NTNU-China cooperation overview

Bilateral cooperation on Research and Education

Since 2017, Norway and China cooperation in research and innovation has been elevated profoundly, especially in joint research cooperation. In 2017, the Research Council of Norway signed a MoU with the National Natural Science Foundation of China (NSFC). When the delegation of Ministry of Science and Technology (MoST) of China visited Norway, **MoST has signed an action plan[1] in 2017-2020 with Norwegian Ministry of Education and Research (KD)**. In which Norway and China will prioritize collaboration in the following research areas:

- environment, climate and low-emission communities
- renewable energy and low carbon technologies
- polar research
- marine and maritime research (including fisheries research and fisheries technology)
- life sciences (including health and care as well as agriculture, food safety and food safety)
- materials
- information and communication technology (ICT)
- other areas to which a joint committee agrees during the period the action plan applies

In 2017 RCN published a **Roadmap for Cooperation in Research and Education with China 2018-2020**[2] in which the status for cooperation in research and education with China is summarized and thematic areas of particularly relevant as a basis for cooperation in the years ahead are identified. In the roadmap 10 thematic areas have been identified:

- Sustainable Urbanization
- Environment-friendly energy
- Carbon capture and storage (CCS)
- Sustainable aquaculture
- Sustainable agriculture
- Climate, the environment and the polar regions
- Cooperation on infrastructure
- Maritime activities
- Digitalisation
- Health innovations
- Social sciences and humanities

Joint publication

[1] The action plan is available on https://www.regjeringen.no/contentassets/6c5b2c3bb2fa4c6f82f962283b953b7c/nor-action-plan-2018-2020.pdf

[2] The road map is available on https://www.forskningsradet.no/contentassets/0aa5c0c035d3480d9c74afccf32939d8/chinaroadmapenglish.pdf

Co-authorship on scientific papers with China is one of the main indicators to evaluate the cooperation results. At NTNU co-publication with China has increased every year and the average rate is 36.9% (from 2015-2019). **In terms of growth rate and number of co- publications with China NTNU is number. 1** in comparing with the other two major national universities (UIO and UIB) (figure 6,7)**.** And among Panorama Countries (Brazil, China, India, Japan, Russia, and South Africa) NTNU-China co-publication has been the leading place in past 5 years regarding on the total number of co-publications and annual increasing rate. In 2019 NTNU's co-publication with China (528) is more than its combined co-publications (485) with the rest of Panorama Countries. (figure 8)

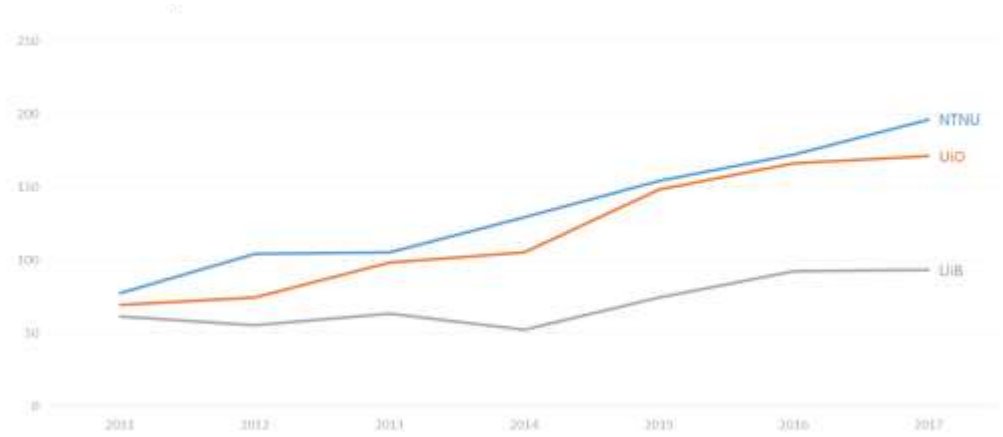
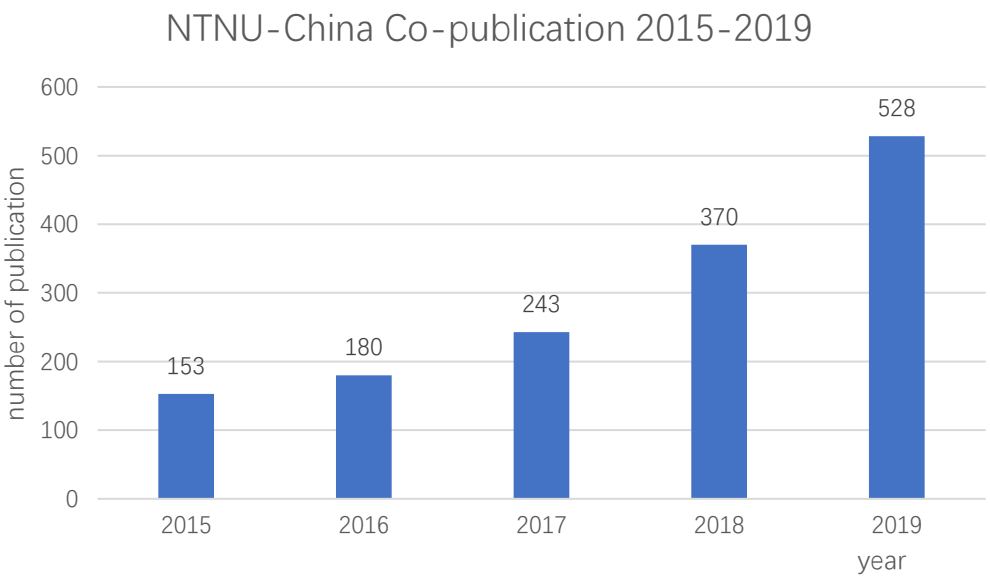
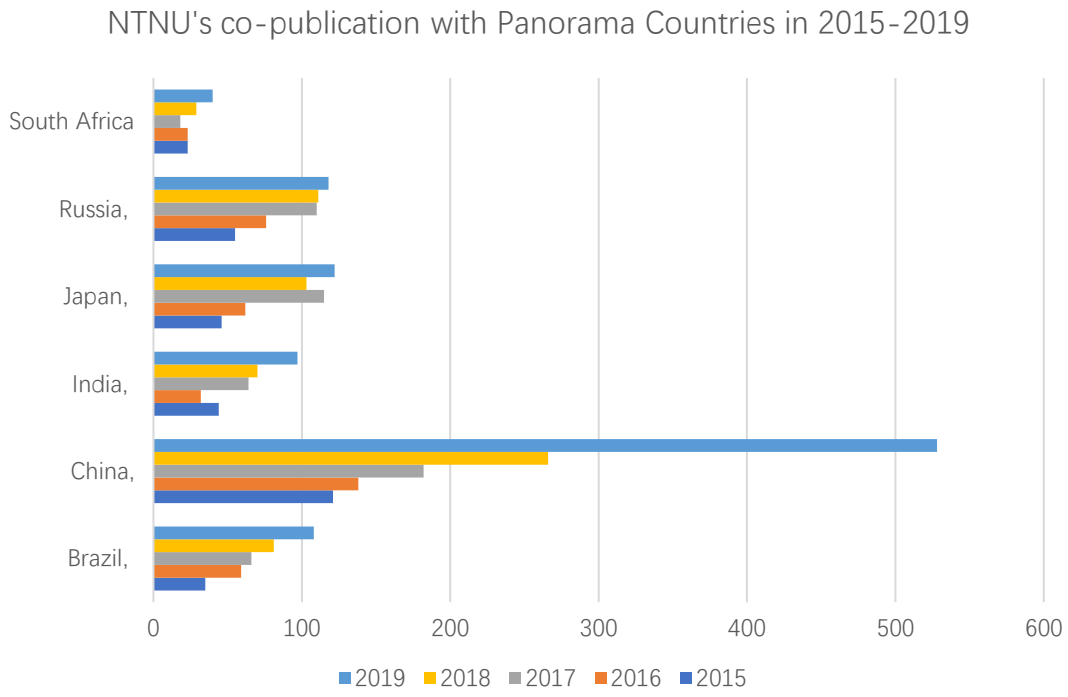


