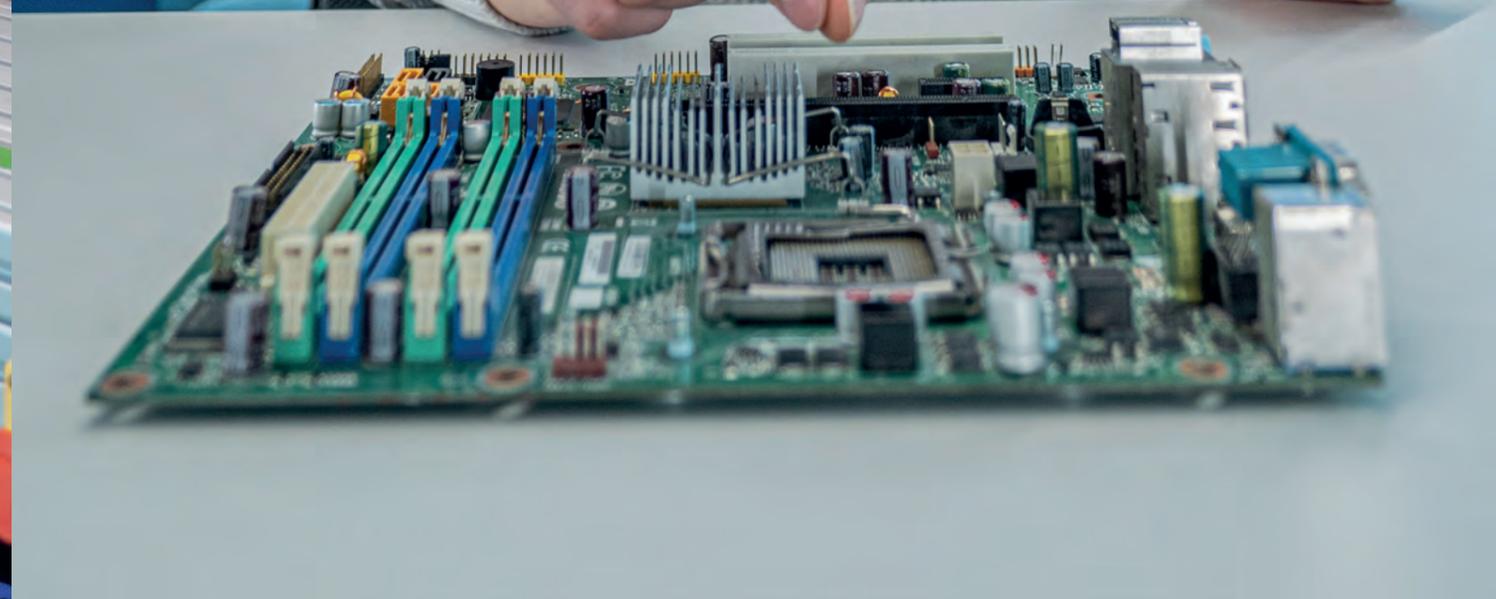CAS   Certificate of Advanced Studies

Balestra Building

Lugano city centre

Department of Innovative Technologies

East Campus USI-SUPSI

Boscioro Building (150 m)
From 2024