CHINESE-HUNGARIAN SCIENCE KNOWLEDGE, TECHNOLOGY AND INNOVATION TRANSFER RELATIONS

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Executive Summary

There is strong competition amongst advanced economies to maintain technology leadership. In this 'war' China is performing better year-after-year and is positioned well to outperform the USA and Europe in the mid-long run by investing in domestic innovation, capacity and capability.

Diversifying Hungary's partner base in research, development and innovation, strengthening ties with China in this domain, while maintaining EU relations will allow Hungary to remain competitive, access the newest technology trends, elevate the country's negotiating power and revitalize its industries.

This document examines Chinese and Hungarian relations from the point of view of science knowledge, technology and innovation transfer with the hypothesis that relations in this field are limited. The analyses confirm that Hungary's research, development and innovation relations with China are more complex and nuanced than what was at first anticipated and shows great variation in terms of success based on the science knowledge, technology and innovation provider.

Yet, there is room for improvement, especially in generating new business relations, strengthening researcher to researcher relations and institutional relations and by filling up with concrete actions the numerous cooperation initiatives established in recent years between the two countries.

All Hungarian innovation ecosystem actors have some form of bilateral tie with China. The challenge is to further cultivate the currently sporadic initiatives across the Hungarian innovation ecosystem actors in a strategic, synchronised, systematic and proactive approach in line with Hungary's innovation policy.

Part 1. | About the Research

1. Objective

The aim of the research was to understand the Hungarian Innovation Ecosystem, collect and synthetize knowledge in relation to China–Hungary science knowledge, technology and innovation Transfer and set guidelines for those interested in working with China in research, development and innovation (R&D&I).

In the first stage of the project, the Hungarian Innovation Ecosystem was mapped and information was collected from the various Hungarian innovation ecosystem actors in relations to China. The assessment focused on a diverse set of Hungarian actors working with China in the field of science knowledge, technology and innovation transfer: Hungarian companies, universities and research institutions and other intermediary organizations and support agencies.

The hypothesis was that despite the numerous visits of high-ranking Chinese officials to Hungary as well as visits of Hungarian leaders to China, there are very limited successful working relations and little exploitation of cooperation opportunities in the field of science knowledge, technology and innovation transfer between the two countries.

In the research – by generalizing from the empirical experiences of successful actor – we were interested in finding patterns and identifying key success factors in order to cultivate and operationalize more mutually beneficial R&D&I cooperation between the two countries that would ultimately lead to science knowledge, technology or innovation transfer.

2. Relevance of the Research

There are several aspects which make the topic relevant. The first is that the Hungarian government explicitly and openly stated its interest in opening towards China. The Orbán government began strengthening ties with China in 2011, when it announced its *'Opening to the East'* initiative.

"The goal of the policy is to shift the focus of economic relations to the Eastern countries, especially to China."[1]

Since the initiative was launched, the government attended and hosted several high-level meetings and the country is host to several China–CEE joint institutions.

The second aspect which makes the research relevant is the impressive development of China in the field of R&D&I in recent years, which is either not known or is being highly underestimated by the Hungarian innovation ecosystem actors. This elevates the status of Chinese research and development organizations among the most developed ones in the world. This means that any innovation ecosystem actor that understands Chinese science knowledge, technology and innovation trends quickly and is willing to learn the *'Chinese way of doing business'* can benefit from the relation. It can take the form of joint projects where new science knowledge, technology or innovation are co-created or it may also manifest in gaining access to the highest and most novel R&D&I infrastructure and talent pool of the world. But in order to be successful, the Hungarian innovation ecosystem actors need to understand the Chinese science knowledge, technology and innovation ecosystem trends. A shift in perspective is equally needed where the Hungarian innovation ecosystem actors consider China as the high technology leader of the world from where knowledge, technology and innovation might be absorbed.

3. Background of the Research

As part of the research, interviews were conducted with Hungarian entrepreneurs, researchers and representatives of university/research institutes (in particular, representatives of knowledge and technology transfer offices (KTTO). The research focused on those companies and university/research institutions that have cultivated and operationalized successful working relations with China in the form of corporate or bilateral relations or through education programs.

By following semi-structured interviews, interviewees were encouraged to tell their personal stories with their own words. In this way, the research builds on the interviewees' empirical experiences. Later, findings were synthetized into a concrete implementation road map that, when applied, may help to "grow the pie" by realizing more successful science knowledge, technology and innovation transfer joint projects with China.

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[1] https://china-cee.eu/wp-content/uploads/2020/01/70_YEARS_PDF_CEE.pdf

4. The Hungarian Innovation Ecosystem and the Main Actors

The Hungarian innovation ecosystem is characterized by centralized policy programming and implementation; it is a highly complex, multi-actor system. The Hungarian innovation ecosystem has undergone several changes in recent years. The key directions of the institutional development policy processes of the Hungarian innovation ecosystem can be summarized by the following main points:

a. The reduction of regional inequalities remains a relatively important development priority in Hungary. The government supports innovation processes by encouraging the development of *'Regional Innovation Strategic Clusters'* based on the Triple Helix[2] model. The model promotes collaboration regionally and internationally and encourages deeper interactions between the local innovation ecosystem actors with the aim to create societal and economic impact with international visibility[3].

b. In this process, leading universities and research institutions across the country have significant new roles. In particular, to manage regional multi-actor innovation networks, leading science knowledge technology and innovation creation and educating future academics and professionals[4]. Recent government initiatives[5] serve to improve basic R&D&I infrastructure capacity and aim to support SMART Specialization[6] of the regions.

c. The Hungarian government actively participates in the innovation ecosystem as funder in the form of:

- **providing grants to and financing the venture capital market[7], any**
- **supporting universities and research institutions to carry out industry-funded research.**

d. In Hungary, the development program of 2014–2020 boosted the start-up innovation ecosystem evolution due to the available financial resources.

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[2] Etzkowitz's (2003)

[3] https://www.eua.eu/downloads/publications/eua%20innovation%20ecosystem%20report_final_digital.pdf

[4] https://link.springer.com/content/pdf/10.1007%2F978-981-13-1190-1_6.pdf

[5] For example: The Ministry for Innovation and Technology launched Higher Education and Industrial Cooperation (FIEK) program. Higher Education and Industrial Cooperation are on the one hand independent university units, but at the same time a new science knowledge, technology or innovation transfer model with joint, strategic cooperation and management of the institution and the regional companies. In this model, companies articulate research, development and training needs while the universities support science knowledge, technology or innovation generation and absorption.

[6] Resources get allocated to specific priority areas e.g. industries or niches with high market potential.

[7] http://unipub.lib.uni-corvinus.hu/4082/1/VT_2019n5p2.pdf

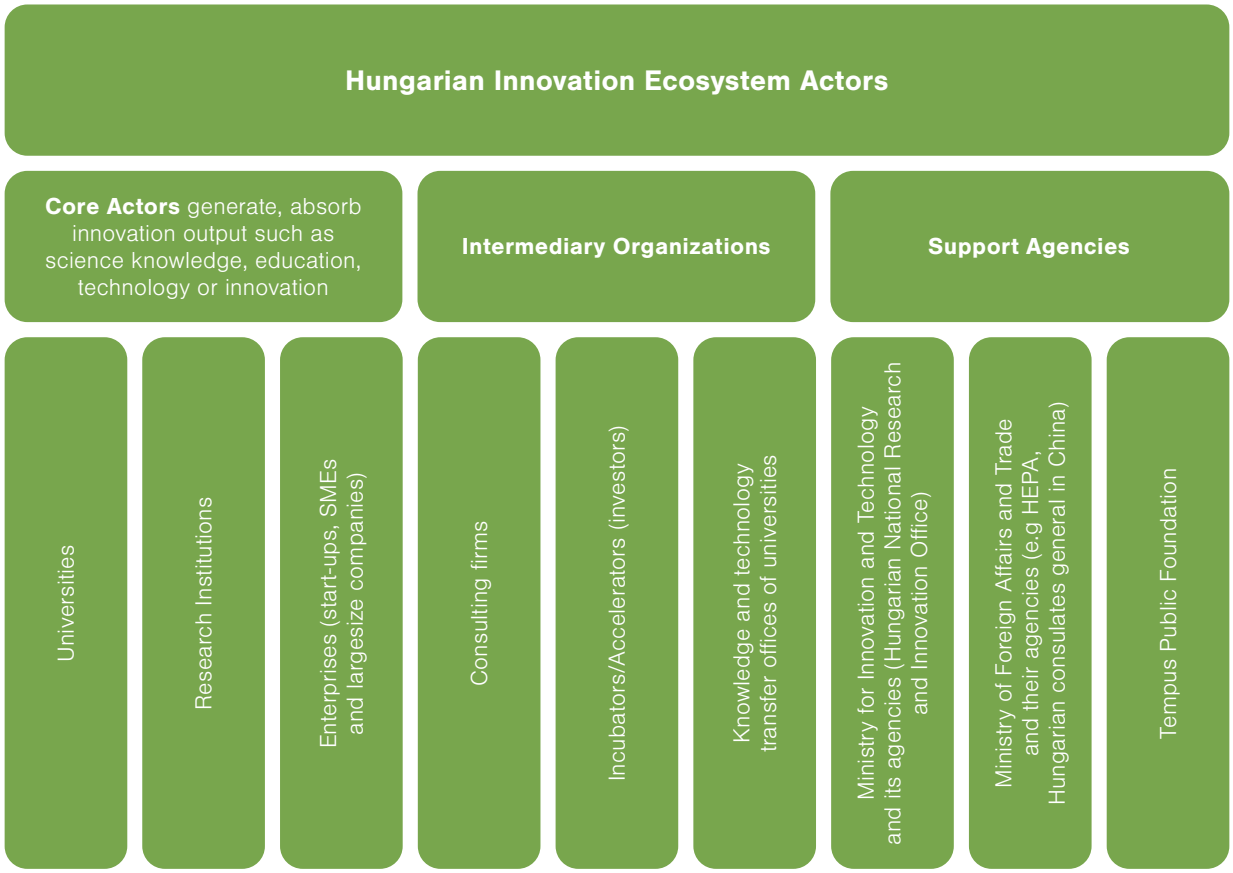
These elements show a systematic and integrated approach to building the Hungarian Innovation ecosystem and they are deeply transformational. The above-described government related initiatives inextricably intertwined with the science knowledge, technology and innovation transfer. The evolving Hungarian Innovation Ecosystem – in case the Innovation policy initiatives bear fruit – will lead to the co-creation of new science knowledge, technology or innovation through the increased interaction between the innovation ecosystem actors.

