

# **Structural measures of the National Centres of Competence in Research (NCCRs)**

Bern, March 2022

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## 1 Introduction

In accordance with the Ordinance on the Promotion of Research and Innovation (German acronym: V-FIFG), the National Centres of Competence in Research (NCCRs) are required to develop so-called “structural measures”. Their goals are to establish a sound and long-term basis for strengthening the specific research field(s) and to maximise the scope and impact of the research. As mentioned in the V-FIFG, structural aspects also reflect strategic and political aims. Traditionally, they can be categorised as **institutional structures**, which range from **research positions** (mainly new professorships), **junior group leaders positions** (to retain promising young researchers working in the NCCR), **organisational positions** (permanent positions linked to management tasks of the NCCR) and **infrastructures** (including centres, networks and platforms). Besides structural measures in this narrower sense, additional measures referred to as **structure-related aspects** are also required. These include **knowledge and technology transfer**, **education**, **equal opportunities**, **communication & outreach** and **open science**.

The aim of this document is to provide a concise overview of some key and diverse structural measures from past and current NCCRs, highlighting their impact and the challenges they are resolving. A chapter on their international impact is also included. Importantly, this document is not an exhaustive list of all

implemented structural measures and structure-related aspects, and many outstanding initiatives were not be mentioned.

## 2 Institutional structures

Institutional structural measures involve targeted developments in the home institutions aimed at supporting the NCCR's research domain. They require thoughtful and substantial investments, often by the home institutions, as they are designed to drive top-quality research, to generally last beyond the end of the NCCR, and to be visible and used nationally or internationally. These measures include, among other implementations, staff positions (such as professorships), technology platforms, networks and research centres.

### Research centres / networks

Several NCCRs created research centres that have strengthened the impact and further developed the aims of completed NCCRs. Research centres emerging from NCCRs address field-specific challenges, attract excellent researchers, sustain scientists' collaborations and provide long-term platforms connecting researchers across Switzerland and beyond. Centres can also be broad, decentralised networks, coordinating interactions between various infrastructures or nodes. Undoubtedly visible on a national level, such centres and networks also reinforce Switzerland's international position and visibility. Successful, long-lasting research centres promote all aspects that are encouraged in NCCRs: excellent and collaborative research, international standing, education, science communication, knowledge transfer and equal opportunities. Research centres and networks representing the direct legacy of NCCRs include, among many other examples:

- The [Oeschger Centre](#) for climate change research and the [Center for Climate Systems Modeling \(C2SM\)](#) (created in 2007 and 2008, respectively, by the NCCR Climate and hosted at the University of Bern and ETH Zurich).
- The [Swiss Nanoscience Institute](#) (created in 2006 by the NCCR Nanoscale Science and hosted at the University of Basel).
- The [Centre for Democracy Studies Aarau](#) (created in 2009 by the NCCR Democracy and situated in Aarau).
- The [Centre for Intelligent Systems](#) (created in 2020 and hosted at EPFL, linked to the NCCR Robotics).
- The [MaNEP Switzerland Network](#) for research on materials with novel properties (created in 2013 by the NCCR MaNEP to continue networking activities).

**The Centre Interfacultaire en Sciences Affectives (CISA)**, hosted at the University of Geneva and created in 2005 by the NCCR Affective Sciences (2005 - 2017), is a unique research centre which aims to deepen our understanding of human emotions and their influence on our decisions and health. It uses fundamental, translational and interdisciplinary research across social sciences, humanities and natural sciences. It is one of the first broad research centres in its field and currently employs 60 staff members. This particular centre is also known for its public outreach: it has been involved in many festivals and museum exhibitions, including the 2021 ["De l'amour" exhibition](#) in France, and invites the public, as well as private partners, to participate in their research.

### Technology platforms / facilities / workflows

Many NCCRs create or strengthen a physical or virtual technology platform, facility or workflow. All of these structures are important for excellent research, fast progress and networking within and outside the NCCR. In clinical fields, these measures can also include establishing new patient cohort studies as a workflow, from sample acquisition to processing, storage and data sharing (with strict regulations). The technology-driven nature of most platforms implies continuous development. Running and maintaining these structures often relies on motivated, competent and specialised staff, who need to be appropriately trained and nurtured. A few examples of technology platforms and workflows (among many) include:

- The [FastLab](#) platforms with ultrafast lasers and detectors, which are not usually available in single research groups (created by the NCCR MUST at ETH Zurich and the University of Bern)
- The [Swiss Kidney Stone cohort](#) (SKSC), created by the NCCR Kidney to collect and store samples and data from patients suffering from kidney stones, accessible to researchers.
- The [22q11 deletion syndrome cohort](#), supported by the NCCR SYNAPSY, to collect clinical samples and brain imaging and activity data in the same cohort of patients with the 22q11 deletion syndrome and an increased risk of schizophrenia.

