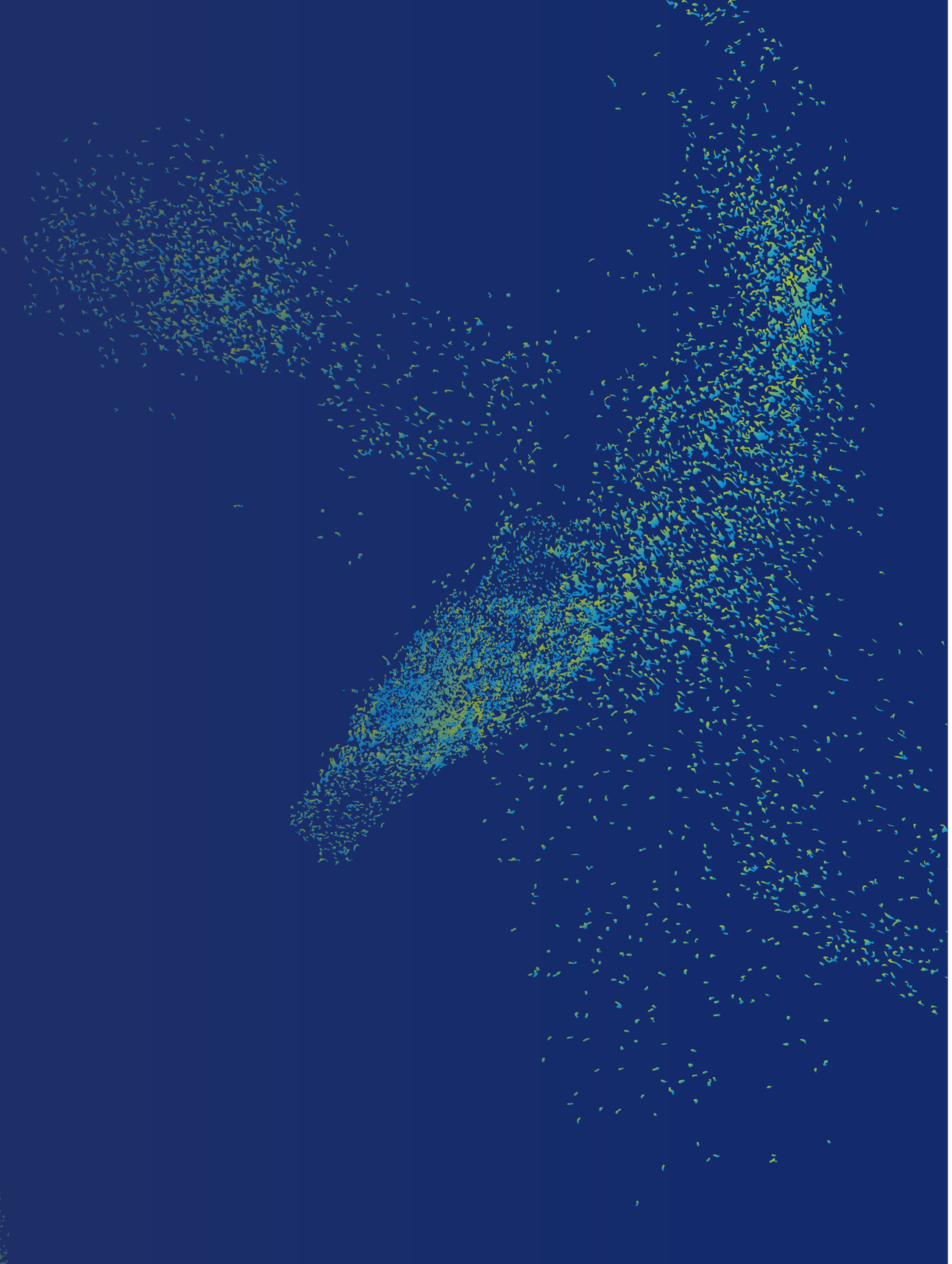
HUMAN TECHNOPOLE

STRATEGIC PLAN 2024-2028



STRATEGIC PLAN
2024-2028

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HUMAN TECHNOPOLE

In 2015, Milan hosted the Universal Exposition. For six months, the city opened its doors to 21 million visitors worldwide and positioned Milan as an internationally attractive destination for businesses, students and tourists.

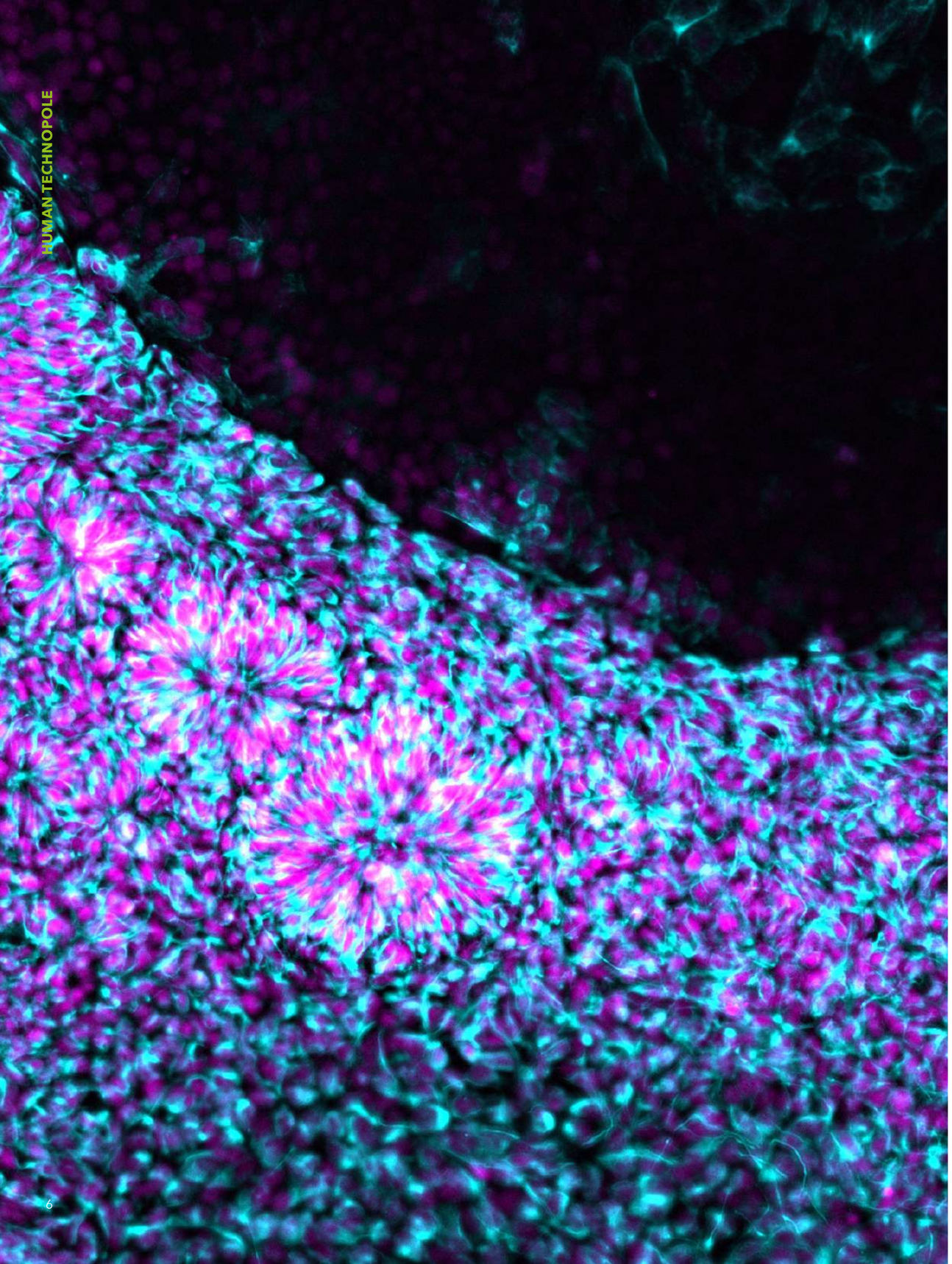
The legacy of Milan Expo 2015 was taken up by MIND Milano Innovation District, a regeneration project based on a public-private partnership to transform the Expo area into a large urban park and a centre for research, knowledge and innovation.

