Sano Centre for Computational Medicine after one year of operation

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Sano Centre project is funded by

- H2020-WIDESPREAD-2016-2017 TEAMING PHASE 2 program (grant 857533) (15 MEur)

- International Research Agendas program (IRAP) of the Foundation for Polish Science, co-funded by the European Union in the scope of the European Regional Development Fund (10 MEur)

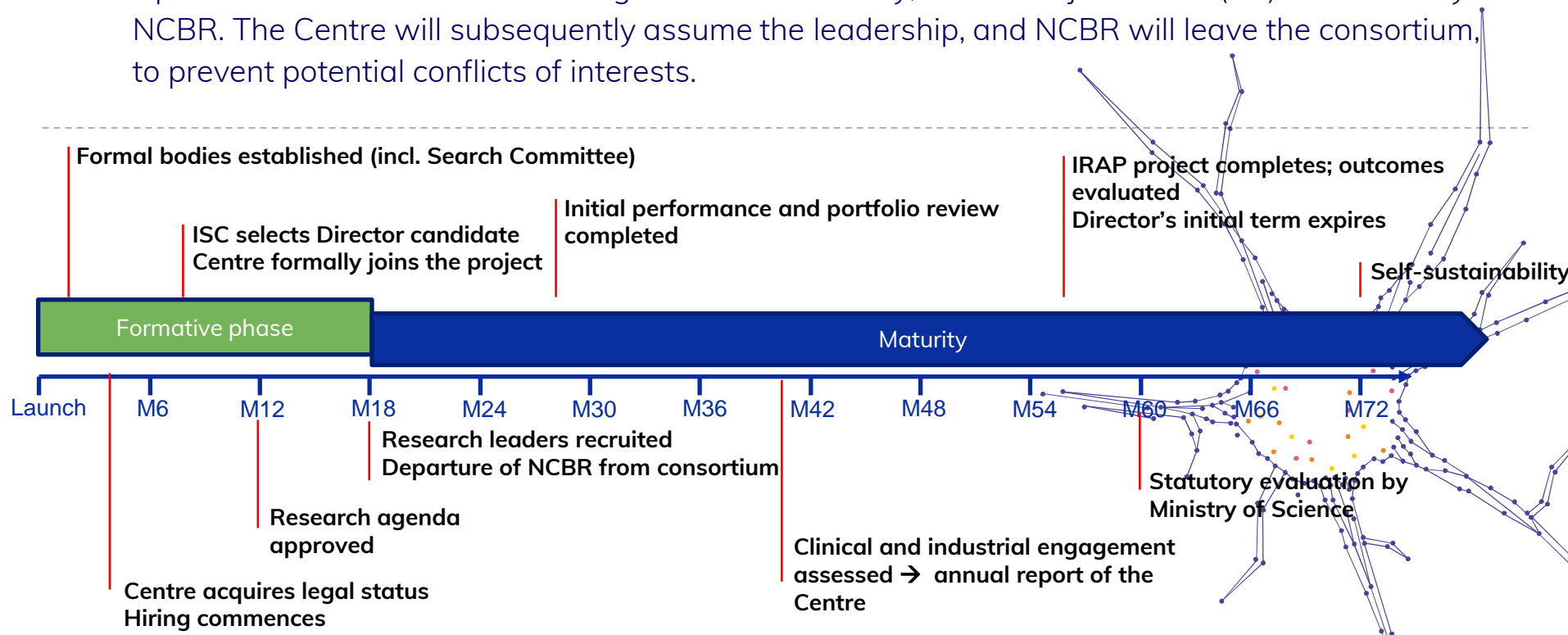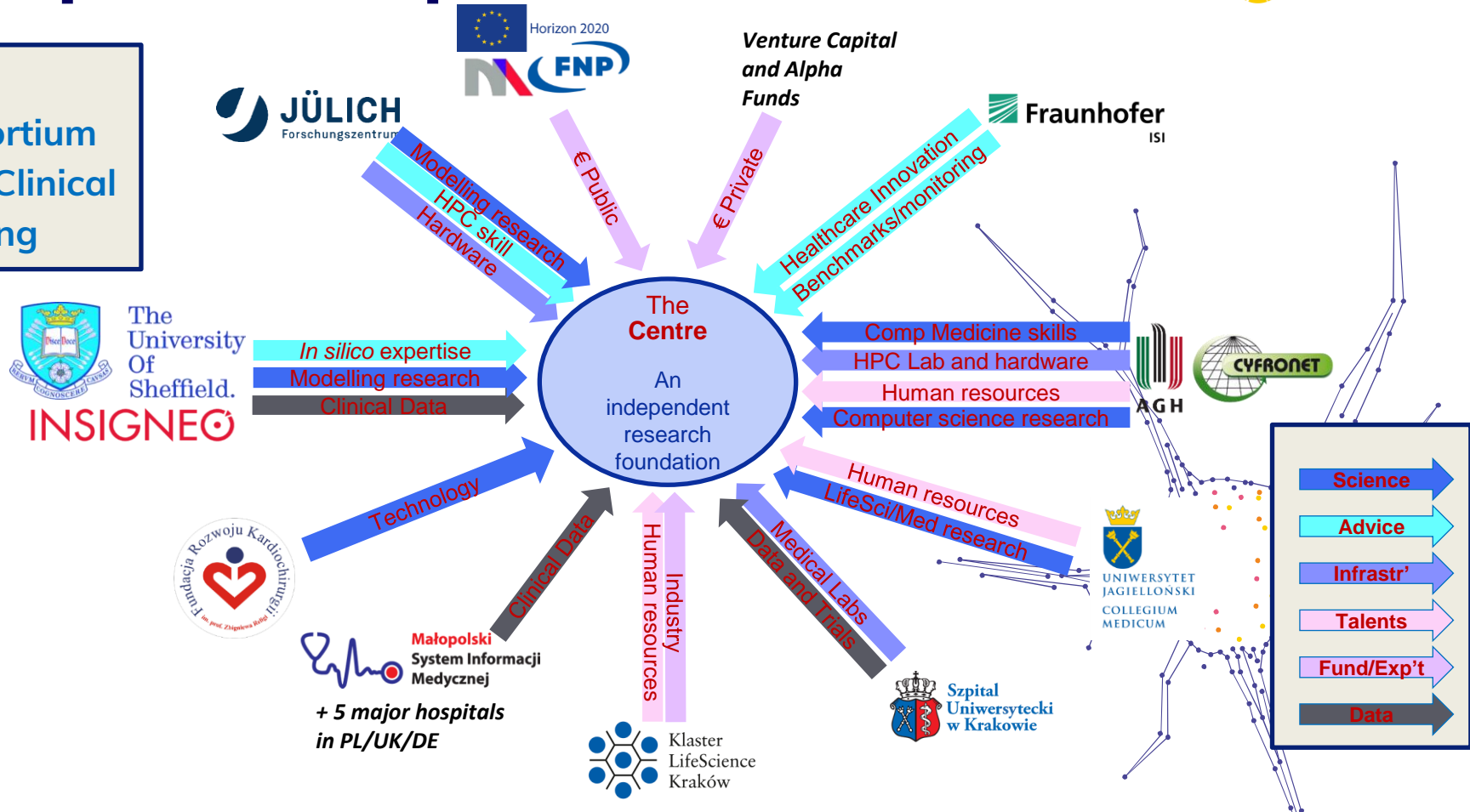- Polish Ministry of Science and Higher Education (after 2023, 5 MEur)
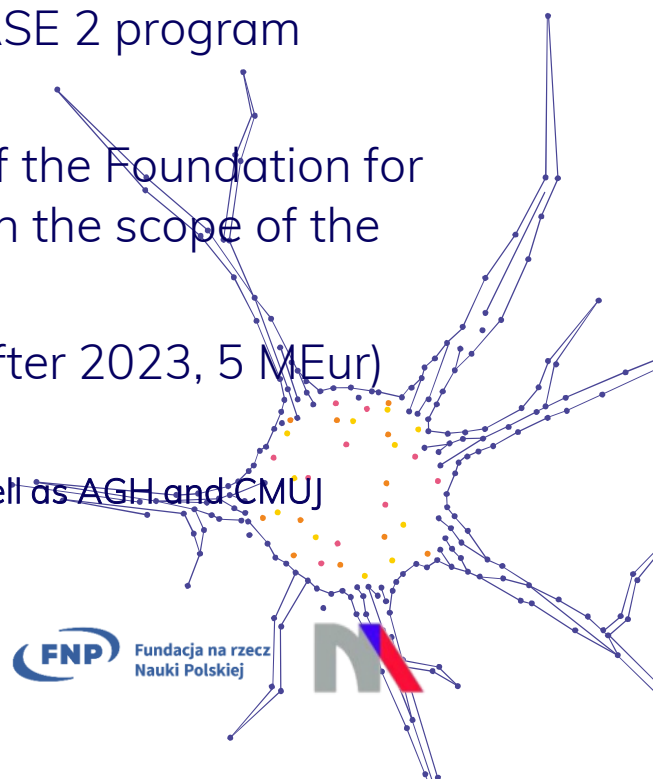
Sano timeline

