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# Science and Innovation Diplomacy from a Practitioner's Perspective – A Case-study of “Nordic+” Countries in China

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### Abstract

Science and innovation diplomacy is at a crossroad – facing the need for enhanced cooperation to tackle global challenges and in a more complex geopolitical landscape. Built on “learning-by-doing” and “learning-by-experimenting” as well as focusing on future development needs and opportunities, the science and innovation diplomacy practices of “Nordic+” countries, *i.e.*, Denmark, Finland, Sweden and the Netherlands, in China are presented in the paper. Their common strategic insights can be summarized as: 1) a new policy narrative on “co-opetition”, 2) a balanced approach and a long-term and future-oriented perspective on “co-opetition” and 3) more agile, targeted and impact-oriented instruments and partnerships for “co-opetition”. Concrete suggestions for the future development include: 1) a deepened understanding of how science and innovation are inter-connected with strategic and economic interests of countries and continents, 2) publicly funded schemes and instruments for engaging Nordic multinationals and deepening science-industry-policy collaborative efforts, 3) systematic methods through combining evidence-based and future-oriented analyses and 4) skill- and capacity development for identifying, preventing and mitigating multifaceted risks in cooperation. In such contexts, the implementation of EU's mission-driven innovation and the twin-transition, *i.e.* the sustainability transition and digital transition, can open up new opportunities for the future cooperation.

### Keywords

innovation diplomacy; science and innovation policy; business-driven innovation

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## 1. Introduction

### 1.1. Why this paper?

The development of science and innovation is moving forward and changing fast, driven by new market needs, increasing public funding to tackle societal challenges, and not least strengthened innovative brainpower and strong scaling-up capacities from emerging economies. The needs for enhanced international and joint efforts in science and innovation, particularly in the face of global challenges, such as public health and sustainability transformation, are more urgent than ever. At the same time, the research and innovation policy at a national level as well as international cooperation in research and innovation are facing new and profound uncertainties. These uncertainties are associated with increased complexities in science and innovation development per se as well as a more strategic role played by science and innovation in economic competitiveness and geopolitical relationships.

Consequently, science and innovation cooperation is no longer only a relatively neutral “door-opening” or “soft-power” issue. Instead, we see increasingly demanding, and even challenging interactions between the evolving complexities in science and innovation on the one hand and a more competitive mind-set in science and innovation policymaking and policy dialogues on the other. The competitive thinking or even the “securitisation” (Van Munster, 2016) of science and technology has already, to various extents and in different ways, affected or even limited the role that science and innovation cooperation can and should play to combat the global challenges and create the global common good. On the top of these emerging uncertainties and tensions, the ongoing Covid-19 pandemic as well as the systemic vulnerabilities that it reveals have put the future science and innovation cooperation into an even more mixed context, shifting from fully embraced globalisation to an increasing focus on de-globalisation, regionalisation and even “de-coupling”.

Against this backdrop, the science and innovation diplomacy on the ground, particularly in science and innovation hotspots, is facing a fast-changing reality with new challenges and uncertainties. Accordingly, new approaches and new tools need to be explored to bridge the mindset-, knowledge- and skill-gaps and to shed light on long-term thinking and future opportunities. In other words, science and innovation diplomacy is at a crossroad and in the need to deepen, renew and innovate itself.

### 1.2. Why “Nordic+” countries in China?

In such a context, science and innovation diplomacy of “Nordic+” countries in China can be seen as an exceptional, but illustrative “show case”. It sheds light on both the current and the future developments of science and innovation diplomacy, in the fast-changing global science and innovation landscape. It also represents exploratory thinking and innovative practices, to bring the emerging “co-petition” in science and innovation into practice, *i.e.*, a context-adaptive and balanced approach to competing and cooperating, particularly when dealing with global and common challenges.

“Nordic+” countries, *i.e.*, Denmark, Finland, Sweden and the Netherlands are the most innovative small and open economies among the high-income economies (World Intellectual Property Organization, 2021; Sachs *et al.*, 2021). There is clear and strong domestic policy consensus that, their growth and welfare are highly dependent on the capability of their research and innovation systems to tap into and cooperate with the global research and innovation hotspots. At the same time, the most promising and strategic value-creation and impact from their research and innovation strengths are embedded in their contributions to the global sustainability transition, beyond their borders (See Table 1).

**Table 1 “Nordic+” countries as forerunners in innovation-driven sustainability transition**

Country	Global Innovation Index 2021 (Ranking in high-income economies)	Sustainable Development Goal (SDG) Index Scores 2021 (Ranking of progress towards 17 SDGs)
Denmark	9	3
Finland	7	1
The Netherlands	6	11
Sweden	2	2

With strategic mind-sets and high ambitions, the “Nordic+” countries have over the past years carried out experimentation and “learning-by-doing” in complex and challenging policy and market environments, such as China, to address global and strategic policy agendas, such as sustainability transition.

At the same time, given China’s increasingly important and strategic role, both in a more competitive and complex global research and innovation landscape as well as for the global sustainability transition, the experiences and practices from the “Nordic+” countries are of both policy relevance and empirical importance. They serve as important departure points, for identifying the most strategic policy issues and creating implementational best practices of the future science and innovation diplomacy and for an accelerated global sustainability transition.

### 1.3. Objectives, key questions and contribution of this paper

The overall objective of this paper is to contribute to an experience- and evidence-based overview and analysis of “Nordic+” countries’ science and innovation diplomacy practices, focusing on their main implementation agencies/bodies in China:

- (1) Denmark: Innovation Centre Denmark (ICDK)
- (2) Finland: Business Finland (BF)
- (3) The Netherlands: Netherlands Innovation Network (NIN)
- (4) Sweden: Office of Science and Innovation (OSI)

Through country-specific experience and mutual learning, the following key questions are elaborated in the following sections of this paper:

- (1) An overview of key set-ups or changes of governance, organisation and mission of science and innovation diplomacy as well as the motivations behind the adjustments<sup>4</sup>.
- (2) Key features of the current organisation, capacity and promotion activities.
- (3) Key success factors as well as limitations observed from the current set-ups and premises.
- (4) An evidence-based, action-oriented and forward-looking “working taxonomy” of “science and innovation diplomacy” from a practitioner perspective.
- (5) Reflections regarding existing possibilities and desirable improvements for the future development.

The above questions will be discussed from a generic and a comparative perspective, so that both common and country-specific strengths and challenges can be highlighted for the purpose of experience sharing and mutual learning.

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<sup>4</sup> The overview is intentionally limited to the past 5 to 7 years to bring in relevant historical factors and to keep the focus on current development.

Departing from an action-oriented perspective and based on daily promotion practices and policy dialogues on the ground, this paper aims to contribute with some analytical and strategic insights on how to bridge the national innovation system development and science and innovation diplomatic functions abroad, which are probably the most strategic and costly investments that various national governments have made to reach out to the global innovation system. The observations and reflections in this paper can serve as concrete inputs to the future policy discussion and development, in terms of the international dimension of research and innovation policies in the “Nordic+” countries as well as the implementation practice to enhance the efficiency and impact of science and innovation diplomacy on the ground.

## **2. Science and Innovation Diplomacy - Conceptualisation through the Lens of Diplomatic Practices**

Instead of an integrated concept of “science and innovation diplomacy”, the current academic literature and policy papers have so far, focused on two separate concepts, namely science diplomacy and innovation diplomacy.

On the one hand, “science diplomacy” is consistently defined in the academic literature and policy reports, as activities that “enable international scientific research partnerships and influence foreign policies with scientific evidence and advice” and “address common problems and build constructive international partnerships, “ranging from competition to collaboration” (Melchor, 2020; Aukes, 2020; Bound, 2017).

“Innovation diplomacy” is, on the other hand, still a new and exploratory concept. It is generally perceived as publicly funded supporting activities and practices of bridging distance and other divides (cultural, socioeconomic, technological, etc.) with targeted initiatives to connect ideas and solutions with markets and investors, more specifically (Leijten, 2017; Bound, 2017):

(1) Exert soft power and influence through the attractiveness (to talent, ideas, and investment) of a nation, region, or cluster as an innovation hub.