At the heart of MIND Milano Innovation District lies Human Technopole (HT), a **research centre** for the **life sciences** established in 2018 by the Italian Government **to promote frontier research, foster collaboration among scientists and bring added value to the scientific research ecosystem in Italy and the rest of Europe**.

Over its first few years of activity (2019-2023), HT prepared the groundwork for the future development of the institute. Renovation works were carried out to refurbish Palazzo Italia – the Italian Pavilion for Milan Expo 2015 – and transform it into the institute's main headquarters. In just a few months, amid the global COVID-19 pandemic, the HT campus expanded and research laboratories were built to host HT's initial research groups and core facilities. Concurrently, scientific training programmes and initiatives were established to foster the institute's development.

Today, HT is a young and dynamic institute where internationally recruited researchers have laid the foundations for **unravelling fundamental mechanisms of life across biological scales** (i.e. molecules, cells, tissues, organs, organisms, and populations) in **space** and **time**.

Over the next five years, HT will gradually move from start-up to scale-up phase: promoting interdisciplinary research, fostering collaboration with the national community and disseminating scientific results and achievements to reinforce the message that science is a global public good.



Mission and Goals

HT's overarching mission is to **improve human life and technology** by investing in human **health and disease prevention research**. To achieve its mission, **HT aims to deepen our understanding of human physiology and disease by adopting an open innovation, multi-scale systems biology approach**.

HT will accomplish its mission by pursuing **four main goals**:

1 FOSTER RESEARCH FOCUSING ON FUNDAMENTAL MECHANISMS UNDERLYING HUMAN BIOLOGY, WITH RELEVANCE TO HUMAN HEALTH AND WELL-BEING;

2 SUPPORT RESEARCH BY PROVIDING TECHNOLOGIES TO THE ITALIAN SCIENTIFIC COMMUNITY VIA SHARED RESEARCH INFRASTRUCTURES, THE NATIONAL FACILITIES;

3 OFFER ADVANCED SCIENTIFIC TRAINING TO THE ITALIAN RESEARCH COMMUNITY;

4 ENABLE THE EXPLOITATION OF ITS RESEARCH AND TECHNOLOGICAL RESULTS VIA TECHNOLOGY TRANSFER.

In addition, as part of its mission, HT strives to promote an institutional culture grounded in **scientific excellence** and **integrity**, influence and contribute to **health policymaking** and advocate for the **importance of basic research among citizens** to empower them in the public discussion of science.

HT's uniqueness in the national and international life sciences ecosystem

The uniqueness of HT stems from the **four main programmatic goals outlined in its mission:**

1 **Research**. HT embraces the full complexity of human physiology by adopting a **multi-scale research** approach – from molecules to human populations – combining **experimental research and theory** to **derive fundamental molecular mechanisms from clinical observations**. The institute operates on the principle that pathological mechanisms in humans can offer functional paradigms to help understand the basis of biological systems. Accordingly, HT has decided to focus **on experimental model systems closely resembling human conditions**. Defining the molecular basis and mechanisms of human pathologies is a prerequisite for the development of new diagnostic and therapeutic tools.

2 **HT shared research infrastructure**. The **National Facilities** have been implemented according to well-established models of international research infrastructure. They are available to **HT research groups and the Italian research community**. Users will access the National Facilities following an evaluation by an international Standing Independent Evaluation Committee (in Italian, *Commissione Indipendente di Valutazione Permanente*). In addition to accessing cutting-edge technologies and instrumentation, they will receive high-quality training and support in planning their experiments and analysing data.

3 **Advanced scientific training**. Top-notch scientific training is offered to in-house scientists and the external - national and international - scientific community. **Internal and external training** activities will be complementary and contribute to **educating the next generation of researchers and providing them with the proper skills to cope with ambitious research projects**, taking advantage of the technologies offered by the HT Facilities.

4 **Technology Transfer**. HT will promote networking among its researchers and facilities, (inter)national research institutes and industry to **expedite technology transfer in the life sciences** – a sector where the path from discovery to market is significantly long; lasting several years or decades.

With its vocation of research in biological science, development of biomedical research technologies and providing services through the National Facilities, HT **can be a flywheel to propel Italian science and economy forward**.

Interactions with stakeholders and open innovation

Thematic overlaps in life sciences provide a foothold on which to build bridges connecting research institutions to enable communication and synergies, rationalising national resources and catalysing relations with external institutions. In this respect, HT acts as an "**interaction hub**", facilitating and coordinating the interconnection and cooperation among the Italian research community.

The **interactions among HT and internal** (e.g. HT Governance, Boards, staff and researchers) **and external stakeholders** (for example, national and international research community, clinicians, industry, and technology providers) will be instrumental for HT to achieve its mission and goals. HT adopts an **open innovation model** relying on scientific partnerships and collaborations and largely complements and synergises with other publicly founded private institutions in Italy. While supporting its partners and the Italian research community, the anticipated exchange of ideas and resources will allow HT to grow and become a leading institution in the life sciences sector.

HT adopts an **open innovation model** relying on scientific partnerships and collaborations and largely complements and synergises with other publicly founded private institutions in Italy.

The way forward

During the first years of HT's activity, Research Centres focusing on five key areas (Genomics, Neurogenomics, Structural Biology, Computational Biology and Health Data Science) were established alongside six world-class facilities (Genomics, Cryo-EM, Light Imaging, Image Analysis, Automated Stem Cell and Organoid and a large-scale Data Centre). Administration and scientific management offices were structured and staffed to provide scientists with the necessary support to effectively carry out their activities.

A first round of scientific training initiatives was carried out, providing scientists at all levels of their careers with opportunities to broaden their knowledge and skills, advance their careers and position HT as an internationally competitive scientific training centre.