- During the formative phase the Centre will establish its principal administrative bodies and seek candidates to fill key staff positions, a.o. the Centre director and research team leaders

- Up until the Centre has attained organizational maturity, the T2 Project Board (PB) will be led by NCBR. The Centre will subsequently assume the leadership, and NCBR will leave the consortium, to prevent potential conflicts of interests.

Formal bodies established (incl. Search Committee)

ISC selects Director candidate
Centre formally joins the project

Initial performance and portfolio review completed

IRAP project completes; outcomes evaluated
Director's initial term expires

Self-sustainability

Formative phase

Maturity

Launch | M6 | M12 | M18 | M24 | M30 | M36 | M42 | M48 | M54 | M60 | M66 | M72

Research leaders recruited
Departure of NCBR from consortium

Research agenda approved

Statutory evaluation by Ministry of Science

Clinical and industrial engagement assessed → annual report of the Centre

Centre acquires legal status
Hiring commences

The partnership

Core Consortium Tech/Clinical Funding

The future medicine

- Most clinics will be driven by Clinical Decision Support Systems (but still with a clinician as the final judge)
  - Computational simulations will sit at the centre of most processes

- The patient's journey will be controlled by a supervisory algorithm
  - Additional data will be sought by the system (tests, simulations...) until a single optimum treatment option remains

- All hospitals will provide the same high standard of decision-making
  - Allowance will automatically be made for differences in available equipment, resources, scheduled access...

- The introduction of a new treatment option will be accompanied by an updated decision system
  - All hospitals, all patients will benefit simultaneously

- The roles of healthcare personnel will be completely altered
  - Skills will be matched to the true role requirements (patients will meet staff trained in communications and empathy)

- Medical expertise will reside in the machines, routinely updated
  - Today's clinicians will become tomorrow's researchers, designers, programmers, teachers...

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Healthcare in Poland and Sano

Sano addresses the challenges identified in the Poland *Country Health Profile* and has conducted extensive consultation with medical professionals

- CFP: Poland lags behind many EU averages in healthcare

- Our digital technologies offer disruptive improvement

- Sano addresses Polish issues…
  and boosts EU leadership in *in silico* technology

- 50+ Letters of Interest from medical community

Main objectives of Sano

- Strong advancement of data science, models, algorithms, and technologies involved in personalised medicine, including design of holistic, replicable, generic framework for simulation-based Decision Support Systems creation

- Development of new computation-based solutions for diagnostics and therapy in daily healthcare

- Systematic involvement of regional biomed businesses, specialising in technologies and services for personalised medicine, in high-profile research projects and clinical adoption of their outcomes

- Education initiatives to train knowledge workers with skills in data analytics, simulation, and HPC/Big Data, to respond to the growing demand for skilled workforce in bio-engineering and medical devices

Main research directions / teams

- Clinical data

- Computer vision

- Personal health

- Health informatics

- Modelling and simulation

- Extreme-scale data and computing

Towards a sustainable Centre
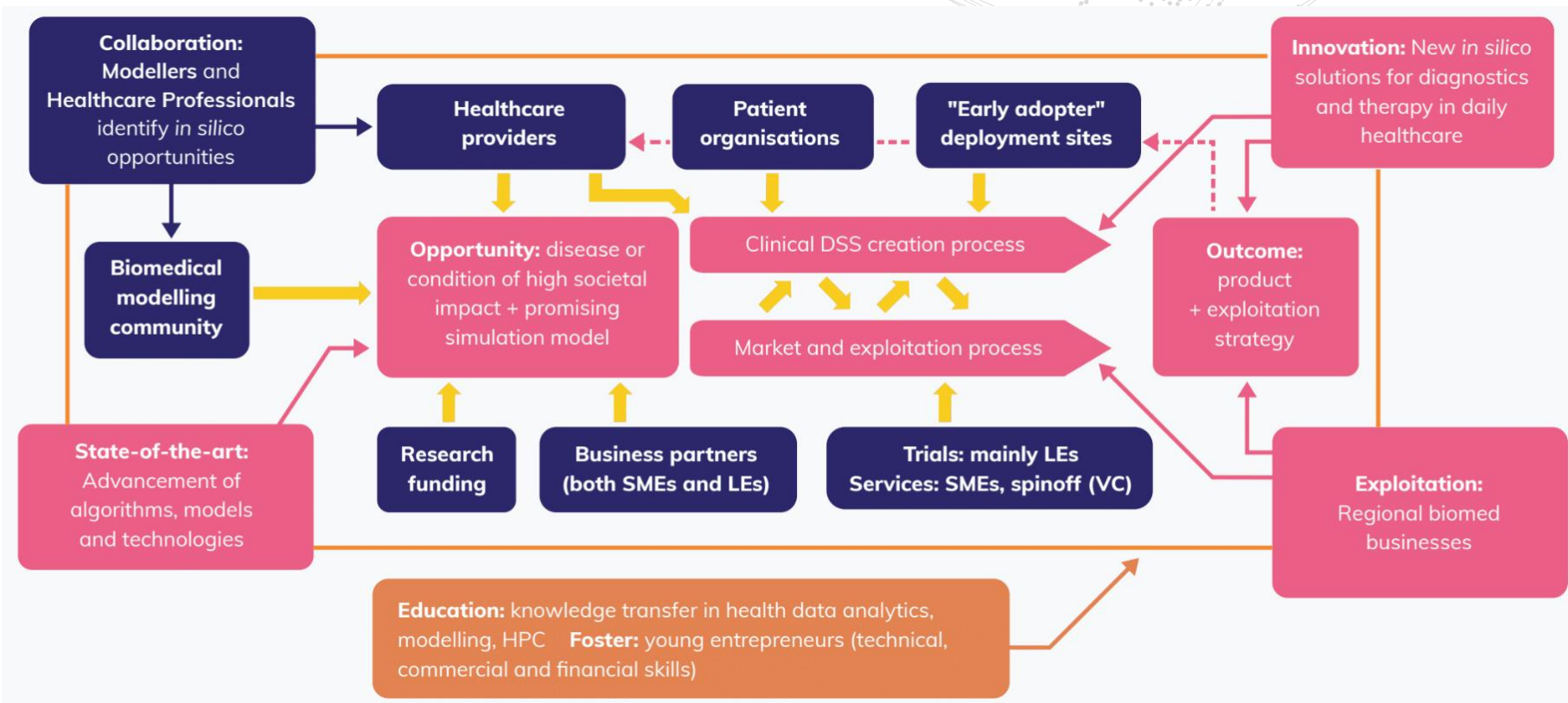
Sano Foundation