(2) Develop early-stage international pre-commercial and commercial partnerships between businesses, or between businesses and universities, that sow the seeds for future national economic growth and competitiveness.

(3) Create the framework conditions (such as intellectual property regimes, trade conditions, funding schemes, and information about opportunities and barriers) for regional and global innovation partnerships to flourish.

(4) Encourage and enable collaborations between public, private, and non-governmental actors to address global grand challenges.

From the lens of diplomatic practices, science diplomacy and innovation diplomacy are no longer two separate domains. Or put differently, innovation diplomacy is much more than a continuation of science diplomacy into a more commercial arena. Instead, they are increasingly integrated elements in diplomats’ operational practices. This can be explained by both institutional factors as well as the changing nature of science and innovation development. For instance:

(1) Research policy and innovation policy as well as strategic business development are becoming two increasingly integrated elements in the national policy development process. At the same time, the business sectors (including multinational corporates, start-ups and scale-ups) in the innovation-advanced countries are putting an increasingly strong focus on the role played by “strategic research” in their

competitiveness development. Against this background, the degree, to which an integrated science and innovation diplomacy can be elaborated and implemented, will be a new competitive edge of diplomatic practices.

(2) From the perspective of international business development and internationalisation of research and development on the ground, corporates use and depend on research and innovation to acquire market access and adapt to regulatory frameworks. At the same time, they have also started to scout foreign innovation ecosystems to potentially acquire technological knowledge and know-how. In such a context, the publicly funded researchers and their international cooperation play a key role, where science and innovation diplomacy is becoming an important bridge and facilitator for industry-academia partnerships in foreign markets.

(3) When looking at the development in the emerging markets with high ambitions of “catch-up” and “leapfrog”, a fundamental shift is the emphasis attached to basic research for more advanced and strategic innovation development. Ambitious strategies are being developed and deep structural and institutional changes are under way, which have become key priorities for the diplomatic circle to follow, understand and communicate.

Going hand-in-hand with this more integrated approach, an increasingly interactive and mutually supportive relationship is emerging between science and innovation diplomacy on the ground and national policy development in home countries. Beyond implementing various diplomatic practices and tools in foreign countries, the knowledge, insights and networks achieved through science and innovation diplomacy are becoming sources of inspiration and support in the domestic policy development process.

### **3. An Overview of the Science and Innovation Diplomacy by “Nordic+” Countries in China - What Is in Common and What Differs?**

#### *3.1. Governance, organisation and mission*

All the four “Nordic+” countries have been pioneers or “early-movers” among, for instance, EU Member States when it comes to a clear focus on and dedicated sources for science and innovation in their bilateral cooperation with China. Finland and the Netherlands have a wider coverage with multiple offices beyond only Beijing or Shanghai. Another common feature among these four countries is that their science and innovation diplomatic organisations in China are an integrated part of their networks of global innovation hotspots, covering countries outside Europe, such as the USA, Brazil, Japan, South Korea and India.

Since the establishment in the early 2000’s, all the “Nordic+” science and innovation diplomatic organisations have experienced various changes in terms of institutional set-ups and governance structure. In addition, these science and innovation diplomatic organisations have also, to various degrees, developed their links and cooperation with other functions within the diplomatic missions such as trade and investment promotion, higher education and culture. From the current organisation and governance (see Table 2), both similarities and differences can be observed:

(1) Science and innovation diplomacy has become an integral element of developing the international dimension of domestic research and innovation policies as well as an important tool for enhancing competitiveness of domestic industries and enterprises.

(2) With such as a comprehensive scope of development needs, Denmark, Finland and the Netherlands put a clear focus on the role that research and innovation can play to promote business

development and international trade and investment. For Sweden, underlying the comprehensive inter-governmental governance structure, the focus is to address the cross-cutting nature of research and innovation policies, which requires enhanced coordination and interactions among different policy fields in cooperation with China.

(3) When it comes to the operational capacity, Denmark and the Netherlands have increased their local capacity significantly, represented by both Chinese and Danish/Dutch nationals. This is also a remarkable feature, among all foreign diplomatic missions in China.

**Table 2 Organisation and governance - an overview**

Organisation	Home ministry/ Government agency	Office in China /Globally	No. of staff for science and innovation diplomacy in China
Denmark ICDK	Ministry of Foreign Affairs Dept. Trade and global sustainability Ministry of Higher Education & Science Danish Agency for Higher Education & Science	Shanghai/ 1 of 7 offices globally	2 diplomats 8 local advisors
Finland BF	Ministry of Economic Affairs and the Employment Dept. Innovation & Enterprise Financing Ministry of Education and Culture	Shanghai, Beijing, Guangzhou, Taipei/ 4 of 40 offices globally	2 diplomats <sup>5</sup> 1 local advisor
Netherlands NIN	Ministry of Economic Affairs Netherlands Enterprise Agency	Beijing, Shanghai, Guangzhou/ 3 of 23 offices globally	1 diplomat 8 local advisors
Sweden OSI	Ministry of Enterprise & Innovation Secretariate for EU and International Affairs Ministry of Education & Research Research Policy Ministry of the Environment Dept. of Climate Ministry of Infrastructure Dept. of Energy Ministry of Foreign Affairs	Beijing/ 1 of 7 offices globally	1 diplomat 2 local advisors

A closer look at the specific missions and targeted groups (see Table 3), the science and innovation diplomacy of the “Nordic+” countries have common focus on the following aspects:

(1) The engagement of a broad range of stakeholders and outreach towards research and innovation ecosystems of excellence and competitiveness on both sides.

(2) Both national competitiveness enhancement and joint efforts targeting global challenges of common interests and needs for co-innovation and co-creation.

On the other hand, the scope and the depth of support and services delivered by the “Nordic+” research and innovation diplomatic organisations differ significantly, reflecting the differences in organisational set-up, operational priorities and delivering capacity.

<sup>5</sup> In addition to one Business-oriented Finland diplomat under the Ministry of Economic Affairs and the Employment, there is another senior specialist in and counsellor for education and science, as sent-out from the Ministry of Education and Culture based at Finland’s Embassy in Beijing. For the innovation work on the company side, there is only one diplomat in China.

**Table 3 Mission and target groups – an overview**

Organisation	Mission statement	Target groups
Denmark ICDK	Elevate Danish science and innovation through collaboration with world-leading innovation ecosystems by: <ul style="list-style-type: none"> <li>● Connecting with international partners and decision makers.</li> <li>● Bringing home knowledge and partnerships to turn ideas into sustainable solutions and products.</li> </ul>	Research institutions, SMEs, start-ups, innovation networks and organisations, public authorities
Finland BF	Pave the way for new business in China for Finnish companies and at the same time added value for Chinese customers and partners, through: <ul style="list-style-type: none"> <li>● Advising, coaching and networking, e.g., market insights, matchmaking and door-opening.</li> <li>● SME support (see Table 6 below).</li> <li>● Funding through joint innovation calls and Market Access Program (MAP).</li> </ul>	Industrial and academic stakeholders, with a particularly strong focus on innovative SMEs and ecosystemic approach.
Netherlands NIN	Improve the innovation capabilities of the Netherlands by linking global and Dutch innovation networks. Support the implementation of the government of the Netherlands international knowledge and innovation agenda. Address national and global challenges and further develop key enabling technologies through international cooperation.	Companies, research institutes and public authorities in the fields of innovation, technology and science.
Sweden OSI	Long-term and strategic promotion of Swedish innovation, research and higher education in areas of importance for Sweden: <ul style="list-style-type: none"> <li>● Strengthen Sweden's global connections to strategic science, innovation and higher education environments.</li> <li>● Promote Sweden as a leading knowledge nation.</li> <li>● Attract international investments, skills and human capital.</li> <li>● Increase the international impact of Swedish science, innovation and higher education.</li> </ul>	Companies, research institutes and public authorities in the fields of science and innovation.