Over the next five years, HT will move into **a new phase of its development** which will include the **following milestones**:

1 REFINE ITS RESEARCH VISION BY PURSUING INTERDISCIPLINARY, CROSS-CENTRE FLAGSHIP RESEARCH PROGRAMMES RELEVANT TO HUMAN PATHOPHYSIOLOGY;

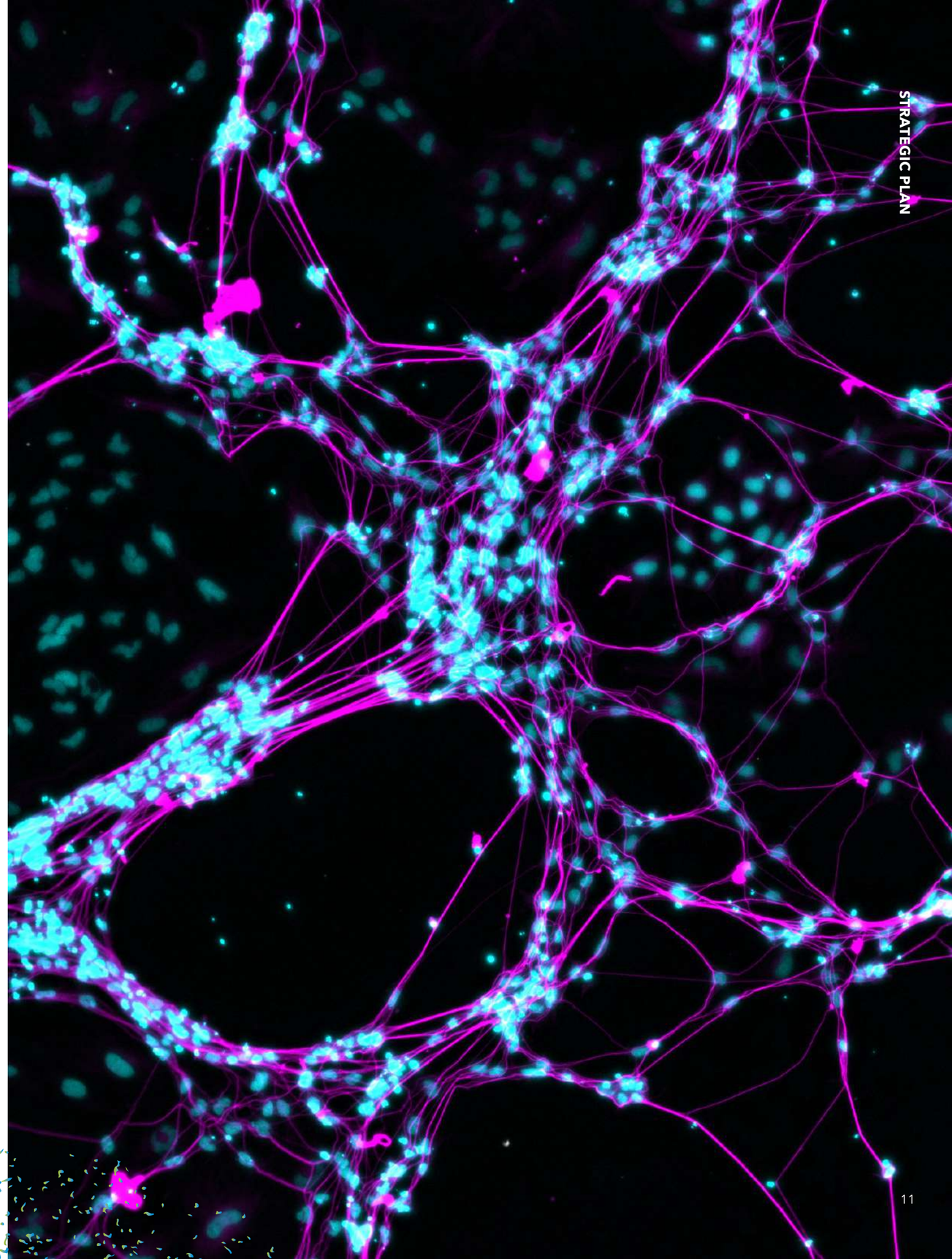
2 SUPPORT THE FLAGSHIP RESEARCH PROGRAMMES BY STRENGTHENING MISSION-CRITICAL ACTIVITIES. NEW EXPERTISE AND APPROACHES WILL BE ADDED THROUGH THE RECRUITMENT OF NEW RESEARCH GROUPS AND SHARED INFRASTRUCTURE WILL BE EXPANDED;

3 OPEN NATIONAL FACILITIES TO FULFIL THE NEEDS OF THE ITALIAN LIFE SCIENCE RESEARCH COMMUNITY;

4 DEVELOP AND CONSOLIDATE HT'S INTERNAL AND EXTERNAL SCIENTIFIC TRAINING OFFERS;

5 FOSTER INTERACTIONS AMONG RESEARCHERS, TECHNOLOGY PROVIDERS, AND INDUSTRY STAKEHOLDERS, FACILITATING A SEAMLESS TRANSFER OF TECHNOLOGY;

6 REVIEW THE INSTITUTE'S INTERNAL ORGANISATIONAL STRUCTURE TO IMPROVE THE MANAGEMENT OF RESEARCH PROGRAMMES, NATIONAL FACILITIES AND SHARED INFRASTRUCTURE, AND TO SUPPORT RESEARCH BY EFFICIENT AND TRANSPARENT ADMINISTRATION AND IMPROVED FLOW OF INFORMATION.