- The Sano Foundation was established by a notarial deed on July 17, 2019
- entered into the National Court Register on September 5, 2019,
- From October 1, 2019, Sano has been implementing the IRAP - FNP grant
- The implementation of the EU Teaming 2 project began on August 1, 2019

Sano Foundation Council

- Agnieszka Szymańska – ACC Cyfronet AGH Krakow, PL
- Tanja Bratan – Fraunhofer ISI, Karlsruhe, DE
- Andrew Narracott - University of Sheffield. UK
- Kazimierz Murzyn - LifeScience Krakow Cluster, PL
- Olav Zimmermann – FZ Juelich, DE
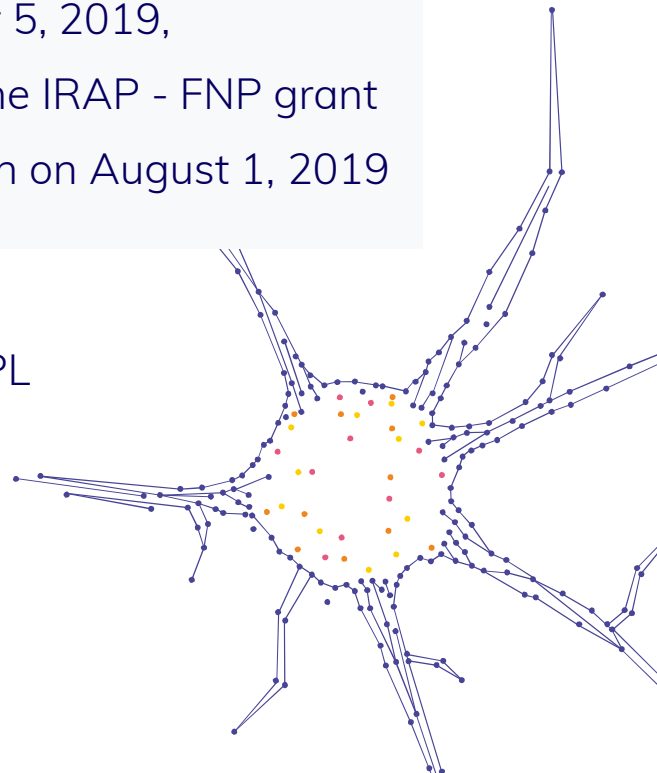
Sano International Scientific Committee