Figure 6: NTNU, UIO and UIB co-authorship with China in 2011-2017. Source: CRISTIN





students exchange

Chinese PhD graduates at NTNU

PhD researchers from China can be one of the indicators for NTNU-China cooperation. From 2010-2019, 207 PhD candidates who are Chinese citizens earned the title of PhD at NTNU with an average 21 PhDs/year. (ref. figure 22)

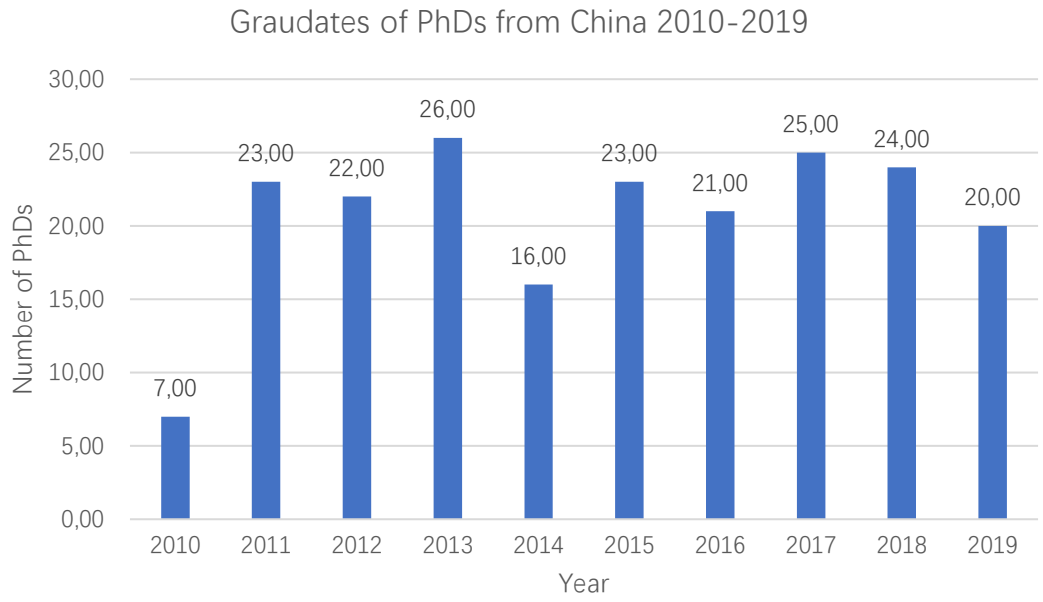


Figure 22: Graduates of PhDs from China 2010-2019 Source: Ivar Pettersen

In 2010-2019 the top 3 faculties at NTNU for Chinese graduating PhDs are the Faculty of Engineering (IV) (96 candidates), the Faculty of Natural Sciences (NV) (51 candidates) and the Faulty of Information Technology and Electrical Engineering (IE), which are also the top 3 faculties for co-publication with China (ref. figure 23). **One of every 15 entitled PhDs each year at NTNU is Chinese.**

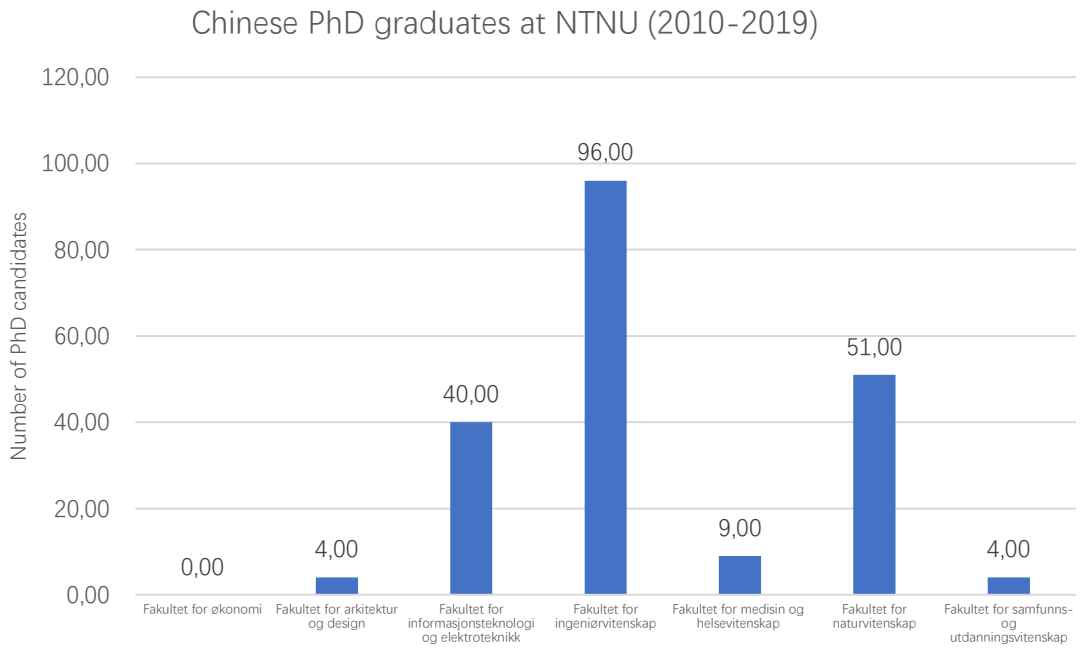


Figure 23: Chinese PhD graduates at NTNU (2010-2019) Source: Ivar Pettersen

Students Exchange between NTNU and China

Students exchange between NTNU and Chinese universities are crucial for the knowledge circulation. 92 NTNU students exchanged to China from 2007-2018 and 1652 Chinese students went to NTNU for study and exchange from 2007-2018.[3] **Comparing with the other universities in Norway, NTNU is behind BI, UiO and UiB in term of number of students exchange with China.** (ref. figure 24-25)