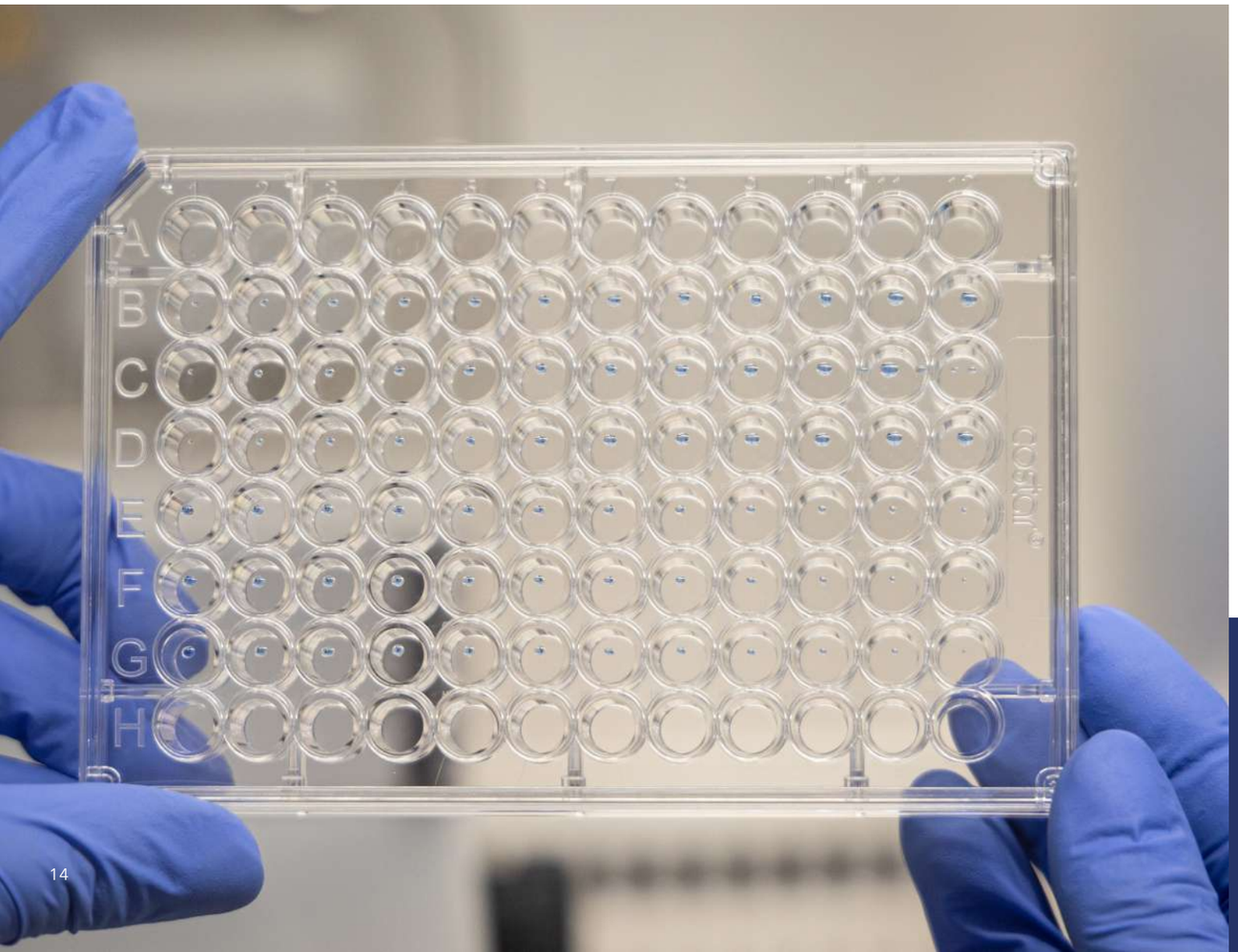
HT's approach to research

Like any other form of life, the human being is a **complex system made up of elementary components**. Each component has its own functions, but through the interaction with other components, they give rise to **overall properties of the system** that are more than the sum of its parts. Physicists call these "**emergent properties**". Studies on complex systems and their emergent properties earned the Italian physicist Giorgio Parisi the Nobel Prize in Physics in 2021. A flock of birds, a single cell and the cells in an organism are all examples of complex systems based on emergent properties.

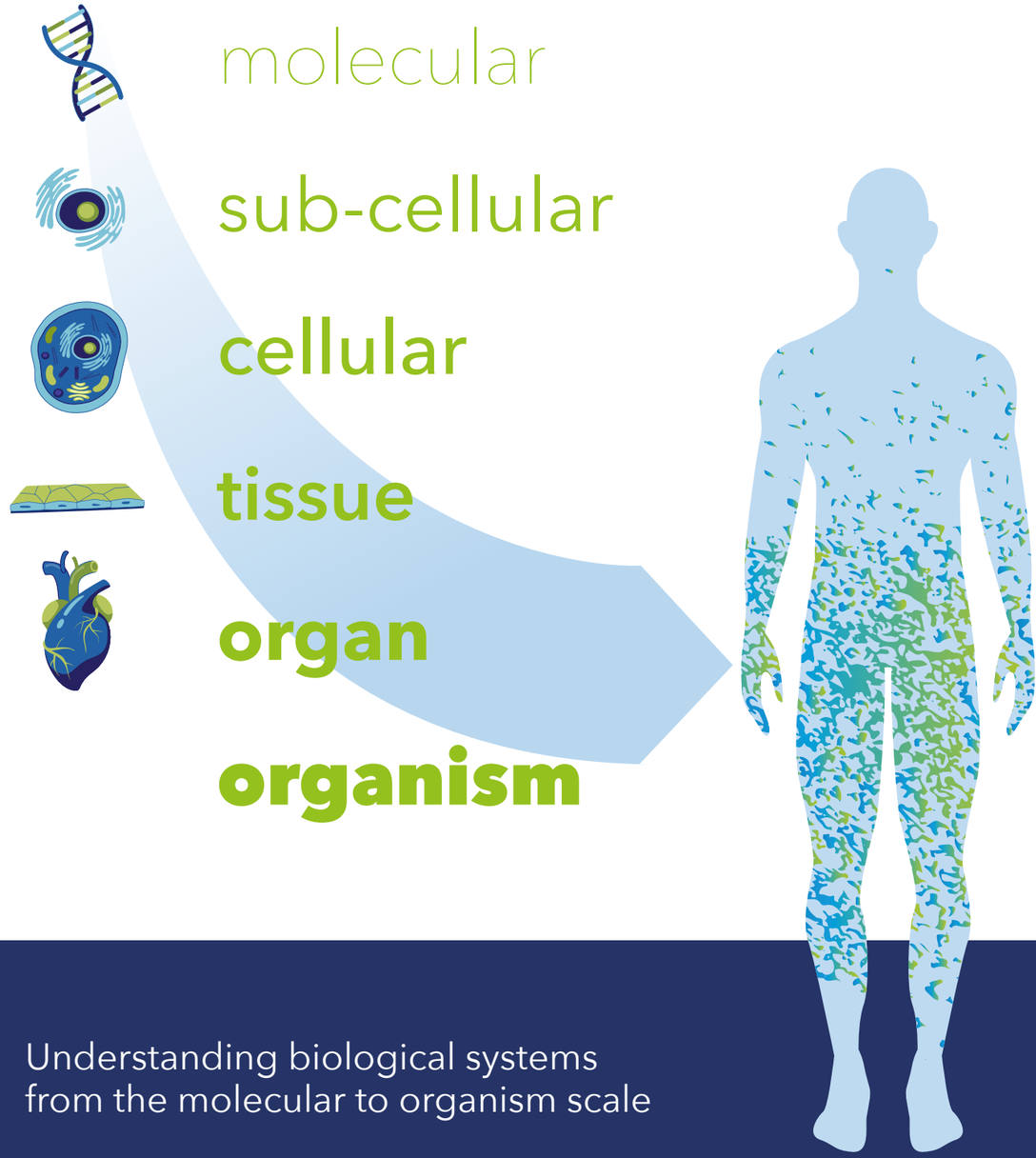
Understanding the **interactions between the components** is fundamental to understanding biological systems, including human physiology and its pathological dysfunctions.

HT researchers will investigate the emergent properties of biological systems across scales and how these evolve over time.
They will adopt a **multi-scale systems biology approach**, allowing **holistic investigations of biological systems** and their components across different levels of complexity. Systems biology requires a combination of experiments, theory and computer science. **Theory** will help design experiments, whereas **computational and Artificial Intelligence-based methods** will be used to **extract biological information from complex datasets**. Predictive models will allow (in)validating experiments, and **biophysical modelling** will help predict the influence of biological and physical factors on complex systems.

This **interdisciplinary method**, coupled with **cutting-edge scientific infrastructure**, provides HT with the tools to become **a centre of excellence for biomedical research at the national and international levels**.



Self-organisation propagated over scales



Understanding biological systems
from the molecular to organism scale

Core Values

Through its scientific activities, HT will actively promote **open science** and **research integrity** and implement the rules of **good scientific practice**. It will broadly share its results, data, and software and establish a culture of **honesty**, **transparency**, and **openness** in planning and performing research, handling and analysing data and communicating science. Generally, in carrying out all its activities – both inward- and outward-facing – HT will strive to **promote a culture of research and innovation** based on a set of core values:

INTEGRITY

All activities at HT are carried out in line with international best practices and in respect of ethical values, deontological obligations, and professional standards.

INCLUSION

HT values diversity and preserves it by supporting equity between all genders, ethnicities and cultures.
By promoting equality and integrating diversity, HT favours inclusion to enable everyone to feel accepted and valued while condemning discrimination or harassment.

OPENNESS AND COLLABORATION

Collaborations between research teams of different expertise typically yield the most innovative results.
HT's working environment is based on collaboration, interdisciplinarity and strong teamwork.
HT pursues all its activities in an open and collaborative manner by involving academics, clinicians, industry, and other relevant stakeholders to broadly promote life science research and innovation.