Name	Affiliation
Prof. Marco Viceconti	Dipartimento di Ingegneria Industriale, Università di Bologna, IT Visiting Professor, Dept. Mechanical Engineering, University of Sheffield, UK
Prof. Rod Hose	Insigneo Institute and Faculty of Medicine, University of Sheffield, UK
Prof. Richard Clayton	Insigneo Institute (Director of External Affairs) and Faculty of Engineering, University of Sheffield, UK
Prof. Marek Behr	Aachen Institute for Advanced Study in Computational Engineering Science (Scientific Director), DE; Department of Mechanical Engineering, Aachen University, DE
Prof. Holger Gohlke	Faculty of Mathematics and Natural Sciences, Heinrich Heine University Düsseldorf, DE
Prof. Dieter Kranzlmüller	Chair of Communication Systems and System Programming, Ludwig-Maximilian University Munich, and Leibniz Supercomputing Centre (Chairman of the Board), DE
Prof. Zbigniew Nawrat	Silesian Center for Heart Diseases in Zabrze, PL; Heart Prosthetics Institute (Director), Cardiosurgery Development Foundation, PL
Prof. Irena Roterman-Konieczna	Faculty of Medicine, Jagiellonian University Medical College, PL
Prof. Jerzy Gąsowski	Faculty of Medicine, Jagiellonian University Medical College, PL
Prof. Knut Koschatzky	Fraunhofer Institute for Systems- and Innovation Research, DE
Dr Claire Chalopin	Innovation Center for Computer Assisted Surgery, University of Leipzig, DE
Dr Stefan Zachow	Zuse Institute Berlin (ZIB), DE Solutions for Individualized Medicine, DE
Prof. Ewa Deelman	Computer Science Department and Science Automation Technologies (Director), Information Sciences Institute, University of Southern California, USA
Prof. Peter Sloot	Institute of Advanced Studies (Director) and Institute of Informatics, University of Amsterdam, NL; Complexity Institute (Co-Director), NTU, SG; Professor of Advanced Computing, ITMO University, RU
Prof. Jacek Kitowski	Department of Computer Science (Professor) and ACC Cyfronet (Head of International Affairs), AGH University of Science and Technology, PL

Sano Centre Team *(as on 23.11.2020)*

Research (IRAP – FNP)

- Marian Bubak - Scientific Affairs Director and President of the Management Board
- Tomasz Gubała - Scientific Programming Manager
- Maciej Malawski - Senior Postdoctoral Researcher
- Piotr Nowakowski - Senior Scientific Data Manager
- Tadeusz Satlawa - Scientific Programmer

Support (Teaming – EU)

- Maja Więckiewicz – Director of Operations
- Karolina Jarosińska - Human Talent Manager
- Karolina Tkaczuk - Business Development Manager
- Jan Meizner - Technical Manager, IT and Security Expert
- Katarzyna Tabor - Junior Project Manager
- Wioletta Niwinska - Legal Counsel
- Marta Jarkiewicz - Financial & Payroll Expert (external support)

The administrative part of Sano is located at ACC Cyfronet, and the research and IT team (thanks to the Agreement of Sano-AGH and the favor of the Rector of AGH) in the premises of the CE AGH

Personnel at Sano Teaming project partners

- NCBiR – 2

- ACC Cyfronet AGH – 5

- Krakow LifeScience Cluster – 4

- FZ Juelich – 2

- Fraunhofer ISI – 4

- University of Sheffield – 6
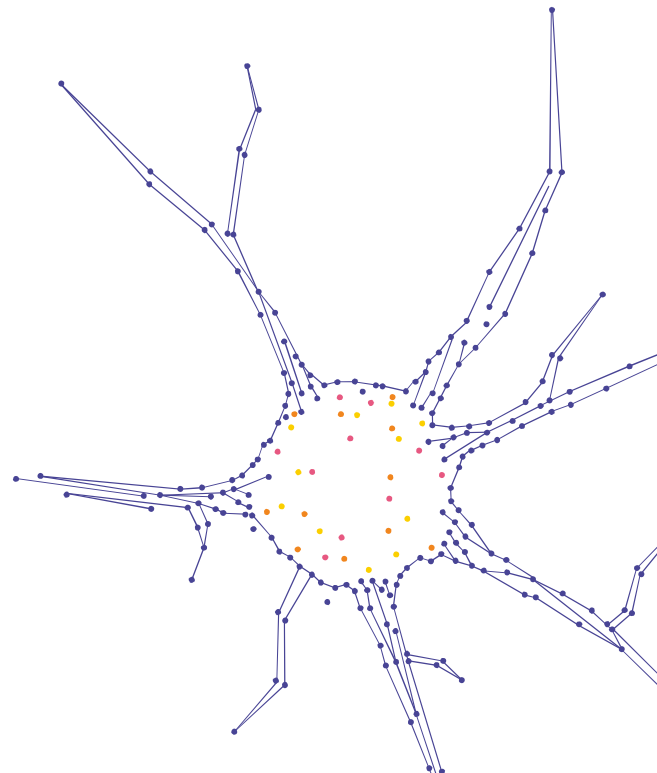
PhD degree granting institutions

- Typical duration 3.5 years
- Staff will (co-)supervise PhD students.
- Remote students, located at the Centre
- 5 students with fees covered

- 4-year PhD program
- Computer Science, Biomedical Engineering or Biophysics
- Option for "Industrial" PhD
- Option for "External" PhD

- External PhD
- Computational Science
- Flexible timeline
- No fees

- Degree in Medicine, Health Sciences, Pharmacy
- Rules similar to AGH

- Advanced training program
- Degrees via RTWH Aachen (TBD)

Staff structure

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Staff balance, mix of high value jobs: R&D, programming, complex support & IT