[Materials Cloud](#) is a web platform launched in 2018 by the NCCR MARVEL to share resources in computational materials sciences. It offers open-access, transparent and comprehensive simulation services, using the open-source Python infrastructure AiiDA to streamline complex computational workflows. The AiiDALab cloud computing platform offers an interactive interface to perform complex simulation workflows directly from a web browser. AiiDALab and Materials Cloud are suited to academic and industry projects, allowing efficient knowledge and technology transfer. During the first half of 2021, 20 to 25 new users registered on average every month, and Materials Cloud received around 13,500 unique monthly visits. Their increasing user community promises long-term sustainability and international visibility.

[ACCESS](#), which stands for “academic chemical screens in Switzerland”, is a screening facility established in 2010 by the NCCR Chemical Biology as an extension of the Biomolecular Screening Facility at EPFL, and with a second antenna created in 2015 at the University of Geneva. The high-content and high-throughput screening platform offers assay development support and tools, access

to data acquisition microscopes and plate readers, and image and data analysis support. The facility organises workshops and courses to train the next generation of imaging experts. By providing personal support to screening projects, it also promotes excellent research and knowledge and technology transfer. The facility is accessible for researchers all over Switzerland and works with academic and industry partners.

### Faculty and staff positions

Excellent researchers drive the progress of an NCCR. NCCRs represent unique opportunities to create new and lasting research positions within institutions, such as group leader, assistant professor (preferably tenure-track) and full professor positions. These positions will strengthen a defined NCCR topic in the long term, re-orient the NCCR and home institutions into new emerging directions, retain promising researchers and promote their independence. Education, training and equal opportunities at all career levels are also encouraged through specific programmes and activities (see sections below). Permanent positions linked to research, management and the coordination of, for example, networks, centres, platforms and cohort studies, are equally important for the long-lasting success of an ongoing or completed NCCR.

**In numbers:** Since the launch of the NCCR programme in 2001, more than **150 new full professorships** and more than **160 assistant professorships** have been created in the context of the 42 NCCRs funded during this time. In addition, more than **75 successors of existing Chairs** were selected by taking into consideration the topic of a running NCCR.

## 3 Knowledge and technology transfer

Knowledge and technology transfer are important aspects of every NCCR in order to translate scientific results into relevant knowledge for society or into innovative technologies, and to create links with potential users in different domains (e.g. industry, politics and society). Transfer of knowledge is a particularly versatile area composed not only of exchanges within the scientific community, but also of interactions with various stakeholders from society, politics and industry. The NCCR's communication to the broader public sector is addressed in the section "Communication and outreach".

Most NCCRs achieve international recognition within the academic sector by organising scientific conferences, symposiums and workshops to which they invite top-class experts in their fields. In addition, joint publications – also with collaborators outside the NCCR community – add to the international visibility.

Measures for technology transfer are often tightly linked to institutional structures, such as technology platforms and facilities. It is of particular importance that the entire scientific community and, if applicable,

interested industrial partners have access to these research infrastructures. A further central element of technology transfer is the transformation of the NCCR's developed technologies into an economic benefit. In this regard, intellectual property (IP) rights and the foundation of spin-offs/start-ups are typical outputs.

**Bench2biz** is a consortium composed of multiple NCCRs of the 3rd and 4th Series (NCCRs Chemical Biology, TransCure, PlanetS, RNA&Disease, Bioinspired Materials and Kidney). Together, they organise intensive hands-on workshops for researchers with a view to realising potential commercial value. Business and industry experts help the researchers to develop their ideas into a concept, to determine the commercial value of their ideas and to launch their business plans. Importantly, Bench2biz's sustainability is ensured through the support of many NCCRs, even beyond the 3<sup>rd</sup> Series.

**INCATE** (Incubator for Antibacterial Therapies in Europe) is a non-profit organisation, co-founded by the NCCR AntiResist, the University of Basel and other international institutions. Its aim is to bring together translational and basic antimicrobial research scientists, industry experts, experienced entrepreneurs and investors from across Europe. Through non-dilutive funds and coaching, translational projects and early stage start-ups are supported to become investible ventures.