The main focus of the research was on the Hungarian innovation ecosystem actors and their output and it focused solely on those actors that deal with science knowledge, technology or innovation transfer to China or support science knowledge, technology or innovation transfer processes. For the purpose of this research actors include:

a. **Science Knowledge, Technology or Innovation Providers:** innovative businesses (start-ups, SMEs and large-size companies); universities and research institutions with joint projects with China. These organizations create or provide innovative products or services in the form of bilateral research and development projects or through joint development of new science knowledge, technology or innovation. For the purpose of this project, science knowledge transfer also includes quality education and mobility programs that are discussed separately in this report.

b. **Resource providers:** intermediary organizations such as knowledge and technology transfer offices of universities, consulting firms and investors. These organizations provide complementary services to facilitate science knowledge, technology or innovation transfer processes e.g. in the form of commercialization and/or internationalization of science knowledge, technology or innovation.

c. **Support Agencies:** state actors such as the Ministry for Innovation and Technology (MIT) and its agency, the Hungarian National Research and Innovation Office; the Ministry of Foreign Affairs and Trade and its agencies, the Hungarian Export Promotion Agency (HEPA), and the Hungarian Consulates in China or the Tempus Public Foundation. Their roles include creating a supportive economic environment, providing adequate innovation/industrial policies, positively supporting business and research collaboration and providing funding.



5. Innovation and Internationalization

This research lies in the intersection of innovation and internationalization with special focus on science knowledge, technology and innovation transfer between China and Hungary.

> **"Through innovation, enterprises, universities and research institutions can improve their competitiveness and expand to international markets through science knowledge, technology or innovation transfer. At the same time, the process of internationalization provides opportunities to learn from the international science knowledge, technology or innovation transfer processes; hence the two processes mutually promote each other."[8]**

To relate this concept to the topic, in practice it means that if the Hungarian innovation ecosystem actors keep up with the impressive development of the Chinese research and development trends

[8] https://www.scirp.org/journal/paperinformation.aspx?paperid=98902

they can contribute to the *'Regional Innovation Strategic Cluster's (RISC)*[9] competitiveness and can elevate Hungarian R&D&I position on the global market in the mid-long run.

Working with China will bring benefits for the Hungarian innovation ecosystem actors in an increasingly competitive and global world where the ability to innovate and internationalize are essential competitiveness factors for any organization and country.

6. Aim of China in the Fields of Research, Development and Innovation

> **"China is lead player in the global economy. It is also increasingly relevant in the science, technology and innovation domain worldwide."**[10]

Understanding the most recent developments in China in the field of R&D&I, could help the Hungarian innovation ecosystem actors to make informed decisions and understand opportunities and challenges in relation to science knowledge, technology or innovation transfer to China.

According to ENRICH (European Network of Research and Innovation Centres and Hubs), China, China's Innovation & Technology Transfer in the Global Context report:

> **"China continuously invests into science knowledge, technology and innovation and aims to become innovation power by 2025, as outlined in China's national strategy for 'innovation-driven development' document, titled 'Outline of the National Strategy of Innovation-Driven Development (2016)'**[11]**."**

China is working toward becoming a more research-intensive and innovation-driven country as opposed to the labour-intensive country it used to be. China is slowly growing out from imitation/ copying foreign science knowledge, technology and innovation though reverse engineering is not prohibited under the Chinese law, and until February 2020 it was even lawfully supported.
For example, setting up joint ventures in China required the foreign partner to fully share its knowledge and technology or know-how with the Chinese partner.

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[9] Regional Innovation Strategic Clusters: firms and other organizations systematically engaged in interactive research, development and innovation generation usually characterized by SMART specialization.

[10] http://china.enrichcentres.eu/sharedResources/users/4807/ENRICH%20China%20report%20THU.pdf

[11] https://cset.georgetown.edu/wp-content/uploads/t0076_innovation_driven_development_strategy_EN.pdf

Chinese firms have used the above described practice for their own advantage to successfully compete domestically and internationally. In other words, they absorbed international knowledge, adopted, exploited and excelled primarily for the benefit of their home economy.

In parallel, China invests heavily into domestic innovation capacity and capability, and domestic competition remains strong. This so-called *'Indigenous Innovation'* is a national strategy put forward by the Chinese government to promote the development of technological innovation in domestic firms, eventually leading to the ownership of their own core IP rights.

> **"Ernst (2011) examined the impact of China's innovation policy on the country's innovative capacity and reviewed data on the speed of learning and catching-up that is transforming China's production and innovation system. He found that both input indicators (R&D investments, number of engineer and scientists) and output indicators (science and technology publications, patents) show that China has grown to rival the US, not only in price but also in technology."[12]**

As interviewees phrased:

"Working with a Chinese counterparty on a bilateral project, one can get access to the highest and most advanced infrastructure, competitive with the US."

China's ambitious plan is so to reshape the global technology industry.[13] These new ambitions are reflected in the newly published China Standards 2035, a new industry policy. It builds upon Made in China 2025, a key industrial policy for the development of technology in China, to nurture companies that are leaders in design and innovation.

Another factor contributing to China's impressive and fast research, development and innovation results is the active utilization and combination of international resources with domestic ones. In particular, domestic enterprises are encouraged to launch cooperation with internationally-

[12] http://china.enrichcentres.eu/sharedResources/users/4807/ENRICH%20China%20report%20THU.pdf

[13] https://www.china-briefing.com/news/what-is-china-standards-2035-plan-how-will-it-impact-emerging-technologies-what-is-link-made-in-china-2025-goals/?fbclid=IwAR3gR6QVFd6gzK7pXLL4Jw_K1QhcdaxOW1J6FHZA3-oakr2oSUv-TTxwQO8
China Standards 2035: blueprint for China's government and leading technology companies to set global standards for emerging technologies like 5G internet, the Internet of Things (IoT), and artificial intelligence, among other areas.

renowned universities and research structures and to "go global" by providing facilitation and support for international mergers and acquisitions (M&As) and for the establishment of overseas R&D centres; and to cooperate in joint research with partners along the Belt and Road Initiative (BRI).

The central government of China has recognized that the best Chinese students often go abroad for advanced studies, resulting in many highly educated overseas Chinese *(rencai).* The central government of China recognized the need to attract overseas Chinese and top foreign-born talents from the world's best universities to China. They use the *'Thousand Talents Program (TTP)'*[14] to attract renowned scientists and teams. The program was established in 2008 and further elevated in 2010 by the central government of China to recognize and recruit leading international experts in scientific research, innovation and entrepreneurship. Within the program, participants receive substantial resources for research and academic exchange and other assistance. Thousand Talents scholars are eligible for high levels of government funding. These are very favourable conditions under which research, technology development and innovation can flourish.

7. Cultural Differences

There are certain social structural elements embedded in the Chinese way of doing business, including building science knowledge, technology or innovation transfer relations. These are crucial to understand in case Hungary would like to boost successful science knowledge, technology and innovation transfer deals with China. Among the most important terms worth understanding are the so-called *'bamboo network'* and the other, strongly connected terminology *'guanxi'* (personal relations).

The Chinese cultivate business relationships similar to how bamboo grows in nature. A bamboo grove uses energy from existing canes to produce larger and more numerous offspring and expand the root structure. To apply this concept to the Chinese–Hungarian science knowledge, technology and innovation transfer relations, it means that the Chinese cultivate research, development and innovation partnerships by planting the first initial 'bamboo' – the first interactions with their international partners – in order to establish the relationship and build trust.

[14] Thousand Talent Program professorship is the highest academic honor awarded by the State Council, analogous to the top-level award given by the Ministry of Education. The program includes two mechanisms: resources for permanent recruitment into Chinese academia, and resources for short-term appointments that typically target international experts who have full-time employment at a leading international university or research laboratory.

The Chinese do not expect anything more from these first interactions, since they nearly never bring tangible results, at least not from the European business creation perspective. That is why many interviewees reported for example:

"After receiving many Chinese delegations and signing MoUs with Chinese partners nothing has happened."