### 3.2. Formalised cooperation agreements and policy dialogues

For all the “Nordic+” countries, the formalised government-to-government policy processes and cooperation in science and innovation with China are carried out through Memoranda of Understanding (MoU) or cooperation agreements with Chinese ministries and funding agencies (see Table 4):

(1) Ministry of Science and Technology of China (MoST): responsible for the development of science and innovation policy development as well as providing funding for national and strategic research and innovation programmes, including international cooperation programmes.

(2) National Natural Science Foundation of China (NSFC): China's major funding agency for basic research.

In addition, both Finland (through the Academy of Finland) and the Netherlands have established cooperation with the Chinese Academy of Sciences (CAS) and the Chinese Academy of Social Sciences (CASS) to diversify their cooperation portfolios and to take advantage of the strong local research networks that CAS and CASS have in China. Denmark has established the Sino-Danish Center for Education and Research as a partnership between CAS, the University of Chinese Academy of Sciences (UCAS) and eight Danish universities. Beyond the government-to-government agreements at the national level, Finland is the first European country to develop formalised cooperation agreements in science and innovation with regional and local governments in one of China's most developed regions, the Yangtze River Delta region. Having such a comprehensive cooperation framework, Business

Finland and the Academy of Finland collaborate in order to identify and implement mutually beneficial initiatives by connecting industrial and academic stakeholders. From the experience of Finnish actors, the joint innovation calls underneath these formalised MoUs, particularly at the national level with MoST, have gained an increasing traction among the Finnish enterprises, as both quality assurance of cooperation projects and an important channel to reach strategic Chinese partners.

At the operational level, Business Finland in Shanghai, Innovation Centre Denmark Shanghai and OSI of Sweden in Beijing are taking an active role in supporting and facilitating their home ministries' formal dialogues with MoST and NSFC. For the Netherlands, the ministries and involved funding agencies manage the dialogues and cooperation, directly from the capital city.

**Table 4 (Selected) Bilateral agreements for science and innovation cooperation with China**

Country	Description
Denmark	Danish Ministry of Higher Education and Science - MoST MoU as an operative framework for scientific collaborations. Danish Innovation Foundation-MoST agreement for joint innovation calls.
Finland	Business Finland-MoST MoU as an operative framework for the collaboration, including annual joint innovation calls. Academy of Finland's MoU with NSFC, CAS and CASS on basic research. Business Finland's MoU with municipality-level and regional-level governments, including annual joint innovation calls, in the Yangtze River Delta region, including Shanghai, Jiangsu and Zhejiang. China-Finland Joint Action Plan (2019-2023) on Promoting the Future-oriented New-type Cooperative Partnership.
Netherlands	Dutch Ministry of Economic Affairs & Climate Policy (EZK) - MoST MoU on innovation cooperation, which is up for renewal in 2022 and MoU with Shanghai S&T Commission. Dutch Ministry of Science Education and Culture cooperation with MoST, CAS, CASS and Ministry of Education (MoE) Netherlands Funding Agency's cooperation with CASS, CAS and NSFC in science and innovation.
Sweden	Sweden's Innovation Agency (Vinnova)- MoST agreement for joint calls (until 2020). Swedish Research Council's and Swedish Foundation for International Cooperation in Research and Higher Education's cooperation with NSFC on basic research and researcher mobility. Swedish Energy Agency's joint calls with NSFC through JPI Urban Europe, together with other EU Member States.

As a complement and more importantly, as implementational tools, science and innovation dialogues with China, either policy-focused or business-oriented, have been carried out by the "Nordic+" countries (see Table 5). For instance, such dialogues have been carried out between Danish and Chinese universities in the framework of Denmark's flagship cooperation instrument with China, Sino-Danish Centre for Education and Research. Supported by the comprehensive and multi-level government-to-government as well as business cooperation frameworks, Finland has been the most active country among the "Nordic+" countries, aiming to utilise science, innovation and business dialogues. The dialogues are carried out as an integrated business promotion at both national and local levels, to address overarching issues related to business and market environment as well as sector-



specific opportunities and barriers for bilateral cooperation on innovation-driven businesses, supported by relevant science and technology angles.

Nevertheless, not all the cooperation agreements have been as active or fully utilised as anticipated. The potential of using these formalised government-to-government agreements for more systematic and in-depth policy dialogues is still largely underutilised and needs to be further developed.

**Table 5 (Selected) Science and innovation dialogues at different levels with China**

Country	Description
Denmark	Ministry of Higher Education & Science-MoST dialog on cooperation including innovation but focusing more on science and education. Bilateral innovation dialogues between universities, esp. related to the Sino-Danish Centre for Education and Research in Beijing, Huairou. City level cooperation addresses innovation, e.g. Central Region Denmark and Shanghai.
Finland	Bi-annual dialogue at Vice Minister level (Joint Committee Meeting) under the Agreement on Scientific and Technological Cooperation, since 1986. Led by the Ministry of Economic Affairs and the Employment, with the Ministry of Education and Culture, Business Finland, Academy of Finland and other key stakeholders as participants from the Finnish side. Annual meetings of China-Finland Committee for Innovative Business Cooperation: company-led forum with 4 sector-specific WGs, since 2017, involving high-level participation from ministries and sectoral representatives in energy, forestry industry, maritime logistics and cleantech. Due to pandemics and related travel restrictions, only Chairmen-level WG discussions and limited hybrid events have taken place since 2020. Sector specific Working Groups between Finnish Ministry of Economic Affairs and Employment and National Energy Administration (NEA) of China. Cities and business hubs dialogues, supported by Business Finland's cooperation with different provinces, especially with Shanghai, Jiangsu and Zhejiang.
Netherlands	Ongoing discussions between EZK and MOST to open high-level innovation policy dialogues.
Sweden	Bi-annual Joint Committee Meeting between Ministry of Education and Research and MoST, with participation of the Ministry of Enterprises and Innovation and other key stakeholders from the Swedish research and innovation ecosystem.

### 3.3. Promotion of innovative small- and medium-sized enterprises (SMEs)

All the "Nordic+" countries have a high ambition and rather long history of promoting innovative SMEs in China. Finland has been the true pioneer and set up its "FinChi Innovation Center" in Shanghai already in 2005 (more details in Section 4.2). Beyond the "conventional trade council" consulting services, the "Nordic+" countries have been experimenting with new approaches to better meet the needs of innovative SMEs in such a complex and demanding market as China (see Table 6 below). What they commonly want to achieve and improve is highlighted below:

(1) Deeper insights and more targeted market and sector knowledge, supported by the monitoring and networking of science and innovation diplomacy on the ground and through closer integration between innovation promotion and business promotion.

(2) Instead of one-off study trips and matchmaking events, more efforts and stronger focus on continuous exchanges, long-term partnership and deeper engagement in research and innovation ecosystems on both sides, including knowledge institutes and universities.

(3) Capacity-building and trust-building for the innovation ecosystems on both sides, with focus on incubators and science parks, *i.e.*, not only targeting directly towards individual companies.