Furthermore, HT engages in outward-facing scientific activities to benefit the national and international research community, such as offering services through the National Facilities, opportunities for training and career development and outreach initiatives.

RESEARCH

Research Centres and Groups

Five broad, complementary, and highly relevant biomedical and health-related research areas were selected to form the basis for HT's initial research plans. Accordingly, Research Centres were set up based on these broad disciplines or fields and applied to many different topic areas and problems related to human health and disease.

The **Genomics Research Centre** includes two complementary research programmes: the Functional Genomics programme aims to identify the mechanisms governing gene expression and their biological functions, whereas Population and Medical Genomics investigates how heritable genetic information translates into phenotypic traits and causes specific defects.

The **Neurogenomics Research Centre** studies the mechanisms responsible for neuropsychiatric and neurological disorders (ranging from neurodevelopmental to neurodegenerative diseases) by combining basic and translational research, several experimental systems (e.g. brain organoids, animal models and epidemiological cohorts) and computational approaches.

By gaining detailed knowledge of the structure of macromolecules and macromolecular complexes, the **Structural Biology Research Centre** investigates how macromolecular nano-machines work and harmonise their activities in cells and how they are (de) regulated in human diseases.

The **Computational Biology Research Centre** develops new mathematical and computational approaches - from mathematical modelling of dynamical systems to machine learning and Artificial Intelligence - to analyse and interpret biological data.

The **Health Data Science Centre** aims to understand, prevent, and treat diseases using large-scale data science applied to biological and medical data to improve population health.

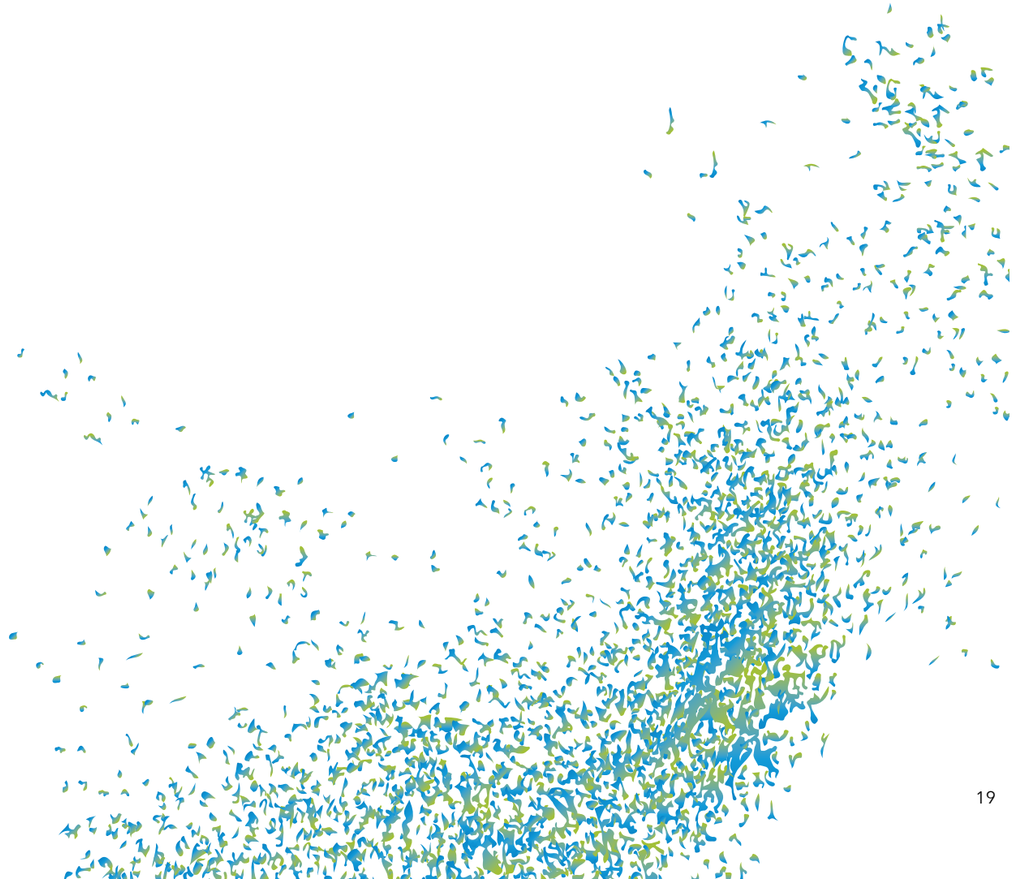
New research areas and groups will be introduced, thus creating synergies with HT's existing research programmes that will impact each field.

HT already has a strong expertise in investigating molecules, organisms and populations. Nevertheless, pursuing HT's multi-scale research programmes will require the addition of new competencies to fill the existing gaps in knowledge and approaches.

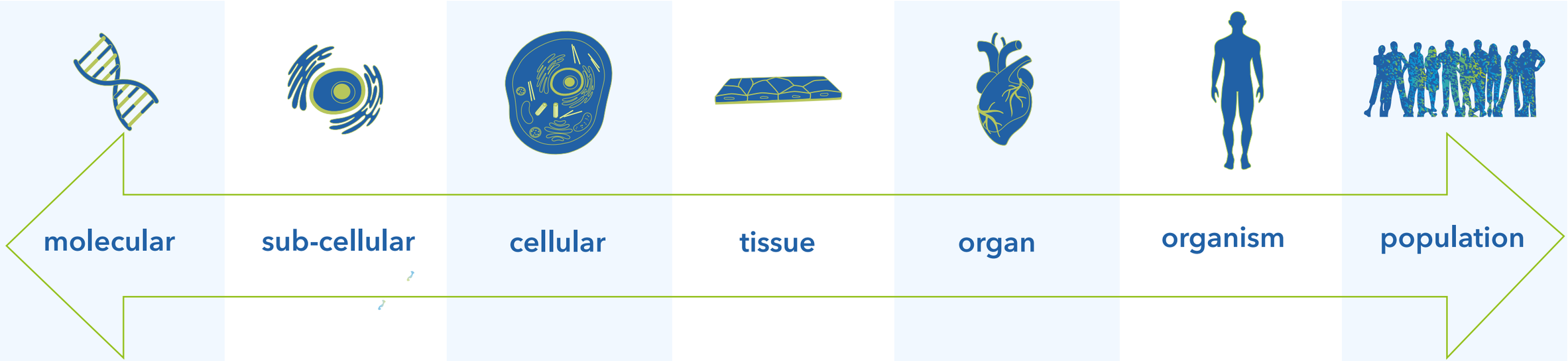
Research areas to be established and/or expanded soon will be Molecular Cell Biology and Biophysical Modelling and Simulation. To strengthen the bridge from the cell-to-organ scales, new research groups will be recruited in these areas.

- **Molecular Cell Biology**, including related fields such as mechanobiology and cell metabolism. The goal of Molecular Cell Biology is to study the molecular basis of biological processes using a variety of approaches and perspectives (i.e. from standard molecular methods to biochemical reconstitution and biophysical manipulation) and across scales (i.e. from molecules to cells and tissues, with the cell as the central area of study).

- **Biophysical Modelling and Simulation** aiming at elucidating mechanisms underlying human physiology.