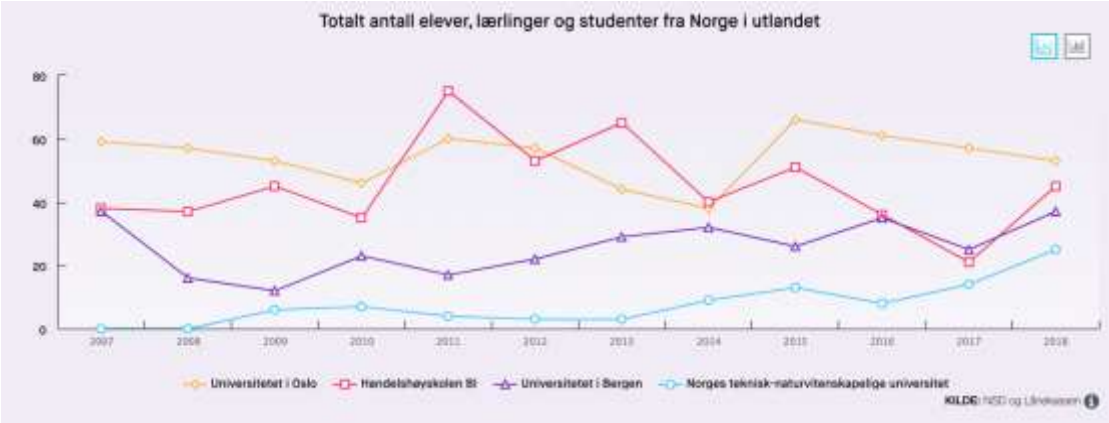


Figure 24-25: students exchange with China in 2007-2019 Source: DIKU database espresso

NTNU still have space to improve the volume of students exchange with China. The number of exchange students and master students has substantially increased **since 2010 and more and more Chinese students want to study in Norway one of the reasons is that Norway has become the only countries in Europe who has free tuition fee in the public universities.**

NTNU-CSC joint scholarship program

Academic exchange is one of the important factors for evaluating the level of internationalization. China Scholarship Council, the national funding agency for supporting international academic

[3] Source: DIKU: https://statistikk.siu.no/home?country=2&county=0&level=0&institution=0&portfolio=0&program=0&from=2007&to=2018&&dimension=&freetext=

exchange, has sponsored many Chinese scholars for exchange to abroad and provided full scholarship to the Chinese students to take further study. According to Chinese Embassy in Oslo, **in 2018-2019, CSC have supported 59 candidates for PhD exchange, visiting scholar and PhD degree seeking to NTNU.** In which the Dept of Civil and Environmental Engineering received 8 CSC-supported visiting scholars which is the no. 1 department at NTNU.

Table 10: 2019-2019 CSC sponsored Chinese scholars to NTNU

2018-2019 CSC sponsored Chinese scholar exchange to NTNU	
Category	**Number of persons**
PhD exchange	25
PhD degree seeking	22
Visiting scholar	12
Total	59

Source: Chinese Embassy in Oslo

The full scholarship from CSC before 2019 is less than 10,000 NOK/month/person and after 2019 is raised to 12500 NOK. That is not enough for supporting daily living in Norway especially for PhD degree seeking students who have far lower income than the regular salary for PhD at NTNU. With the aim of fulfilling the gap between CSC supported PhD and regular recruited PhD at NTNU, NTNU have contacted CSC for establishing a joint scholarship. **The NTNU-CSC Joint Scholarship agreement was signed in the end of 2019 and is put into implementation in the beginning of 2020.** The program coordinator has been identified and the program webpage has been created and released in public in the middle of January 2020 (https://www.ntnu.edu/phd/ntnu-csc-scholarship)

According to the agreement, every year NTNU will receive a maximum of 20 PhD scholarships (36-48 months) and 10 exchange PhD scholarships (6-12 months). NTNU ensures there is a guaranteed funding of no less than 17 000 NOK per month for each PhD students coming to NTNU under the NTNU – CSC Agreement. The monthly funding from CSC is 12 500 NOK. Departments at NTNU receiving CSC students are responsible for the top-up funding. In 2020, NTNU centrally has received many inquiries from students from China and supervisors at NTNU. **By the middle of March 2020, the program has announced 10 PhD scholarship positions and 6 exchange PhD positions.** In which 75% of the scholarship positions are announced by the Faculty of Engineering (ref figure 26). Due to the coronavirus (COVID-19) outbreak in China, the CSC has postponed the deadline for submitting the application to CSC online and NTNU has also extend the deadline in order to let applicants have more time to prepare. In the beginning of April 2020 NTNU has finished the internal evaluation and deliver a list of selected candidates to CSC which is including 13 candidates (7 PhD scholarship positions and 6 exchange PhD scholarship positions).

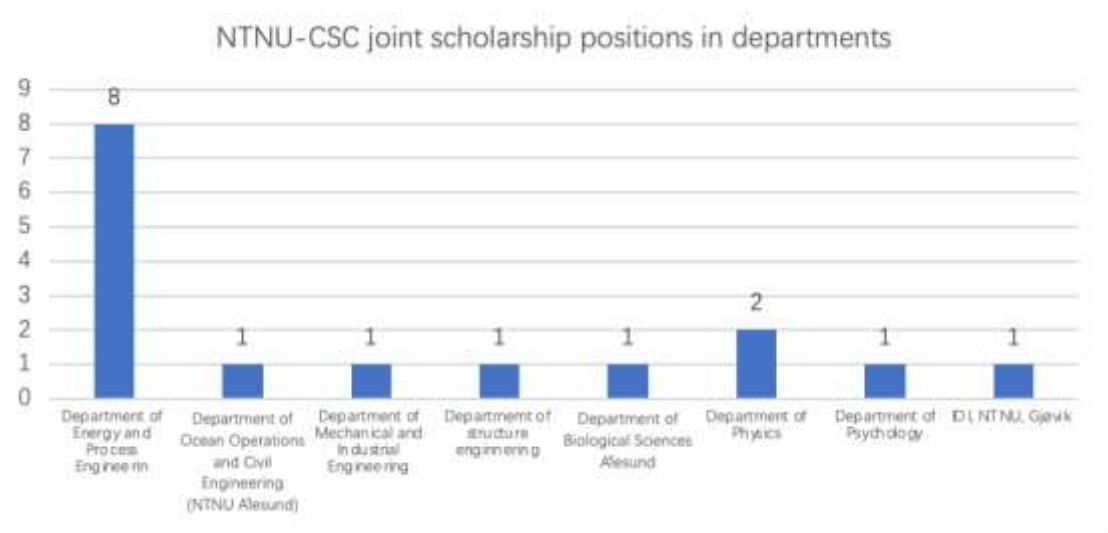


Figure 26: NTNU-CSC joint scholarship positions in departments and faculty

In the first year of the implementation of the program, some challenges are also exposed. **Some departments have a different understanding and therefore give different instructions to the supervisors.** In specific, the calculations of overhead cost for receiving a CSC supported candidates at department level are different, especially for the degree seeking PhDs. Another challenge is **the English proficiency and academic performance of the candidates.** Some supervisors want to have the candidates who have very good academy performance, but the result of English ability proficiency is not reaching the entry line which NTNU and CSC required although the supervisors think the applicant is good enough in English of carrying out his/her PhD project. For 2021 and onwards NTNU-CSC Joint Scholarship program will adapt into a new timeline as following (ref figure 27):

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Joint Master and PhD education with China

Cooperation with China on education to master students and PhDs can positively promote the student mobility with China. There are some instruments at NTNU for education cooperation with China as Double Degree master programs, Sandwich PhD programs, Joint PhD programs, Summer schools, and study trips/excursions etc.

