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## Characteristics of EU-China Research Co-operation in Information Technology

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Erich Prem

eutema Technology Management GmbH  
Dr.-Karl-Lueger-Ring 10, A-1010 Vienna, Austria.  
E-mail: [prem@eutema.com](mailto:prem@eutema.com)

**Abstract:** Research reported in this paper aims at clarifying drivers, motivations, and experiences of European organizations that are active in research and technological development in the area of information and communication technologies in China. Our approach is based on qualitative assessments of interviews with research managers and company executives from European organizations. We present results on research objectives, ICT areas of collaboration, collaboration type and model, IPR issues, problems and future recommendations for RTD co-operation. While research organizations are interested in basic and applied research, industrial research co-operation focuses more on applied research, technology and application development. Industrial research co-operation is mostly regarded as a tool for gaining access to Asian growth markets. This includes access to standards and networks. These results suggest a number of strategy recommendations for ICT RTD policy makers.

**Keywords:** International Research Cooperation, Research Policy, Information and Communication Technology, Research Strategy.

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### 1 Motivation

Research reported in this paper aimed at clarifying drivers, motivations, and experiences of European organizations that are active in research and technological development in the area of information and communication technologies in China. This research was part of a larger study to devise strategic recommendations for future Sino-European ICT research collaboration. With annual growth rates of more than 9% China is a driving force for the economy in the whole Asian area and the world-economy as well. For example, China manufactures 29 percent of the mobile phones in the world [Pitsills et al. 04].

Even despite recently rising wages in China, low production costs are regarded as China's most important competitive advantage in the future [Albrecht et al 08]. China is less known internationally, however for excellence in research and technology development (RTD). But the country has today one of the largest markets in information and communication technologies (ICT) [Skillnet 05]. Industrialized countries worldwide have been confronted with the relocation of major ICT production facilities to China. Such relocation has also often been paralleled by increased offshoring of research activities. This is particularly true for research and development activities that are close to production processes, but it also services and technologies for new products.

Not surprisingly, RTD policy makers in Europe and elsewhere are concerned about these trends while at the same time international RTD co-operation is considered vital and mutually beneficial. The European Commission, for example, has launched several initiatives for deepening research co-operation with China. Research presented here is thus motivated by the need to better understand RTD co-operation between Europe and China in the area of ICT, but also to devise strategies for future RTD collaboration. This work included the identification and analysis of the ICT RTD research potential in China, and an analysis of different ICT areas with respect to their co-operation potential. Work reported in this paper focuses on the analysis of existing collaboration and the experiences of key EU ICT research actors active in China.

### *Objectives*

The analysis of existing collaboration between European and Chinese ICT researchers aimed at collecting qualitative information about co-operation experiences, needs, expectations, and recommendations for future collaboration. The interviews thus covered the following areas:

- Background information: ICT areas, in which the organization performs research; position in the R&D value chain; start of co-operation; technology areas of the co-operation; types of Chinese partners; characteristics of the co-operation; IPR issues; support through funding EU or Chinese programmes
- Collaboration objectives: initial objectives when starting the work; alleged objectives on the Chinese side; change of objectives during the co-operation; success in meeting the objectives
- Strengths and opportunities: drivers and potential of RTD co-operation with China; most effective results so far in the co-operation
- Weaknesses and threats: problems and barriers for R&D engagement of EU ICT players in China, objections concerning continued co-operation
- Outlook: requirements and expectations for future R&D co-operation with China; solutions and proposals to improve the co-operation

### *Approach*

We performed interviews with European ICT organizations active and experienced in research cooperation with China. The target group of the interviews consists of representatives of European ICT companies and research organizations that are actively engaged in research collaborations with China. These representatives (interviewees) should be able to define their organizations' strategy and provide detailed information about previous and current R&D activities in China. Interviewees consisted mostly of CEOs or CTOs of EU industry or research division leaders. For the companies, emphasis was given to those with actual RTD presence in China. Also for the companies, many company managers felt that their CTOs or leaders of the Chinese collaboration lab could provide best insight into research activities, co-operation challenges and outcomes etc.

In total, 25 persons took part in the interviews conducted. 12 persons were contacted by phone or were – in only two cases – personally interviewed. 13 persons filled in an email questionnaire (written text). In total, the respondents comprise 14 industry

representatives and 11 experts from research organizations. The questionnaires for both oral and written answers were identical.

The respondents are from Austria, Belgium, France, Germany, the Netherlands, Spain, Sweden, and the United Kingdom. Most of the companies are large players but a few smaller industry actors were also interviewed. The interviews were mostly conducted within a time frame of 30 minutes to one hour.