**Table 6 (Selected) support for innovative start-ups and SMEs**

Country	Description
Denmark ICDK	<p>Support Danish companies and higher education institutions in exploring opportunities for activities in China, through:</p> <ul style="list-style-type: none"> <li>● Scouting for disruptive technologies, innovative business models and growth opportunities in key sectors, such as ICT, Fintech, EDtech, healthcare, cleantech etc.</li> <li>● Innovation Sparring: 15 hours of free innovation sparring for counselling about opportunities on a specific market.</li> <li>● Innovation Camps: a government subsidized program designed for a group of companies around a certain topic. Typically runs for 4-5 days in a local market with tailor-made contents.</li> <li>● SDG Landing Pad (a pilot from January 2022 to June 2023): a programme funded by a private foundation to support companies in finding SDG challenges.</li> </ul>
Finland BF	<p>Innovation, project and funding advising and coaching services, such as:</p> <ul style="list-style-type: none"> <li>● Advising and coaching (or sparring) for new opportunities and concrete projects.</li> <li>● Funding for market entry and innovation projects.</li> <li>● Matchmaking events for joint innovation calls and innovation-driven collaboration with Chinese companies.</li> <li>● Market Access Programs (MAPs) for SMEs with Tsinghua University and Fudan University .</li> <li>● Soft landing platform and services: FinChi centre and accelerator programs in cooperation with local innovation ecosystems.</li> <li>● Collaboration with export promotion and invest in teams to discuss the growth paths of the companies from the perspective of complete portfolio of Business Finland services, including supporting them with exhibition participation in order to market innovative products/solutions and getting investors to enable their growth.</li> </ul>
Netherlands NIN	<p>Provide information services and introduction to companies and entrepreneurs on “How to do business in China”, market scan and knowledge of specific sectors.</p> <p>Support for participation in start-up fairs or industry exhibitions in China Innovation missions on specific themes and individual support upon request.</p> <p>Partners in international business instrument designed to support a group of SMEs entering a foreign market together, including knowledge institutes.</p> <p>Subsidy schemes for demonstration projects, feasibility studies and investment preparation projects.</p>
Sweden OSI	<p>Support to start-ups and SMEs through tailor-made study trips.</p> <p>Support to science parks and incubators through collaboration with the key organisations in the Swedish innovation ecosystem.</p>

### 3.4. Science and innovation diplomacy in the new policy contexts and faced by new uncertainties

The Chinese market is becoming highly dynamic and competitive with both great potential and challenges for innovation development and cooperation. At the same time, the increasing complexities in the market and policy environments in China as well as in the global geopolitical landscape are making science and innovation diplomacy more challenging and more strategically important. As small and open economies with strong research and innovation capacity and performance, the “Nordic+” countries have an unusually strong leverage when navigating in such a complex landscape. To be able to utilise the leverage in international research and innovation cooperation, with balance, effectiveness and impact, it requires long-term, strategic and coherent policy orientation and re-orientation. In this context, the specific national strategies and policy papers to address the overall relation with China from the “Nordic+” countries, such as Finland, the Netherlands and Sweden will have significant implications for their current and future cooperation in the fields of research and innovation (see Table 7).

**Table 7 National research and innovation strategies/policies addressing China**

Country	Description
Denmark	No specific innovation strategy addressing China
Finland	Finland's Governmental Action Plan on China (2021) Recommendations for academic cooperation with China (2021)
Netherlands	The Netherlands & China: a new balance (2019)
Sweden	Approach to matters relating to China (2019)

The common departing points in these strategies or policy papers are the recognition of China's role as an emerging economic superpower and science and innovation powerhouse and having "EU-China – A strategic outlook" (European Commission, 2019) as a key reference point. They aim to outline a constructive-critical position towards China cooperation, where systemic and value-based differences and underlying conflicts of ideologies and interests are addressed.

The fundamental and common standing point in these strategies and policy papers is a balanced approach to the China relation and cooperation, *i.e.*, a clear awareness of risks and barriers as well as a clear message on the needs and benefits, particularly when it comes to shared and global challenges.

When it comes to cooperation in the fields of science, technology and innovation and in addition to the persisting problems associated with undesirable technology transfers, lack of IPR protection and leveled playing field for foreign businesses, the following aspects are commonly highlighted as new challenges or risk factors:

(1) While data-driven research and innovation are becoming increasingly attractive and important in China cooperation, particularly in the context of China's rapid digital transformation, data-sharing and data governance, especially in international cooperation and cross-border co-innovation are issues of great regulatory uncertainties and market risks.

(2) Security-related issues, such as cybersecurity, military-civil fusion and dual-use of research and technologies as well as ethical and value-based considerations will call for more attention and caution in the future international research and innovation cooperation, including with China.

When it comes to practical research and innovation, the principles of openness, fairness and reciprocity to ensure mutual benefits from China cooperation and to increase access to the Chinese market are more emphasised than ever. At the same time, the "Nordic+" countries are generally inclined to a rather pragmatic approach of "cooperate whenever possible, protect whenever necessary". In the case of Finland, the Governmental Action Plan on China proposed a more proactive approach to "build partnerships and promote the transfer of technological expertise from China to Finland, especially in areas where China is a pioneer" (Ministry for Foreign Affairs of Finland, 2021).

#### 4. Country-specific Highlights – Why and How?

Having provided an overview of the policy contexts for and the operational practices of science and innovation diplomacy of the "Nordic+" countries, some country-specific highlights are presented in this section focusing on the following aspects:

(1) The unique platforms, methods and practices that have been developed to illustrate key success

factors in the past as well as strategic thinking for the future.

(2) Differentiated approaches and different priorities for individual “Nordic+” countries to shed light on complementary strengths as well as needs for and benefits from closer exchange and cooperation in the future.

#### *4.1. Innovation Centre Denmark (ICDK) Shanghai – a process-facilitator to make innovation cooperation happen*

ICDK Shanghai was established in 2007 as an independent diplomatic mission<sup>6</sup>. It was the second Innovation Centre Denmark after the mission in Silicon Valley had been established in 2006. In 2016 it became co-located at the Consulate General and they have since operated as one mission. Green Transition, Life Science and Digitalization are defined as the three main areas of expertise of ICDK. Depending on local market potentials as well as the strengths of local ecosystems for research and innovation, ICDK Shanghai has the flexibility of identifying and developing China-specific initiatives for research and innovation cooperation. Beyond the conventional “trade council” approach, ICDK Shanghai aims to, and has managed to, create a hybrid/dual structure of its operation. The commercial promotion and research and innovation promotion co-exist as two separate functions in the organisation but play a complementary and mutually supporting role for each other. More specifically:

(1) It opens up new opportunities for the Danish research communities and higher education, particularly through broader and deeper interaction with both the Danish and the local business communities in China.

(2) It opens up new engagement channels and builds up deeper knowledge for the Danish business community in China, through policy-research dialogues that Danish researchers can establish through their cooperation and dialogues with the Chinese research and policy communities.

In the daily operation, ICDK Shanghai, as a process-facilitator, is applying a combined “interest-driven” and “challenge-driven” approach and playing a bridging role between the ecosystems on the Danish and the Chinese sides to create “two-way” cooperation (see Box 1 for concrete examples in appendix). This is the key to ensuring a continuous and long-term exchange and network-building and to moving from interest only to collaborative actions, instead of one-off new events and initiatives.

In such processes, several highly flexible funding schemes are instrumental for both continuity and flexibility, including:

(1) “In-house” grants at ICDK Shanghai: The innovation attaché has a fixed, yearly grant of 200.000 DKK for network activities, without need for any application processes.

(2) Global Innovation Network Programme (GINP): For establishing networks, alliances and platforms with international partners, where the applicant must be an organisational unit rather than an individual researcher or entrepreneur.

When it comes to country-specific initiatives, the Sino-Danish Center for Education and Research (SDC) is a unique platform for an integrated higher education – innovation promotion, for ICDK Shanghai and for Denmark’s promotion activities as a whole. It is a partnership between all eight Danish universities, the Ministry of Science, Innovation and Higher Education, the University of Chinese Academy of Sciences (UCAS), and the Chinese Academy of Sciences (CAS). The overall aim of SDC is to promote and strengthen collaboration between Danish and Chinese research and education environments for the

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<sup>6</sup>The other ICDK are located in Bangalore, Seoul, Tel Aviv, Boston and Munich, with Copenhagen as headquarter. For more information see, e.g. <https://icdk.dk/>.

benefit of both countries. Before the Covid-19 outbreak, about 150 researchers from Danish universities came to SDC every year to carry out teaching activities at the master-level. The education programmes at SDC have a clear multidisciplinary profile and put a strong focus on interactions between higher education and business communities. SDC has not only been a strong driver for both student and faculty mobility but has also generated a dynamic flow of ideas and exchange between the Danish research community and the Danish business community in China. SDC has even financed a “secondment” to be based at ICDK Shanghai to further strengthen the engagement of the higher education sector in innovation promotion on the ground. The SDC-affiliated researchers have also been engaged in various official events at the Danish diplomatic missions, where both the government officials and the Danish business community are represented.