Double degree Master program

NTNU have signed several agreements with Chinese universities on establishing a Double Degree Master program which will allow students to get two master degrees with one-year exchange to the counterpart university. For example, NTNU has set up a double master's degree program in sustainable energy with Shanghai Jiao Tong University since 2013 which contains two topics:

- Sustainable Heat Pumping Processes and Systems (started in 2013)

  11 to NTNU – 5 to SJTU (2013-2017)

- Sustainable Energy Use in Buildings (started in 2015)

  4 to NTNU – (4 to SJTU) (2015-2017)

Sandwich PhD and joint PhD program

PhD in Sandwich model has been adapted in the NTNU-SJTU JRC in sustainable energy, NTNU-SJTU JRC in material science and NTNU-Chongqing Uni cooperation by using PhD candidate as the bridge for connecting the research group at NTNU. For example, at JRC in sustainable energy, NTNU invested 6 PhD positions who have been actively cooperating with the research topic matched PhDs at SJTU. In 2017, the PhD in sandwich model is well recognized in term of benefiting the research cooperation NTNU has signed a joint PhD agreement with SJTU.

Projects on Erasmus and Horizon 2020 etc.

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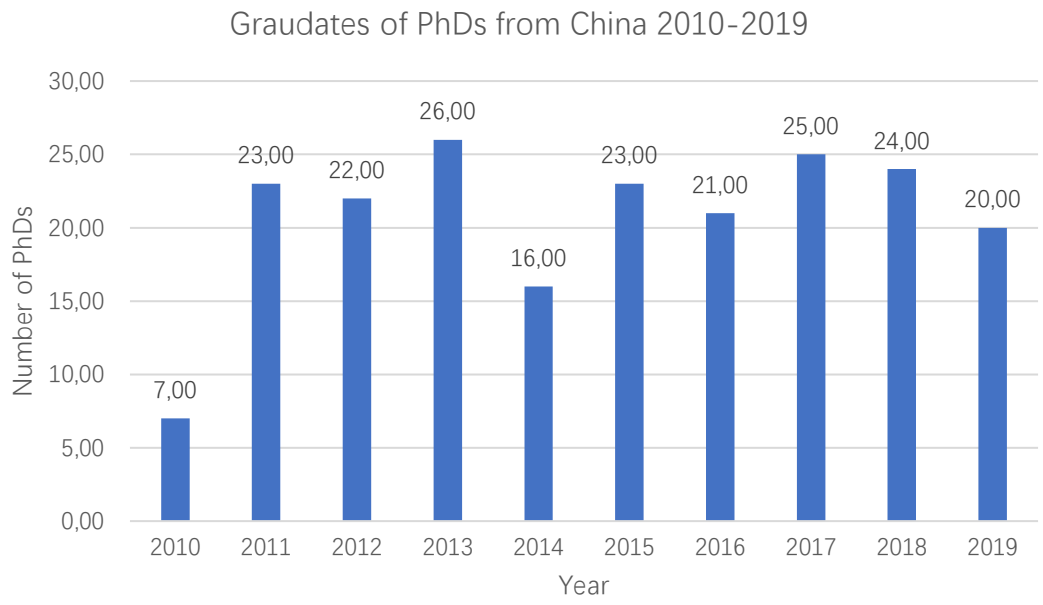

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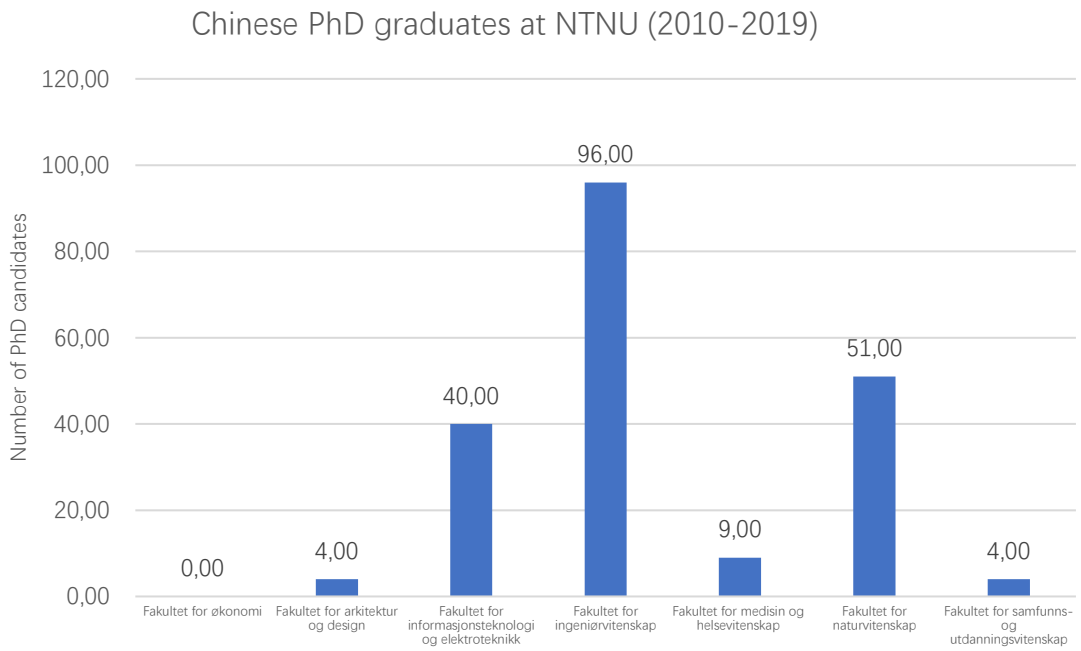

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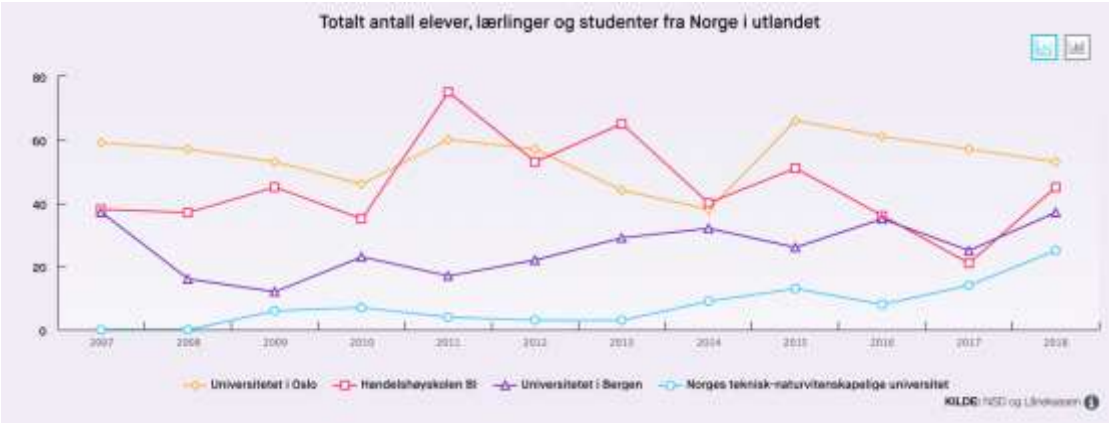

[4] Source: DIKU: https://statistikk.siu.no/home?country=2&county=0&level=0&institution=0&portfolio=0&program=0&from=2007&to=2018&&dimension=&freetext=