Research 58%*

- Scientific Affairs Director
- Research Team Leaders
- Visiting Professors
- Postdocs
- PhD Students

Development 22%

- Business Development
- Scientific Programming
- Portfolio Manager
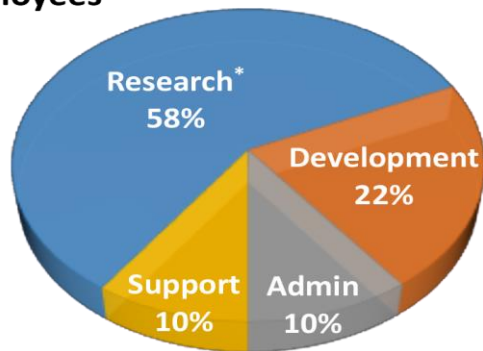- Marketing/Fundraising
- Communications
- Project Management

Support 10%

- Project/Portfolio Manager
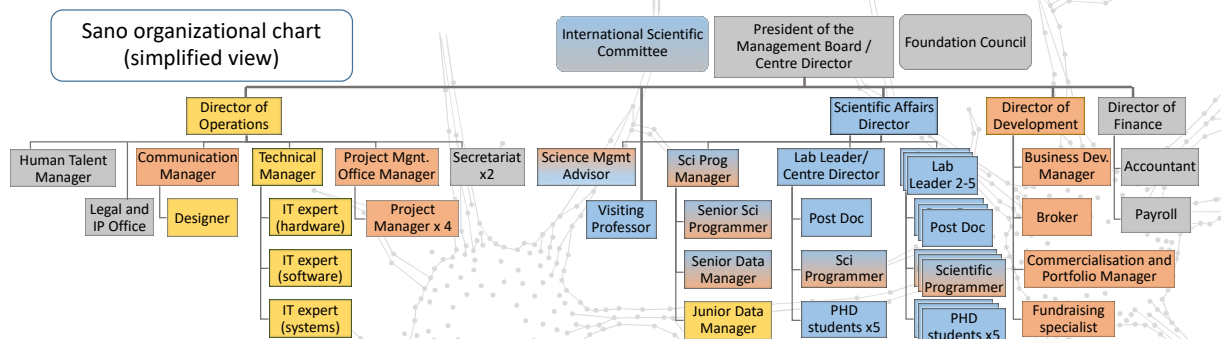- IT Experts (software/hardware)
- Technical Manager
- Data Manager

Administration 10%

- Administrative assistant
- Financial services (accounting, payroll)
- Human Resources
- Legal Office

Sano employees 2026

Research* 58%
Development 22%
Support 10%
Admin 10%

* Includes stipends

Sano organizational chart (simplified view)

Overlapping roles, e.g. Scientific Programming Manager:

25% research   55% development   10% support   10% administration

Main results of the Teaming project

- Milestones
  - Formal bodies created
  - Centre formally established
  - Centre joins the Teaming project
  - Director is recruited

- Documents
  - Statue of the Centre
  - Research agenda
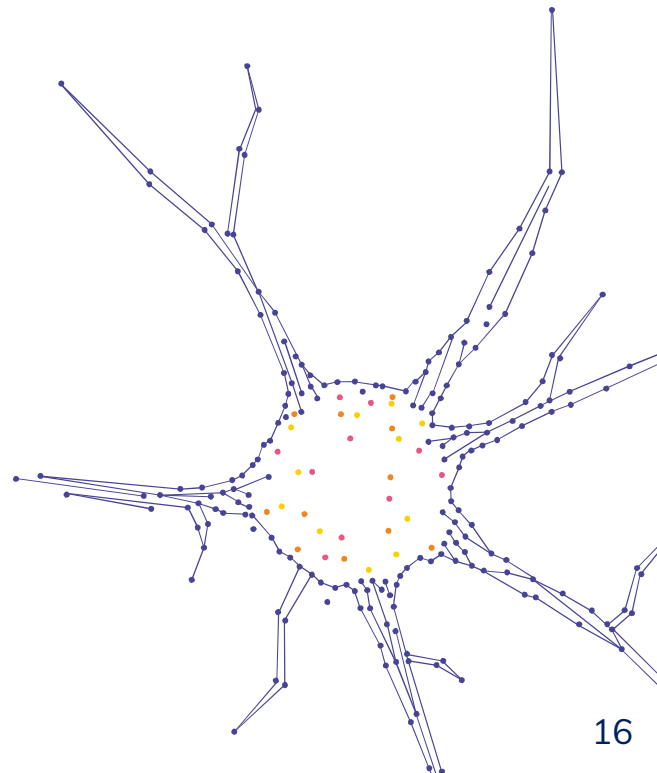 - Strategic plan
  - Fundraising plan
  - …

# Image classification for immunological diseases

- Goal: Automated image analysis to determine the type of antibodies present in serum in the diagnosis of immunological diseases.