Bridging biological scales: from molecules to populations



Genomics

Structural Biology

Computational Biology

Neurogenomics

Molecular Cell Biology

Biophysical Modelling and Simulation

Genomics

Health Data Science

Flagship Research Programmes relevant to human health and disease

Pathological processes impact cellular and tissue homeostasis and are strongly related to their physiological counterparts. Therefore, **studying human diseases can offer functional paradigms to understand fundamental molecular mechanisms and create opportunities for translational research**. Over the next five years, HT aims to *i)* pursue **interdisciplinary cross-Centre Flagship Research Programmes** built on the ongoing and programmed work of HT Research Groups and Centres and *ii)* elucidate fundamental molecular mechanisms underpinning diverse pathophysiological processes across scales.

Such Programmes are intended to **promote synergies** among HT Research Centres and **catalyse interactions among HT researchers** into pipelines of activities and expertise towards **achieving common goals for the whole institute**. Synergies will emerge not only among Research Centres but also among Flagship Research Programmes. The HT shared infrastructure will strongly support the Programmes through constantly developing and optimising technologies.

The **advantage** of structuring research into programmes is manifold:

- FOSTERING INTERDISCIPLINARY RESEARCH AND ENHANCING COLLABORATION, INCLUDING WITH CLINICIANS, BIOTECH AND PHARMA COMPANIES;
- INCREASING THE AMBITION OF THE INSTITUTE'S RESEARCH AS A WHOLE. GROUPS FROM DIFFERENT RESEARCH CENTRES WILL CONTRIBUTE TO THE COMMON OBJECTIVES OF EACH FLAGSHIP RESEARCH PROGRAMME;
- FREEDOM TO WORK ON BASIC MECHANISMS WHILE OFFERING THE OPPORTUNITY TO CONTRIBUTE TO RESEARCH ON HUMAN DISEASES;
- IDENTIFYING GAPS IN KNOWLEDGE AND TECHNOLOGIES THAT REQUIRE BRINGING NEW EXPERTISE OR COLLABORATIONS WITH EXTERNAL PARTNERS.

CARDIOMETABOLIC DISEASES

Cardiometabolic diseases – encompassing conditions like heart disease, stroke, and diabetes – **collectively represent the leading causes of morbidity and mortality worldwide**. The Programme relies on the hypothesis that integrating genomic data with specific characteristics (or traits) of an individual can reveal significant insights into cardiometabolic diseases. It will combine molecular assays with multi-omic analysis of the "expressed genome" (e.g. RNA, proteins and metabolites), electronic health records and population and patient cohort studies to identify causal pathways for cardiometabolic diseases. These analysis will be complemented by targeted deep phenotyping of smaller groups of individuals to identify and validate novel therapeutic targets. Finally, HT researchers will develop risk assessment tools, strategies, and interventions to improve the prevention and management of cardiometabolic diseases in Italy and globally.

METABOLIC DISEASES

This Programme expands the scope of the previous one and aims to **study the processes that drive cells into dysmetabolic states**. Addressing this question requires the integration of molecular mechanisms with the regulation of metabolism across scales, from the molecular and sub-cellular (organelles) to the organ scale and organism physiology. HT scientists will investigate two broad areas of metabolic dysregulation: metabolic-associated liver diseases and hormonal metabolic regulation in the central nervous system. The former will focus on **the identification of molecular mechanisms leading to dysmetabolic regulation in various types of liver diseases** (for example, non-alcoholic fatty liver disease, non-alcoholic steatohepatitis, primary biliary cholangitis, and ciliopathies). The latter will investigate the impact of endocrine and metabolic disruption on brain development and health. In addition, this programme will also touch upon nutritional and other metabolic diseases (e.g. obesity) as well as the role of nutrition in disease aetiology. As such, it will interface with other Flagship Research Programmes (for example, "Cardiometabolic diseases" and "Evolving diseases – Cancer").

EVOLVING DISEASES: IMMUNOGENOMICS, CANCER, INFECTIONS

Unlike engineered systems, biological systems can react to perturbations, adapt and evolve. Cancer, immune-mediated and inflammatory conditions are often defined as “evolving diseases” due to their capacity to evolve and progress over time. These diseases represent an enormous health and economic burden. In collaboration with Italian and foreign hospitals, HT researchers will investigate **the molecular basis of evolving diseases**. They will perform population-scale multi-omic studies, investigate rare autoimmune diseases and apply machine learning techniques to infer cellular and disease mechanisms from imaging and molecular data. Mathematical and biophysical modelling will allow them **to identify cancer vulnerabilities, investigate the evolution of antibiotic resistance in bacteria and find parallels with cancer drug resistance**.

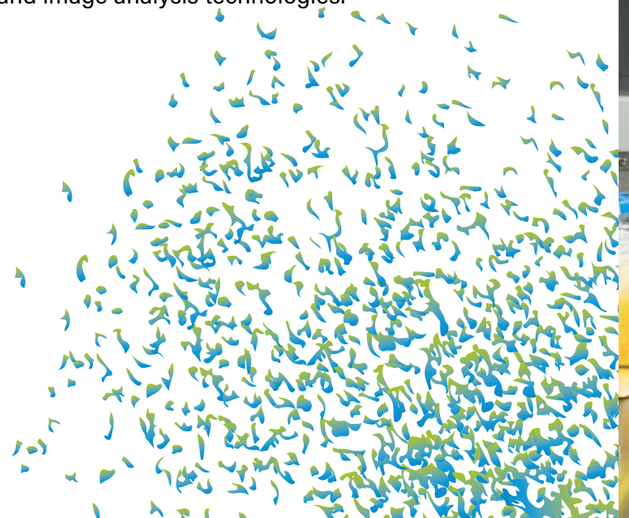
NEURODEVELOPMENTAL AND NEUROPSYCHIATRIC CONDITIONS

Neurodevelopmental (such as autism spectrum disorders) and neuropsychiatric disorders (NPDs, e.g. schizophrenia) are complex diseases originating from multiple genetic and environmental factors. **HT researchers aim to investigate and dissect the fundamental mechanisms of these diseases across biological scales**. The overarching goal of this Programme is to improve our ability to diagnose, prevent and support the broad spectrum of neurodiverse individuals. This will be possible through the phenotyping of clinical cohorts as well as integrating cohort-derived clinical data with those from multi-omics analysis, stem cell reprogramming, brain organoids, and other in vitro and in vivo models. Such a systematic approach will be complemented by cutting-edge computational methods for analysing complex datasets.

CILIOPATHIES

Cilia are hair-like cellular organelles that **extend from the surface of various cell types within the human body and serve diverse vital functions**. Some cilia are devoted to motility (motile cilia), as the ones in the ciliated cells in the lungs that push inhaled particles out of the airways. Others play a role in sensory perception and cell signalling (primary cilia), such as those in the hair cells of the ear or the epithelial cells in the kidney. Not surprisingly, given their almost ubiquitous presence, defects or anomalies in the ciliary structure manifest in a broad group of diseases, called ciliopathies. Ciliopathies range from infertility to vision and cognitive impairment, cystic diseases, skeletal abnormalities, hydrocephalus, situs inversus and persistent respiratory issues. Elucidating the molecular mechanisms underlying ciliopathies requires an interdisciplinary, multi-scale approach involving multi-omic and structural analyses and advanced imaging techniques.