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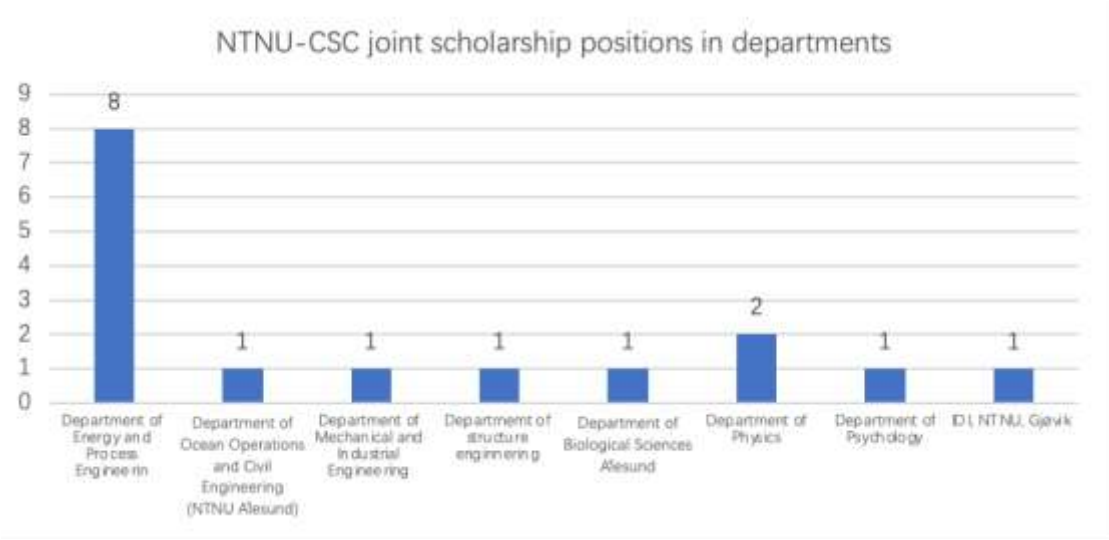

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NTNU-China Joint research projects

Projects funded by Norway

Currently two national programs (**INTPART and UTFORSK**) support the cooperation with China, as well as the other countries such as Brazil, India, Japan, US and Canada etc.

INTPART

The INTPART programme "promotes the development of long-term relations between Norwegian higher education and research institutions and strong research groups and institutions in eight

priority partner countries: Brazil, Canada, China, India, Japan, Russia, South Africa and the US. From 2017 the programme has also included partnerships with institutions in Germany and France. The INTPART programme is a collaborative effort between the Research Council of Norway and the Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education (Diku)".

From 2015-2019 **NTNU has won 23 INTPART projects with a total funding of 71.5million NOK from the INTPART program** which is 2nd most funding recipient. 5 of those 23 projects have included Chinese partners. According to the RCN during 2015-2019, the INTPART program has granted 18 projects which include partners in China (ref. table 1).

Table 1: NTNU-China projects in INTPART program (source: Data base of RCN Project Databank)

Prosjektnummer	*År*	*Tittel*	*Total bevilgning for prosjekt*	*Prosjektleder*	*Department*
288851	2019–2022	Teknologi for nye havindustrier og infrastruktur - havvind, akvakultur og flytebroer	NOK 3,237,998.00	Sverre Steen	Institutt for marin teknikk
288187	2018–2021	Material Appearance Network for Education and Research	NOK 4,165,997.00	Jon Yngve Hardeberg	Institutt for datateknologi og informatikk
288491	2018–2021	Den norsk-kinesiske innovasjonsplattformen på bærekraftig byutvikling	NOK 4,499,997.00	Annemie Wyckmans	Institutt for arkitektur og planlegging
274816	2017–2020	Internasjonalt partnerskap innen informasjonsteknologi	NOK 4,499,995.00	Maria Letizia Jaccheri	Institutt for datateknologi og informatikk
250146	2015–2019	SINO - Norsk Partnerskap for bærekraftige energiløsninger	NOK 4,049,997.00	Annemie Wyckmans	Institutt for arkitektur og planlegging

UPTFORSK

UTFORSK is a "central measure in the Panorama Strategy, the Norwegian government's strategy for cooperation on higher education and research with Brazil, China, India, Japan, Russia and South Africa. The goal is to enhance the quality in higher education through development of strong ties between education and research and between education and work life. The UTFORSK Partnership Programme is funded by the Norwegian Ministry of Education and Research and administered by Diku."

In 2013-2018 DIKU (predecessor SIU) has approved 110 projects in the UTFORSK program, of which NTNU has led 16. In those 16 projects, 5 are related to China. DIKU in the program has invested in 30 projects which have Chinese partners involved., in which the University of Oslo have taken 4 projects and the University of Bergen taken 4 projects as well. Besides UiB and UiO, the Western Norway University of Applied Science (HVL) has received 5 UTFORSK projects with Chinese partners, which is the same as NTNU. From the total budget/resource, UiB is number .1

who has received funding for the projects towards China and NTNU is taking the 2nd place with a total budget of 5.2 million NOK. (ref. Table 2 and Figure 20)

Table 2: NTNU-China projects in UTFORSK program (source: Data base of DIKU espresso)

Prosjektnummer	År	Tittel	Total bevilgning for prosjekt	Prosjektleder	Department
UTF-2014/10069	2015–2016	SEniC - Sustainable Energy in Cities	NOK 794 500	Annemie Wyckmans	Institutt for arkitektur og planlegging
UTF-2016-short-term/10080	2017–2018	iSTAR_interdisciplinary intensive SusTainable ARchitecture course	NOK 300 000	Finocchiaro, Luca	Institutt for arkitektur og teknologi
UTF-2017-four-year/100	2017–2020	AMMM - Additive Manufacturing of Metallic Materials - Sustainable long term cooperation between Norway-China-India-Brazil	NOK 1 985 870	Grammatikos, Sotirios	Institutt for vareproduksjon og byggteknikk
UTF-2017-four-year/10058	2017–2020	Norway-ChINa-JApan Consortium for safe and efficient operations of Health 4.0 (NINJA)	NOK 1 882 000	Liu, Yiliu	Institutt for maskinteknikk og produksjon
UTF-2018-two-year/10047	2018–2019	Gateway to China	NOK 300 000	Qiaoqiao Wang	Institutt for energi- og prosessteknikk