## 2 Results

### 2.1 Background information

#### *Area of research*

The participating organizations covered different technology areas within ICT: ad-hoc networks, databases, electrical engineering, electronics, embedded systems, hardware reference design, electronics for energy efficiency, image processing, integrated circuits design, microelectronics, nanotechnology, secure computing architectures for PCs and telecommunication, semiconductor process technologies, software-middleware and open source. This list clearly shows a focus on the hardware or hardware-related side of ICT research, i.e. microelectronics and integrated circuits, electronics.

#### *Type of research*

Most of the foreign organizations (more than 55%) that are engaged in ICT R&D in China said they were doing applied research within the R&D value chain. In detail this includes 64% of the research organizations and 50% of the companies. Application oriented development is also very common with 28% of all interviewees engaged in that area. A more detailed look reveals that only 9% of the research organizations are engaged in application oriented development in comparison to 43% of the companies.

**Table 1** Type of research for EU-China ICT RTD co-operation in percent of respondents, multiple choices possible

<i>Research Type</i>	<i>Companies</i>	<i>Research Organizations</i>
Product development	29	9
Application oriented development	43	9
Technology development	27	21
Applied research	50	64
Basic research	7	45

Basic research (24%), technology development (24%) and product development (20%) are covered by less than ¼ of the interviewed organizations. Only 7% of all companies are engaged in basic research compared to 45% of the research organizations. For product development this ratio is nearly exactly opposite with research organizations

at 9% and companies at 29%. Technology development is equally strong approached by research organizations (27%) and companies (21%).

### *Start of co-operation*

Most of the companies started R&D cooperation with China after the year 2000. Only a few have been engaged since the 90ies or even mid 80ies. Some companies have not entered R&D cooperation with China yet but are eagerly interested in doing so and are currently evaluating their possibilities.

Concerning Chinese R&D partners, the majority of the foreign organizations is working with or would like to work with a Chinese university as R&D partner. Mostly, they cooperate with the big universities such as Tsinghua University and Shanghai Jiaotong University or with local universities that have a specialization on the respective ICT area. Government organizations, state-owned organizations, and privately owned organization are also favored R&D partners. Only one organization said it had cooperated with a non-profit organization for R&D in China purposes.

### *Co-operation model*

An important feature of international research collaboration concerns the type of co-operation model. Such co-operation can range from direct research contracts with no or little direct co-operation during project work to joint ventures with very close interaction of the partners.

Based on our data, assigned projects are still the most popular business model for ICT R&D cooperation of Chinese and foreign companies. The majority of the cooperation was assigned (some of them EC-funded). Other models used included contract-based collaboration or the setting up of project specific consortia. Only two of the interviewees had been cooperating through a joint-venture with a Chinese partner and only one cooperation model was based on a revenue share from R&D services rendered.

Within the cooperation value chain, many European organizations regard themselves as providers of knowledge and/or technology expertise, in particular concerning past co-operation. But they also emphasize the mutual exchange of know-how and contacts and the quick take-up of knowledge and technologies on the side of the Chinese partners. Many organizations expect a more equal level partnership for the future.

R&D cooperation is considered a tactical advantage for meeting partners with the same shared R&D idea, building up a basis for potential strategic partnerships and setting up an infrastructure for future projects in China. Some of the interviewed organizations also mentioned that R&D cooperation with China opened new “research avenues” for them as they have the chances to get to know the local market and a potential customer group much better. One interviewee also mentioned that the access to top level researches for lower costs is a relevant driver for the company to participate in R&D cooperation.

Interestingly, almost no interviewee could define a special process model or R&D methodology they use in the cooperation. In this context though, it was emphasized by some organizations that regular updates with the Chinese partners or even continuous interaction is important for successful cooperation.

### *IPR issues*

All questioned parties are aware of IPR (intellectual property rights) and agreed that this was an important issue in R&D cooperation but the majority said that there had been no major IPR problems so far. Interviewees emphasized that IPR should be shared among the R&D partners and not be “locked-up” through strict agreements. Not only were there doubts that this will work in practice, it was also argued that this significantly impairs the co-operation. Nevertheless, most organizations have set up standard agreements with the Chinese partners to regulate the IPR protection policies and measures.

Companies who thought of IPR more critically additionally set up special project-by-project contracts or left core competencies in the national headquarters. One organization follows the strategy of predefining R&D packages and separating teams that will be working on each package. The sensitive R&D know-how then will just be shared within own resources of the knowledge holder.