The Danish industry, particularly in sectors of energy, pharmaceuticals and food, is well-integrated into the Danish university system. They are also the most active business community in the Chinese market. This innovative way of engaging broader stakeholders, particularly policymakers, in these policy-driven and regulation-intensive sectors is of great importance and value. The researchers became a strategic “door-opener” with their deep knowledge insights and the latest research results, for the business and competitiveness development of Danish companies. In the current Covid-stricken circumstances, this type of mobility-dependent platform and initiative, has unfortunately turned out to be vulnerable. The mobility restrictions have seriously hampered the impact of these types of activities. It is also more apparent than ever that, in order to move from interest to collaboration, mobility, exchange and trust-building are not only desirable, but simply necessary.

#### *4.2. Business Finland (BF) – business-driven innovation collaboration for bridging current business with future opportunities*

Finland has a long history and rich experience of science and innovation cooperation with China. FinChi Innovation Center in Zhangjiang High-Tech Park (Free-Trade Zone) of Shanghai Pudong New District has been a pioneer in exploring business-driven innovation collaboration, having innovative SMEs as a key target group. The Center was established by the Finnish Ministry of Trade and Industry in 2005 (the current Ministry of Economic Affairs and Employment) and it is now also a Licensed Innovative Incubator by Pudong New District and Shanghai Government. The Center provides a soft-landing platform and related services for Finnish companies who want to test their business and innovation approach in China. For instance, companies can operate under FinChi business license up to 2-4 years for screening and learning the Chinese market without registering their own company. Over more than 15 years, around 150 Finnish companies have been in FinChi and over 70% of them have successfully landed in China. The Center, as a trusted environment and service provider, has supported and enabled Finnish companies to focus on their core business and innovation development in a new and complex market environment. Given increasingly mature local and regional innovation ecosystems in China, the Center sees a greater potential for providing a broader range of support and services through its trusted networks with local and international stakeholders and partners in China.

Another distinctive feature of Finland’s innovation promotion is the special organisational structure of BF. In 2018 Tekes, the national innovation funding agency and Finpro, the national export promotion were merged into one organisation as BF. Today, BF, under the Ministry of Economic Affairs and the Employment, is responsible for the business-driven and industrial collaboration, while the Academy of Finland, under the Ministry of Education and Culture, is responsible for the basic research collaboration.

Underlying this profound transformation, there were high ambitions and strong commitments to make innovation and business promotion more integrated and mutually supportive. With its new and comprehensive organisation, BF China is providing a broad portfolio of services and support to Finnish companies, *i.e.* from advice and networks, market access programmes and soft landing to innovation funding schemes. From BF's continuous experimenting and trial-and-error learning in the past years, some strategic insights, which are both China-specific and generic in nature, can be summarised as below:

(1) The balance between short-run business activities and the long-term innovation capacity development and network building is one of the key success factors for an integrated approach to business-driven innovation collaboration.

(2) When evaluating outcome or success of business-driven innovation collaboration, a one-size-fits-all measure or criteria, such as future export performance is necessary, but not sufficient. A broader and long-term perspective to reward and incentivise collaboration for creating enabling solutions, platform-building as well as for improving framework conditions, such as standardisation and regulatory issues, needs to be further elaborated. This is particularly relevant for co-innovation projects, involving research institutions and academic partners.

(3) Given increased knowledge-intensity in innovation development as well as the need for deepened science-business collaboration, new collaborative models as well as new funding schemes need to be considered for engaging research institutions and higher education into BF's business-driven innovation collaboration.

Departing from these strategic insights as well as with the ambition of enhancing the integrated approach to the next level, a new model of innovation promotion has been introduced in the operation of BF China, *i.e.* through export-innovation-foresight collaboration. In this context, innovation promotion plays a bridging role between "hand-to-mouth" business activities and future analysis, *e.g.* through industry-specific foresights (see Figure 1). It implies that innovation promotion is now embedded in an integrated understanding of both current business and future opportunities for Finnish companies interested in the Chinese market. Accordingly, innovation promotion activities and funding schemes are used to guide their current business development, including identifying future market demands.



Fig. 1 Export-Innovation-Foresight collaboration

Source: BF China, Shanghai office

This new operational model drives and transforms the mindsets of both BF personnel and Finnish companies towards an even higher ambition with a future-oriented perspective in business and innovation development. It has also a positive impact on BF's operation as a whole, moving towards more long-term and strategic planning rather than year-to-year activity-based business planning. Looking ahead, to be able to fully explore the potential of this new operational model, new funding instruments are applied or under discussion, such as:

(1) Co-innovation project: Business Finland organizes and funds from the Finnish side joint

innovation calls, where the academic partners also can join. Co-innovation projects with both industrial and academic partners build a bridge between the organizations. It is a comprehensive tool to introduce innovative Finnish companies to the Chinese counterparts. At the same time, it enables both sides to build trust leading to further business collaboration.

(2) Co-creation project, carried out by research organizations and/or universities as above, is a kind of short-term project, aiming at preparing for a co-innovation project, including both industrial and academic partners in a new area where there is no former existing collaboration, but there is at the same time innovation and business potential – in this case regarding areas relevant to the Chinese market.

(3) Co-research project (under discussion), carried out by research organisations and/or universities, with participation and co-funding from companies, as “bridging project” between basic research and applied research to introduce new technology opportunities to companies as well as scanning and scouting opportunities of commercially viable technologies that could lead to deeper cooperation between research organizations and companies.

The collaboration between BF and Academy of Finland in China, through the Trade and Innovation Consul and Education and Science Counsellor is being further developed and aims at creating collaboration platforms through a more long-term academic cooperation and paving the way for industry-academic collaboration in the next stage – and eventually business development.

To further clarify and strengthen the long-term perspective, mission-driven innovation policy and its implementation could also be important for BF China in the near future. Finland’s two missions, “Low-Carbon Future” and “Digital Native Finland” are highly relevant for China’s new “30-60 climate goals” and the digital transformation of industries.

#### *4.3. Netherlands Innovation Network (NIN) – data-driven approach to deeper insights and evidence-based analysis*

NIN has long and broad presence in China, with 3 offices in Beijing, Shanghai and Guangzhou, established during 2005-2007. While the governance structure and organisational structure have largely remained the same, the operational activities on the ground in China have been more focused on strategic support to Dutch companies. The long and well-established cooperation with China between academic research institutes and universities are partly managed by various government agencies and research funding agencies in the Netherlands. However, universities and research institutes are still an important stakeholder group for NIN, both individually and in public-private consortia. The ambition and strategic direction of NIN-China’s operation in the past years have been more long-term thinking, more in-depth knowledge and more targeted networks and partnerships for innovation cooperation with China. NIN China has also a significant degree of freedom to define and develop its strategies, approaches, and activities for achieving its strategic goals and deliverables. Having a strategic mind-set as well as a highly hands-on focus, NIN China has become a pioneering example of developing and applying a demand-driven and data-driven approach to its monitoring and promotion activities. From the demand-driven perspective, NIN-China uses the Netherlands’ research and innovation policy initiatives at different levels to set up a “reference framework” to identify the priorities of and focus on cooperation with China, *i.e.* what the Netherlands wants and needs (see Figure 2).