Relationship building in the Chinese context is a long process and made for the future, therefore they don't require immediate business or financial benefits. It is also worth mentioning that even though the memoranda of understanding (MoUs) are frequently signed as a means of legalizing relations, such legal documents mean a lot less in the Chinese context than in the European context. The Chinese adopted this contracting practice mainly to be more in tune with European and Western expectations.

> **"A fundamental difference between West and East is that people in the West trust the institutions, whereas in the East they tend to be put their faith directly in the individuals."[15]**

Another characteristic of the *'bamboo network'* is the Chinese diaspora across the world, including Hungary. From a science knowledge, technology and innovation transfer perspective, this means a growing number of new generation Chinese educated in international schools or universities abroad, including Hungary, where they cultivate personal relations. These Chinese represent enormous opportunities and information to China as *guanxi* is the key building block to grow the established relationships.

It's no wonder that those from the Hungarian innovation ecosystem who report successful working relations with China, all report long-established personal relations that, in the past, were very often never even legally formalized.

There are, however, opposing forces that stand in sharp contrast with traditional Chinese values (e.g. control and community) and business development practices. These new trends also deserve

[15] http://www.sociologiecraiova.ro/revista/wp-content/uploads/2018/12/04.-ŞTEFAN-CIORÎIA-THE-"BAMBOO-NETWORK"-OF-SOUTHEAST-ASIA-AND-ITS-SOCIO-PHILOSOPHICAL-GROUNDS-PP.-41-65.pdf

attention in the context of science knowledge, technology and innovation transfer and are related to the new generation of Chinese. The new Chinese generation has a strong entrepreneurial spirit, a hunger for uniqueness and is characterized by growing spending power. As a result, this generation has grown to discredit hierarchy, promote individual talents and spend more compared to their Western counterparts. In relation to research, development and innovation, this results in a *"rise of basic start-ups, particularly in the field of technology",* a defining trend among Chinese youth.

> **"There are currently more than 10,000 new companies launched every day, – according to China Daily – about seven start-ups every minute."[16]**

These new trends benefited and will continue to benefit China through technology transfer and spillovers, acceleration of rapid growth of new advanced technologies and technology capacity and put China in the forefront as a leader and provider of advanced technology.

There is strong competition amongst advanced economies to maintain technology leadership. In this 'war' China is performing better year-after-year and is positioned well to outperform the USA and Europe in the mid-long run. From an economic standpoint, Europe as a whole has wasted interest in having diversified trade partners to leverage its negotiating power. Therefore, it is crucial to integrate into the Chinese industrial value chains as early as possible to maintain a competitive position, upgrade technology and have access to the newest technology trends and talent pools.

[16] http://cosmeticschinaagency.com/focus-on-the-new-chinese-generation/

Part 2. | Science Knowledge, Technology and Innovation Transfer Outputs

In contrast with the research hypothesis, the research shows that there are relatively many science knowledge, technology and innovation transfer relations established between the two countries. Still, these relations are sporadic and vary considerably by intensity and science knowledge, technology and innovation transfer providers.

The research results show great variations in Chinese–Hungarian science knowledge, technology and innovation generation and absorption among science knowledge, technology and innovation providers. There is an uneven distribution as most of the relations are realized by universities and research institutions, while the Chinese–Hungarian science knowledge, technology and innovation performance of companies is very limited, virtually non-existent.

The success rate of these projects was assessed based on the number of bilateral R&D projects, the number of Chinese students attracted to Hungarian higher education programs and the number of innovation-driven joint projects.

1. Bilateral Research and Development Projects

Bilateral research and development projects include grant-based bilateral industrial research and development projects realized in the framework of Chinese–Hungarian science and technology, and support science knowledge and technology transfer.

The assessment includes winning projects between 2015–2018 in two funding mechanisms:

- **Bilateral Industrial R&D Cooperation:** promotes larger applied industrial research, technical development and commercialization, with project value between 20 and 70 million HUF; with project duration of 3 years. In a grant cycle 4–5 projects get support.

1. Table: Winning Bilateral Industrial R&D Cooperation between 2015–2018[17]

Project identifier	Winning institute	Grant value (HUF)
2017-2.3.6-TÉT-CN-2018-00025	Centre for Agricultural Research	52 923 642
2017-2.3.6-TÉT-CN-2018-00023	Pharmacoidea Ltd.	52 910 760
2017-2.3.6-TÉT-CN-2018-00003	Centre for Energy Research	45 000 000
2017-2.3.6-TÉT-CN-2018-00002	Budapest University of Technology and Economics	53 017 776
TÉT_16_CN-1-2016-0014	Szent István University	43 833 333
TÉT_16_CN-1-2016-0008	Wigner Research Centre for Physics	57 108 913
TÉT_16_CN-1-2016-0006	Szent István University (Mecsekérc Ltd. and Bay Zoltán Nonprofit Ltd for Applied Research)	63 524 663
TÉT_16_CN-1-2016-0004	National Agricultural Research and Innovation Centre	38 440 709

- **Bilateral Science and Technology Cooperation:** promotes researchers' mobility and exchange such as study trips of researchers'/PhD students' mobility, dissemination activity of research results (e.g. participation in conferences and publishing in science journals). These projects have lower grant value, between 4–5 million HUF. Projects duration is 2 years and approximately 10 projects are supported in a grant cycle.

[17] Source: Hungarian National Research and Innovation Office

2. Table: Winning Bilateral Science and Technology Cooperation between 2015–2018[18]

Project identifier	Hungarian institute	Grant value (HUF)
2018-2.1.14-TÉT-CN-2018-00001	Research Centre For Astronomy and Earth Sciences	3 816 000
2018-2.1.14-TÉT-CN-2018-00003	Wigner Research Centre for Physics	2 464 000
2018-2.1.14-TÉT-CN-2018-00004	Biological Research Centre, Szeged	4 616 000
2018-2.1.14-TÉT-CN-2018-00008	Office for Research Groups Attached to Universities and Other Institutions	5 000 000
2018-2.1.14-TÉT-CN-2018-00010	Centre for Agricultural Research	2 152 000
2018-2.1.14-TÉT-CN-2018-00011	BioTalentum Ltd.	4 505 800
2018-2.1.14-TÉT-CN-2018-00013	Research Centre for Natural Sciences	2 057 000
2018-2.1.14-TÉT-CN-2018-00021	Eötvös Loránd University	4 020 000
2018-2.1.14-TÉT-CN-2018-00022	Eötvös Loránd University	4 936 000
2018-2.1.14-TÉT-CN-2018-00025	Budapest University of Technology and Economics	4 887 000
2018-2.1.14-TÉT-CN-2018-00040	ELI-HU Non-Profit Ltd.	5 000 000
TÉT_15-1-2016-0108	Centre for Agricultural Research	4 229 000
TÉT_15-1-2016-0113	Centre for Agricultural Research	3 124 800
TÉT_15-1-2016-0114	Centre for Ecological Research	4 890 000
TÉT_15-1-2016-0116	RT-Europe Research Center Ltd.	4 999 200
TÉT_15-1-2016-0120	Centre for Energy Research	3 315 000
TÉT_15-1-2016-0135	Szent István University	4 514 000
TÉT_15-1-2016-0137	Research Centre for Natural Sciences	2 530 000
TÉT_15-1-2016-0144	Biological Research Centre, Szeged	4 807 600
TÉT_15-1-2016-0146	BioTalentum Ltd.	3 927 800
TÉT_15-1-2016-0154	Eötvös Loránd University	4 890 000

[18] Source: Hungarian National Research and Innovation Office

Owing to the grant mechanism's current structure, funds are somewhat equally distributed among *'Bilateral Industrial R&D Cooperation'* and *'Bilateral Science and Technology Cooperation'* projects. The call, in 2018, for Bilateral Science and Technology Cooperation had available funds in the amount of 250 million HUF, while the Bilateral Industrial R&D Cooperation in 2017 had 200 million HUF, based on the calls published on the Hungarian National Research and Innovation Office's website.

3. Table: Summary of the bilateral Chinese-Hungarian projects by the type of Science, Knowledge and Technology (SKT) provider between 2015–2018

Type of Hungarian SKT provider	Number of participating organizations 2015–2018	Number of winning projects 2015–2018	Eligible grant amount from bilateral cooperation	% of eligible grant amount
Eötvös Loránd Research Network member	9	16	236 474 664	46%
University	3	8	189 157 772	37%
For-profit organization	2	2	70 590 700	14%
Non-profit organization	2	3	13 433 600	3%
Total	**16**	**29**	**509 656 736**	**100%**

Ties are particularly strong with China amongst the members of the Eötvös Loránd Research Network[19] having the highest number of winning bilateral projects (16 out of 29 projects). In terms of eligible grant value, projects are somewhat more equally distributed between universities and research institutes. The largest grant amounts were given to Eötvös Loránd Research Network members (46% of all eligible grant value between 2015–2018), but some universities won considerable amounts in the consecutive funding cycles too. Of the Hungarian universities, three universities take an active part in Chinese-Hungarian bilateral cooperation projects: Eötvös Loránd University; Budapest University of Technology and Economics and Szent István University. Although the calls support for-profit participation, such organizations are highly underrepresented among the applicants and winning projects. In terms of research fields, Chinese-Hungarian Science, Knowledge and Technology bilateral cooperation is strong in the fields of physics, agriculture (in particular plant biology), medical and animal biotechnology, chemistry and ecology.