### *Public funding*

Most European participations in joint projects with Chinese partners have not received funding from the Chinese side (e.g. in the TORCH, 863, 973 programmes) or the EU (Framework Programme 6 or 7). Only three organizations mentioned participation in some form in these programmes. But the majority expressed interest in future participation or is already planning their upcoming participation. In this context one interviewee mentioned IPR concerns which might come up during cooperation under one of these programs. One interviewee expressed dissatisfaction with the programs supported by the Chinese government, claiming insufficient support of foreign based R&D projects. Other interviewees mentioned that the involvement in those projects usually requires a long time and additional efforts (concerning documentation, distribution of profits etc.) which makes the participation rather complex and unattractive.

## **2.2 Collaboration objectives**

### *Objectives of Co-operation*

Major objectives for foreign companies to start R&D cooperation with China are market and customer access and the chance to build up a better basis for a possible market entry. They are aiming at getting insight into the Chinese market and technologies and create local competence. Collaboration with experienced Chinese researchers and staff is also a major objective. Through joint work on technology applications and usage opportunities, customization & localization of the foreign technology or application can be achieved.

Some interviewees mentioned that the objective of their China engagement was to position themselves as a global research organization. Their aim is to introducing a European standard into the strategically important Chinese market. Others see the possibility of being a part of the establishment of an industry standard and therefore have a unique selling proposition in the market. Companies that had been longer engaged in R&D cooperation with China confirmed that objectives partly changed over the last decade. Earlier, cooperation was mostly set in a typical “tutor-student” model, with the

Chinese being the student. With the change to a more equal partnership model, foreign companies also raised their objectives hoping not only to introduce their know-how and technology to the Chinese market but to exchange and gain know-how on Chinese state-of-the-art technologies.

### *Chinese objectives*

The interviews and questionnaire also asked the EU organizations concerning the alleged objectives for RTD collaboration of the Chinese side. EU interviewees said that the exchange of expertise and contacts were also major objectives. Working with European organizations in research promises to bring expertise and allows access to ideas, best practices, and insights into European technologies. This co-operation consequently provides the potential to become more successful in the Chinese market.

While none of the European companies claimed to get engaged in R&D cooperation because of the funding or financial support, they assumed that the financial issues/funding was one of the major drivers for the Chinese partners as for instance their own R&D capabilities did not allow own R&D on some topics.

### *Changes of objectives*

Based on experiences and certain difficulties in their cooperation with China, some of the objectives of European companies have changed during the process.

For the majority, the objectives have not changed but certain insights have become clearer:

- on the existing process model
- on restrictions
- on keeping track of “where the money goes”
- on who is the right partner for different task
- on what to expect from partners
- on which connections/network you need

and in some cases the cooperation process was accordingly adapted.

For those European companies that have been involved for a long time, objectives and motivation have changed a lot during the course of the cooperation. Along with China's developing position in the worldwide R&D market, some companies have been handing over more competencies to the Chinese partners throughout the process.

### *General goal achievement*

Most of the respondents are still involved in R&D cooperation projects and can not fully evaluate yet whether their objectives have been met. But the majority was satisfied with the results up to now. One interviewee mentioned that a long term approach is probably a good decision. “We see ourselves as in this for the long term so we are not pushing for a sudden impulse to new research but for a gradual building of relationships via personal contact and identifiable research benefits.” Only one company is a little disappointed with the current project progress. Of those companies that have already completed R&D projects with China, the majority is satisfied and sees their objectives met. Only one

company said that their objections have not been met and that a rethinking of the previous approach and business model is necessary.

### ***2.3 Strengths and opportunities***

#### *Main drivers*

Access to the Chinese market and customer base is the biggest driver of R&D cooperation for most European companies. Another important driver is the access to Chinese experts and their know-how. Many companies are hoping to benefit from the cooperation in the international competitive environment. Moreover, a lot of European companies are looking for access to new technology. Only for few companies cost saving is a major driver of R&D cooperation. But as one respondent noticed, the situation in the R&D pricing landscape is becoming more international: "Price is considered, but if you want good quality, high level, prices have become comparable. It is not only manpower also hardware which is internationally priced." One company pointed out that R&D cooperation also offers potential access to a political network which is still very important in the Chinese market.

Those companies that have already completed at least one R&D project with China mostly mentioned positive results and achievements. Aside from the establishment of specific technologies or facilities, the interviewees mentioned the successful exchange of human resources and expert know-how and successful transfer and promotion of concepts. One company pointed out the future-oriented benefit of setting up a good basis within the local R&D network and further potential opportunities which might spring up after the project. Another interviewee said that projects results had been achieved much faster than it would have been possible in the home country. One player whose experiences were not very satisfying mentioned that the R&D cooperation with China triggered to rethink the cooperation model.