NIN China has developed a methodology for “mapping exercises”, using data such as scientific publications, patent applications and public funding for research and innovation to provide evidence-based analysis and to support priority-setting. The inspiration came from the mapping practice by Erasmus University Medical Center, who has used scientific publication data for determining their

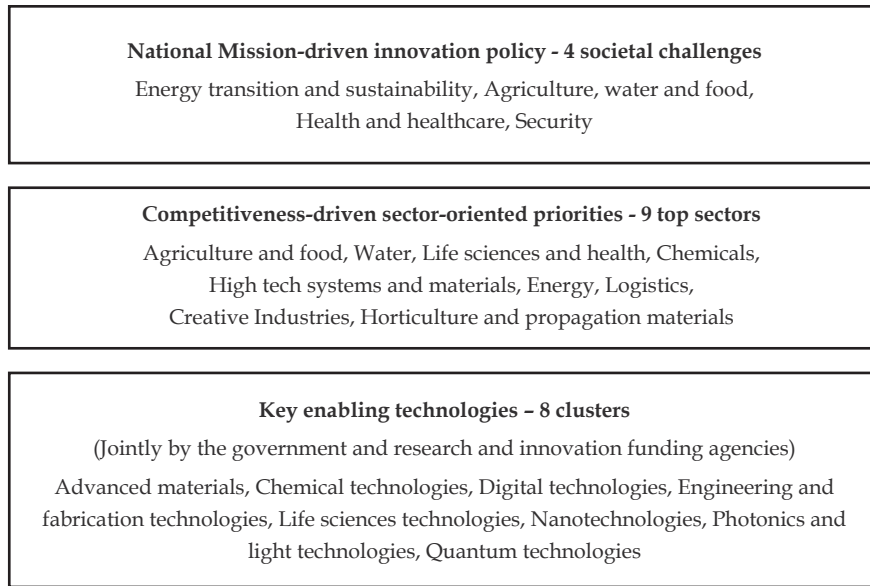
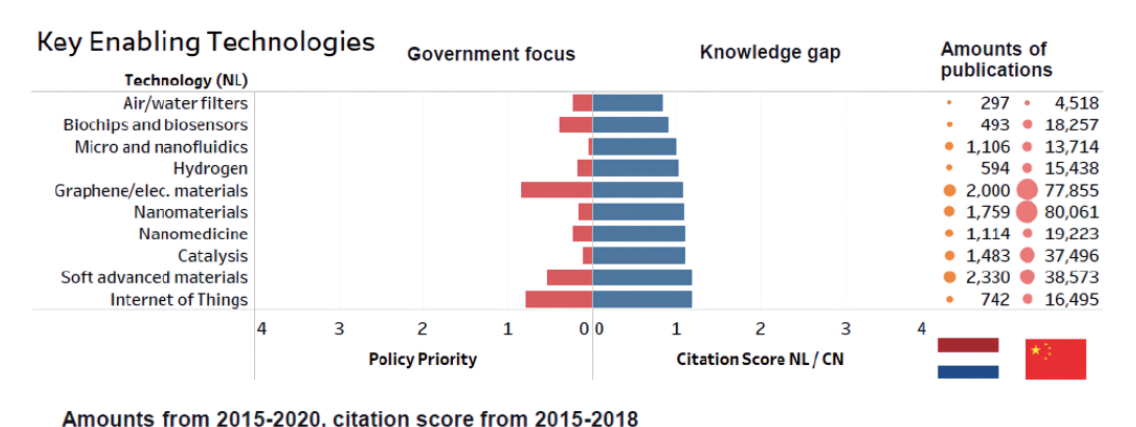


Fig. 2 Reference framework for priority-setting in China cooperation

collaboration strategy and for reaching out to envisioned partners. In the past years, NIN China has gradually and organically integrated this data-driven mapping exercise into its science and innovation diplomacy for providing strategic insights and advice to stakeholders in the public sector and universities in the Netherlands, who are interested and/or engaged in China cooperation.

For instance, the mapping exercise has been applied to a comparative analysis of priorities in China’s 13th Five-Year Plan (FYP) and the priorities of the Netherlands (see Figure 3). In this mapping, four societal challenges and eight clusters of key enabling technologies were further subdivided into sub-technologies. For each sub technology a “policy priority score” was assigned based on how it is addressed in the 13th FYP. Combining this with scientific publication and patent data, it is possible to identify the technologies where China and the Netherlands have a similar level of priority as well as where China had a higher policy priority, or verse vice. For example, the Netherlands and China have a similar scientific impact in graphene and electronic materials, an area that also has a high priority in China’s 13th FYP.



Amounts from 2015-2020, citation score from 2015-2018

Fig. 3 Comparative analysis of scientific impacts and policy priorities: China- the Netherlands

Source: NIN China, Shanghai Office



As another example, in the mapping of next generation semiconductor industries<sup>7</sup>, it is possible to identify emerging trends in the Chinese innovation ecosystem by counting keyword occurrences in scientific publications and patents. It turned, for example, out that the interface between semiconductor design and AI is one of the fastest developing areas in the Chinese semiconductor industry (see Figure 4).

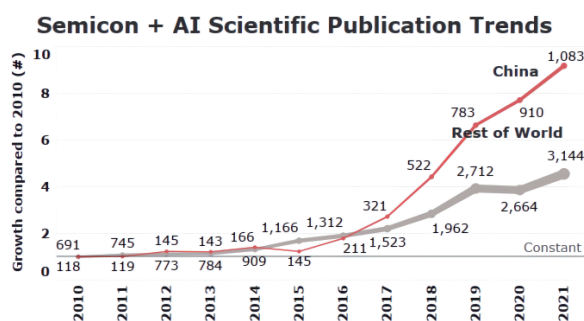


Fig. 4 Sectoral mapping example – next-generation semiconductors

Through the mapping exercise, the NIN China has enhanced the efficiency and effectiveness of its science and innovation diplomacy, particularly when it comes to identifying, specifying and justifying what to focus on in China cooperation. It concretises a more nuanced picture of China's science and innovation development and a comparative perspective on China's performance in research and innovation in relation to the Netherlands and in a global context. For instance:

(1) China is leading or will be leading in some technological fields, such as batteries, nanomaterials, biosensors and environmental technologies (water and air filters).

(2) China has the biggest knowledge gap with the Dutch innovation system in areas such as semiconductors, marine technology, and neurology.

(3) The Netherlands and China are already scientifically collaborating a lot on climate and circular economy, but not so much on health and smart manufacturing.

(4) Compared to the US or the UK, the Netherlands has significantly less scientific collaboration with China.

Departing from the insights gained from mapping exercises, such as key actors and comparative strengths in specific sectors, NIN China carries out validation on the ground from both the Dutch and the Chinese sides and thereafter designs targeted actions and activities for knowledge exchange and network- and partnership building between Dutch and Chinese organisations and actors. Based on mappings, NIN China has also begun to look more towards initiating collaboration in areas where the Netherlands is not necessarily ahead of China.

Such a data-driven approach is, however, highly skill- and resource intensive, which impose an apparent limitation or challenge to most foreign missions in China, despite the significant interest in it. For both best-practice sharing as well as to enhance the capacity and mobilising more resources, NIN China is leading an informal working group, organised and financed by the EU-delegation in China to enlarge the scope of the mapping excises, through joint efforts with other EU Member States.

#### 4.4. Office of Science and Innovation (OSI) of Sweden – policy intelligence as a knowledge basis for co-innovation and co-creation

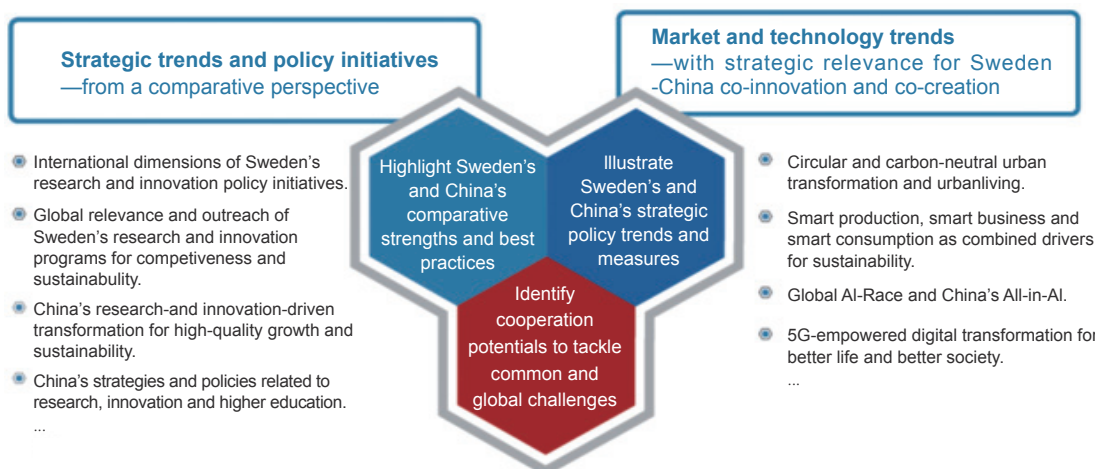
<sup>7</sup> More information on this mapping will be published by NIN China, Shanghai Office in September 2022.