[19] Formerly known as Hungarian Academy of Sciences' (MTA) Network of Research Excellence

Based on the interviews, most of the bilateral relations in the fields of science and research cooperation were established around the end of the '80s as a result of the Cooperation Agreement signed in 1984 by the Hungarian and Chinese Academies of Sciences (CAS). Relations established in those early years were maintained as researcher-to-researcher, person-to person relations, based on mutual research interests. Based on the data presented above, bilateral projects were won, year after year, by the same research institutions/research groups and universities. There is a relatively low number of new relation-building being realized by the research and academic community with China, despite the fact that the purpose of the *'Bilateral Science and Technology Cooperation'* is to establish new ties.

Based on the current trends in the Hungarian innovation policy it would be justified to somewhat restructure the internal funding structure of the Chinese–Hungarian bilateral calls, to diversify and provide more funding for applied industrial research, technical development and commercialization. It would be more advantageous to support projects where Triple Helix partners jointly pursue industry led innovation projects.

A good example, in terms of consortium structure, is the Szent István University led TÉT_16_CN-1-2016-0006[20] project[21]. The project was realized in Hungary in close cooperation with Mecsekérc Ltd. and Bay Zoltán Nonprofit Ltd. for Applied Research, and in China with the involvement of the China University of Geosciences.

In the mobility sphere, it would be advantageous to open opportunities for SMEs or already funded start-ups directly through intermediary organizations or incubators to learn more about China, establish new business ties and intensify business partnership building.

2. Business related Technology and Innovation Transfer

Technology and innovation transfer projects to China are realized through innovative products, technologies, services or through new business models. Data was collected based on the information provided by intermediary organizations and support agencies, from online articles and through personal interviews. As presented below, research in this domain resulted in very

[20] Joint research, methodological development and testing of cost-effective, in-situ microbiological mineralization-based remediation technology for complex contamination of toxic elements and testing on colored ore mining flotation tailings.

[21] https://www.mecsekerc.hu/magyar-kinai-kutatas-fejlesztes

limited amount of technology and innovation transfer in general. Only companies with pre-existing presence in China and with value added to technology and innovation transfer were considered. Companies with trade activities only have not been considered in this research.

4. Table: Hungarian companies with pre-existing presence in China and with value added to technology and innovation transfer

Name of the company	Business profile	Company size	Comment
Aquaprofit Co.	Engineering activities and related technical consultancy (Terminal water)	Large	
Automotive Proving Ground Ltd. (ZalaZone)	Research and experimental development on natural sciences and engineering	SME	
Back and Rosta Information Security Consulting Ltd.	Other software publishing	SME	Magic Wall in cooperation with the Hungarian National Museum [22]
Basilicon Consulting	Professional advisory	SME	
BIOPOLUS Technologies Plc.[23]	Engineering activities and related technical consultancy (wastewater)	SME	
CBC Hungary	Professional advisory	SME	
EPS Global	Service activities incidental to land transportation	SME	
Európa Ázsia Ltd.[24]	Business and other management consultancy activities	Large	Support agency – Linked to HEPA: Trade promotion activity in China
Gedeon Richter Rxmidas Joint	Pharmaceutical	Large	
Graphisoft	Computer-aided design (CAD) software solutions	Large	
NNG LLC	Wholesale of computers, computer peripheral equipment and software	Large	
Innomed Ltd.	Medical equipment	Large	
LC Innoconsult International (Laser Consult Ltd.)	Professional advisory	SME	Intermediary organization
Morgan Star Group	Professional advisory	SME	Intermediary organization, related start-ups: Teqball, Skycruise[25]
OTP representative office	Banking services	Large	
Sputnik Goods Inc.	Electronic equipment design and manufacturing	SME	
Tradeland Ltd.	Professional advisory	Large	Intermediary organization
Transmoduls (Shenzhen Transmoduls Designing and Manufacturing Co. Ltd.)	Automation and machine manufacturing	Large	

[22] https://www.facebook.com/brmagicwall/

[23] Formerly linked to ORGANICA

[24] https://hepa.hu/uploads/798cb1febc3ead0a9d689c331c6cc42a.pdf

[25] http://morganstargroup.com/

Based on data presented in the table above, what pops out immediately is the very low number of successful start-up initiatives in relation to China. There are some known start-up/innovation project initiatives like Shaper3d, Teqball, Skycruise, but they are mainly related to or supported by intermediary organizations, such as Morgan Star Group.

Based on the interviewees, investments by SMEs to the Chinese market almost never brought outstanding financial benefits or met their financial expectations. After a few years of involvement, some even considered to divest with disappointment.

Some larger size financially stable companies, on the other hand, successfully entered the Chinese market with their products and services, although the success rate here, too, was low.

In recent years there were some attempts, especially from start-up incubators to engage with China. For example, Start-up Campus has initiated to set up offices in Chengdu and Shenzhen but these initiatives have ultimately not been realized. Attempts might have failed because of the very low interest from Hungarian start-up companies.

One of the interviewees describes the situation like this:

"Since I have moved to China – i.e. in the last 3 years – there has been only one Hungarian company that has approached me with interest to do business in China".

In addition, there are numerous already established incubators (including European start-up incubators) all over China. For example: StartupBootCamp[26], a Copenhagen based accelerator with strong international presence is established in Chengdu. For their competition there are over 500 registrations from all over the world in China but they incubate only 15 yearly. Another example is the Beijing B&R International Co-incubation with the mission of *"connecting the incubation service providers together and facilitating partnerships with B&R countries"*[27].

Although the number of Hungarian accelerators and incubators with projects interested in China is very low, those with good projects should encourage their start-ups to take part in international competitions and get hands-on knowledge and international (including China) experience.

[26] https://www.startupbootcamp.org/about-us/

[27] http://www.bjici.net/sites/en/index.html

Another reason of the low success rate of start-ups and SMEs might be the low technical readiness level (TRL) of their innovations. Based on empirical experience, low TRL innovations have very little chance to succeed in the Chinese market without a government grant or EU support to upscale first. Both upscale and internationalization are lengthy processes and can take years as they represent high cost and risk factors to investors.

As one of the interviewees explained:

"In relation to our start-up project, it would have been more advantageous to allocate the financial resources differently. In particular, to spend more money on key technical developments first rather than to establish the Chinese presence."

Another initiative to mention was started by Tradeland. They were interested in taking Hungarian technologies to China from various research institutions. Projects, here, have not been realized, even though Hungarian technologies were actively introduced to Chinese counterparts and MoUs have been signed to establish possible cooperation. These relations could potentially be used and further cultivated in the form of new grant-based bilateral R&D projects with Chinese counterparties. If relations are re-established and person-to-person interactions are further cultivated, these relations might be used to rejuvenate bilateral R&D projects. This, however, needs proactivity from the Hungarian research institutes to strengthen business ties, engage in in-depth discussion on expert levels and leads need to be continuously and systematically monitored and supervised, which is a rather time consuming and challenging process.

In summary, the lack of success on the business side might be attributed to several factors:

a. Hungarian companies – just like research institutions – have the tendency to orient toward the West if they even open at all to internationalization. If they do, they first initiate working relations with traditional Western trade partners like with Austria, Germany or the USA.

b. Hungarian companies, irrespective of the company size, are reluctant to invest in high-risk, faraway countries and international development projects, especially where there really is no best practice to rely on.

c. Hungarian companies are short of the financial resources necessary to engage in technology and innovation transfer. China, just like any other far away country, is very costly to reach and a return on investment is at risk.

d. Hungarian companies don't assess the Chinese market and don't take seriously the magnitude of the competition in China. The Chinese market, despite its size, is highly competitive. Competition is very intensive among local players, due to the above-described national strategy, 'indigenous innovation'. In addition, the most innovative technology leaders compete in the Chinese market such as Korea, Singapore and the Western European countries. In this very intense competition, Hungarian companies only have a chance if they have highly specialized niche knowledge where competition is severely limited because of the specialization and receive large capital influx to mitigate risk.

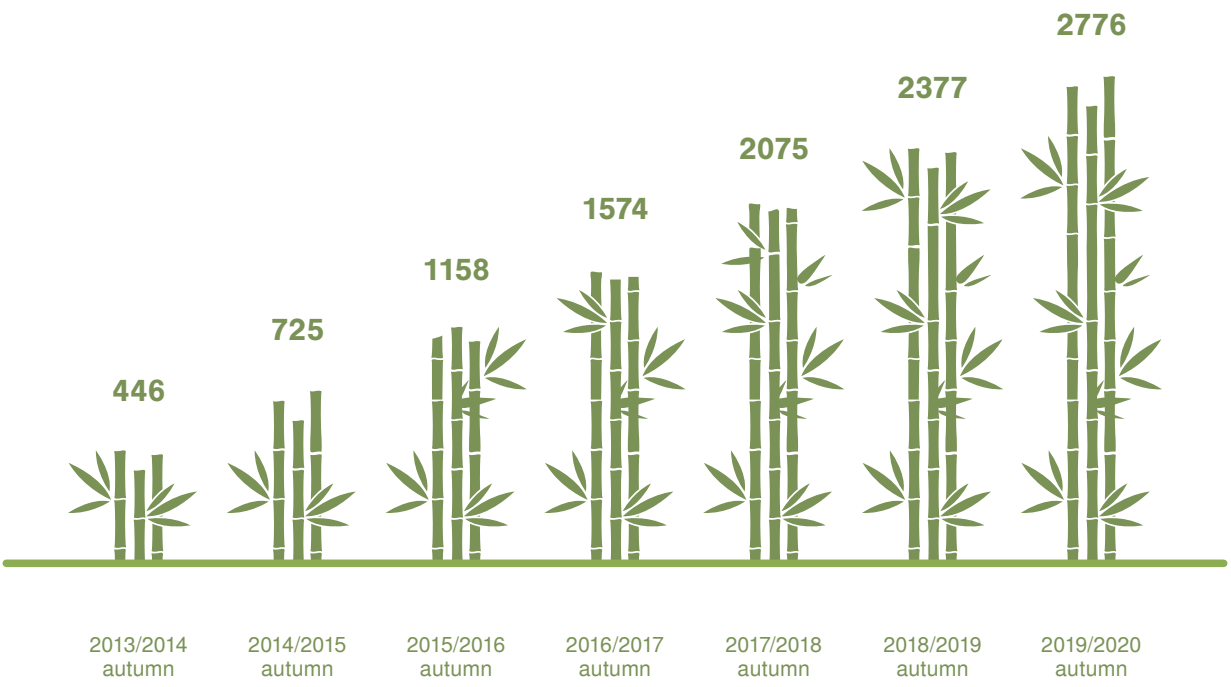
Successful Hungarian companies in the Chinese market are mainly intermediary organizations and larger size companies. Their success might be attributed to the following factors:

a. They have an established, existing or unique science knowledge, technology, product or business model. In addition, cost and risk of internationalization is not further burdened with the costs of adaptations and technology upgrades and Chinese partners see immediate benefits of implementation on the local market.
b. Projects that reached China with their innovation are supported by high investments or backed by high net worth individuals.
c. They received support from the Hungarian government by joining official political delegation's visits to China and by becoming flagship projects of the Hungarian government. This allowed them to establish a high-level political–business relation, which is the most secure way to establish trusted partnership and secure business.
d. They engaged and secured local partners to manage the administration of local business operations. They selected well-positioned Chinese partners with complementary business knowledge and accepted limited oversight and insight into the management and daily operation of the local business.

3. Education based Science Knowledge Transfer

This part of the analysis concentrated on the number of Chinese students Hungarian universities attracted in recent years. Data was provided by the Hungarian Ministry of Education and Tempus Public Foundation. Based on the information provided by the Hungarian Ministry of Education – data drawn from the Higher Education Information System[28] – in the 2019/2020 autumn, 2,776 students Chinese students studied in the Hungarian higher education system. This number, in comparison with the 2013/2014 autumn semester, shows a six-fold increase of Chinese students studying in Hungary.

1. Figure: Number of Chinese students studying in Hungarian higher education[29]



Chinese students are studying in 32 Hungarian higher education institutions where over 80% of the students are attracted by 9 universities.

[28] Source: Higher Education Information System (FIR)

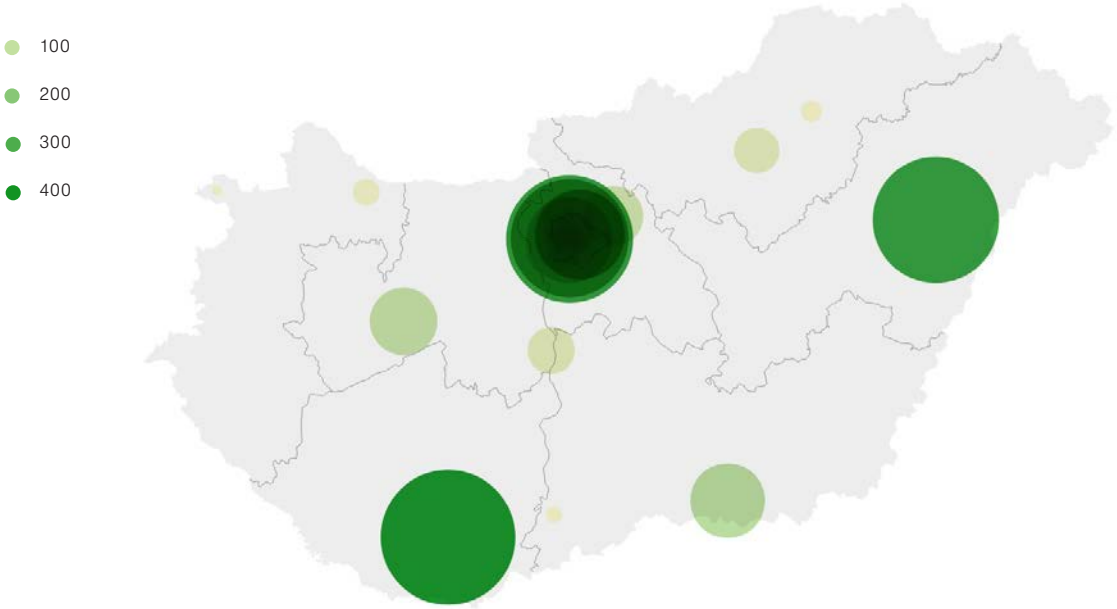
[29] Source: Statistics extracted from the Higher Education Information System on 15 October 2019 on the data of the autumn semester 2018/2019, supplemented with the data of 2019/2020

5. Table: Number of Chinese students by Hungarian university 2019[30]

Name of the University	Number of Chinese students in Hungary 2019
University of Pécs	430
Corvinus University of Budapest	381
University of Debrecen	376
Eötvös Loránd University	326
Budapest Business School	188
Budapest Metropolitan University	184
Budapest University of Technology and Economics	171
University of Szeged	127
University of Pannonia Faculty of Business and Economics	103
Szent István University	80
Semmelweis University	64
International Business School	57
University of Dunaújváros	48
Eszterházy Károly University	44
Liszt Ferenc Academy of Music	42
Edutus University	31
CEU Business School	24
Tomori Pál College	19
Wekerle Business School	19
Széchenyi István University	14
Óbuda University	10
Pázmány Péter Catholic University	8
University of Miskolc	8
University of Veterinary Medicine Budapest	7
Eötvös József College	4
The National University of Public Service	3
Baptist Theological Academy	2
The University of Theatre and Film Arts Budapest	2
Golgota Theological College	1
Moholy-Nagy University of Art and Design	1
Sopron University and Collage	1
The Hungarian University of Fine Arts	1

[30] Source: Ministry of Education, 2019.

2. Figure: Geographical distributions of Chinese students studying in Hungarian higher education institutions



Based on information provided by Tempus Public Foundation, the most successful disciplines attracting Chinese students are those of economics and management studies and 1-year language preparatory courses.

6. Table: The most popular courses among Chinese students

University	Name of B.Sc.	Education Level	Language of the education	Type of education	Form of financing
Corvinus University of Budapest	Applied Economics	BA/BSc	English	Full-time	Tuition-fee based
University of Debrecen	Management and Business Administration	BA/BSc	English	Full-time	Tuition-fee based
University of Pécs	Management and Business Administration	BA/BSc	English	Full-time	Tuition-fee based
University of Dunaújváros	Management and Business Administration	BA/BSc	English	Full-time	Tuition-fee based
University of Pécs	Preparatory courses	BA/BSc	English	Full-time	Tuition-fee based
University of Debrecen	Preparatory courses	BA/BSc	English	Full-time	Tuition-fee based

Information technology, design-related courses also attract a relatively high number of Chinese students according to Tempus Public Foundation. However, it is clear that Chinese students are underrepresented in hardcore natural science disciplines and engineering. This is unfortunate, as natural sciences are the ones where bilateral, grant based cooperation is strong and where there would be a need for a new generation of researchers who can infuse new blood into researcher-to-researcher relations building with China to maintain our country's relative competitive position in these fields. On the other hand, cultivating stronger ties in the field of engineering – besides architecture and design – is necessary as one of Hungary's lead industries is still the automotive industry, where resupply of talent and access to the latest and newest trends are much needed (e.g. robotics, AI, green technologies). Therefore, it is unfortunate that lead Hungarian technology universities have a very low number of Chinese students and non-existing bilateral grant-based cooperation with China, as it was presented above.

Universities with a high number of Chinese students represent a great potential source for cultivating new relations and science knowledge, technology or innovation cooperation with China through developing new researcher-to-researcher relations, on the one hand, and by strengthening institutional ties, on the other hand. Both types of relations are key to improve working science knowledge, technology and innovation transfer relations with China.

To demonstrate with an example:

"I met with my Chinese partner during the beginning of the 90s, when she worked for a German research institute. We had common research interests and when she moved back to China, we maintained contact and continued working together. The relationship started in Europe, but with her return to China, it continued through the research institute she worked for in China."

Stories like this are not uncommon and show how *'guanxi'* is applied in practice.

On the institutional relations front, a recent development is the establishment of the Shanghai based Fudan University campus. This project is treated both by the Hungarian and by the Chinese government as a priority bilateral cooperation project. According to QS World University Rankings[31] Fudan ranks the 40th in 2020. The establishment of the university in Hungary will likely

[31] https://www.topuniversities.com/university-rankings/world-university-rankings/2020

attract renowned Chinese professors and support the establishment of new science knowledge, technology and innovation transfer relations – including the likely establishment of research and development centres of Chinese companies in Hungary.

The above-described picture shows that Hungarian universities have become gradually better in attracting Chinese students as they realized the new income potentials these students represent. Here, the strategy of diversifying 'customer base' and opening towards the East, had clear advantages.