### ***2.4 Weaknesses and threats***

#### *Barriers*

The major barriers of R&D engagement of European ICT players in China are intercultural and language barriers as well as IPR issues. Almost all companies find it difficult to reach a common understanding based on differences in communication – in terms of language but also concerning customer orientation of products and services.

Another major challenge is IPR topics. A different attitude to IP and copyright as well as a system of legislations and administration that appears rather unpredictable drives the problem. In some cases there is still more technology and knowledge transfer than cooperation and "information does flow more than expected".

Another barrier which was mentioned by some companies is the matter of financing and funding. There is still a different understanding about that. "Many researchers take the view that funding comes as a right on the basis of prestige, rather than as a consequence of research contracts," says one interviewee. Some European companies made the experience that an active engagement of the Chinese partners is depending on the money. "The Chinese are very pragmatic, there is a strong profit pressure. These days they have to transform into profit and leverage what was given to them. Thus they are not

really investing in the future but monetizing public heritage.” R&D relies on government funding and “funding will be granted very hesitantly”. Therefore, in some cases, a long-term vision is missing. But as one interviewee commented: “...our hope is that we will accelerate when money becomes available.”

Other problems and barriers mentioned by the interviews are:

- different stages of R&D development in China and Europe,
- the structure of networks and connections,
- the physical distance and hindering restrictions in traveling (visa issues)
- as well as a high employee turnover.

All but one company said that there were no objections to continue R&D cooperation with China and most of them were aiming at future cooperation after their project would be finished. Only one company that has also dealt with problems in their previous R&D cooperation refrains from continuing R&D cooperation with China, “unless the business model will be changed and IPR issues get under control”.

## ***2.5 Outlook and future co-operation***

Concerning future ICT co-operation with China, one of the most important requirements for European organizations are standards and regulations concerning Intellectual Property. In addition, it was suggested to establish general cooperation standards (e.g. standard co-operation contract models) to avoid costly negotiation of every detail in each project.

As the Chinese R&D landscape develops it was argued that in the future it will be more important that both sides contribute equally within the co-operation and no partner dominates the business. “New technology investments are made and there will be success. There will be more great labs in China. The country is big enough to impose standards”, one interviewee commented. Therefore, short-term profit orientation may be a problem in the long run. For lasting and substantial business a mid-term and long-term approach has to be understood. Similar to previous objectives some companies still mentioned access to the Chinese market, universities and research areas will remain a major expectation for future cooperation. One company even hoped to start joint China R&D cooperation with other European companies.

To improve future co-operation, China should be seen as a competitor but also as a partner. “We have to take part; the request of the market is here in China. They are continuing – with or without us. If we take part we are partner, if we are not taking part then it will go on without us.” commented one interviewee. When asked for solutions and proposals, many companies mentioned that “bridging the cultural gap” and building a common cultural understanding is a very important step to manage mutual trust. By providing local training to European and Chinese organization, both sides can get to know local culture and needs of the other site better. Moreover, it was suggested that special emphasis should be put on increasing the understanding about China among the European cooperation partner. One solution that was mentioned to overcome the gap would be to hire people that have a “double culture” background. A well-working project internal diversity can be the stepping stone for creating an efficient diversified cooperation environment.

Moreover, some interviewees proposed to simplify the exchange of staff (traveling and visa regulations), especially for Chinese partners coming to Europe. This seems to be

important as regular personal meetings were also suggested by the respondents. Improving IP rights and cooperation standards were also proposed as was a decrease of the level of administrative burden on the cooperation on both the European and Chinese side.

### *Public support*

Asked about support to be expected from public policy, e.g. the European Commission, some of the above mentioned issues (red tape, visa) were mentioned including existing export restrictions (e.g. the Wassenaar agreement). Due to certain export restrictions it was not possible to have a Chinese partner for some projects. One respondent also mentioned US export restrictions that the company has to comply with for certain new technologies. There is a severe need for the European Commission to become active in lifting export restrictions for research but also for some of the important institutions with Chinese R&D partners. Moreover, it was suggested that the EU also becomes strategically involved in talking to the US to improve export restrictions at least in the area of R&D.

Other ideas concerned search tools for finding contacts in universities and companies in China.

A major request concerned funding of Sino-European RTD projects. Currently, there is a strong asymmetry as mentioned above in that the European Commission provides funding for research collaboration with China, but hardly any Chinese funds are available in practice for non-Chinese organizations.