**Scientific Conferences:** as one of many excellent examples of conferences organised by NCCRs, the biennial [International Conference on Molecular Systems Engineering \(ICMSE\)](#) stands out as a unique event in the emerging field of molecular systems engineering. Co-organised by the NCCR MSE and the Dutch Research Centre for Functional Molecular Systems (FMS), the ICMSE has the potential of leading to a long-term paradigm shift in molecular sciences.

## 4 Education

The contribution of each NCCR to education and training, particularly on the PhD level, is key to strengthening and sustaining Switzerland's international standing in the respective research fields and to supporting young researchers. Typically, NCCRs create specific Bachelor, Master and/or PhD programmes. Apart from these well-established measures, NCCRs often organise additional training events, such as topic-specific winter/summer schools, preferably in collaboration with partner universities within or outside of the NCCR consortium. Further examples of educational and training activities are pre-PhD ([Pre-doc](#)) rotation programmes, which allow students to work in different labs before choosing one for their PhDs, and "flying" postdoc positions that are linked to multiple projects, thereby fostering internal knowledge and method transfer.

**Online Courses:** Considering the technological advances of recent years, online courses are gaining importance in current and future educational programmes. In this regard, the NCCR Kidney has successfully developed a postgraduate degree "Certificate of Advanced Studies" (CAS) or "Diploma of Advanced Studies" (DAS) in [Translational Nephrology](#). Six e-learning courses, which have been

developed by the [Health Sciences eTraining Foundation \(HSeT\)](#) in collaboration with several specialists from the NCCR Kidney, form the core of this programme. Other outstanding examples are the [Small Private Online Course \(SPOC\)](#) and [Massive Open Online Course \(MOOC\)](#) in chemical biology, initiated by the NCCR Chemical Biology. While the SPOC online course is designed as an internal course for Master and PhD Students at the University of Geneva, the MOOC features on the Coursera platform, targeting students worldwide.

As part of their education strategy, the NCCR SYNAPSY established two strong training programmes: the [MD-PhD and the clinician-scientist training programmes](#). Their overall goal is to promote a new generation of MDs and psychiatrists with neuroscience skills. In order to reach this target, specific courses at the pre- and post-graduate level and rotations research labs are included in the clinicians' training. This knowledge allows basic research results to be directly translated into clinical benefit.

Of the many excellent educational programmes, the [Master in Robotics](#) of the NCCR Robotics at the EPFL stands out as an exceptional measure to sharpen the interest of young students in the NCCR's core topic. In combination with theoretical modules, students gather hands-on practical experience by working with researchers on challenging problems within EPFL robotics laboratories or industry. Importantly, the programme also reaches international recognition, with numerous international applicants.

## 5 Equal opportunities

NCCRs put measures in place to provide equal opportunities for all genders and ideally reflect on ways to provide equal chances for all types of minorities, such as persons coming from different cultural backgrounds and ethnicities, or persons with disabilities. Most of the efforts in this category so far have focussed on providing equal opportunities for women and men to pursue their research careers, for example by making financial support available for [childcare](#). The NCCR RNA & Disease provides lab assistance before and during maternity leave, a scheme now implemented at the Department of Biology of ETH Zurich. They also offer six additional weeks of paid leave to fathers and partners. In recent years, many NCCRs have organised internal workshops on unconscious gender biases, for example during the hiring process or when writing letters of recommendations (for example [1](#) and [2](#)). However, providing a diverse and inclusive working environment goes further than gender equality and activities encouraging diversity in a broader sense are starting to arise in the Swiss research landscape and in NCCRs as well ([example](#) from the NCCR PlanetS).

**INSPIRE Potentials** are Master's fellowships from [NCCR MARVEL](#) and [NCCR QSIT](#). These fellowships are an initiative to broaden the opportunities for women in science. By providing stipends for

female master or PhD students, the goal is to retain talented students for PhD or Postdoctoral positions in the decisive stage of their academic career.

NCCR Bio-Inspired Materials built a dedicated career support for young female researchers called **[WINS \(Women in Science\) Postdoctoral Fellowships](#)**. These fellowships support the residency of researchers in the laboratory of one of the research groups of the NCCR. So far, six WINS fellowships have been granted (two completed and four running). Both grantees who concluded their projects have meanwhile acquired permanent research positions.