- Data source: Pictures of cells used for laboratory tests
  - Each image contains cells showing one of seven basic staining patterns
  - Every cell within a single image is characterized by the same staining pattern

- Collaboration with CM UJ

- Preliminary results
  - Currently the network is trained to recognized the three most frequent staining patterns (centromere, speckled and homogeneous)
  - Data augmentation through random sampling is used to balance the number of cells per each pattern type within the training set
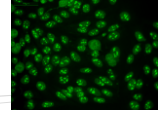
Preprocessing
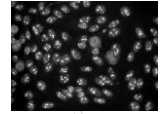
Segmentation
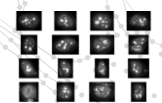
Classification

NUC	92.34%
HOM	06.21%
ACA	01.45%

Multiclass classification for cardiovascular disease

- Identification of discriminative features for multiclass classification of genomic data

- Data source: Center for Medical Genomics – OMICRON

- Rising amount of genomic data and space for new analysis methods

- Python API allowing for combining feature selection algorithms into a voting model with validation and visualization features

- Multiple machine learning methods integration

- Datasets used for tests and benchmarks : BRCA, Internal OMICRON cardiovascular disease dataset
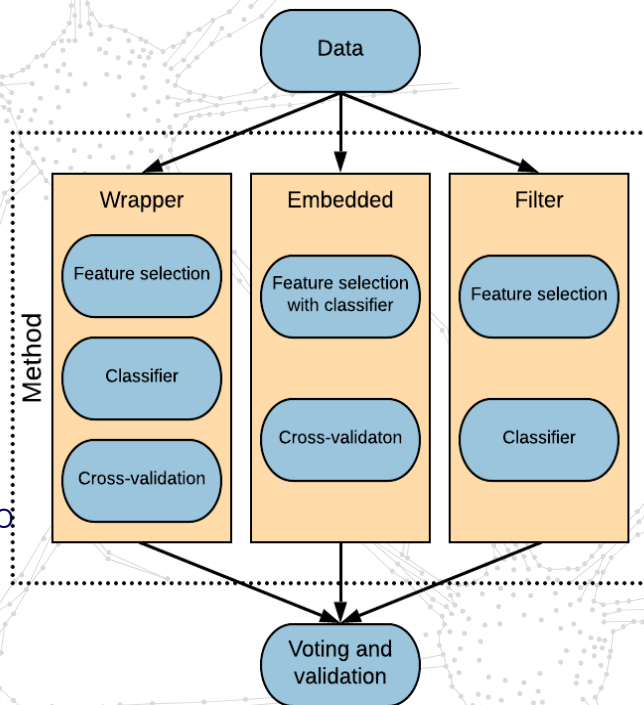
Analysis COVID-19 patient data

- Goal:
  - Creating a COVID-19 time series analysis toolbox
  - Use regular blood sample tests to find correlatons with COVID-19 progression
  - Provide support for clinicians in terms of treatment prognostics

- Data sources under discussion:
  - University Hospital Krakow
  - Brazilian hospital via USFD

- Collaborations:
  - University of Sheffield (internal grant)
  - CM UJ

Sano as Associate Partner of CompBioMed2

- Scientific program – many common topics and complementary ones, hence a unique opportunity for synergy as well as for collaboration, and for competition

- Common workshops, schools, etc.

- Sano – a "testbed" for CompBioMed methods, procedures, and software tools in the process of their development

- Sano – a way for sustainability of methods, procedures, and software tools elaborated by CompBioMed2 partners

- Sano – an attractive place for advancement of scientific carriers, not just for young researchers involved in CompBioMed2

Sano and PRIMAGE project

- Scientific program – many common and complementary topics, an opportunity for collaboration

- Common workshops, schools...

- Sano – a "testbed" for PRIMAGE methods, procedures and tools

- Sano – a way for sustainability of methods, procedures, and software tools elaborated by PRIMAGE

- Sano – an attractive place for advancement of scientific carriers not just for only young researchers involved in PRIMAGE

EU H202 project proposals

- ## StHeart-Up
  - Smart and auTomated Heart-on-chip system for in vitro drUg and theraPy assessment
  - H2020 Call: H2020-NMBP-TR-IND-2020-twostage
  - Plug-and-play, smart and automatic heart-on-chip that will drastically simplify the use of organ-on-chip while providing high reproducibility and standardisation of the experiments, and thus improving the efficiency of the in-vitro experiments.
  - **Sano role**: data processing, machine learning