HT stands as an ideal hub for pursuing this ambitious goal with its expertise in cilia and studies on ciliated systems such as the liver, kidney, brain, pancreas, and thyroid, combined with proficiency in population genomics, transcriptomics and cutting-edge structural biology, imaging, and image analysis technologies.



SHARED RESEARCH INFRASTRUCTURE

Research and technology are two sides of the same coin. The high costs of developing and maintaining know-how and instrumentation require a structure that allows it to maintain its relevance over time whilst remaining financially affordable.

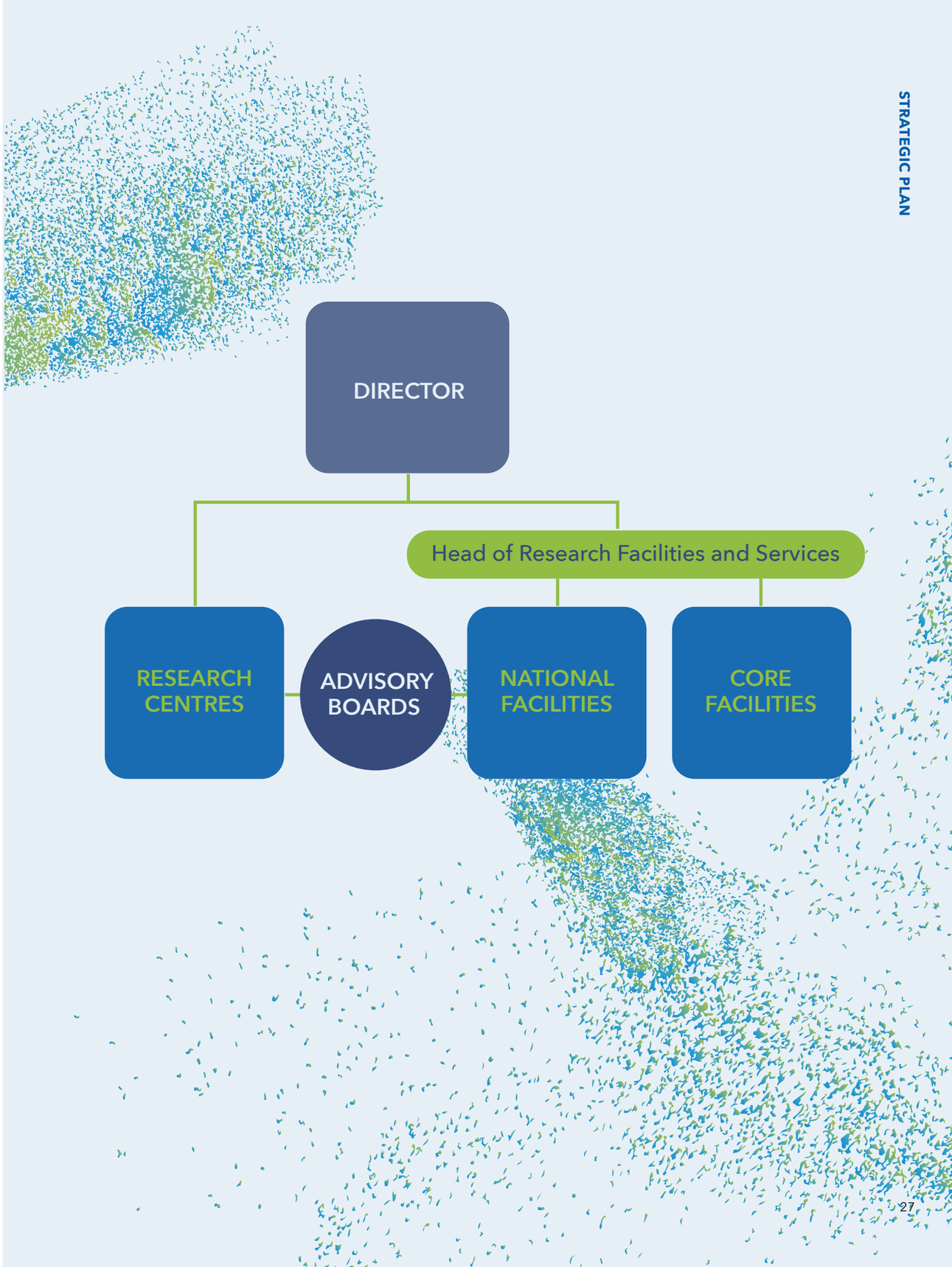
The model adopted by HT is to support research through large-scale infrastructure, **National Facilities (NFs)** and **Core Facilities (CFs)**, the latter providing technologies not included in the NFs but widely used by the internal research groups at HT. If necessary, the CFs will contribute to research projects of external users, like the NFs, to ensure their success. Should the CFs be deemed helpful by the national scientific community, they could be made available as NFs in the future.

The NFs and CFs will be **managed independently** of the HT Research Groups and coordinated by a Head of Research Facilities and Services to ensure equal and fair access to the shared infrastructure for both internal and external users.

Maintaining the HT NFs and CFs at the forefront of technological innovation will be a prerequisite for their functioning and growth. This will be mainly achieved through:

- A **dedicated unit and/or budget** devoted to **technology development** in each Facility;
- **Collaborations** with **internal and external researchers** that take place via an **internal reward mechanism** (a credit in the Facility's budget). This mechanism will encourage the contribution of researchers to the development of technologies in collaboration with the HT Facilities to benefit the entire scientific community;
- **Interaction with technology providers**.

Facilities' efforts in technology development will always and exclusively aim to implement services of general interest to the scientific community.



National Facilities

The **National Facilities (NFs)** are being implemented following the provisions of the *Convenzione* between HT and the founding Ministries as a result of a two-stage public consultation with the Italian research community. They will provide the national scientific community and HT researchers with vanguard technologies within the omics, imaging and data handling and analysis domains. In addition, they will promote a dynamic infrastructure that encourages **collaboration**, **knowledge sharing** and **innovation** among researchers nationwide.

Beyond their instrumental role in delivering essential services and technologies, **the NFs will be pivotal in offering high quality scientific training to Italian researchers**.

NATIONAL FACILITY FOR GENOMICS

The NF for Genomics seeks to empower research in all genomic domains for the broader Italian scientific community. This NF includes four Infrastructural Units (IUs) – High-throughput Sequencing (IU1), Multi-omics Technologies (IU2), Computational Genomics (IU3), and Technology Development (IU4) – and is committed to providing invaluable resources and support for ground-breaking genomics research, making genomics research in Italy competitive at an international level.

NATIONAL FACILITY FOR GENOME ENGINEERING AND DISEASE MODELLING

The NF for Genome Engineering and Disease Modelling stands as a distinctive endeavour within the country, serving HT and the broader Italian scientific community. This NF – including Pluripotent Stem Cells and Advanced Cell Cultures (IU1), Gene Editing Technologies (IU2), Validation (IU3), and Technology Development (IU4) units – specialises in creating advanced cell model systems by integrating cell reprogramming, cell differentiation, genome engineering and robotics. In addition, the NF supports developing and optimising innovative methods and offers training and education programmes.

NATIONAL FACILITY FOR STRUCTURAL BIOLOGY

The NF for Structural Biology stands as a one-of-a-kind scientific and technological hub for integrative structural biology. This NF aims to provide access to a highly productive, world-class technological hub that addresses disease mechanisms across scales. The NF comprises six tightly interconnected IUs: Cryo-Electron Microscopy (IU1), Biomass Production (IU2), Biophysics (IU3), Structural Proteomics (IU4), Dynamic Single-molecule (IU5), Technology Development (IU6). The synergy of expertise and technological offerings provides an excellent example of how an NF can be more than the sum of its parts.