To celebrate the 50<sup>th</sup> anniversary of women obtaining the right to vote in Switzerland in 2021, the 22 running NCCRs launched the **[#NCCRwomen](#)** campaign. 107 women scientists working in NCCRs were portrayed in short videos shared on the #NCCRwomen YouTube channel. With over 100'000 views, this highly successful initiative showed how diverse, valuable and inspiring scientific careers can be.

## 6 Communication and outreach

Communication and outreach to the general public is an opportunity for NCCRs to showcase their passion and results to society. Most NCCRs have created newsletters and areas on their webpages for the public to get involved, with quizzes and [games](#) for example. The “Nuit de la Science” / “Nacht der Forschung” / “Science Info Day” are yearly events held in larger Swiss cities that provide a great opportunity for NCCRs to be in direct contact with the public. Many NCCRs have further organised events and camps for [school children up to high school students](#). In particular, NCCRs in STEM topics have put in place events especially targeted at involving girls in traditionally male-dominated fields. For example, the **[“Coding club des filles”](#)**, supported among others by the NCCR MARVEL, offers very successful coding workshops for girls aged 11 to 15 years. They built a virtual platform to allow participants to share their experiences and projects and have contact with coaches and mentors.

The NCCR Robotics organised a first **[Cybathlon](#)** in 2016 that received wide attention on an international level. The Cybathlon is a championship in which people with physical disabilities compete against each other to complete everyday tasks using state-of-the-art technical assistance systems. Although the Covid-19 pandemic disrupted the original plan for a live event with an audience, Cybathlon 2020 went ahead. Completely reinvented as a global, distributed event, the race was a huge success. 51 teams from 20 countries competed against each other in different time zones and locations. One of the two home institutions, ETH Zurich, will continue to finance the Cybathlon office after the NCCR ends.

Several NCCRs have founded **learning centers**, such as the **[Mathscope](#)** from the NCCR Swiss-MAP. The Mathscope is an out-of-school learning place, offering activities related to mathematics and its applications. They are intended to convey the intellectual, esthetic and emotional values of



mathematics to a wide audience, from the general public to school classes of various ages. The Mathscope holds regular events and permanent clubs (“le club de maths”) where children are able not only to participate in Olympiad-like contests, but can also study interesting mathematical questions and participate in research.

## 7 Open science

The SNSF values open research as a fundamental contribution to the impact, transparency and reproducibility of scientific research. To promote efficiency, transparency, knowledge transfer and innovation, among other examples, it is a requirement that all publications from SNSF-funded research be available to third parties free of charge. Furthermore, the SNSF also expects its researchers to detail how the data from SNSF-funded research will be generated, stored, shared and archived, and to share the data underlying publications through publicly accessible, FAIR (findable, accessible, interoperable and reusable) digital databases.

With their large organisational structure and 12-year timeframe, NCCRs have the unique capacity to become role models for open science in their respective fields. By adopting strong data management and open science policies, sharing data practices will evolve, first within the NCCR network and then beyond. Young scientists trained in the NCCR will adhere to better practices and raise open science standards in their scientific disciplines.

In the **NCCR AntiResist**, principal investigators (PIs) receive and can provide feedback on all NCCR manuscripts recently or soon to be submitted to a journal. This not only ensures that collaborations and contributions are acknowledged and valued, but also that research groups stay informed on and engaged with their colleagues' work. It creates an environment of trust within the network. In parallel, the scientific officer and research data officer check that the manuscript and associated datasets comply with SNSF policies. This innovative process will promote open science, bring about new ideas and collaborations, and strengthen the network's communication and cohesiveness.

[Materials Cloud](#), the NCCR MARVEL's web platform mentioned in the section on Technology platforms, also offers data repository services adhering to FAIR (findable, accessible, interoperable and reusable) principles. In May 2021, Open Research Europe from the European Commission named it an official repository for Horizon 2020-funded research. As of May 2021, 370 users share and archive their data on Materials Cloud.

## 8 International reach and impact of NCCRs

Since their inception, NCCRs have provided attractive platforms for the funded research teams to make an impact and extend their academic networks beyond the borders of Switzerland. Many examples can illustrate this international impact, and a few are described in this section.

In some fields, the Swiss research community, supported through NCCR funding, has achieved international leadership positions. For example, research in material and quantum sciences, which are of strategic importance for Switzerland, has been financed through several NCCRs since 2001. Over time, the research communities have grown and several Swiss research groups have become world-leading, for example in quantum materials and technology and in two-dimensional materials such as graphene.