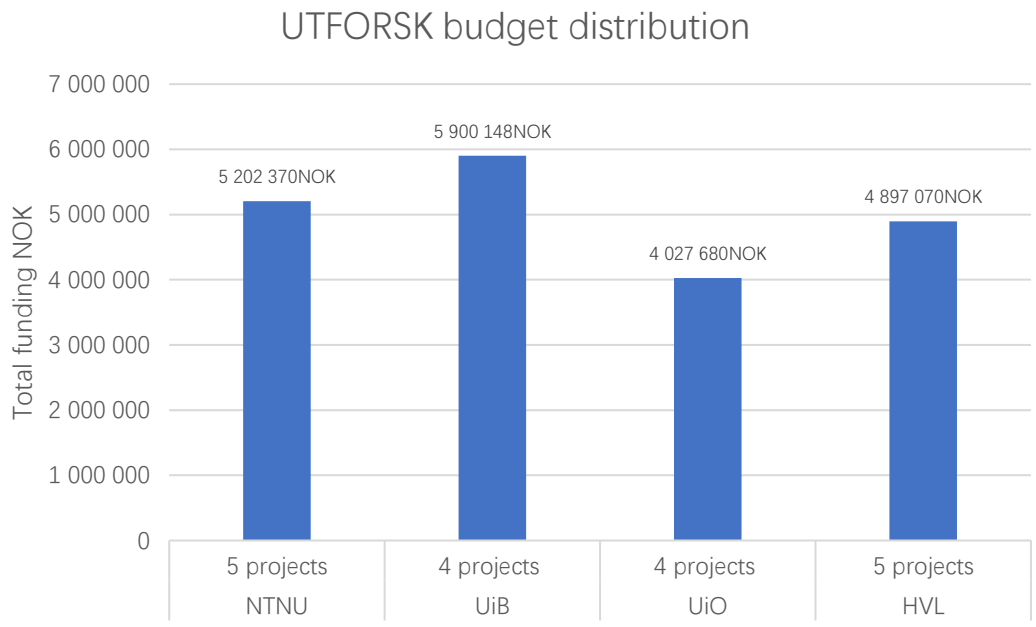

Figure 20: UTFORSK budget distribution. Source: DIKU database espresso

In general, **NTNU has the advantage in winning the national funding for cooperating with China compared with the other universities and research institutes in the country.** In the national flagship programs INTPART and UTFORSK, NTNU has taken 2nd place in INTPART projects in cooperating with China in terms of number of projects. And NTNU shared 16% of the projects which DIKU has invested in the program of UTFORSK relating to China and at the 2nd place for receiving the funding from it.

In the 10 INTPART and UTFORSK projects with China, **SJTU is the strategic partner to NTNU in 4 projects (2 in UTFORSK and 2 in INTPART)** which echoes and strengthens the close partnership between NTNU and SJTU. (ref. Table 3)

Table 3: NTNU-SJTU Joint project in INTPART and UTFORSK.

288851	2019–2022	Teknologi for nye havindustrier og infrastruktur - havvind, akvakultur og flytebroer	NOK 3,237,998	Sverre Steen	Institutt for marin teknikk
250146	2015–2019	SINO - Norsk Partnerskap for bærekraftige energiløsninger	NOK 4,049,997	Annemie Wyckmans	Institutt for arkitektur og planlegging
UTF-2014/10069	2015–2016	SEniC - Sustainable Energy in Cities	NOK 794 500	Annemie Wyckmans	Institutt for arkitektur og planlegging
UTF-2018-two-year/10047	2018–2019	Gateway to China	NOK 300 000	Qiaoqiao Wang	Institutt for energi- og prosessteknikk

NTNU-China cooperation in EU projects

China is the world's third largest economy after the EU and the USA, and the EU is China's biggest trading partner. EU and China have initiated the annual high level EU-China Innovation Cooperation Dialogue (ICD) which is carried out by DG R&I from EU side and the Ministry of Science and Technology (MoST) from the China side since 2012. At the 3rd Innovation Cooperation Dialogue (ICD), EU and China have identify the focus areas of food, agriculture and biotechnologies, environment and sustainable urbanisation, surface transport, safer and greener aviation, and biotechnologies for environment and human health, with a co-funding mechanism for research and innovation (CFM) for the period 2018-2020.

According to the Roadmap for EU-China S&T cooperation[5] "Overall in Horizon 2020 until October 2018, Chinese entities have participated 337 times to 158 signed grants of collaborative, Marie Sokolowski-Curie Actions (MSCA) and European Research Council (ERC) actions …Chinese entities have 183 participations (181 times as beneficiaries) in 78 signed grants, receiving 3.0 million EUR from EU while 33.8 million EUR is the non-EU budget of Chinese beneficiaries… Chinese entities have participated 152 times in MSCA actions."

NTNU is actively participating in the European Framework Programmes for Research and

[5]The full text of the roadmap is available on https://ec.europa.eu/research/iscp/pdf/policy/cn_roadmap_2018.pdf#view=fit&pagemode=none

Innovation, currently Horizon 2020.NTNU has signed 154 projects by 17th Sep 2019 which contain 1473 partners from 49 countries. In **4 Horizon 2020 projects NTNU have Chinese partners.** In one of the 4 projects, URBAN-EU-CHINA (CSA: EU-China innovation platform for sustainable urbanisation), NTNU is the coordinator with 5 Chinese partners involve. (ref. Table 4)

Table 4: NTNU-China cooperation in H2020 (source: https://www.ntnu.edu/horizon2020)

Project name	Overall budget	Start-end date	Project coordinator	Chinese Participants
URBAN-EU-CHINA (Grant agreement ID: 733571) EU-China Innovation Platform on Sustainable Urbanisation	€ 1. 5 Million	1 Jan 2017-31 Dec 2019	NTNU	European Chamber of Commerce in China
				CHINA ACADEMY OF URBAN PLANNING AND DESIGN
				CHINA CENTER FOR URBAN DEVELOPMENT
				TONGJI UNIVERSITY
				THE UNIVERSITY OF NOTTINGHAM NINGBO
GoJelly - A gelatinous solution to plastic pollution（Grant agreement ID: 774499）	€ 6. 2 Million	1 Jan 2018-31 Dec 2021	SYDDANSK UNIVERSITET	INSTITUTE OF OCEANOLOGY, CHINESE ACADEMY OF SCIENCES
TRANS-URBAN-EU-CHINA (Grant agreement ID: 770141) Transition towards urban sustainability through socially integrative cities in the EU and in China	€ 2 .5 Million	1 Jan 2018-31 Dec 2020	TECHNISCHE UNIVERSITAET DRESDEN	CHINA ACADEMY OF URBAN PLANNING AND DESIGN
				INSTITUTE OF GEOGRAPHICAL SCIENCES AND NATURAL RESOURCES RESEARCH, CHINESE ACADEMY OF SCIENCES
				CHINESE ACADEMY OF SCIENCE AND TECHNOLOGY FOR DEVELOPMENT*CASTED
				CHINA CENTER FOR URBAN DEVELOPMENT
				TONGJI UNIVERSITY
				TSINGHUA UNIVERSITY
NAVIGATE（Grant agreement ID: 821124）Next generation of AdVanced InteGrated Assessment modelling to support climaTE policy making	€ 7 Million	1 Sep 2019-31 Aug 2023	POTSDAM INSTITUT FUER KLIMAFOLGENFORSCHUNG	NATIONAL CENTER FOR CLIMATE CHANGE STRATEGY AND INTERNATIONAL COOPERATION

Besides Horizon 2020, NTNU has also joined other EU-China joint funding calls. For example, JPI Urban Europe and the National Natural Science Foundation of China (NSFC) has launched a joint

call on Sustainable and Liveable Cities and Urban Areas. The total funding available in this programme is approximately M€ 9.35 on the European side, across the participating European funding agencies. NSFC will fund the Chinese part of all projects. And NTNU has wined 2 of 11 projects as following (ref. Table 5):

Table 5: NTNU-China cooperation in JPI UE-NSFC joint calls (source: https://jpi-urbaneurope.eu/calls/sustainable-urbanisation-china-europe/)

Project name	Overall budget	Start-end date	Project coordinator	Chinese Participants
SMUrTS-Sustainable mixed urban transit system with electric and conventional buses	€877,000	2019-2022	NTNU	Beihang University
				Beijing Jiao Tong University
HERMES-Integrated evaluation of energy saving, emission reduction potential and management strategies for urban road systems	€1,117,263	2019-2022	SINTEF	Wuhan University of Technology
				Huazhong University of Science and Technology