One interviewee pointed out the importance for the Chinese to be „independent“ from the United States. When working with leading Chinese companies problems occurred because of additional interest of working with US companies and Taiwanese companies at the same time. This has been a main obstacle for the cooperation. This case shows that there is a need for the European Commission to emphasize “independence” from the US when promoting Sino-European R&D partnerships.

Finally, it was pointed out by four organizations, that the current relation between the EU and China is characterized by a strong asymmetry in understanding each other. While many Chinese researchers are experienced with either EU or US practices based on research visits or education in the EU or the US, only very few European have studied or lived long enough in China to understand its research and innovation system. It was suggested to strategically facilitate stronger engagement of European researchers with the innovation system in China to overcome this asymmetry at least in the long run.

## **3 Discussion and strategic recommendations**

Public discussion in the EU often focuses on comparative wage advantages of Asian countries. Recent research also suggests that relative differences in labor cost will remain a competitive advantage of China [Albrecht et al. 08] despite increases in wages. A case has also been made for technology-related drivers of research collaboration [Lumiste 07]. Our interviews, however, suggest a different major driver of industrially oriented RTD co-operation in ICT: industry is mostly interested in the access to the huge and growing Asian markets and joint research and development are considered important pathways to gaining access to these markets. Our data suggests that this is in fact the strongest driver followed by the availability of engineers and ICT experts who are increasingly difficult to

find at the respective national labor markets or internationally. Price differences for RTD experts are a factor, but should rather be considered an enabler than the original cause for opening labs in China or entering into close collaboration.

The interviews suggest that the relation of the labs and engineers to Chinese companies are at least as important as the results of research and technology development activities gained in the co-operation. RTD is really regarded as a facilitator for improving the contacts with key players, establishing co-operation with distributors, setting up facilities for production, and influencing or gaining access to standards and standardization processes. This is particularly important as the networking with local firms, national industry, but also regional authorities remains a success factor in the Chinese market.

From a strategic point of view these results should impact on future strategies for collaboration at the level of RTD policy makers. Topics that will require more attention in the future include

*Devising instruments for accelerating access to relevant RTD actors.* This is particularly important from a European perspective, where knowledge about research resources in China is clearly lacking. In particular, there is a need for qualitative information about research excellence, networks, research foci, qualified personnel etc. Instruments to implement this recommendation include a web portal to facilitate access to existing initiatives, search tools, and social networking tools for the exchange of academic and industrial co-operation experiences.

*Establishing mid- and long-term collaboration strategies.* Our research suggests that RTD collaboration is increasingly viewed from a long-term perspective rather than only project-based co-operation. Instruments to realize longer term strategies include dedicated contact points, joint research centers, and co-operation at RTD policy maker levels. The latter includes setting-up of joint programmes for funding research.

*Developing and sharing good practices in IPR standards and regulations.* IPR standards and regulations are constant issues when dealing with R&D cooperation with China and can influence the set-up and intensity of collaboration between the partners. Often, government-backed or legal standards or regulations for IPR topics in ICT R&D between the EC and China do not exist yet. Consequently many European companies are very careful about sharing sensitive R&D know-how with all of their Chinese R&D collaboration partners. Although IPR issues were not often considered as a serious risk factor in collaboration, it would be helpful to establish “general cooperation standards” to avoid costly negotiation for every detail in each project and to further support mutual trust – a prerequisite for fruitful co-operation.

*Developing and sharing standardized co-operation models to facilitate and speed-up co-operation.* Similar to the IPR issue, co-operation is often hindered by administrative issues (visa, documentation), management issues (e.g. distribution of funding, exchange of human resources) or market restrictions (export restrictions). Instruments to achieve this include targeted actions of industry associations, targeted actions at policy level concerning red tape, improved networking of experienced actors, or good practice guidelines.

*Creating targeted initiatives in relevant ICT sub-areas.* A number of topics lend themselves for fostering co-operation (e.g. telecom or RFID research). Selection criteria for these topics include market potential, RTD potential, joint policy challenges, and opportunities for joint standards. An exemplary list of topics can be found in [Prem 08].

*Bridging the cultural gap.* Common awareness and understanding of cultural differences remains an issue for fostering Sino-European co-operation. Despite a common interest in ICT R&D intercultural differences and language barriers often lead to misunderstandings between the R&D partners and hinder an efficient project progress and workflow. While language differences might be solved with an interpreter, without a common cultural (and also political) understanding, the structure and system of networks and relations could be misinterpreted and form a major threat for successful R&D cooperation. Instruments to achieve this, include RTD staff with a background in both cultures, a project-internal diversity, and in the mid- to long run the training of more EU ICT researchers in China and fostered exchange visits of EU scientists to China.

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