Sweden has a long history of having science, technology and innovation as focus in exchange and cooperation with China. Compared to the other “Nordic+” countries, the difference is the more analytical nature of Sweden’s science and innovation diplomacy, as a result of a different institutional set-up in the past decades. Until 2017 independent government agencies<sup>8</sup>, who had their representative offices in Beijing, conducted monitoring and analytical tasks for the Swedish government offices and other stakeholders and organisations in the Swedish research and innovation ecosystem. The bilateral cooperation at the operational level with China in basic research and innovation, such as jointly funded research and innovation programmes, was handled directly from Sweden by the research and innovation funding agencies. As a major institutional reform, the function of science and innovation diplomacy was moved to the government offices under the Ministry of Enterprise and Innovation and co-financed and co-governed by the Ministry of Education and Research, the Ministry of the Environment and the Ministry of Infrastructure and in close cooperation with the Ministry of Foreign Affairs. The underlying motivation as well as anticipated strategic strengths of this cross-departmental governance structure can be summarised as follows:

(1) Recognising the increasingly strong cross-cutting nature of research and innovation policies, the coordination and cooperation among different ministries will serve as an efficient support for Sweden’s OSI abroad<sup>9</sup>.

(2) Both sustainability transformation and digital transformation have become increasingly strong drivers for research and innovation. By engaging the Ministries in charge of the policy processes in these fields, the international dimension of research and innovation policies can be addressed more in-depth through an integrated approach.

From a strategic and analytical viewpoint, one of the key ambitions of Sweden’s OSI abroad is to integrate qualified inputs, in terms of key policy, technology and market trends in the global innovation hotspots into the domestic policy development process. In the case of China, the Swedish government offices’ position paper on “Approach to matters relating to China” provides the overall policy guideline for OSI Beijing’s operation. To be able to develop a solid knowledge base and in-depth analysis of the development in China as well as to put the key observations and conclusions into a comparative context, OSI Beijing has developed an analytical framework, with specific thematic priorities for its daily monitoring and analysis (see Figure 5).



**Fig. 5 The analytical framework and thematic priorities for monitoring and analysis**

Source: OSI Beijing

<sup>8</sup> The latest two since the earlier 2000’s were the Institute for Growth Policy Studies (IIPS) and the Growth Analysis.

<sup>9</sup> Sweden has 7 OSI abroad: London, Beijing, New Deli, Tokyo, Seoul, Braila, and Washington DC.

Departing from the above analytical framework as well as through a close dialogue with the home Ministries and key stakeholders engaged in the research and innovation policy development, OSI Beijing has in the past four years provided substantial inputs into the policy development process, with a particular focus on cross-sectoral innovation development in China of strategic relevance for Sweden, such as:

(1) The policy, technology and market development in China as part of the global context for the development of Sweden's Innovation Partnership Programmes, with focus on life science, climate transformation and digital transformation.

(2) The regulatory framework and policy development related to emerging technologies in China and their implications for diffusion and scaling-up.

(3) Policies for promoting and regulating digitalisation and digitalisation-related research and innovation in China and their implications for international cooperation.

(4) The role of digitalisation in China's energy and climate transformation.

(5) An international outlook of China's policy measures for skill and competence development for digital transformation and their implications for China's international competitiveness.

As most foreign missions in China, OSI Beijing has limited human resources for developing strategic intelligence and in-depth analysis with a sufficient scope and scale, despite the high ambition and continuous refinement of its methodology and approach. In this context, the engagement in organised and systemic joint activities in the EU diplomatic circle has played an important complementary and strengthening role. More specifically:

(1) OSI Beijing leads the informal working group of EU Science and Innovation Counsellors on sustainable urbanisation, which was supported by the EU-delegation and engaged all the "Nordic+" countries as well as other EU Member States, such as Germany and Portugal.

(2) OSI Beijing actively participated in other two informal working groups on technological innovation, led by France and on sectoral mapping, led by the Netherlands.

(3) OSI Beijing actively supported the EU-delegation's monitoring on China's 14th Five-Year-Plan, with focus on key elements of science and innovation and their implications for climate transformation and digital transformation, in both a Chinese and an international context.

The outcomes from OSI Beijing's own "in-house" monitoring and analysis as well as from the cooperation with other Nordic and EU countries have served as a substantive basis for engaging in strategic dialogues with the key stakeholders in Sweden and the Swedish business community in China. Given the relatively limited practical and operational experience of the Swedish innovation ecosystem in the Chinese market, particularly when it comes to the promotion of innovative SMEs, OSI Beijing's analytical work is a first step to fill the existing knowledge gaps as well as for initiating an informed dialogue on the future development towards a more action-oriented direction.

## 5. Concluding Remarks – Key Observations and Future Prospective

The above experience and evidence-based overview and analysis of the science and innovation diplomacy illustrate the differences in the current organisational structures and priorities among the "Nordic+" countries, as well as their shared ambitions and developmental needs for the future. Underlying their differentiated approaches, there are accumulated and important experiences in the form of "learning-by-doing" and "learning-by-experimenting" in a highly complex policy and operational environment, such as China, even though both human and financial resources have been limited. Against this backdrop, the experience and

the achievement of the “Nordic+” countries represent valuable insights and creative ideas that are not only specifically useful for the ongoing and future China cooperation, but also for the development of science and innovation diplomacy, in a generic and global context. Table 8 below has reviewed the inter-governmental STI collaboration key special projects under the National Key R&D Program of China. Having this as a departure point, the new contexts, the new elements as well as a few reflections and suggestions for the future development are presented below, from the perspective of practitioners.

**Table 8 Inter-governmental STI collaboration key special projects under the National Key R&D Program of China**

Year	Research topic(s)	Cooperation model
<b>Sweden</b>		
2018	Transport safety, life science	'2+2' model – at least one research organisation and one enterprise on each side. Participating enterprises should provide funding at least equivalent to the government fund.
2019	Life science, traffic safety, applied ICT	See above
2020	Life science, traffic safety	See above
<b>Finland</b>		
2018	IoT factory, medical science, smart and flexible energy, smart transport	Chinese companies, universities and institutes as leading partners with possible consortia; 50% grants. Individual Finnish companies; 40-50% grants for research-oriented work, 50-70% loans for development and piloting-oriented work.
2019	As above.	As above.
2020	Energy, health, sustainable manufacturing, smart mobility	Chinese companies, universities and institutes as leading partners with possible consortia; 50% grants. Individual Finnish companies or co-innovation projects including (a) two or more Finnish companies or (b) at least three Finnish companies (at least two applying Business Finland funding) and one or more research organisations; 40-50% grants for research-oriented work, 50-70% loans for development and piloting-oriented work (research organisations 70% grant in co-innovation projects).
2021	Energy, health, sustainable manufacturing and industrial renewal, smart and green mobility	As above.
2022-1	Ice and snow sports technology (one-time additional call) with green sports, sports injury and rehabilitation, digital sport, and smart sports equipment	As above.
2022-2	Smart and green energy, smart and green mobility, smart and green industries, health and ageteck	As above.
<b>Denmark</b>		
2020	Solutions to the sustainable development of future cities. Priorities include energy and storage, smart cities and transport	Companies from both sides are encouraged to submit joint applications with research institutes. Participating companies should provide in-kind contribution at least equivalent to the government fund applied for. The Chinese and Danish partners should sign agreements on intellectual property rights. Project duration no more than 3 years in principle. Project should contribute to the achievements of SDG on climate change and so on.
2021	CCUS, Green fuels for transport and industry (Power-to-X, etc). Climate- and environment-friendly agriculture and food production. Circular economy with a focus on plastics and textiles.	See above

### 5.1. *The new contexts and the new landscape for science and innovation diplomacy*

Given the more strategic role played by science and innovation, neither cooperation nor competition alone, will be able to provide a complete, balanced and justified relationship between science powerhouses and innovation hotspots. While exploring the new relationship of “co-opetition”, the new contexts in a new landscape for science and innovation diplomacy need to be better articulated and understood. For instance:

(1) Science diplomacy and innovation diplomacy are more integrated on the ground than ever. It requires deeper interaction and integration of research policy and innovation policy as well as with other key sectoral policies in the home countries. This needs to be an integrated “policy framing” for promotion activities and long-term partnership and platform building with foreign countries.