NATIONAL FACILITY FOR LIGHT IMAGING

The NF for Light Imaging provides user support for imaging and advice on image-related projects. It includes six IUs – Imaging (IU1), Tissue Processing (IU2), Flow Cytometry (IU3), High-content Imaging (IU4), Ion Imaging (IU5) and Technology Development - Custom Microscopy (IU6). This NF currently hosts several commercial microscopes, ranging from wide-field epifluorescence microscopes to confocal, multiphoton, and spinning disk confocal systems and super-resolution and Structured Illumination Microscopy-based systems.

NATIONAL FACILITY FOR DATA HANDLING AND ANALYSIS

The NF for Data Handling and Analysis comprises three IUs that reflect the core challenges of biomedical research in the age of computation: the Bioimage Analysis (IU1), the Omics Analysis (IU2), and the DevOps and Web Development (IU3) units. While IU1 and IU2 provide high-quality analysis and quality control, IU3 focuses on web data portals and supplying containerised versions of the Facility workflows. Overall, the Facility aims to deliver world-leading infrastructure and resources to the Italian research community through: 1. project coordination with the other HT NFs; 2. development of analysis pipelines, databases, visualisation and open-source tools; and 3. provision of training.

SCIENTIFIC TRAINING

One of HT's objectives is to provide **training to its researchers and the Italian scientific community**. The ambition and goal of Scientific Training at HT is to train the **next generation of researchers** to address scientific challenges in the life sciences by performing cutting-edge, interdisciplinary and innovative research.

Internal Training

HT's approach to Internal Scientific Training is based on **emerging scientific needs**, **diversity** and **inclusion**.

The primary tool to train HT scientists is the **annual internal training curriculum**, an extensive portfolio of courses that includes scientific/technical as well as transferable ('soft') skills, along with career development activities and networking opportunities.

Opportunities for **undergraduate** or **postgraduate** students include internships and the ability to conduct a Master's thesis or a short research project for up to 12 months.

HT is a partner of several **doctoral programmes** (National PhD Program in Systems Medicine of the European School of Molecular Medicine, PhD Programme in Data Analytics and Decision Sciences run by the *Politecnico di Milano*, PhD Programme in Theoretical and Scientific Data Science by the *Scuola Internazionale Superiore di Studi Avanzati* and National PhD Programme in Artificial Intelligence-Health and Life Sciences coordinated by the Italian National Research Council and the Campus Bio-Medico University of Rome). Over the next few years, HT's scientific leadership will explore the possibility of designing a PhD programme tailored to HT's research vision using the educational and legal framework of established degree-awarding bodies.

Postdocs have access to several target-specific initiatives and events, such as bi-weekly 'chalk talks' and opportunities to interact with professionals in the industry. Dedicated training and career development opportunities are made available to the HT postdoc community to support the transition towards the next phase of their careers.

Facility staff and **Faculty members** have access to professional development courses and training customised to the specific challenges of their roles, including a laboratory leadership course and external mentoring programmes.

External Training

The overarching and inspiring theme for HT's external training activities is to create a centre of excellence for training promising researchers in the biomedical sciences while **providing the external community with broad access to HT's expertise, methods, and resources**.

Scientific training events for external scientists include **Symposia**, **Workshops**, **Conferences**, and **theoretical and practical Courses** at the forefront of scientific and technological development in the areas of HT expertise, which are highly relevant for modern biomedical research.

In addition, HT has developed a framework to welcome and host **Scientific Visitors** into HT labs for periods from one week to one year. During their stay, Scientific Visitors have access to all HT training courses and seminars and form an active part of HT's vibrant scientific community.

TECHNOLOGY TRANSFER

Promoting an entrepreneurial mindset in the academic world is paramount. **Contributing to economic and social progress by transferring its research results into applications, therapies and products is a significant goal of HT and a further way to fulfil its mission**.

It is evident from multiple examples in different parts of the world that hubs of innovative industry grow around world-class research centres. To this end, **promoting connections between academia and industry**, **handling matters related to intellectual property**, and **fostering an entrepreneurial mindset in the academic world** are the jobs of successful technology transfer endeavours.

As HT's research activities grow, technology transfer activities will be set up in a structured way to help translate the discoveries and inventions of HT scientists into tangible applications and marketable products. New technologies and methods that could emerge from HT's work broadly cover the span of the life sciences, including diagnostic and therapeutic strategies, enabling technologies, molecular tools and assays, instruments and devices, as well as software applications and databases to be potentially developed in close connection with industrial partners in the pharmaceutical, biotech, engineering and IT fields.

HT's strategy to collaborate with industry foresees an extensive array of possible interactions, ranging from project-based research collaborations on joint training programmes to long-term strategic partnerships in specific areas of research and development.

Therefore, HT will support researchers during all phases of the technology transfer process – including development, prototyping, benchmarking, preliminary clinical validations, market analysis and industrialisation – thus accelerating the entire process.

In addition to setting up its own Technology Transfer Office, HT was assigned dedicated funding to establish and operate a Centre for Innovation and Technology Transfer (CITT) in the field of life sciences. Since its establishment in late 2021, the CITT has been carrying out several activities aimed at raising young researchers' awareness of the possible practical applications of research results in life sciences, training young researchers on technology transfer fundamentals, and promoting a culture of technology transfer as well as networking at the local, national, and international levels.

STAKEHOLDER ENGAGEMENT

HT engages in relations with many institutions, organisations, entities and associations. Maintaining and fostering close ties and open dialogue with these stakeholders contributes to the consolidation of HT as a renowned research centre and hub for the scientific and innovation community and as a strategic project for Italy.

Scientific partnerships and collaborations

Connecting with the scientific community is vital to HT's external relations activities. The challenges posed by contemporary biomedical research are so formidable that no single group, not even an institute, can face them alone. Over the next five-year period – and as critical mass is progressively reached in existing and new areas of HT research – the institute will continue to seek opportunities to work with the external biomedical and health research community. Aimed at enhancing the more translational aspects of HT's research, we plan to intensify collaborations with clinical partners to ensure that HT's research, skills, databases, and infrastructure can be effectively channelled to strengthen Italian clinical research and healthcare capabilities. In this context, HT's future research plans and new disease-relevant Flagship Research Programmes offer the perfect opportunity to engage in new, ambitious collaborations with clinicians in the specific disease areas that HT plans to tackle.

Institutional relations and communications

In addition to the Italian Government and its founding Ministries, HT engages in productive relations with several international, national and local authorities and other relevant (mainly national) associations and representative bodies, including through the organisation of or participation in specific events. Overall, such institutional activities and HT's involvement in particular events contribute to building consensus around the institute and ensuring that relevant decision-makers hear HT's voice.
HT is involved in institutional activities, events and initiatives in coordination with its MIND partners.

As part of its institutional and communication activity, HT creates opportunities for the public to learn about and discuss basic research and its impact on national health, economy, and society, for example, by engaging in proactive media relations to present HT's scientific achievements and by promoting public events and initiatives involving relevant stakeholders and the local community.

In summary, HT will contribute to building the (inter)national technology and life sciences ecosystems of the future by collaborating with, and receiving input from its partners, thus becoming a hub for open innovation.

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