Besides INTPART and Norway-China joint funding projects there also have some other NTNU-China projects supported by RCN in following:

Table 6 the other RCN-funded projects at NTNU involving partners from China. Source: Patrick Reurink

Program/aktivitet	Prosjekttittel primærspråk	Prosjektleder	Prosjektansvarlig	Samarbeidspartner
MILJØFORSK - Miljøforskning for en grønn samfunnsomstilling	Strategies to Mitigate Pressures on Terrestrial Ecosystems from Multiple Stressors	Francesco Cherubini	Institutt for energi- og prosessteknikk	Beijing Normal University
NANO2021 - Nanoteknologi og nye materiale	Designing new renewable nano-structured electrode and membrane materials for direct alkaline ethanol fuel cell	De Chen	Institutt for kjemisk prosessteknologi	Chang Gung University
MILJØFORSK - Miljøforskning for en grønn samfunnsomstilling	Strategies to Mitigate Pressures on Terrestrial Ecosystems from Multiple Stressors	Francesco Cherubini	Institutt for energi- og prosessteknikk	Chinese Academy of Sciences (CAS)
PETROMAKS2 - Stort program petroleum	Carbon Membranes for CO2 Removal from High Pressure Natural Gas in Subsea Process	Xuezhong He	Institutt for kjemisk prosessteknologi	Chinese Academy of Sciences (CAS)
FINNUT - Forskning og innovasjon i utdanningssektoren	Developing national standards for the assessment of writing. A tool for teaching and learning	Synnøve Matre	NTNU FAKULTET FOR LÆRER- OG TOLKEUTDANNING	Education University of Hong Kong

ENERGIX - Stort program energi	Development of Joint Research Centre (JRC) in Sustainable Energy between Shanghai Jiao Tong University (SJTU) and NTNU	Arne Mathias Bredesen	NTNU FAKULTET FOR INFORMASJONS-TEKNOLOGI OG ELEKTRONIKK	Shanghai Jiao Tong University
MILJØFORSK - Miljøforskning for en grønn samfunnsomstilling	Ecosystem footprints: Land Use Impacts and their Socioeconomic Determinants	Francesca Verones	Institutt for energi- og prosessteknikk	Shinshu University
IKTPLUSS - IKT og digital innovasjon	ShuttleNet: Scalable Neural Models for Long Sequential Data	Zhirong Yang	Institutt for datateknologi og informatikk	South China Normal University
CLIMIT - Forskning, utvikling og demo av CO2-håndtering	Low Temperature Post Combustion CO2 Capture Technology Using Solid Sorbents	De Chen	Institutt for kjemisk prosessteknologi	Southeast University, Jiangsu
ENERGIX - Stort program energi	Energy efficient upgrading of historical villages in SheXian County, China	Tore Brandstveit Haugen	NTNU FAKULTET FOR ARKITEKTUR OG DESIGN	Southeast University, Jiangsu
ENERGIX - Stort program energi	Energy efficient up-grading of historical villages in SheXian County, China	Tore Brandstveit Haugen	NTNU FAKULTET FOR ARKITEKTUR OG DESIGN	Tsinghua University
ENERGIX - Stort program energi	Methods for Transparent Energy Planning of Urban Building Stocks - ExPOSe	Natasa Nord	Institutt for energi- og prosessteknikk	Zhejiang University

Joint calls between Norway and China

Norwegian funding agencies also signed a series of agreements with Chinese funding agencies for creating joint research calls under the guidance of KD-MoST action plan (2017-2020). Between 2018-2019 Norway and China have announced 3 joint calls as follows:

RCN-NSFC joint call (2019-2021)

The Research Council of Norway (RCN) and the National Natural Science Foundation of China (NSFC) have created a Sino-Norwegian joint research in the field of sustainable agriculture, food security and food safety, and integrated multi-stressor impacts on ecosystems with a budget NOK 40 Million from RCN side. After the evaluation, **9 joint projects have been approved. Among them, two projects are led by NTNU** (ref. Table 7)**.**

Table 7: NTNU lead calls in RCN-NSFC joint calls (2019-2021)

Project name	NTNU partner	Chinese partner
Plant-insects relationship study	Xinrong WANG, China Academy of Agricultural Sciences	Bente Gunnveig Berg, Dept of Phycology, SU NTNU
Strategies to Mitigate Pressures on Terrestrial Ecosystems from Multiple Stressors (MITISTRESS)	Wenwu ZHAO, Beijing Normal University	Francesco Cherubini, Dept of Energy and Processing Engineering, IV NTNU

Source: http://www.nsfc.gov.cn/publish/portal0/tab442/info74602.htm (in Chinese)

RCN-MoST joint call on sustainable energy

MoST and the RCN announced a joint call within the energy topics offshore wind, combined cooling, heating and power generation, and new energy vehicles with a budget of 75 million NOK (Norway side) and each project is 15-25 million NOK. Chinese partner will get the same amount of funding from the Chinese side. **In the 2019 RCN-MoST joint call 3 projects were approved, of which 2 are coordinated by NTNU** (ref. Table 8)**.**

Table 8 RCN-MoST joint calls on Sustainable Energy

Nr	Tittel	Ansvarlig inst.
304191	Key technologies and demonstration of combined cooling, heating and power generation for low-carbon buildings/neighbourhoods with clean energy, ChinoZEN	NTNU
304213	Research and Demonstration of Key Technologies for Reliable and Efficient Application of New Energy Vehicles in China and Norway	NTNU
304229	Research on smart operation control technologies for offshore wind, CONWIND	NORCE

Source: RCN

In the funded projects, there are more Chinese partners. For example, in ChinoZEN, the partners in China comprise the following prominent universities and industry partners as:

- Beijing Jiaotong University,
- China Academy of Building Research,
- Gree Electric Appliances Inc of Zhuhai,
- Solareast Holdings Co. Ltd.,
- Lanzhou University of Technology (LUT),
- North China Electric Power University (NCEPU),
- Qingdao Somir Energy Science and Technology Co. Ltd.,
- Shanghai Jiao Tong University (SJTU),
- Tsinghua University (THU),
- Xi'an University of Architecture and Technology (XUAT).

RCN-MoST joint call on digitalization

The RCN-MoST collaboration projects on Digitalization aim to develop products, services and processes which are beneficial to individuals, businesses and society in a safe and responsible manner with a total budget of 74 million NOK (from Norway side) and 6-10 million for each project. Chinese partner will get same amount of funding from the Chinese side. **In 2019 RCN approved 8 projects and in 5 of them NTNU are the project coordinator** (ref. Table 9)**.**

Table 9: RCN-MoST calls on digitalization

Project no.	**Project title**	**Organisation**	**Granted amount**
309205	Perception & Fusion of Multidimensional Information & Cooperative Decision-making for	NTNU, Institutt for marin teknikk	8 401 000