- ## InSilicoWorld – kick-off in January 2021
  - Lowering barriers to ubiquitous adoption of In Silico Trials (ISW)
  - H2020 Call DTH 06-2020
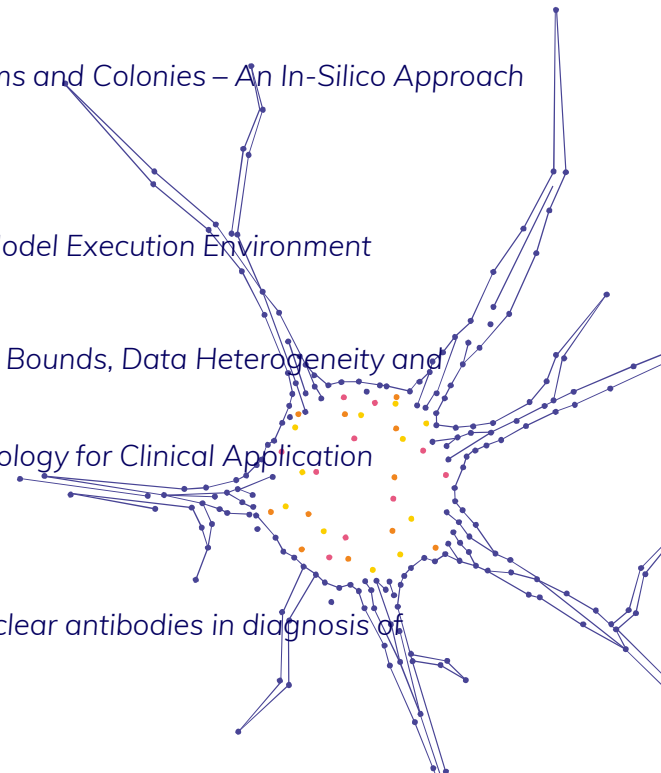 - **Sano role**: Scalability and efficient computing
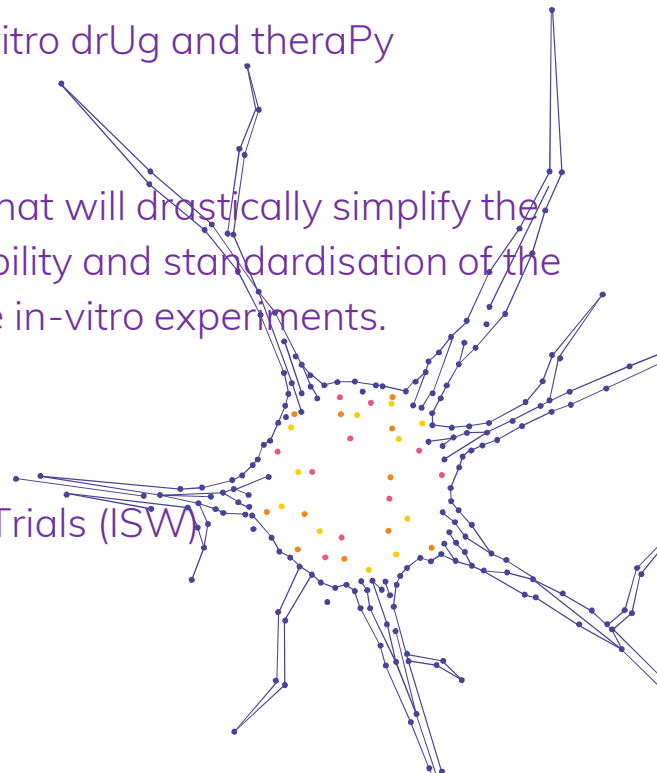
Sano Computational Medicine Seminars in 2020
(Monday at 14.00 CET, via Zoom)

- N14.12 Irenna Roterman-Konieczna

- 07.12 Dieter Kranzmueller

- 30.11 Thomas Reiss

- 23.11 Vivek Sheraton Muniraj, *Exploring Complex Interactions in Bacterial Biofilms and Colonies – An In-Silico Approach*

- 16.11 Maximilian Hoeb, *Towards Exascale-ready Ecosystems*

- 10.11 Tadeusz Satława, *Introduction to clustering in medicine*

- 26.10 Piotr Nowakowski and Marek Kasztelnik, *Composing applications in the Model Execution Environment*

- 19.10 Witold Dzwinel, *Supermodeling in tumor dynamics prediction*

- 12.10 Mara Graziani, *Emerging needs of AI for Digital Pathology: Computational Bounds, Data Heterogeneity and Interpretability*

- 05.10 D. Rodney Hose, *Progress in Personalised Computational Models of Physiology for Clinical Application*

- 13.07 Zbigniew Nawrat, *Everything that a cardiac surgeon and his patient need*

- 08.07 Marco Viceconti, *Credibility of In Silico Medicine model*

- 29.06 Mateusz Szpyrka and Maciej Malawski, *Automatic classification of antinuclear antibodies in diagnosis of autoimmune diseases*

- 22.06 Sabina Licholai, *Personalized medicine in oncology*

More at
http://sano.science
and

http://dice.cyfronet.pl/projects

contact: m.bubak@sano.science