Over time the community has grown and Swiss research groups have become world-leading especially in many facets of quantum sciences, quantum materials and technology, and in some fields relating to two-dimensional materials (graphene). Swiss researchers in these fields have been awarded many European Research Council (ERC) grants over the years.

Current or former NCCR leaders who have received individual recognitions or appointments are also examples of leadership roles. Only two of many examples are included here. **Prof. Willy Benz**, director of the NCCR PlanetS from 2014 (start) to 2021 served as President of the European Southern Observatory (ESO) Council between 2018 – 2020. The ESO Council provides world-class observatories on the ground for scientists worldwide and oversees which instruments will be designed, built and operated at the ESO site in the Atacama high plateau in Chile. Prof. Benz will serve from 2022 as the President-elect of the International Astronomical Union (IAU) and will thus preside over this major science association in astronomy for two additional years. **Prof. Peter Messerli**, who became renowned for his research in Laos as part of the NCCR North-South, is currently a professor in sustainable development and the director of the Wyss Academy for Nature at the University of Bern. He has been the Co-chair of the independent group of scientists appointed by the UN Secretary General to draft the UN Global Sustainable Development Report (GSDR) in 2019. He also holds other top-level appointments at the international level, e.g. as the Co-chair of Future Earth's Global Land Programme (GLP), plus many positions to do with advising and guiding governmental, scientific and civil-society organisations related to sustainable development.

The international impact of NCCRs has been clearly visible in research fields where local cultural and historical conditions influence research approaches and concepts. The innovative approaches of two NCCRs in Humanities, NCCR Eikones and NCCR Mediality, rooted mostly in German-based traditions, were taken up by the whole European community. They became visible in the US and established long-lasting collaborations with American colleagues.

Moreover, NCCRs disseminate their work not only via the traditional scientific outlets and publication channels or during conferences, but also by (co-)organising major science events that attract attention in their community (e.g. NCCR Bio-Inspired Materials as a co-sponsor of the Bioinspired Materials Gordon Conference series).

**In numbers:** In 2021, the 16 NCCRs of the 3<sup>rd</sup> and 4<sup>th</sup> series reported numerous ongoing collaborations with international partners including:

- More than **800 ongoing collaborations** with **research institutions** in **48 countries**
- **70 ongoing collaborations** with **business or industry** in **22 countries**

With about as many past collaborations, NCCRs are impressive and active international networks.

## 9 Conclusion and outlook

NCCRs promote long-term research networks in areas of strategic importance for Swiss science, economy and society. Besides promoting outstanding research, their mandate is to mobilise the entire Swiss research community in their field and to sustainably strengthen the research structures available to move forward together. This non-exhaustive compilation of structural measures implemented by the NCCRs illustrates both their diversity and the extent of their impact.

By supporting developments beyond pure science in strategic areas such as equal opportunities, outreach, and knowledge and technology transfer, the NCCRs help to reduce inequalities and build the necessary bridges between scientists, the general public and policy-makers. Their dedicated and flexible funding encourages NCCRs to be pioneers on issues that go beyond their discipline: How to ensure that a woman does not suffer any consequences from having to interrupt her research project while on maternity leave? How to make sure that the next generation of researchers is adequately trained to tackle the challenges that the research world is going to face tomorrow? The NCCRs test ambitious initiatives. The most successful ones may then be developed on a larger scale in Swiss institutions – but with a nuance: what works in one context for one discipline may not work in another. In this respect, the bottom-up approach of the NCCRs is essential to tailor the measures to the specific needs of each community and achieve maximum impact.

In the last years, NCCRs have made joint efforts in the form of specific actions (e.g. [Bench2biz](#), [#NCCR-Women campaign](#)). Not only did those common initiatives foster exchange between the large research centres, they also provided a critical mass to maximise the visibility and impact of researchers among the public and among their institutions. In the future, creating a network of (past and present) NCCRs which would go beyond the institutions could become a fantastic lever for change and a lobby for science. This would also strengthen the NCCRs in their institutions and reinforce the influence of the SNSF's role in shaping science.

For an NCCR to create solid foundations for a research field or community to flourish, and to become or confirm its position as a key player on the international scene, is a long-term task. In this context, the home institutions play an essential role in sustaining their structural efforts beyond the lifetime of the NCCR. Thanks to these extended responsibilities, the nationwide projects we support not only promote the scientific excellence of Swiss research, but also the values it stands for.