4. Mobility as a Means of Science Knowledge Transfer

There are various forms of mobility schemes to support science knowledge transfer:

- **students' mobility for study purposes;**
- **students' mobility for traineeship;**
- **education institute staff mobility for teaching purposes;**
- **education institute staff mobility for training;**
- **researchers' mobility for work purposes (short and long term).**

A lot has been written about students' mobility between China and Hungary, but lot less is said about researchers and education professionals' mobility to China for education, training, research and work purposes, despite this type of mobility could help to improve and broaden opportunities for joint research, development or innovation and science knowledge transfer between China and Hungary. This chapter summarizes mobility schemes other than *'Bilateral research and development projects'* described in Part 2.1.

Outbound mobility:

I. Campus Mundi program

Under the Campus Mundi program, China offers 230 person months of Chinese government scholarships (full-time and part-time) per year (for a maximum of 23 people per year) to pursue studies at state-recognized Chinese higher education institutions. Currently, 279 Chinese

universities offer scholarships under the program. Scholarship holders get tuition fee exemption, scholarships, free health insurance and accommodation. As part of the program, Hungarian students also have the opportunity to participate in professional practice and study tours to China.

7. Table: Campus Mundi Scholarship students traveling to China[32]

	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Study (full-time)	20	16	30	35	17
Study (part-time)	0	4	16	0	3
Student traineeship	0	5	1	0	0
Short study trip for students	1	2	3	0	2
Total	**21**	**27**	**50**	**35**	**22**

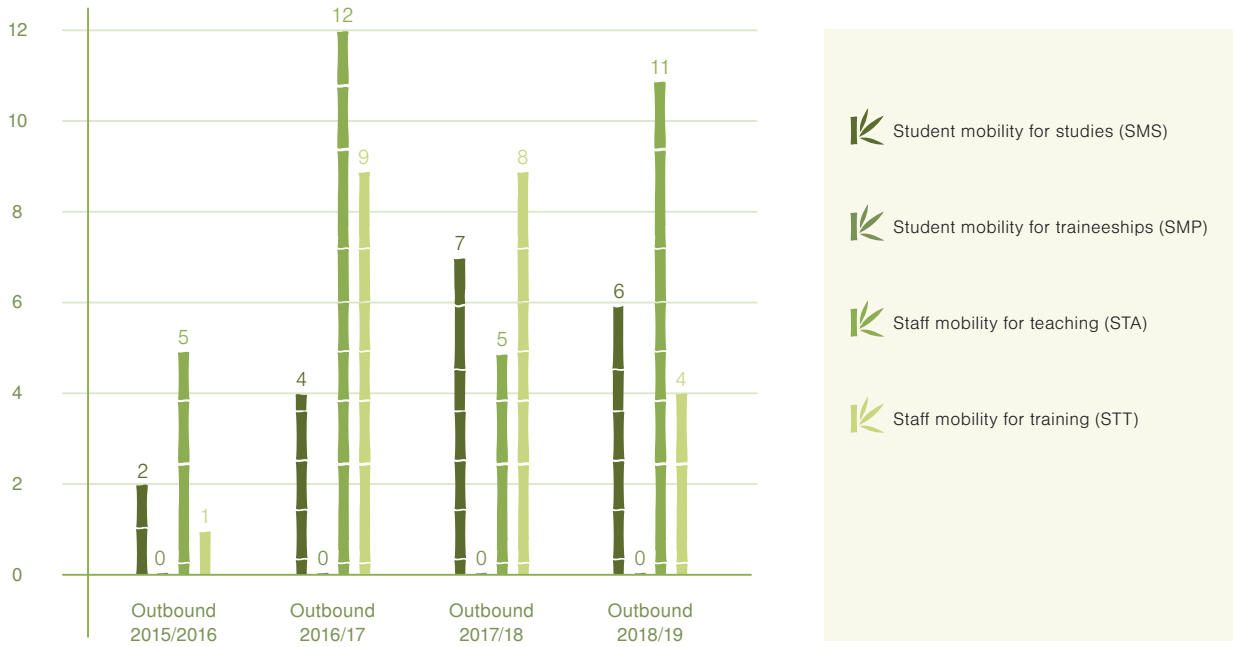
This scholarship is used mainly by students to pursue Chinese language studies in China. It is unfortunate that short study trips for students have a very low utilization rate – especially by PhD students.

II. ERASMUS+ International Credit Mobility Schemes

Erasmus+ International Credit Mobility scheme has been available since 2015 for Hungarian higher education institutions with the Erasmus Charter for Higher Education. In any case, the application is submitted by the Hungarian higher education institution to the Hungarian national agency (Tempus Public Foundation). If a project is accepted, an inter-institutional agreement is signed between the Hungarian and the partnering higher education institution and student and staff mobility may take place. Students and staff/professionals (lecturers and researchers) in higher education can apply for a grant from their institution through an Erasmus+ Credit Mobility application.

[32] Source: Tempus Public Foundation

3. Figure: ERASMUS+ International Credit Mobility Schemes[33]



As the above graph shows, the interest form Hungarian higher education institutions toward China is low and even this low number shows a declining trend.

III. Bilateral state scholarships

Bilateral state scholarships are based on scientific and educational cooperation agreements signed by the governments of the two countries. State scholarships offer the opportunity for researchers and academic staff to travel to China for study trips (short and long-term), build cooperation, exchange experience, collect data and participate in conferences, seminars and other events or to do research. Based on the information provided by Tempus Public Foundation, the utilization rate of this scheme by Hungarian researchers is extremely low. There is plenty of room here for improvement to better utilize these scholarships for research-based study trips by Hungarian researchers, PhD students both form universities and research institutions and to extend Hungarian researcher's and academic staff's knowledge about Chinese research, development, innovation and infrastructure.

[33] Source: Tempus Public Foundation

IV. The 'China Government' scholarship

In addition, China-sponsored programs and scholarships are also offered and supported by the Chinese state government, local or provincial governments, ministries such as the Ministry of Technology[34] or by universities and institutions themselves. In Hungary, these programs are coordinated by the China Scholarship Council[35]. Scholarships and programs are available for undergraduate students, graduate students, general and senior scholars.

Regarding this latter, Chinese higher education and research institutes offer scholarships to professionals with at least a master's degree or for doctoral studies. The duration of the research fellowships can be anywhere from 3 to 12 months. Based on the interviews, these mobility schemes are not well-known among scholars and, in recent years, only few senior scholars applied and have been granted scholarship.

To summarize, Hungarian students' and post-doctorate researchers' study tours and work experience are both currently underrated and underutilized, although they could be used as non-traditional ways to collect new knowledge and access Chinese research, development or innovation results as the interest of the Hungarian economy requires. In addition, it could become the foundation for building new bilateral ties with China in science knowledge, technology and innovation transfer and could help diversify trade relations beyond Western Europe.

Inbound mobility

I. Stipendium Hungaricum (SH)

Stipendium Hungaricum Scholarship Program was launched in 2013 by the Hungarian government. The core mission of the program is to increase the number of foreign students in Hungary and to encourage Hungarian higher education institutions to attract top foreign students.

The program is based on bilateral educational cooperation agreements signed between the ministries responsible for education of the sending countries/territories and Hungary or between institutions. Amongst others, bilateral educational cooperation agreements exist with China, as well.

[34] For example: Talented Young Scientist Program: http://tysp.cstec.org.cn/en/index.aspx

[35] http://www.campuschina.org/

Inbound mobility from China through the Stipendium Hungaricum program is summarized in the article *"Sino-Hungarian cooperation in higher education and research: a 70-year overview in light of bilateral diplomatic dynamics"*[36] by Tarrósy István and Vörös Zoltán.

As it is written and explained in their article:

> **"Among the partner countries, China has an annual quota of 265 as of 2019 (for the initial year it was only 200). Applicants from the PRC can get admitted to 22 institutions of higher education, including the Balassi Institute."**

8. Table: Chinese students in the SH program[37]

Chinese students in the SH program	2016–2017	2017–2018	2018–2019	2019–2020
Number of applicants	**263**	**284**	**333**	**396**
Awarded grants	**126**	**161**	**163**	**158**
BA/BSC/OP (sub-quota: 75 person)	67	66	71	56
MA/MSc (sub-quota: 75 person)	49	75	75	78
OTM[38] **(sub-quota: 20 person)**	4	4	2	1
PhD/DLA (sub-quota 30 person)	6	16	15	23

It is a positive trend that year after year the number of applicants and PhD students increases. This latter is especially important form science knowledge transfer perspective and could be a new source for bilateral research, development or innovation cooperation between the two countries in the future.