(2) Risks and opportunities in cross-border research and innovation cooperation are co-existing and the difficulties and uncertainties when creating a balanced approach are greater than ever. It requires a deeper understanding of, and more (not less) policy dialogue on the rapid technology and market developments that policy-making will never be able to “catch up” with, particularly when it concerns countries/economies with different institutional and regulatory contexts.

(3) Given the changing role and enhanced competitiveness of emerging economies, particularly China, in the global research and innovation landscape, it is no longer merely about market accesses and cheaper research and development personnel. A more strategic and sophisticated approach to “scouting” in China and “sourcing” from China when it comes to research and innovation competence and skills is emerging but is still in an early stage.

(4) While recognising both necessities and benefits for research and innovation cooperation on global challenges, such as green transition and climate change, it is essential to remember that both trust-building and knowledge-building are the necessary first steps to align political commitments for such comprehensive and profound cooperation. At the same time, even cooperation on global challenges involves technical, political and market risks. Without addressing these perceived risks as well as emerging and new “transition risks”, international cooperation on research and innovation for tackling global challenges will be neither creditable, nor effective.

### 5.2. *The new elements in a “working taxonomy” of an integrated science and innovation diplomacy*

While recognising and agreeing on the key tasks and main elements of science diplomacy and innovation diplomacy in the academic literature, some new elements for an action-oriented “working taxonomy” of an integrated science and innovation diplomacy, is proposed from a practitioner perspective below:

(1) Stronger diplomacy-promotion-policy interface, where science and innovation diplomacy in foreign countries and mainstream science and innovation policy processes at home are more closely integrated.

(2) Evidence-based and knowledge-driven methodology development for an in-depth science and innovation diplomacy of greater precision and effectiveness.

(3) Mutually supportive market-readiness building and long-term partnership building, engaging higher education, research institutes and business sectors, not only for joint project implementation, but also for long-term platform building and strategic policy dialogue.

### 5.3. *A few reflections and suggestions on the future development of science and innovation diplomacy*

An integrated science and innovation diplomacy needs to be developed at different levels. Starting from the implementational level:

(1) It requires deepened understanding of how science and innovation are inter-connected with strategic and economic interests of countries and continents, such as trade and investment as well as industrial and market developments. It also calls for more informed and strategic insights into how to balance the short-term versus long-term competitiveness development as well as how to integrate the national and the global perspectives. At the operational level, new skills, new competences and not least new mindsets need to be developed for both dealing with new challenges and for exploring emerging opportunities.

(2) Innovation-focus and risks-sharing should not be diluted when innovation promotion and business promotion are integrated. Long-term strategic platform-building needs to take place in an early stage of strategic business development. In such a context, the engagement of research institutes and academic partners in the co-innovation setting is a necessary step to enable and engage companies in the platforms and ecosystems.

(3) Given greater complexities, but also emerging and new opportunities, the research- and innovation-intensive Nordic multinationals are facing a fast-changing and new reality in the global market. A deeper understanding of the policy and regulatory landscape as well as a strategic approach to engaging with the research and innovation ecosystems in different market environments are becoming two fundamental success factors for their current and future business development, for instance, in China and beyond. Against this backdrop, how publicly funded schemes and promotional instruments can be designed and used to engage the Nordic multinationals as well as to deepen bilateral and multilateral science-industry-policy collaborative efforts will be a new, but strategically important task for the future science and innovation diplomacy.

(4) The level of concretion and precision, *i.e.*, what to focus on in international cooperation on science and innovation for real impact, is becoming increasingly important. Purely experience-based priorities or largely relying on observations from the current and ongoing business operation will not be enough. More systematic methods, combining evidence-based analysis (like mapping) and future-oriented analysis (like foresights) need to be developed and institutionalised in the future science and innovation diplomacy practices.

(5) In the face of increasing awareness of risks and securitization of science and innovation policy, an integrated approach requires the development of tools and practices related to risk assessment, including ethical, economic and security risks. However, it will not suffice to identify the risks, the innovation diplomacy of the future will also need to develop skills and tools for risk prevention, management and mitigation, including due diligence practices, background checks and evaluation procedures.

When it comes to the policy level, the overall policy contexts and geopolitical development for international cooperation on science and innovation are getting increasingly complex and sensitive. It implies that science and innovation diplomacy per se as well as research- and innovation-intensive business development need to be put into an informed and strategic framing and backed up by an aligned and common position and agenda, not least among the Nordic and EU countries. In this context, EU's mission-driven innovation policy and the twin-transition, *i.e.*, the sustainability transition and digital transition open up new entry points and opportunities for the future cooperation on science and innovation with third countries, including China, both through joint efforts, led by the EU as well as among the Member States. More specifically:

(1) The mission-driven innovation approach will help to clarify the national focus of, not only

innovation, but also future-driven and system-oriented activities. It will create a more integrated and coherent policy and cooperation framework, instead of a large number of often fragmented sectoral and industrial focuses on all kinds of activities.

(2) The mission-driven innovation approach will also help to create longer timeframes and a more long-term perspective for science and innovation cooperation, which is particularly important and beneficial for innovation-driven activities. The business-driven activities have, in practice, also shortened the project-cycle for innovation-driven activities. We need a clearer mandate and favourable conditions for further developing the bridging role of innovation promotion between business development today and future opportunities.

(3) Given the common interests, but also increased competitive pressures in the fields of “twin-transition” related research and innovation, designing and implementing a constructive and innovative “co-opetition” model can provide a promising “test-bed”, where efforts to tackle the global challenges are encouraged while risks and uncertainties are addressed and managed, instead of lost opportunities and delayed transition.

To summarise, the limitation of old or existing funding and cooperation instruments and approaches for science and innovation diplomacy are more visible and apparent, while new approaches to developing more agile, targeted and impact-oriented instruments and partnerships are not mature yet. In this context, the good examples and on-going experiments of “Nordic+” countries serve as a source of inspiration for the future development of science and innovation diplomacy, both in China and beyond. The mutual learning and joint reflections presented in this paper are also a promising start for a more in-depth exchange and cooperation, both among the “Nordic+” counties as well as with their European and international partners.

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## Disclaimer

The paper is produced for the purpose of mutual learning and for stimulating the future research in the fields of research and innovation policy in a global context as well as for contributing to the development of science and innovation diplomacy. The views expressed in this paper are those of the authors and do not reflect the official policies or positions of their affiliated organisations.

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### Box 1 “Interest-driven” and “Challenge-driven” Denmark- China innovation cooperation

Blockchain Business Bridge – This project is funded by a private foundation, the Danish Industry Foundation, and is driven by an interest from Danish blockchain companies and researchers in the Chinese ecosystem. The project has been delivered over 3 years, through a series of online workshops with the same clusters of stakeholders to facilitate establishment and development of a long-term network and to continuously deepen the mutual interests for concrete cooperation.

Circular economy and food packaging with Elema – The project is based on a challenge and interest from the Chinese food delivery company, Elema, regarding minimising the amount of plastic waste generated by the food delivery industry. ICDK Shanghai has identified and gathered Danish stakeholders interested in developing solutions to the challenge.

Source: ICDK Shanghai.