	Intelligent Diagnosis of Wind Turbine Critical Parts		
309323	Remote Control Centre for Autonomous Ship Support	NTNU, Institutt for havromsoperasjoner og byggteknikk	9 000 000
309494	Platform as Service Technologies for High-performance Blockchain-based Supply Chain Management Systems	NTNU, Institutt for datateknologi og informatikk	9 981 000
309628	AutoPRO: Digitalization for Autonomous Prognosis and Production Optimization in Offshore Production Systems	NTNU, Institutt for kjemisk prosessteknologi	9 999 000
309691	Development and application of key big data technologies for mineral processing	SINTEF Industri	10 000 000
309708	Digital Arctic Shipping - New data products and visualisation services	Stiftelsen Nansen senter for miljø og fjernmåling	9 105 000
309997	Intelligent dispatching and optimal operation of cascade hydropower plants based on spatiotemporal big data	NTNU, Institutt for elkraftteknikk	9 995 000
310137	Digital technologies for post-operative remote care and rehabilitation of thoracic and cardiac surgery patients	OSLO UNIVERSITETSSYKEHUS HF	9 992 000

Source:https://www.forskningsradet.no/contentassets/f523e6d3e0c84941bdfe0b8dda2e08cb/application-results-iu-digitalisation.pdf

From there joint calls NTNU has earned a very good result in term of getting research funding, NTNU has won 2 out of 9 in RCN-NSFC joint calls on food/agriculture and ecosystem, 2 out of 3 in RCN-MoST joint calls on energy and 5 out of 9 in RCN-MoST joint calls on digitalization (ref. figure 21). **NTNU-SJTU cooperation has also been strengthened by the RCN-MoST project of ChinoZEN** (the co-lead from the Chinese side is SJTU).

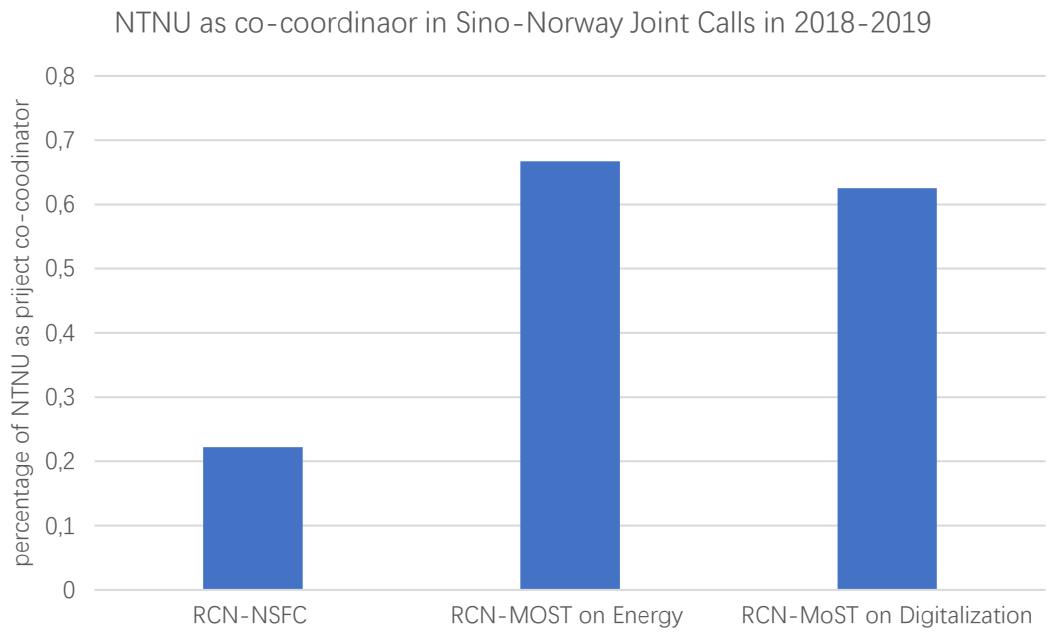

Figure 21: NTNU as co-coordinator in Sino-Norway Joint Calls in 2018-2019

Joint research centers with institutes of China

To build joint research centers and research programs with Chinese universities is an effective measure to develop long-term and robust cooperation. Making an agreement on co-creating a joint research center/program will shift the personal random cooperation into the institute level cooperation. NTNU has signed three joint research center agreement with Shanghai Jiao Tong University in the areas of sustainable energy, marine technology and material.

NTNU-SJTU Joint Research Center on Sustainable Energy: In 2010 NTNU signed a Joint Research Center agreement in sustainable energy with Shanghai Jiao Tong University. Both SJTU and NTNU have developed substantial research and education activity over a broad specter of energy technologies. By teaming up together in this goal-oriented JRC with the common mission of Sufficient and clean energy for a sustainable and peaceful society. Since 2010 the NTNU-SJTU JRC has achieved:

- 14 “sandwich” PhD candidates educated (7 at SJTU and 7 at NTNU), which are also financed by the universities
- The JRC team has carried out 7 summer courses
- 13 Double Degree Master students have been educated
- 67 presentations at workshops and conferences
- 35 joint publications.
- INTPART-funded project “Sino-Norwegian Partnership on Sustainable Energy” (SiNoPSE)
- UTFORSK-funded project “Gateway to China”
- RCN-MoST joint call on energy: Key technologies and demonstration of combined cooling, heating and power generation for low-carbon buildings/neighbourhoods with clean energy, ChinoZEN

NTNU-SJTU Joint Research Center on Ocean Engineering and Naval Architecture: The agreement of NTNU-SJTU JRC was signed in April 2018 when NTNU's delegation visited SJTU. The JRC was co-founded by the dept of Marine Technology at NTNU and School of Naval Architecture, Ocean and Civil Engineering at SJTU. The center is virtual at the current stage. According to the agreement of JRC the aim of the center is to foster a world-leading scientific and technological collaborative research, innovation and education center for ocean engineering and novel architecture. The JRC has identified 8 thematic research areas: basic discipline areas; oil and gas facilities; ocean renewable energy facilities; green shipping; very large floating structure for transport infrastructure; deep sea mining; marine operation and aquaculture facility. NTNU and SJTU has applied an INTPART project (2019-2022) for the JRC which supports the JRC's activities such as academic staff and student mobility, education cooperation, and scientific seminars etc. In Oct 2019 a face-face seminar was taken place at NTNU. In 2020, several PhD and master students exchange to NTNU was planned which is interfered by COVID-19 worldwide outbreak. JRC also planned to join the international conference and co-hosted few sessions in the conference. Two intensive courses also planned at SJTU which will be carried out by NTNU professors. Both parties also plan to co-apply the research calls from RCN and EU.

NTNU-Chongqing Uni. JRC and NTNU-SJTU JRC on lighter metals and new energy based on light metals: Dept of Materials Science and Engineering at NTNU has two joint research centers on lighter metals and new energy materials based on light metals. The Chinese partners are Chongqing University and Shanghai Jiao Tong University. The two JRCs are both founded in 2010. The aim of the JRCs is to rise world-leading scientific and technological collaborative research, innovation and education centers for light metals and new energy materials based on light metals. The JRCs have co-hosted 6 times of Chinese-Norwegian Symposium on Light Metals and New Energy Materials (CNS) since 2005 and the latest one was taken place in Shanghai Jiao Tong Uni in Shanghai in 2017 with more than 190 participants join the symposium. And next CNS will be taken place in Trondheim in 2020 or 2021 which depends on situation of CIVID-19 pandemic. Currently NTNU in working with Chongqing Uni and SJTU has got one INTPART project (2020-2023) to support the activities of JRCs; the JRCs have received the PhD candidates from SJTU for exchange who are supported by CSC; ramp-up double MSc degree exchange with Chongqing Uni. Further the model of JRCs with China has been multiplied at Dept of Materials Science and Engineering who are exploring the possibilities of establishing new JRCs with some institutes in China.