[36] https://china-cee.eu/wp-content/uploads/2020/01/70_YEARS_PDF_CEE.pdf

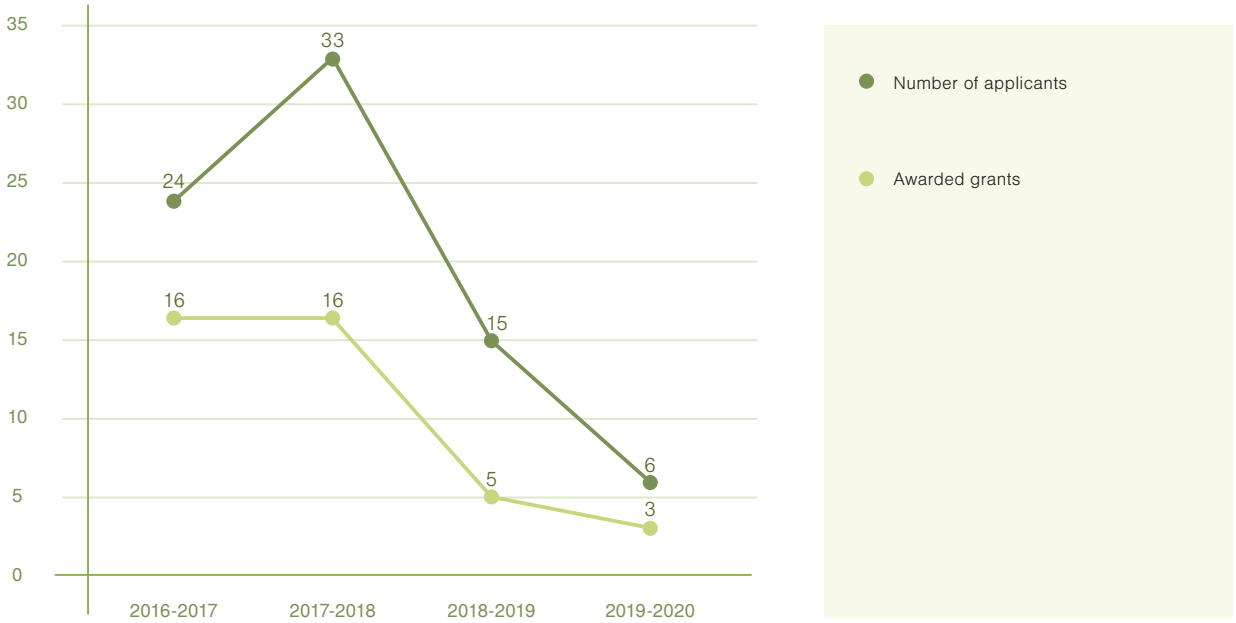
[37] Source: Tempus Public Foundation; Number of applicants for 2020-2021: 360

[38] OTM: One Tier Master

II. Hudec Program

Hudec program was established within the framework of the Stipendium Hungaricum Scholarship Program. In previous years, Shanghai East China Normal University, Jiao Tong University and Tongji University participated in the program. Within the framework of the program, Hungary offered 65 scholarships per year to Chinese (Shanghai) students studying architecture, design (garden and landscape, industrial product design, photography, digital design and animation), architecture and engineering in Hungary.

4. Figure: Hudec Program – Number of applicants and awarded grants, 2016-2020



As can be seen from the chart above, the number of applications for the Hudec program has been below quota in every year and shows a declining trend.

5. Memorandum of Understanding

Hungarian universities: Based on the information provided by the Hungarian Ministry of Education, Hungarian universities have over 170[39] MoUs[40] signed with various Chinese institutions[41]

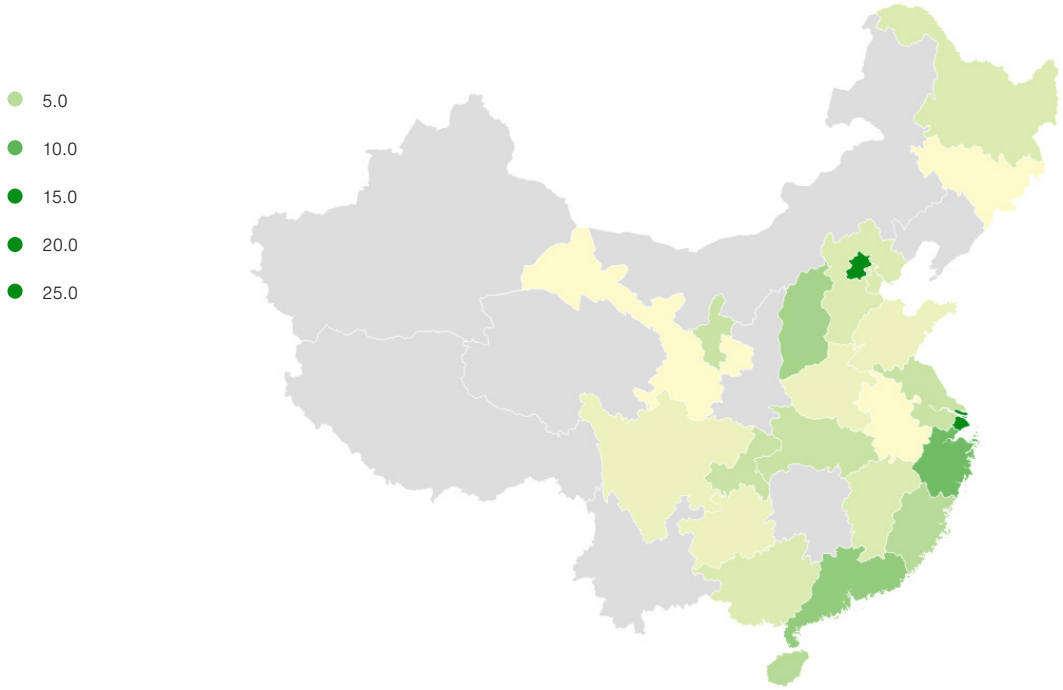
[39] Mainland China only.

[40] MoU: Cooperation agreement written and signed by the cooperating parties.

[41] Source: Ministry of Education, 2019. Note, this number can be higher as some universities might not have provided information

from all over China. Most MoUs were concluded between Hungarian universities and universities in Beijing and Shanghai, but universities in other provinces have also gotten in contact with Hungarian universities. The high numbers, however, don't mean that this cooperation has been active or with tangible results.

5. Figure: Number of Chinese-Hungarian MoUs signed by Chinese provinces



One exception is clearly education. As it was presented under the section *'Education based Science Knowledge Transfer',* those universities which have high numbers of Chinese students have established stronger bilateral ties and have more active MoUs with top Chinese universities (for example: Tsinghua University, Peking University, (The) University of Science and Technology of China, Zhejiang University, Fudan University) for education, such as ELTE, BME, CORVINUS, University of Debrecen, Széchenyi István University and the University of Pécs. These universities – especially university admission units – had vested interest in attracting tuition fee-paying international students, so, it is no wonder that relations with China in the education sphere are flourishing. Universities have active MoUs mainly to support students' and researchers' mobility, to co-host education programs, co-organize conferences and professional programs. The MoUs often mention the possibility of mutual research, but these are very rarely realized between the universities, which is an untapped potential for the future.

Hungarian university's knowledge and technology transfer offices (KTTO) on the other hand paint a less rosy picture about working with China, and often express disappointment and scepticism about the possibility of future cooperation. This is due, in part, to the fact that despite numerous visits by Chinese delegations and MoUs signed with Chinese counterparts, these relations have hardly ever resulted in tangible knowledge, technology or innovation transfer. Hence, KTTOs are gradually losing interest in China and prefer working with Western European or USA counterparts and are reluctant to further cultivate science knowledge, technology or innovation transfer ties with China. Giving up on building stronger strategic alliances with China on science knowledge, technology or innovation levels will ultimately lead Hungarian universities to lose sight of the latest and newest research, development or innovation trends, access high-tech Chinese R&D infrastructure and the ability to absorb the newest technologies already available in China.

This is especially unfavourable in the sight of the Hungarian innovation policy initiatives requiring universities to build close alignments with other regional industry actors to innovate and become engines of regional economic development. In the strategy of the Ministry for Innovation and Technology, universities have key roles in supporting deep and long-term transformation of the regions through knowledge spillovers to local industry players where the latest knowledge and technology trends on many fields will likely come from China. Therefore, KTTOs are encouraged to reassess their view on building closer ties with Chinese partners beside the Western European and USA partners and to find mutually beneficial ways to cooperate on research, development and innovation. In attempting this, using the growing number of Chinese alumni, by building on their personal ties in mainland China, might be a good starting point.

Research institutes: at research institution level MoUs are almost always connected to bilateral R&D projects and remain documents supporting project level cooperation. Yet, there are very good examples where cooperation has been elevated first, to institutional level and, later, to state level in the form of bilateral agreements and thus becomes institutionalized. Two specific examples to mention are:

1. **A 3-year joint plan for detector development between the Wigner Physics Research Centre and the Institute of Modern Physics (Lanzhou), Chinese Academy of Science; and**
2. **Establishment of a joint research laboratory between the Institute of Experimental Medicine (KOKI) and the Institute of Neuroscience (Shanghai), Chinese Academy of Sciences with the aim of implementing brain research projects by the partner institutes.**

The biggest advantage of the above-mentioned initiatives is that both cooperations represent R&D fields where Hungary holds word-class, highly specialized knowledge.

Yet, the above-described projects are rather the exceptions, not the rules. Not to invest in relationship building with China is far more common. The main reason – as one of the interviewees described – is:

"It takes a lot more time, money and energy to build and nurture R&D relationships with Chinese partners than to access state support, local grants or to build fruitful relations with EU partners where distance and culture are closer. Plus, you have to keep going after your Chinese partner, to 'push' them, because the Chinese side itself doesn't necessarily keep in touch."

This attitude is not without precedent. When Research Institutes can get access to state support, local grants or EU grants to finance their operations, they have the tendency to go after the 'low hanging fruit'. Higher rates of local grants or state support hence, have a negative effect on the research institutions' internationalization interests and technology and innovation absorption potentials, in general. This, on the other hand, doesn't mean that state support is not beneficial in certain cases. The above mentioned two examples with already proven results clearly fall into this category. These projects with institutionalized state support to further upscaling and with higher visibility could easily become *'lighthouse initiatives'* of successful Chinese–Hungarian science knowledge, technology transfer and could motivate other research institutes and universities to follow a similar path.

Part 3. | Summary of the Findings

To conclude, based on the above analysis in relation to science knowledge, technology and innovation transfer, Hungary is relatively successful in science knowledge transfer to China but there are severe limitations in relation to technology and innovation transfer.

Universities and research institutions play an important role in science knowledge generation. Through their education programs, Hungarian universities are successfully generating income from attracting Chinese students and, in this capacity, play a key role in spreading word about Hungarian science knowledge excellence and contributing to the science knowledge transfer toward China.

Research institutions *generate* mainly *science knowledge* and earn bilateral grant-based income through their relations with China. Unfortunately, the circle of the research institution and research groups involved with China has not expanded significantly over the years based on the number of winning bilateral grants. Upscaling and, later, commercializing former basic research topics into income generating opportunities – for example, through spin-offs – are marginal. More attention needs to be given to cultivate new researcher-to-researcher relations and expert-to-expert relations through short-term mobility schemes available for senior researchers and PhD students, especially, at research institutes and universities that do not yet use the opportunity presented by bilateral R&D grants.

Commercialization and internationalization efforts of the research institutions need to be elevated from project (researcher-to-researcher) levels to more formalized institutional, administrative and operation levels, as shown by the example of the Wigner Physics Research Centre and the Institute of Experimental Medicine. Here, Hungarian state support to establish new or further develop already existing Chinese–Hungarian joint research institutions is highly desirable, especially in the fields of natural sciences or in fields relevant to the country's economic performance (e.g. engineering, green mobility, design, information technologies (AI, IOT, 5G, Cyber Security)). Interdisciplinary projects are highly desirable, as well.

Universities are expected to gradually take up new roles and become centres of science knowledge, technology and innovation generation and transfer. With the reform of the Hungarian innovation ecosystem described in Part 1.4, universities are expected to get involved in upscaling and commercializing innovations, become a source of not only *science knowledge but technology and innovation generation and absorption,* become drivers of their regions' social and economic development and competitiveness. Hence, stronger interaction between universities and research institutions is expected in the mid-long run in order to upscale low TRL projects and transfer basic research ideas into marketable products or services in joint efforts with other innovation ecosystem participants, such as applied research institutions, companies and incubators. In this effort, *universities' knowledge and technology transfer offices* might play a key role by becoming bridges across the regional innovation ecosystem actors and across disciplines. In this role, they need to become creative in finding new ways to collaborate, find solutions to shared challenges and shape their own role in the equation. They need to shift away from administrative roles towards becoming business model innovators themselves to *absorb and dissolve knowledge, technology and innovation locally and internationally.*

For-profit medium and large-size companies with transferable science knowledge, technology innovation or business models should be given higher priority and more attention especially when financing bilateral projects. Encouraging and providing support through larger collaborative, interdisciplinary, industry-driven projects, in which innovation ecosystem players are diversely represented, is favoured the most. In addition, research should be supported with direct response to Chinese market needs.

Hungarian technology or innovation generation for the Chinese market and their transfer *by start-ups and small enterprises* is severely limited. The successful internationalization of low TRL projects of Hungarian start-ups and SMEs to China remains highly questionable. Nevertheless, through their incubators and through intermediary organizations and support agencies, start-ups and SMEs need to be encouraged and provided opportunities to pay visit to China either in the form of taking part in start-up competitions in China or in the form of short-term study trips and B2Bs. Providing bilateral R&D grants for start-ups and SMEs for networking and mobility could be a good way to encourage more Hungarian companies to become open, learn more about the impressive developments of China in the fields of research, development and innovation, cultivate person-to-person business relations, absorb new knowledge and make informed decisions before entering business with China.

CHINESE-HUNGARIAN SCIENCE KNOWLEDGE, TECHNOLOGY AND INNOVATION TRANSFER (SKTIT)

WHY CHINA?

RAPID GROWTH:
High investment into R&D&I

MARKET SIZE:
Sharp increase in demand for and supply of R&D&I, technology, talent pool

ADAPTABILITY:
Success in industrial applied research

SKTIT

OUTPUT

HUNGARIAN INNOVATION ECOSYSTEM ACTORS SKTIT RELATIONS TO CHINA

HOW TO CULTIVATE RELATION

GENERATE

- Grants to upscale University & Research Institutes basic research projects
- Grants to support Universities Knowledge and Technology Transfer Offices
- Flagship Initiatives & State support to establish Chinese-Hungarian R&D&I Centers
- State support to M&L size enterprises & Intermediary Organisations to internationalize start-up

ABSORB

- Support short-term mobility of Senior Researchers and Phd students to China
- Support short-term study trips of SMEs and startups to China through Intermediary Organizations

List of abbreviations

AI	Artificial Intelligence
B2B	Business to Business
BME	Budapest University of Technology and Economics
BRI	Belt and Road Initiative
CAS	Chinese Academies of Sciences
CEE	Central and Eastern Europe
CORVINUS	Corvinus University of Budapest
ELTE	Eötvös Loránd University
EU	European Union
HEPA	Hungarian Export Promotion Agency
IOT	Internet of Things
IP	Intellectual Property
KOKI	Institute of Experimental Medicine
KTTO	Knowledge and technology transfer offices
M&A	Merger and Acquisition
MIT	Ministry for Innovation and Technology
MoU	Memorandum of Understanding
PRC	People Republic of China
R&D	Research and development
RISC	Regional Innovation Strategic Cluster
SH	Stipendium Hungaricum
SMEs	Small and medium-size company
TTP	Thousand Talents Program
TRL	Technical readiness level
USA	United States of America

About the Chinese–Hungarian Technology Transfer Cooperation

Bay Zoltán Nonprofit Ltd. for Applied Research (BAY) started Chinese–Hungarian technology transfer cooperation in 2015. The cooperation was established between our institution, the Chongqing Hi-Tech Incubation Center and Hungarian Export Promotion Agency (HEPA). To our knowledge, the Chinese Hungarian Technology Transfer Center (CHTTC-Chongqing) is the only institution in Hungary with state background in both countries that serves to promote technological cooperation and exchange between Hungary and China. The Chongqing Office of the Center was officially opened on 16 May 2017 in the presence of Péter Szijjártó, Minister of Foreign Affairs and Trade, and Liu Guiping, Deputy Mayor of Chongqing.

Link to the Chinese–Hungarian Technology Transfer Office's website:
http://www.chttc.com/eng/index/index.html

About the Partners

Bay Zoltán Nonprofit Ltd. for Applied Research

Bay Zoltán Nonprofit Ltd. for Applied Research (BAY) aims to contribute to the competitiveness and efficiency of Hungarian companies by providing services in innovation and technology transfer in cooperation with Hungarian and foreign partner institutions. BAY offers its customers – currently more than 200 companies – complex scientific and technological solutions in several areas of expertise, devised in a way to enhance their competitiveness.
BAY cooperates with institutions of the public sector, universities and with the Eötvös Loránd Research Network members. For these partners, we also act as innovation intermediaries through our applied R&D&I and technology transfer activities. As a think tank with a strong team of researchers and experts, we are able to meet the research and development needs of various industries from an idea's conception to its realization. Moreover, we offer business development services as a technology incubator.
Our mission is to act as a catalyst in national and international projects involving exceptional levels of technology, and creating high added value that is significant for the national economy and the well-being of society.

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Chongqing Hi-Tech Incubation Center (CHIC)

Chongqing Hi-Tech Incubation Center (CHIC) was established in December 1988. In January 1992, CHIC was merged with Chongqing Development and Exchange Center for Science and Technology. What's more, former Chongqing Science and Technology Commission (present Chongqing Science and Technology Bureau) officially appointed CHIC as Chongqing International Science and Technology Exchange Center in September 2009.

CHIC used to be one of the first batch of pioneers among the centres in the hi-tech incubation service at the state level in China and Sino-Russian Cooperation Demonstration Bases for Science and Technology Cooperation, and is one of the earliest three international enterprise incubators certified by the former State Commission of Science and Technology and the UN Development Program (UNDP). As Chongqing International Science and Technology Base, which is certified by Chongqing Science and Technology Bureau, CHIC is also a member of China Science and Technology Exchange Center Joint Directors' Conference and of China Association for International Science and Technology Cooperation.

CHIC has undertaken the key projects for developments of science and technology in the western region of China entitled *'Chongqing's Innovation & Demonstration System of Science and Technology Incubations'* and *'Chongqing's Venture Information-Sharing Platform'* (www.cqibi.cn), *'Establishment of the Chongqing Mass Innovation Cluster Incubation Sharing Platform',* etc. In addition, CHIC initiated the establishment of Chongqing Incubation Base for Undergraduates' Entrepreneurship, Chongqing Incubator Association, Chongqing Association of Hi-Tech Enterprises, Chongqing Invention Association, and Chongqing Study of Innovation Methods and Chongqing Association for International Science and Technology Cooperation.

So far, CHIC contributed to the successful matchmaking of 47 projects. Owing to CHIC's assistance, 13 project agreements were signed, of which 9 projects have been implemented in Chongqing.

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